DESIGN, CONSTRUCTION AND PERFORMANCE EVALUATION OF A LIQUIFIED PETROLEUM GAS INCUBATOR

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF SCIENCE IN MECHANICAL ENGINEERING.

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MARCH, 2016

DECLARATION

I hereby declare that the work in this dissertation entitled "Design, Construction and Performance Evaluation of a Liquified Petroleum Gas Incubator" has been performed by me in Department of Mechanical Engineering. The information derived from the literature had been duly acknowledged in the text and a list of references provided. No part of this work was previously presented for another degree or diploma at this or any other Institution.

Felix Uche OKEOMA _____ _____

(Signature) (Date)

CERTIFICATION

This dissertation entitled "DESIGN AND PERFORMANCE EVALUATION OF A LIQUIFIED PETROLEUM GAS INCUBATOR" by Felix Uche OKEOMA meets the regulations governing the award of degree of Master of Science (M.Sc) in Mechanical Engineering of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Dean, School of Postgraduate Studies	Signature	Date

DEDICATION

This research work is dedicated to God Amighty who has kept me all through the journeys of life and has made the research work a reality.

ACKNOWLEDGEMENT

I use this opportunity to thank God Almighty for the abundance grace and mercy given to me in the course of my research work. I want to appreciate my wife and my family who had stood by me and had endured my long absence from home. Also to my parents, Mr. and Mrs. A.J. Okeoma and my dearest brothers and sisters, for their prayers, affectionate love, moral, financial support and keen interest in my work.

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ABSTRACT

Studies showed that the use of an automated incubator powered from the mains electricity, a solar powered incubator or the kerosene type incubator for the production of day-old chicks is either very expensive to manage or ineffective in operation. Hence, this research work is aimed at designing, fabrication and testing of an automated incubator powered by energy generated from burning of Liquified Petroleum Gas with the use of a micro-controller device. A micro-controller device was developed in order to achieve a timed automated sparking mechanism for a Liquified Petroleum Gas burner and egg crates turner. The micro-controller, which has a screen display of temperature and humidity readouts, has the sole responsibility of maintaining a steady temperature and humidity inside the incubator chamber. A 3D model of the designed incubator was produced using Solidworks software package. Performance evaluation carried out on the incubator revealed that seventy-nine (79) eggs hatched successfully out of one hundred and twenty (120) eggs set for hatching. This represents about 65% of the eggs set. Also fifteen kilogram (15 kg) of LPG was consumed during the incubation process. This cost about four thousand and eighty naira (₦4,080:00). Since only seventy-nine (79) eggs hatched successfully after incubation, this translates to an incubating cost of fifty one naira sixty five kobo (₦51:65k) per chick. Finally, the incubator was able to maintain the optimum temperature and humidity of 37.5 ^{0}C and 45% respectively during performance evaluation test.

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ABBREVIATIONS AND NOMENCLATURE

^{0}C - degree celcius

% - percent

A- Ampere

DC - direct current

IC - integrated circuit

K - Kelvin

kg - kilogram

LPG - Liguified petroleum gas

mm - millimeters

₦ - Naira

N - Newton

V - Volt

W - Watts

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Poultry production forms an important component of Nigeria's livestock sub-sector. As a provider of employment and income, poultry production constitutes an important form of livelihood for rural and urban dwellers. Poultry farmers who are well spread all over the different geographical zones of the country engaged in the production of meat, eggs, day-old chicks, poultry manure, etc. for rural, urban and sub-urban populations.

An egg incubator is equipment which provides opportunity for farmers to produce chicks from eggs without the consent of the mother hen. There are majorly two types of incubation viz; natural and artificial incubation. The most important difference between natural and artificial incubation is the fact that in natural incubation mother hen provides warmth by contact rather than surrounding the egg with warm air as it is in artificial incubation. An Egg incubator is an enclosure which has controlled temperature, humidity, and ventilation for hatching of poultry eggs such as chicken eggs, turkey eggs, quail eggs, guinea fowl eggs, etc. (University of Illinois, 2014)

Study of the chicken egg and its development from the un-incubated stage to the emergence of the chick from the shell has been interesting. The developing chick in an egg is called an embryo, and a careful study of the different stages of embryonic development uncovered many interesting facts. Incubation of eggs shows the effects of heat, air, and moisture on hatchability. It shows how an egg is formed, their different parts and their functions, and how a chick embryo develops. (University of Illinois, 2014)

Eggs have been incubated by artificial means for thousands of years. Both the Chinese and the Egyptians are credited with originating artificial incubation procedures. The Chinese developed a method in which they burned charcoal to supply the heat while the Egyptians constructed large brick incubators that they heated with fires right in the rooms where the eggs were incubated. Over the years

incubators have been refined and developed so that they are almost completely automatic. (University of Illinois, 2014)

Modern commercial incubators are heated by electricity. They have automatic egg-turning devices, and are equipped with automatic controls to maintain the proper levels of heat, humidity, and air exchange. Both still-air and forced-draft incubators are used in hatcheries. However, all the new commercial incubators are forced-draft; that is; they have fans to circulate the air. They are capable of maintaining more even temperature, humidity, and oxygen levels than still-air incubators. (University of Illinois, 2014)

More so, poultry industry has become one of the most efficient producers of protein for human consumption since 20th century. It expanded rapidly during World War II because of the shortage of beef and pork, which require a much longer time to develop; only seven weeks are required to produce a broiler and five months to produce a laying hen (Benjamin, 2012). More recently, in response to public concern over dietary fat, poultry has again become a popular substitute for beef and pork.

On the other hand, the use of energy conservation principle has led to the achievement of Energy Integrated Poultry Farm (EIPF). This farming system creates a system of dynamic flow of material and energy within a poultry farm, where wastes and by-products of one operation becomes inputs for another. This system treats production and consumption as a continuous cyclical process, rather than a linear one and in effect minimises losses, transport costs e.t.c. The system maximises efficiency of natural conversion processes and of nutrient retention. In other words, reusing resources and minimising environmental impact.

The system channels the chicken droppings produced within the poultry farm into biogas plants. The subsequent biogas generated is then extensively used to supply heat energy necessary to run an incubator for the whole twenty one (21) day period for hatching eggs. Surplus generated biogas is extended to other energy needs of the farm. The residue from the biogas digester is rich in essential organic elements which are used as manure in farming to enrich the soil conditions for further

agricultural practices. The farming process in return yield more fodder crops for processing into poultry feeds for feeding the poultry birds, promoting a healthy productive continuous close loop system which can help farmers diversify or combine forces with other complementary operations. Hence, food, biofertiliser (manure), animal feed and fuel can be produced with minimum input of nutrients, water and other resources. The system therefore, helps to achieve the economic, environmental and social aims of sustainable development.

Environmental pressures and economic drivers such as the rising costs of water, fuel and other inputs are stimulating growing interest in eco-efficient production options that minimise resource consumption and pollution. EIPF satisfies these requirements. Because they conserve soil, increase crop diversity and can produce feed, fuel or fertilizer on-site. EIPFs are relatively sustainable and resilient and can do much to support local economies. They can help farmers diversify or combine forces with other complementary operations. Integration can be achieved over a range of scales and can assist in community, catchment and regional planning.

Energy Integrated Poultry Farm provides major advantage over other production systems where waste disposal and remediation are essentially treated as externalities. Sustainable design features percuilier to EIPF include the following (Warburton, 2002):

(i) Minimum resource inputs by redirecting `waste` outputs within the system.

(ii) Contain material flow within the system.

(iii) Treat production and consumption as a continuous cyclical process, rather than a linear one.

(iv) Tighten production-consumption loops to minimise losses, transport costs etc.

1.2 Statement of the Problem

Nigeria began to observe a reverse development in the poultry industry from the mid 1980`s. The problem was multi-faceted but prominent among these were the scarcity and the high cost of day old chicks. The effect of these problems was a serious drop in the production efficiency and resultant high cost of poultry products (NAPRI, 2011).

The demand for agricultural day old chicks by commercial and private poultry farmers has always been on the increase going by the unprecedented population growth. The ever increasing demand for poultry meat all over our immediate environment in response to public concern over dietary fat has resulted to a hike in the cost of poultry meat.

The epileptic nature of the power supply in the country contributes to the difficulty encountered in the smooth running of an incubator machine for hatching of poultry eggs. Alternative source of electricity from a stand-by generator has always been employed to complement the energy needs of an incubator machine for the period of twenty one (21) days for poultry birds' incubation. However, the huge additional cost of power supply from a stand-by generator adds up to the overall cost of day-old chicks upon production.

The maintenance of the stand-by generator on its own incur an added costs, besides the fact that an expert skilled in the services and maintenance of generating sets will have to be available for the whole period of hatching of the eggs. More so, Glasson, *et al.*, (2003) reported that solar incubators have been grossly ineffective and have not yielded the desired results over the years; many constraints faced in the use of a solar incubator were also highlighted.

Automated incubators are presently the source of commercial day old chicks. They are preferred because, production of day old chicks is obviously a demanding task as it requires a steady power supply for the period of incubation for a particular batch of poultry eggs.

Therefore the use of an automated incubator powered from the mains electricity in Nigeria today, a solar powered incubator or the kerosene type incubator for the production of day-old chicks are either very expensive to manage or ineffective in operation.

1.3 Present Work

This research work is aimed at designing, constructing and testing of an automated incubator powered by energy generated from burning of Liquified Petroleum Gas (butane gas) with the use of a micro-controller device (see Appendix B, Plate 4.10). A micro-controller device was developed in order to achieve a timed automated sparking mechanism for a butane gas burner and egg crates turner. The micro-controller, which has a screen display of temperature and humidity readouts, has the sole responsibility of maintaining a steady temperature and humidity inside the incubator chamber.

This egg incubator is designed to offer maximum hatch rates. The incubator has easy to use digital control system which provides a range of useful features like humidity and temperature readouts. This high performance incubator comes with an adjustable setter to accommodate the hatcher baskets. The setter has a set of three (3) automatically turning egg racks.

Other features Include:

i. Large capacity 180 hens' eggs trolley
ii. Automatic d.c. fan blower
iii. Programmable automatic egg turning for every two hour interval
iv. Clear, glazed observation door
v. Humidifier

1.4 Aim and Objectives of the Work

The aim of the study is to design, construct and test an automated Liquified Petroleum Gas (butane gas) powered poultry egg incubator.

The specific objectives of this work are as follows:

i. To design an incubator with capacity for 180 eggs that would derive its heat supply from liquefied petroleum gas (LPG or butane gas)
ii. To construct an incubator with capacity for 180 eggs that would derive its heat supply from biogas/LPG butane gas.
iii. To conduct performance evaluation test on the incubator to determine its percentage hatchability.
iv. To determine the effect of atmospheric condition on the incubation temperature and humidity at strategic points inside the incubator.

1.5 Significance of the Study

The importance of having an improved incubation system which is useful in educational studies, research, industrial and domestic purposes owing to its relevance towards improving the production capacity of poultry chicks for a sustainable economy of our community and the nation in general cannot be over emphasised

It is therefore hoped that this research work would introduce a new dimension in the design of poultry incubators that would be simple in physical nature and economic in material usage that would be affordable, efficient and effective in operation. It is believed that the incubator will go a long way in promoting the culture of incubation of poultry eggs.

1.6 Justification for the Work

Quality and dependable poultry egg incubators of different designs and capacities are readily available in the market of so many developed countries of the world such as the United States of America (U.S.A.), the United Kingdom (U.K.), China, Japan, Australia, India e.t.c. It goes to show why serious industrial and commercial research work in poultry production is pronounced in those

regions of the world. In Nigeria today, the rate of production at hatchery centre's for poultry chicks are hardly enough to meet the needs of the most populous nation of Africa.

The unsteady and unreliable power supply in the country has a huge impact in the economic activities of poultry farms. The conversion of resources (biomass) to generate an alternative energy supply will ease the energy crisis in the economic activities of a poultry farmer. Hence, the application of biogas produced from poultry waste as the source of heat to hatchery units can prove to be the most economical means so far. Biogas is a cheap, clean source of fuel with no bad environmental effects, and therefore must be research into (Ahmadu, *et al.*, 2009).

This research work when implemented will help to achieve sustainable economical development and safe environment.

1.7 Scope of Study

This research work is focused on the design, fabrication and performance evaluation of a liquified petroleum gas powered cabinet incubator for hatching of poultry chicken eggs. The use of microcontroller based control unit on the developed incubator to maintain required incubating conditions during performance evaluation period was also reported.

CHAPTER TWO

2.0 LITERATURE REVIEW

Energy use in agriculture is closely related to the pattern of economic development of a country. This pattern has been seriously affected by the energy crisis in Nigeria, resulting in a difficult situation for the agricultural sector and in particular poultry production of day-old chicks (da Silva and Mhlanga, 2011).

Commercial production of day-old chicks is by the use of an incubator. An incubator is a equipment that provides the necessary heat for the embryonic development of chicks from eggs within a period of 21 days. There are different types of incubators, the prominent ones being (da Silva and Mhlanga, 2011):

i. Electrical incubators
ii. Kerosene stove incubators
iii. Gas incubators
iv. Solar incubators, etc.

These incubators are named according to the source of heat employed in the incubation of the eggs. The electrical incubator is an automated machine that utilizes electrical energy supply from the mains by the Electricity Distribution Companies (EDC). This source of energy is presently erratic and unreliable for use in electrical incubator which will have to run on the mains supply for 21 days. (da Silva and Mhlanga, 2011)

The Kerosene stove is a type of incubator that depends on heat from kerosene for the whole 21 day period of incubation. And due to the exorbitant price of petroleum products, this means of production of day-old chicks has proved to be a very expensive venture to embark upon. The gas incubation is not a cheap venture due to high cost of liquefied gas. The only popular existing incubator that is cheap based on the readily available source of heat is the solar type incubator which requires to

be manned by highly skilled and technically knowledgeable personnel. This will equally add to the cost of the day-old chicks due to its initial capital cost.

An alternative source of heat for the incubation of day-old chicks is the energy supply from Biomass source such as animal waste, municipal solid waste, agricultural waste and industrial waste, which produces energy in the form of combustible gas known as biogas. This has no undesirable effects on the environment. This form of energy could be used directly for supply of heat to the incubator for the whole period of incubation of chicken eggs adequately. The composition of biogas is typically, methane (50-70%), carbon dioxide (30-40%) and the rest is made up of traces of elements like hydrogen, nitrogen and hydro sulphide (Menya *et al.*, 2013).

2.1 Incubators

An incubator is equipment that provides controlled conditions for hatching of poultry eggs artificially without the consent of mother hen. An incubator of capacity 200 eggs was designed to use a solar panel to heat water (solar water heater), from which heat was supplied to the incubator with the aid of natural convection (thermosyphon). At night time, supplementary heating was achieved by reheating the water in a wood fired boiler. Temperature control was achieved using a motorized valve and a thermostat. Another cabinet type with a capacity of 2000 eggs was designed and built by Sportman. It has an efficiency of about 80% and temperature variation of ± 0.5 ºC (Olaleye, 2008).

The Rainbow Power Company Limited (RPCL) designed, built and is now marketing a 12V minilab egg incubator. The minilab will hatch 18 hens, 27 pheasant, 12 duck/turkey, 9 geese or 60 quail eggs. The incubator has a clear Perspex cover which makes it great for students wanting to observe the events inside. However, to retain the heat and save power, particularly at night, it is suggested that the top be covered with a blanket or towel. The eggs are turned by hand (RPCL, 2008). The incubator has a 60W element which is controlled by a thermostat. About two 85W photo voltaic panels are needed to run the incubator continually. It has an alternating current adapter to run it from 240V power outlet.

In China, incubator houses with double walls of mud, a fire room, and several compartments each holding about 6000 hens` eggs were developed in the 1840s and large ones have been used since 1910; some commercial models have trays for as many as one million eggs. The modern apparatus, with computer-controlled temperature and humidity and devices for turning the eggs, is widely used in commercial chick production (Austic and Nesheim, 1990). Eggs are selected for size, weight, and shell texture they are often candled after a week in the incubator in order to remove infertile eggs. The small-scale apparatus for hatching eggs inspired the invention of incubators for prematurely born human infants, whose lives are often saved in an environment of controlled heat, humidity, and ventilation. Another type of incubator has been developed for the culture of microorganisms.

R-Com brings the marvel of watching eggs hatching in a neat, easy to use digital incubator. R-Com makes the process of incubating and hatching eggs a delight to watch and easy with the R-Com 3 eggs incubator (Pace, 2006). The R-Com 3 has been successfully designed in Korea as an educational incubator. Three hens eggs are gently warmed and turned automatically as they incubate and the display even counts down each day to tell you when they are due to hatch. The R-Com is menu driven and extremely easy to use: it is set such that you choose between one of the five settings (chicken, duck, pheasant, quail or mystery bird to be programmed) and the micro-controller holds the correct temperature, turning and length of incubation. Turning will even stop automatically two days prior to hatching; all you need to do is to top up periodically with water. Detailed, attractive instructions are supplied to guide you through the dos and don’ts

2.2 Classification of Incubators

There are basically two classes of incubators available, they are natural and artificial incubators. Artificial incubators are futher classified as forced-air and still-air incubators. Forced-air incubators have fans that provide internal air circulation. The capacity of these units may be very large. The still-air incubators are usually small without fans for air circulation. Air exchange is attained by the rise and escape of warm, stale air and the entry of cooler fresh air near the base of the incubator. Recommended

temperatures vary between the two incubators, so follow the manufacturer's recommendation that accompany the units.

2.2.1 Natural incubation

Large broody hens are chosen for natural incubation (to cover and thus keep more eggs warm). They are healthy and preferably vaccinated, with a good brooding and mothering record. Signs of broodiness are that the hen stops laying, remains sitting on her eggs, ruffles her feathers, spreads her wings and makes a distinctive clucking sound. Brooding may be induced with dummy eggs or even stones.

Eggs usually become fertile about four days after the rooster has been introduced to the hens. A maximum of 14 to 16 eggs may be brooded in one nest, but hatchability often declines with more than ten eggs, depending on the size of the hen. Feed and water are usually provided in close proximity to the hen so as to keep her in better condition and reduce embryo damage due to the cooling of the eggs if she has to leave the nest to scavenge for food.

The hen keeps the eggs at the correct humidity by splashing water on them from her beak. This is a further reason for providing her with easy access to water. In very dry regions, slightly damp soil can be placed under the nesting material to assist the hen in maintaining the correct humidity (between 60 and 80 percent). Fertile eggs from other birds are best added under the brooding hen between one and four days after the start of brooding. In Bangladesh, it has been reported that local broody hens will even sit on and hatch a second clutch of eggs, often losing considerable weight in the process (especially if insufficient attention is paid to the provision of food and water). (King'ori, 2011)

The incubation period for chicken eggs is 20 to 21 days, and increases up to 30 days for other poultry eggs. After sitting for some days, a broody hen can be given some newly hatched chicks and, if they are accepted, the original eggs can be removed and replaced with more chicks. Thus hens with a better record of mothering can be better utilized for their abilities.

Eggs initially need a very controlled heat input to maintain the optimum temperature of 38^0C, because the embryo is microscopic in size. As the embryo grows in size (especially after 18 days), it produces more heat than it requires and may even need cooling. Moisture levels of 60 to 80 percent Relative Humidity (increasing during the incubation period) is important to stop excess moisture loss from the egg contents through the porous egg shell and membranes. Factors to consider for successful natural incubation include the following: (Sonaiya and Swan, 2004)

i. Feed and water should be close to the hen.
ii. The broody hen should be examined to ensure that she has no external parasites.
iii. Any egg stored for incubation should be kept at a temperature between 12 and 14 °C, at a high humidity of between 75 to 85 percent, and stored for no longer than seven days.
iv. Extra fertile eggs introduced under the hen from elsewhere should be introduced at dusk.
v. The eggs are tested for fertility after one week by holding them up to a bright light (a candling box works best. If there is a dark shape inside the egg (the developing embryo), then it is fertile. A completely clear (translucent) egg is infertile.
vi. A hatchability of 80 percent (of eggs set) from natural incubation is normal, but a range of 75 to 80 percent is considered satisfactory.

2.2.2 Artificial incubation

There are many commercial artificial incubators of varying capacities. Most depend on electricity, but some use gas or kerosene for heating. All use a thermostatic switching device to keep the temperature constant within one Celsius degree. The correct humidity is usually maintained by having a pre-determined surface area of water appropriate for each incubator chamber. (Sonaiya and Swan, 2004)

Turning the egg several times each day is important to prevent the embryo from sticking to the shell membranes. With hand-turning systems, an odd number of times turned per day (five to seven times) will ensure that during successive overnight periods the egg is always oriented the opposite way from that of the previous night.

The broody hen carries out all of these incubation tasks instinctively, and artificial incubation attempts to duplicate these tasks. Traditional artificial incubation techniques have evolved over thousands of years in many parts of the world.

2.3 Incubating Conditions

Incubation is done by keeping the incubating environment within 36 ^{0}C to 37.5 ^{0}C at a relative humidity higher than 45%. Poor results are most commonly produced with improper control of temperature and/or humidity. Improper control means that the temperature or humidity is too high or too low for a sufficient length of time that it interferes with the normal growth and development of the embryo. Poor results also occur from improper ventilation, egg turning and sanitation of the machines or eggs. (Smith, 2014)

Smith (2014) obtained the best hatch by keeping the temperature at 37.7 ^{0}C. throughout the entire incubation period when using a forced-air incubator. Minor fluctuations ± 0.5 ºC above or below 37.7 ^{0}C are tolerated, but do not let the temperatures vary more than a total of 1 ºC. Prolonged periods of high or low temperatures will alter hatching success. High temperatures are especially serious. A forced-air incubator that is too warm tends to produce early hatches. One that runs consistently cooler tends to produce late hatches. In both cases the total chicks hatched will be reduced.

Smith (2014) also maintained a still-air incubator at 38.9 ^{0}C. to compensate for the temperature lowering within the incubator. Proper temperature readings were obtained by elevating the bulb of the thermometer to the same height as the top of the eggs when the eggs are lying horizontal. When the eggs are positioned vertically, the thermometer bulb was elevated to a point about 6 mm to 12.7 mm below the top of the egg. This was done to prevent incorrect readings. (Smith, 2014)

Humidity is carefully controlled to prevent unnecessary loss of egg moisture. The relative humidity in the incubator between setting and three days prior to hatching should remain at 58-60% or 28.89 - 30 ^{0}C., wet-bulb. When hatching, the humidity is increased to 65% relative humidity or more. An excellent method to determine correct humidity is to candle the eggs at various stages of incubation. The normal size of the air cell after 7, 14, and 18 days of incubation for a chicken egg is shown. Necessary humidity adjustments can be made as a result of the candling inspection. The egg's weight must decrease by 12% during incubation if good hatches are expected (University of Illinois, 1998). Stages in the decrease of the egg`s weight is as shown in Appendix B, plate 4.12B

Frequently there is confusion as to how the measurement of humidity is expressed. Most persons in the incubator industry refer to the level of humidity in terms of degrees celcius, (wet-bulb) rather than percent relative humidity. The two terms are inter-convertible and actual humidity depends upon the temperature (^{0}C) as measured with a dry-bulb thermometer. Conversion of the two humidity measurements can be made using the following table:

Table 2.1: Common incubation values for temperatures and humidity

Wet-Bulb Values For Four (dry-bulb) Incubation Temperatures				
Relative Humidity(%)	37.22 ^{0}C	37.7 ^{0}C	38.3 ^{0}C	38.8 ^{0}C
45	26.94	27.39	27.89	28.33
50	28.06	28.50	29.00	29.44
55	29.17	29.61	30.11	30.56
60	30.28	30.72	31.22	31.67
65	31.11	31.67	32.22	32.78
70	32.06	32.61	33.17	33.72

Source: (Smith, 2014)

Level of humidity do not usually go high in properly ventilated still-air incubators. Increased ventilation during the last few days of incubation and hatching may necessitate the addition of another pan of water or a wet sponge. Humidity is maintained by increasing the exposed water surface area.

Ventilation is very important during the incubation process. While the embryo is developing, oxygen enters the egg through the shell and carbon dioxide escapes in the same manner. As the chicks hatch, they require an increased supply of fresh oxygen. As embryos grow, the air vent openings are gradually opened to satisfy increased embryonic oxygen demand. Care must be taken to maintain humidity during the hatching period. Unobstructed ventilation holes, both above and below the eggs, are essential for proper air exchange (University of Illinois, 1998).

When the power goes off during incubation, proper response depends on several factors, some of which include the temperature of the room in which the incubator is located, the number of eggs in the machine, and whether the eggs are in the early or late stage of incubation (University of Illinois, 1998).

The two most important considerations in this situation are to (i) keep the eggs from overheating and (ii) be sure they have an adequate oxygen supply. The longer the eggs incubate and the greater the number of eggs in the incubator, the greater the chance that you will experience overheating and suffocation of the embryos.

Eggs must be turned at least 4-6 times daily during the incubation period. Do not turn eggs during the last three days before hatching. The embryos are moving into hatching position and need no turning. Keep the incubator closed during hatching to maintain proper temperature and humidity. The air vents should be almost fully open during the latter stages of hatching (University of Illinois, 1998).

The eggs are initially set in the incubator with the large end up or horizontally with the large end slightly elevated. This enables the embryo to remain oriented in a proper position for hatching. Never set eggs with the small end upward.

In a still-air incubator, where the eggs are turned by hand, it may be helpful to place an "X" on one side of each egg and an "O" on the other side, using a pencil. This serves as an aid to determine whether all eggs are turned. When turning, be sure your hands are free of all greasy or dusty substances. Eggs soiled with oils suffer from reduced hatchability. Extra precautions should be taken when turning eggs during the first week of incubation. The developing embryos have delicate blood vessels that rupture easily when severely jarred or shaken, thus killing the embryo. The following table lists incubation requirements for species of fowl. (University of Illinois, 1998)

Table 2.2: Incubation requirements for species of fowl

Species	Incub. Period (days)	Temp. (F.)[1]	Humidity (F.)[2]	Do not turn after	Humidity Last 3 days[2]	Open vent more
Chicken	21	100	85-87	18th day	90	18th day

(University of Illinois, 1998)

2.4 Design Theories

2.4.1 Theory of heat exchange

The thermal energetics of incubation have been modeled by Kashkin (1961), Kendeigh(1963), Sotherland *et al.* (1987) and Meijerhof and van Beek (1993). A simple form of the model can be given as follows:

$$T_{egg} = T_{inc} + (H_{emb} - H_{water\ loss})/K \qquad (2.1)$$

Where, T_{egg} = temperature of the egg (Celsius); T_{inc} = temperature of incubator (Celsius); H_{emb} = heat production of embryo at a given moment of incubation (Watts); $H_{water\ loss}$ = heat loss from evaporative cooling (Watts); and K = thermal conductance of egg and surrounding boundary of air around the egg (Watts per degree Celsius).

The heat balance of an animal is described by (Schmidt-Nielsen, 1975)

$$H_{emb} = H_{water\ loss} \pm H_{rad} \pm H_{conv} \qquad (2.2)$$

or rewritten,

$$H_{emb} - H_{water\ loss} = H_{rad} + H_{conv} \qquad (2.3)$$

Where, H_{rad} and H_{conv} are the heat lost or gained by radiation and convection respectively (Watts). Equation 2.1 uses the terms $H_{emb} - H_{water\ loss}$ to describe the heat loss or gain from an egg because they are easier to measure than either H_{rad} or H_{conv}. Heat transfer through radiation is assumed to be small because all the surfaces within the machine will be at temperatures (within 1 to 2 ^{0}C of the surface temperature of the egg). Kashkin (1961) estimated that 40 to 45% of the total heat loss from a duck's eggs was by radiation; however, this estimate has assumed that the total egg surface would be able to radiate heat to the surface of the incubator. In a commercial incubator an egg would be surrounded by other eggs at the same temperature, thereby reducing the effective radiative surface of the egg (Kashkin, 1961). It is therefore assumed that the main transfer of heat occurs through convection.

Equation 2.1 contains the term $H_{water\ loss}$ because eggs continually lose water through incubation, typically amounting to 12% of the fresh egg weight between the onset of incubation and the start of piping. The phase change from liquid water to water vapor requires heat and at incubation temperature this equates to approximately 580 kcal/kg of water lost (Schmidt-Nielsen, 1975). For example, a 60-g chicken egg loses approximately 0.4 g of water/day, which equates to a heat loss of 232 cal/day or 11.2 mW.

Embryo heat production can be measured directly, but Romijin and Lokhurst (1960) showed that it can be estimated by measuring O_2 consumption. Every liter of O_2 consumed by the embryo is equivalent to the production of 4.69 kcal of heat (Vleck *et al.*, 1980). Typical O_2 consumption of a chicken egg just before piping is 570 mL/day (Vleck and Vleck, 1987), equivalent to heat production of 2.67 kcal/day or 130 mW.

At the onset of incubation, H_{emb} is negligible and therefore $T_{egg} < T_{inc}$ because $H_{emb} < H_{water\ loss}$. However, at the end of incubation, Hemb >> $H_{water\ loss}$ therefore $T_{egg} > T_{inc}$. Plate 4.12B shows H_{emb} and $H_{water\ loss}$ of chicken eggs measured by Romijin and Lokhorst (1960). H_{emb} was observed to exceed $H_{water\ loss}$ midway through the incubation period. Direct measurements of T_{egg} have also observed that it exceeds T_{inc} midway through incubation in chicken (Tazawa *et al.*, 1989). The result is that during the first half of incubation, eggs will be gaining heat from the surrounding air, whereas during the second half of incubation, eggs will lose heat.

The thermal conductivity term, K, used in Equation 2.1 combines the thermal conductivity of the egg (K_{egg}) and the boundary layer of air around the egg (K_{air}). Sotherland *et al.*, (1987) determined values for K_{egg} and K_{air} and showed that the air boundary layer around the egg was approximately 100 greater a barrier to heat loss than the egg itself. These authors also showed that the value of K_{air} is dependent on the air speed over the eggs and the relationship could be estimated as follows

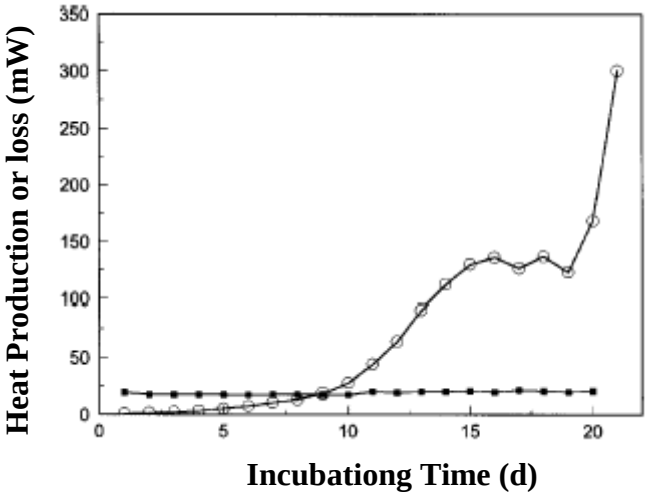


Figure 2.1: Metabolic heat Production (—O—) and Evaporation Heat Loss (—■—) of Chicken Eggs during Incubation. (Romijin and Lokhorst, 1960.)

The thermal conductivity term, K is given by the equation

$$K = (0.97\ U^{0.6})\ M^{0.53} \qquad (2.4)$$

Where, U = air speed (centimeters per second); and M = egg mass (grams). The effect of changing air speed from 0 to either 100 or 400 m/s increased thermal conductance by approximately 2.5 times and 6 times, respectively. A similar relationship was found by Meijerhof and van Beek (1993). An important consequence of the relationship between K_{air} and air speed is that the differential between T_{egg} and T_{inc} during the second half of incubation will become greater at slower air speeds. Meijerhof and van Beek (1993) estimated the increase in T_{egg} over T_{inc} for eggs of different weights and H_{emb} at two air speeds, 0.5 m/s.

2.4.2 Optimum incubation temperature

Optimum incubation temperature is normally defined as that required to achieve maximum hatchability. Most poultry species have an optimum incubation temperature of 37 to 38^0C and small deviations from this optimum can have a major impact on hatching success and embryo development (Wilson, 1991). The vast majority of poultry hatching eggs are artificially incubated in incubators that must be designed to accurately control the temperature inside the machine to ensure that the temperature of the developing embryo does not deviate from this optimum.

The temperature experienced by the developing embryo is dependent on three factors: (i) the incubator temperature, (ii) the ability of heat to pass between the incubator and the embryo, and (iii) the metabolic heat production of the embryo itself.

2.5 Past Research work on Incubator Fabrication

Abraham *et al*. (2014) agreed that incubation of poultry eggs is very important these days as the demand for chicken is increasing day by day. But the process of hatching eggs by the conventional method is very difficult as well as it consumes much power. In short, conventional method of egg hatching requires continuous supply of power. In their work, a new method of solar poultry incubator design was suggested, which could be used to hatch eggs from solar PV and hence could reduce the usage of power and can maximise the usage of solar power which is a renewable source of energy. They submitted that by implementing this method of solar poultry incubator the power consumption of the incubator was reduced by 75% and the cost involved in the design also yields profit and hence could bring out a revolution in this field.

Agidi *et al*., (2014) identified that poultry production is a lucrative business in Nigeria but inadequate hatchery machines limit the expansion and make poultry products for instance day old chicks more expensive. At the moment, few commercially owned poultry hatcheries in Nigeria are located distance far away in the western and Eastern parts of the country. Majority of these hatcheries have little or no access to the national grid system but operate at about 60 % below the installation capacity. Generally, environmental pollution, unreliability, lack of access to grid power supply and low performance efficiency characterize the conditions of the poultry hatchery business powered by conventional energy supply in Nigeria. These hamper and adversely affect the establishment of medium to large scale poultry production outfits in the rural areas of the country. But with the advent of electric powered egg incubator technology in poultry production, poultry farmers in Nigeria are likely to incubate and hatch poultry eggs and breed day-old chicks under a sustained power supply in a clean environment. Therefore, their study was aimed at the design, development and testing of a new

incubator in order to provide a favourable environment for eggs hatching. The machine was tested to assess its performance. The results from the test showed that out of the total 25 eggs, 5 eggs hatched after operating the machine. This gives 33% hatchability. The results showed that with further improvements, the developed machine can adequately be adopted at the household level instead of rearing chickens for the sole purpose of incubating eggs.

From the fore-going, it has been established that hatchery process cannot be run solely on electricity from national grid and use of generator as supplement is not environmentally safe while the use of solar is expensive. Therefore, there is need to research into incubator that can be powered solely by combustion of LPG which is abundant in Nigeria.

CHAPTER THREE

3.0 MATERIALS AND METHODS

This chapter describes in detail the design, materials selection, and the experimental procedure employed in the trial hatching of poultry chick eggs for the whole twenty one (21) days hatching period of chicken eggs. Emphasis is made on the vital role of the microcontroller device, which controls virtually all the devices of the incubator for providing the right conditions for incubation of poultry eggs.

The incubator is simple in physical nature and economic in material usage. Heat is generated in the heat chamber by the microcontrolled gas burner and is evenly distributed throughout the whole of the incubator chamber by the inflow of forced convective air using centrifugal fans installed in strategic areas inside the incubator. The relative humidity of the air as well as uniform temperature conditions is maintained inside the incubator chamber by the microcontroller for the whole period of incubation of the poultry eggs.

3.1 Description of the Cabinet Incubator

A schematic diagram of the cabinet incubator is presented in Figure 3.1. It consists of the following:

i. The Cabinet divided into two compartments
ii. The egg trays and their swivel mechanism
iii. The burner
iv. The heat radiator
v. The microcontroller
vi. The solenoid valve
vii. The spark mechanism
viii. The humidifier
ix. The LPG/Bio-gas cylinder

x. The centrifugal fans and

xi. The battery.

The cabinet incubator is divided into two compartments (Plate 4.13B); the upper chamber housing the egg trolley and the lower chamber containing the heat radiator which enclosed the butane gas burner. The battery, the egg trolley, the humidifier, the spark mechanism, the solenoid valve and the fans are all connected to the microcontroller. The gas hose from the gas cylinder was connected to the burner via the solenoid valve; the spark mechanism was equally linked to the burner (Plate 4.15B).

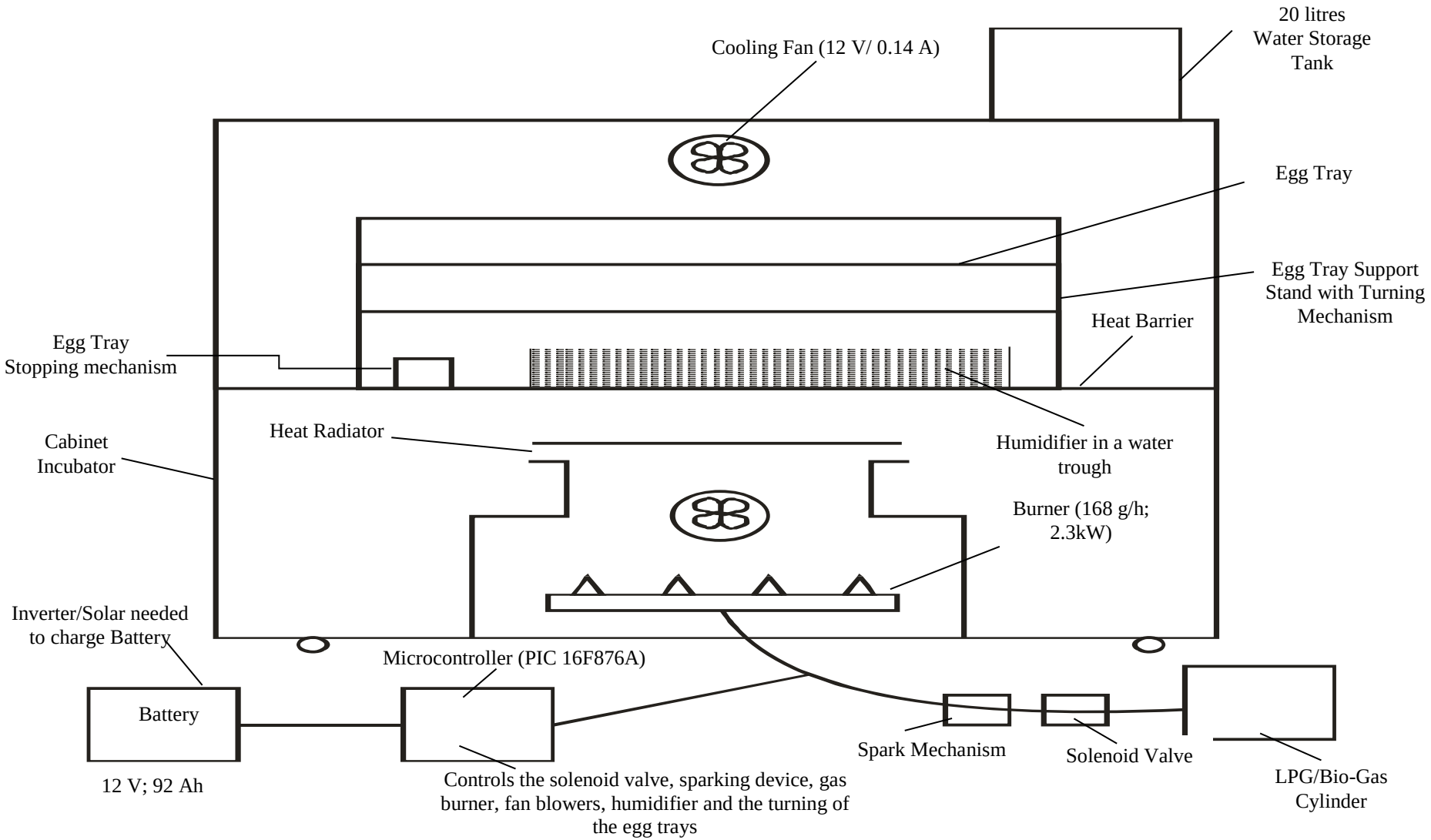


Figure 3.1: Schematic Diagram of the Incubaton

In operation, the battery supplies electrical energy to the microcontroller (Plate 4.10B) which in turn initiates electrostatic sparking (Plate 4.6B) and the inflow of gas through the solenoid valve (Plate 4.9B) simultenously to generarate flame in the burner. Heat is generated in the incubator which raises the temperature up to 37.5ºC and then the temperature sensor (DHT11, see Plate 4.10B) trigger off the flame. When the temperature in the incubator drops down to 36 ºC the process is repeated again. In the same vain, the microcontroller activates the humidifier (Plate 4.11B) to generate the required humidity of 55% and above. When the humidty is 55% the humidity sensor (DHT11) will trigger off the humidifier. It will equally switch on the humidifier when the humidity drops below 45%, and the cycle continues.

The primary function of the centrifugal fans is to ensure circulation and even distribution of heat, humidity and fresh air inside the incubator. The microcontroller also actuates the turning of the egg trays every two hours intervals at an angle of 45º to the horizontal.

The 3D sketch of the incubator was developed using commercial Solidworks software. This was used to develop 2D orthographic projection of each part of the incubator. These orthographic projections were used as working drawings in the fabrication of the incubator. The developed 3D model is presented in Appendix B (Plate 4.13B) while the working drawings are presented in Appendix A.

The schematic diagram illustrating the orientation of the egg trays after rotation in two different direction is presented in Figure 3.2.

The egg crates are rotated at an angle of 45^0 to the horizontal every two hour intervals by the action of a system of electric motor, sprocket and chain activated by the microcontroller. The movement of the egg crates rotates until it is triggered off on making contact with the limiting switch on the stopper as shown in the Figure 3.2.

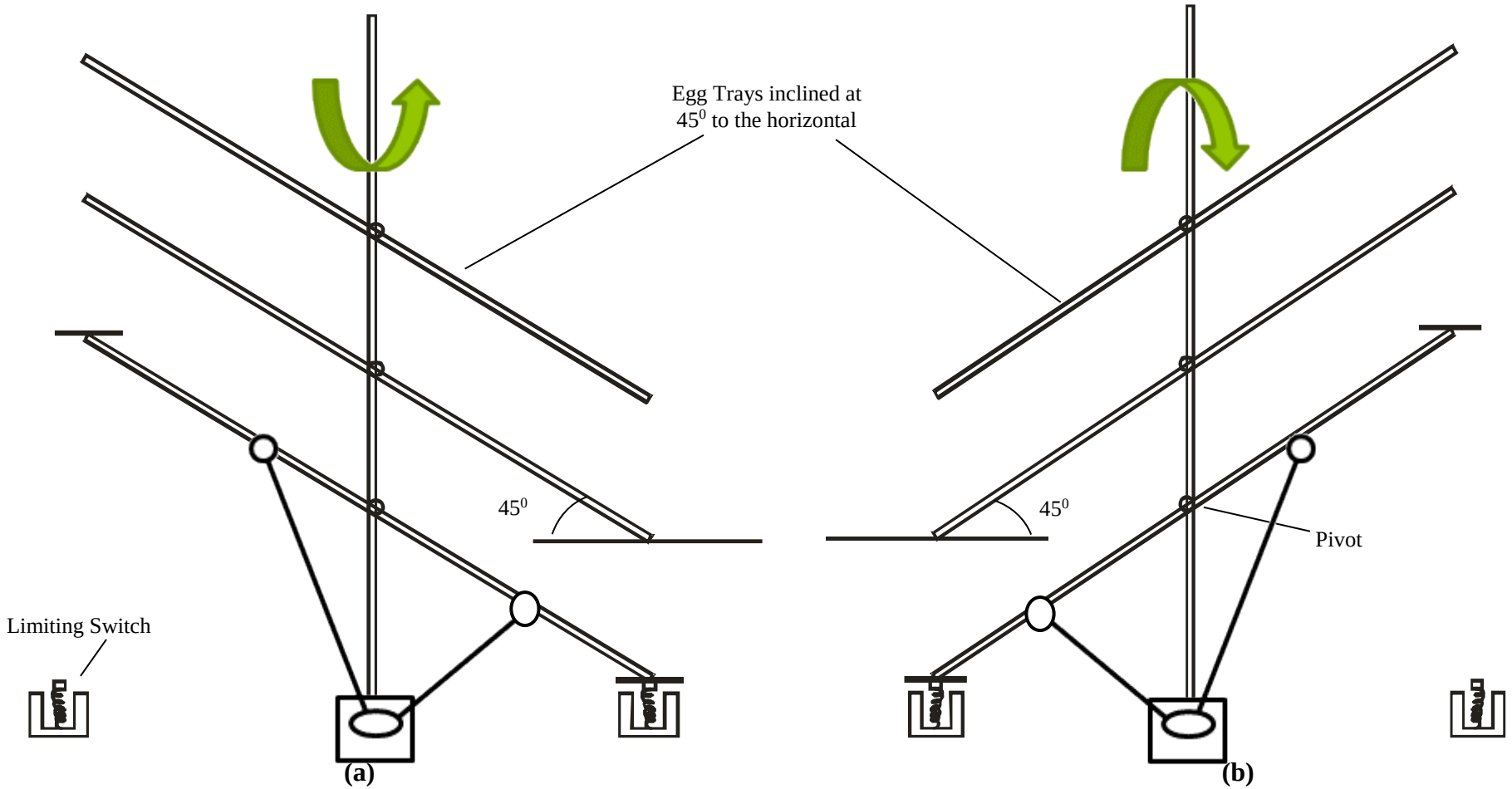


Figure 3.2: The Egg Trays Orientation after Rotation

3.2 Research Materials, Tools and Equipment

The required items for the fabrication of the Liquified Petroleum Gas powered incubator include the following:

i. Two sheets of (8 by 4) inch medium density fibre (MDF) board of three quarter inch thick
ii. 12mm diameter mild steel rods
iii. Sheet of mild steel 1mm thick
iv. Plastic egg crates and plastic baskets
v. Butane gas burner
vi. 12V DC battery
vii. Humidifier container
viii. Gas cylinder
ix. Gas solenoid valve
x. Standard gas hose
xi. Hygrometer and temperature reader
xii. 12V DC centrifugal fans
xiii. Transparent glass

The major material used in fabricating the incubator is medium density fibre board (MDF). It is an engineered wood product made by breaking down hardwood or softwood residuals into wood fibres, combining it with wax and a resin binder, and forming panels by applying high temperature and pressure. The properties of MDF are as follows:

i. Generally denser than plywood. It`s density is typically between 500kg/m^3 and1000kg/m^3
ii. Consistent in strength and size, with stable dimension (won`t expand or contract like wood)
iii. Moisture resistant
iv. Fire retardant

The tools used for the modeling, design and simulation are softwares. These softwares are: Solidworks, Mikrobasic language and Microsoft excel.

A. Solidworks

Solidworks is one of the leading application programs for 3D CAD product design and modeling. Solidworks solution covers all aspects of development process such as, 3D design, simulation, electrical design, 3D experience, product data management and technical communication of complex product details.

B. Mikrobasic language

Mikrobasic language is a computer programming language which makes it possible to write software codes in microcontroller memory, thus enabling the microcontroller to work independently. Mikrobasic is one of the low-level program languages for writing control codes for PIC microcontroller.

C. Microsoft excel

Microsoft excel is an electronic spreadsheet (also known as a worksheet) program that provides tools that is useful in worksheet creation and analysis such as dynamic charts for presentation or interactive worksheets for group collaboration and creation of formulas and functions.

Details of workshop tools and equipment used for fabrication and assembly of the incubator are provided in subsequent section.

3.3 Control Design

The control system monitors and controls two subsystems in the incubator. It controls the turning of the egg trays and automatically ignites and supplies gas to the burner. The system makes use of a microcontroller, which operates on some sets of codes. Two sets of codes were written in HEX file which control each subsystem. The microcontroller circuit for the incubator is presented in Figure 3.3 while the block diagram of the microcontroller circuit is presented in Figure 3.4.

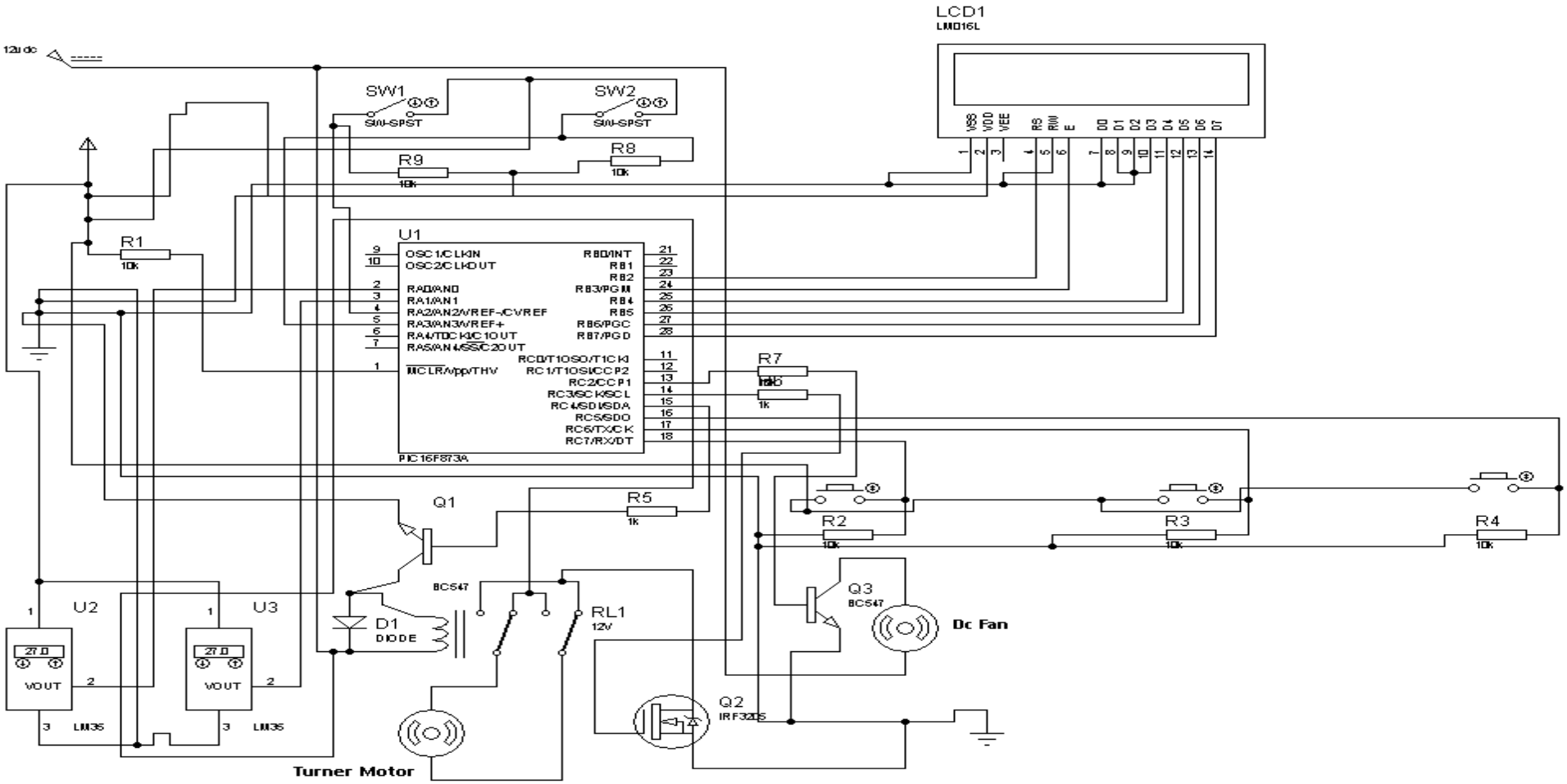


Figure 3.3: The Microcontroller Circuit for the Incubator

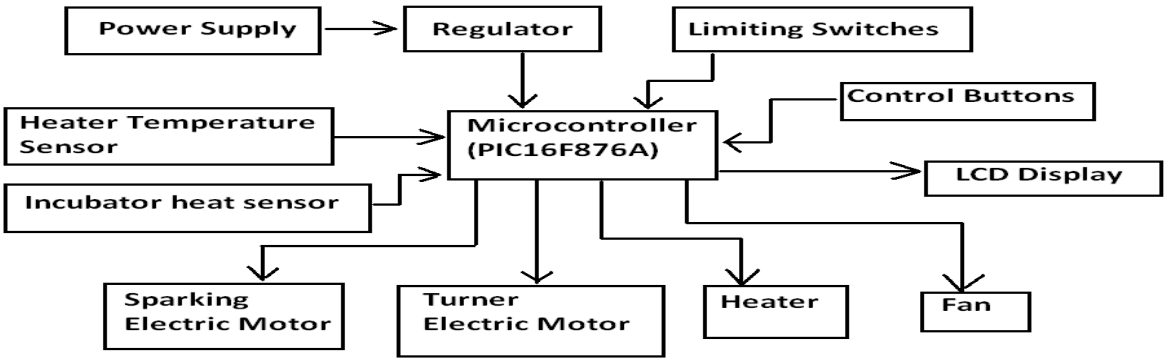


Figure 3.4: Block Diagram of the Microcontroller Circuit

The programming language used in programming the microcontroller for the cabinet incubator is known as mikrobasic language and the integrated circuit (IC) used is the PIC IC (16F873A). A microcontroller is an electronic device, which is capable of executing programmed instructions embedded in a programmable integrated circuit (IC). These programmed instructions are intended to implement functional specification by means of electrical and electronic devices such as servo motors, stepper motors, electric motors, electric fans, solenoid valve, switches, humidifier, etc.

The code (Appendix D) used in programming the microcontroller used in the design of the incubator was done using mikrobasic language and the code burnt into a PIC16F873A integrated circuit (IC) chip. The IC is the brain of the microcontroller and determines the functions carried out by all the component parts of the incubator such as turning the egg trays in every two hour period, igniting a spark and at the same time initiating inflow of gas to produce gas flame, generating humid air from the water trough through the humidifier and controlling the fans for even distribution of heat and humidity within the incubator.

The ranges of temperature and humidity requirement for incubation of chicken eggs are 37.5 ^{0}C ± 0.5 ºC and 45% to 85% respectively. These ranges of temperature and humidity requirement are automatically maintained by the microcontroller device of the incubator by the systematic control of the gas burner, the humidifier and the centrifugal fans.

The size of the cabinet of the incubator was determined by the amount of eggs that would be required to be hatched by the incubator which was 180 chicken eggs. This desired quantity of eggs

were set in the setter on the egg crates of the incubator for the first eighteen days of the incubation period and then the same set of eggs were transferred to the Hatcher for the remaining three days of the incubation period.

The activation of the incubator was done by a switch that activates the digital microprocessor, which in turn automatically ignites sparking while at the same time enabling an inflow of gas into the gas burner through a solenoid valve for a gas flame to generate heat in the combustion chamber. The gas flame is kept on till the temperature in the incubator reaches 37.5 ^{0}C, it then goes off. The ignition occurs again immediately the temperature drops to 36 ^{0}C.

The microcroprocessor had a digital display screen recording the temperature and humidity of the incubator during the incubation of the poultry eggs. The microprocessor controls the centrifugal fans regulating the inflow of hot air from the burner into the incubation chamber thereby maintaining a steady and uniform temperature requirement of the incubator. The microcontroller equally controls other set of centrifugal fans which extract heat out of the incubator in the event of excess heat in the incubator. It is essential to measure temperature of incubation and humidity at an hour interval for the whole period of the twenty one days of incubation, which will aid the comparison of the efficiency of the incubation of the eggs.

3.4 Design Considerations

The design considerations that were used in the fabrication of the incubator are:

i. Number of eggs to be hatched whch in this case is 180 eggs.
ii. Optimum incubation temperature of 37.5 ^{0}C
iii. Humidity within the incubator of average of 45%
iv. Reliability of the incubator.

For the purpose of this research, emphasis will be placed on simply supported beam with a point loading as presented on Figure 3.6. This system of loading was chosen to represent the loading on each egg tray as presented on Figure 3.5.

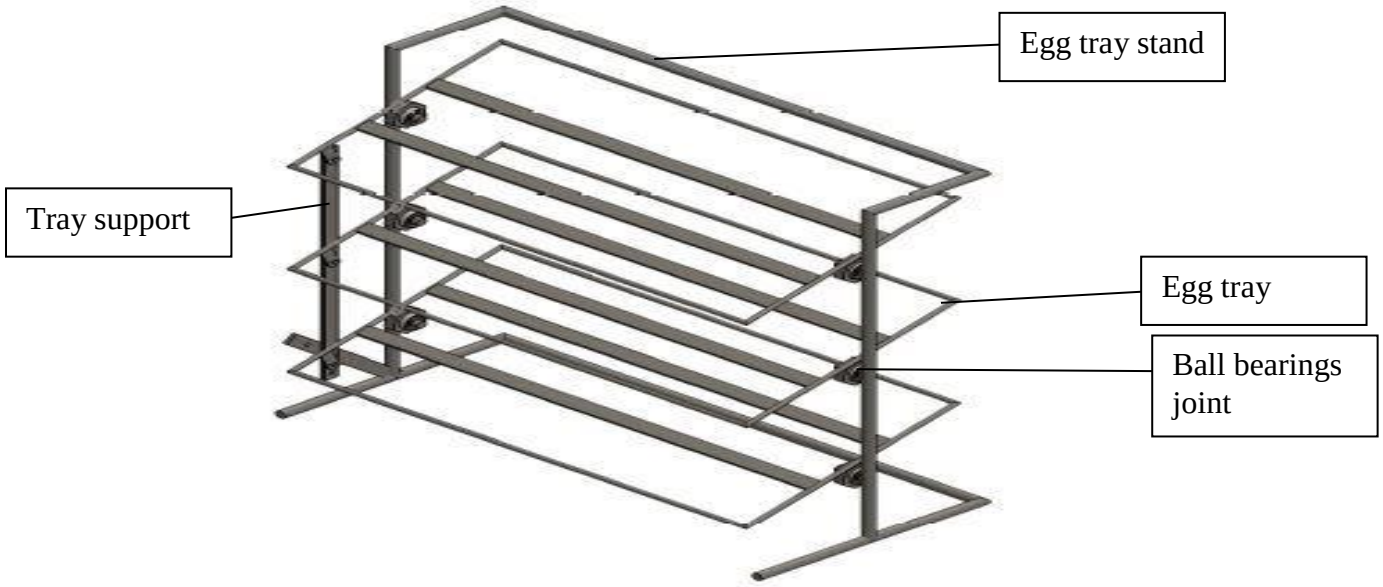


Figure 3.5: The schematic diagram of the egg trolley stand

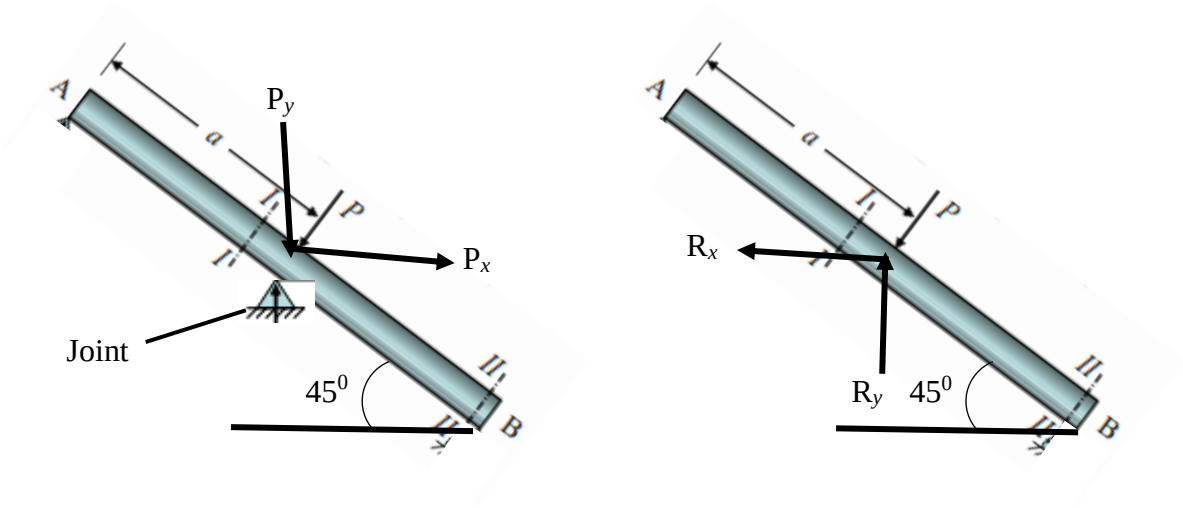


Figure 3.6: Loading and Free Body Diagramof Simply Supported InclinedBeam

Resolving the load (P) into x and y direction we have P_x and P_y for horizontal and vertical components respectively. Solving the forces will give:

$$P_x = P \sin 45^0 \quad (3.1)$$

$$P_y = P \cos 45^0 \quad (3.2)$$

3.5 Design Analysis

This section gives values of parameters used for design calculation as well as definition of terms. It also presents illustration of loads and their location during egg tray rotation.

3.5.1 Definition of Terms

i. n - Number of egg to be incubated.

ii. c - Number of crates required in the incubator given as

$$c = \frac{n}{30} \quad (3.3)$$

iii. m_{egg} - Average mass of a chicken egg. m_{egg} = 0.057 kg

iv. g - Acceleration due to gravity. g = 10 m/s^2

v. M_{TOTAL} - Mass for the total number of eggs

$$m_{TOTAL} = m_{egg}\ x\ 180 \quad (3.4)$$

vi. W_{TOTAL} - Total weight

$$W_{TOTAL} = M_{TOTAL}\ x\ g \quad (3.5)$$

vii. W_x - Weight per tray in the incubator

$$W_x = \frac{W_{TOTAL}}{3} \quad (3.6)$$

viii. W_s - Weight of egg tray support made of Steel. w_s = 32.67 N (from 3D model estimation)

ix. P - The load on each egg tray

$$P = W_x + W_s \quad (3.7)$$

x. P_y; P_x - The vertical and horizontal components of the load (P)

xi. R_y; R_x - The reactions at the support

xii. V_{XYA}; V_{XYB} The vertical component of the shear force at both ends

xiii. V_{XA}; V_{XB} The actual shear force at both ends

xiv. d - Perpendicular distance of shear force from the support point. d = 0.106 m

xv. M_x - Bending moment.

$$Mx = Vx\ X\ d \quad (3.8)$$

xvi. V_{inc} - Volume of the incubation chamber

$$Vinc = l\ x\ b\ x\ h \quad (3.9)$$

xvii. l; b; h - length, breath and height of the incubating chamber

xviii. ρ_{air} - Density of dry air. ρair at 20 ^{0}C and 101.325 kPa, is 1.2041 kg/m^3 (About-Education, 2015)

xix. M_{air}; V_{air} - Mass and volume of dry air

$$M_{air} = \rho_{air}\ x\ V_{air} \quad (3.10)$$

xx. C_{air} - Specific Heat Capacity for air. C_{air} = 1.006 kJ/kg.k (engineeringtoolbox, 2015)

xxi. C_s - Specific Heat Capacity for Steel. C_s = 0.511 kJ/kg.K (Engineersedge)

xxii. Q_{inc} - Total heat required in the incubation chamber

$$Q_{inc} = M_{air}C_{air}\Delta T_{air} + M_sC_s\Delta T_s \quad (3.11)$$

3.5.2 Egg rotation illustration

Figure 3.7 illustrates the free body diagrame of egg tray as used in the design after rotation

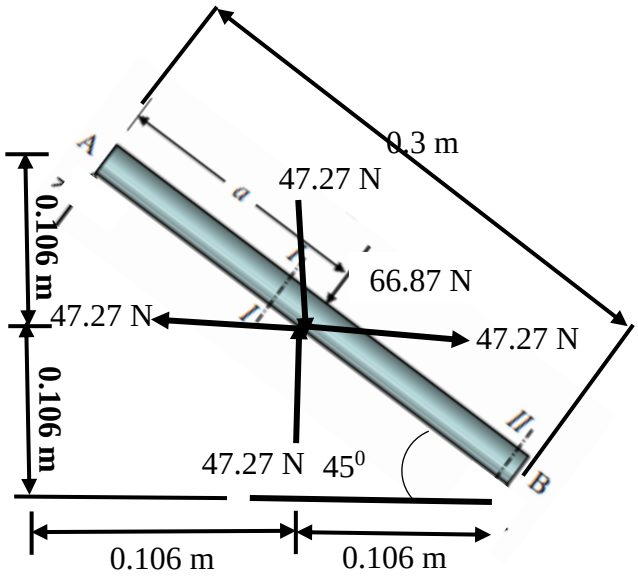
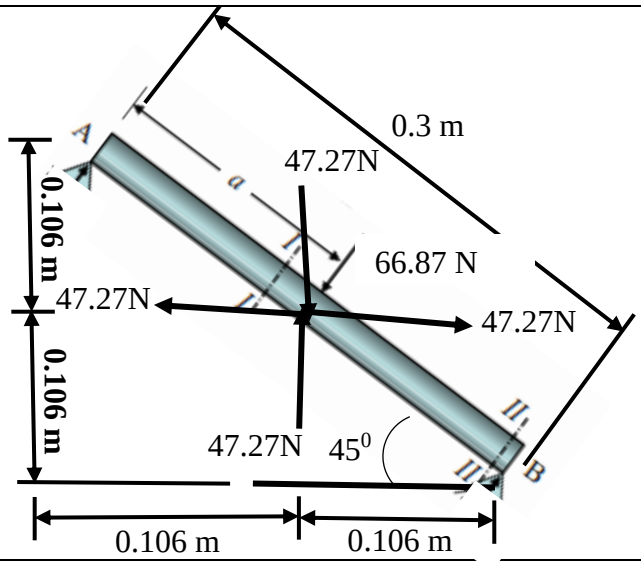


Figure 3.7: Free Body Diagram for Egg Tray Support

3.6 Design Calculation

INITIAL VALUES	CALCULATIONS AND SKETCH	RESULTS
3.6.1 Calculation for crate number		
Number of egg to be incubated is n = 180 eggs	Number of crates required in the incubator is given as c = n/30 = 180/30 = 6	c = 6
3.6.2 Calculation for shear stress and bending moments		
Average mass of a chicken egg is m_{egg} = 0.057 kg	Mass for the total number of eggs is $M_{TOTAL} = m_{egg}$ X 180 = 0.057 X 180 = 10.26 kg Total weight (W_{TOTAL}) = 102.6 N	M_{TOTAL} = 10.26 kg W_{TOTAL} = 102.6 N
Total weight of eggs W_{TOTAL} = 102.6 N	Weight per tray in the incubator is $W_{(x)} = \frac{W_{TOTAL}}{3} = \frac{102.6}{3}$ ≈ = 34.2 N	$W_{(x)} \approx= 34.2\ N$

W_x = 34.2N Weight of egg tray support made of Steel (W_s) W_s = 32.67 N from 3D model estimation	The load on each egg tray is given as: $P = W_x + W_s$ = 34.2N + 32.67 N P = 66.87 N From Equation 3.1 and 3.2 The vertixal and horizontal components can be resolved as follows: $P_y = P \sin 45^0 = 66.87 \sin 45^0$ = 47.27 N $P_x = P \cos 45^0 = 66.87 \cos 45^0$ = 47.27 N	P = 66.87 N P_y = 47.27 N P_x = 47.27 N
P_y = 47.27 N P_x = 47.27 N	From Figure 3.8, the reactions at the support, which are R_y and R_x are obtained as follows: $+\uparrow \sum Fy = 0; Ry - Py = 0;$ $Ry = Py = 47.27N$ $+\leftarrow \sum Fx = 0; Rx - Px = 0;$ $Rx = Px = 47.27\ N$	R_y = 47.27 N R_x = 47.27 N
R_y = 47.27 N R_x = 47.27 N L = 0.300 m a = 0.150 m d= 0.106 m		V_{xyA} = 47.27 N V_{xyB} = -47.27 N V_{xxA} = 47.27 N V_{xxB} = -47.27 N V_{xA} = 66.87 N V_{xB} = -66.87N M_x = 7.0878 Nm

	From the free body diagram (FBD), The vertical component of the share force at both ends are equal but opposite to the reaction at the joint. The vertical component of the share force Vxy is V_{xyA} = -V_{xyB} = 47.27 N. Hence, the actual share force VxA and VxB are V_{xA} = -V_{xB} = $\frac{47.27}{\sin 45^0}$ N = $\frac{47.27}{0.7071} N = 66.87\ N$ While the bending moment (M_x) is the product of the share force and the perpendicular distance from the support point. $$Mx = Vx\ X\ d = 66.87\ X\ 0.106$$ Mx = 7.0878 Nm	
3.6.3 Calculation for heat requirement		
Incubation Chamber's dimension is: 0.770x0.710x0.735 l = 0.770 m b = 0.710 m h = 0.735 m	Volume of the incubation chambers (V_{inc}) is calculated as: $$V_{inc} = l\ x\ b\ x\ h$$ $$V_{inc} = 0.770\ x\ 0.710\ x\ 0.735$$ V_{inc} = 0.402 m^3 Volume of egg trays and the trolley was estimated to be 0.00125 m^3 while that of the humidifier with water trough is 0.015 m^3 from 3D model estimation. Hence, it is assumed that air fill up the remaining space in the incubation chamber. Volume of air in the chamber is (V_{air}) V_{air} = (0.40200 – 0.00125 – 0.01500) m^3 V_{air} = 0.38575 m^3	V_{inc} = 0.40200 m^3 V_{air} = 0.38575 m^3
At 20 ^{0}C and 101.325	Mass of air in the chamber is calculated as $$M_{air} = \rho_{air}\ x\ V_{air}$$	M_{air} = 0.465 kg

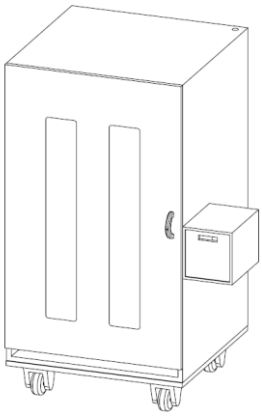
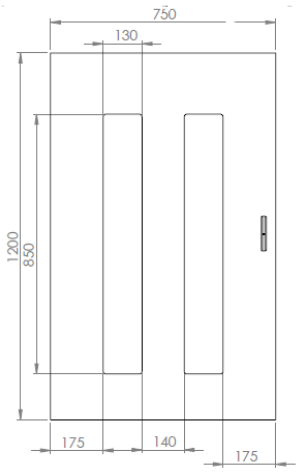
kPa, the density of dry air (ρ_{air}) is 1.2041 kg/m^3 (About-Education, 2015)	$M_{air} = 1.2041\ x\ 0.38575$ M_{air} = 0.465 kg	
M_{air} = 0.483 kg Mass of Steel trolley (M_s) is 9.8 kg from 3D model estimation Specific Heat Capacity for air and steel are C_{air} = 1.006 kJ/kg.k (engineeringtoolbox, 2015) C_s = 0.511 kJ/kg.K(Engineersedge)	Total heat required in the incubation chamber ($Qinc$) $Q_{inc} = M_{air}C_{air}\Delta T_{air} + M_sC_s\Delta T_s$ $\Delta T_{air} = \Delta T_s$ = (37.5 - 27.0) k = 10.5 k $Q_{inc} = 0.465x1.006x10.5 + 9.8x0.511x10.5$ $Q_{inc} = 4.9120 + 52.5819$ Q_{inc} = 57.4939 Kj	$\Delta T_{air} = \Delta T_{(s)}$ = 10.5 k Q_{inc} = 57.4939 kJ
Q_{inc} = 57.4939 kJ	Amount of heat obtainable from complete combustion of butane following the equation: $C_4H_{10(g)} + {}^{13}/_2O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O_{(l)}$is 2874kJ (AUS-e-TUTE, 2015) Since Qinc <<2874kJ Therefore, combustion of butane is expected to generate enough heat required for incubation within a short period of time.	

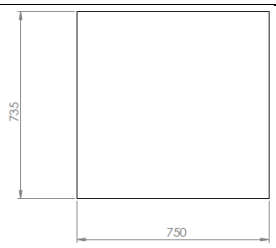
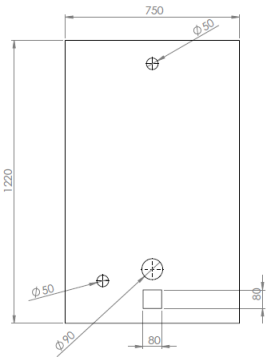
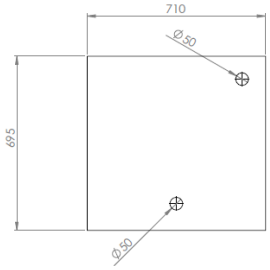
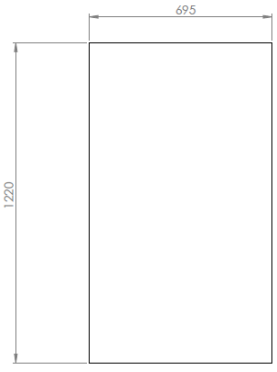
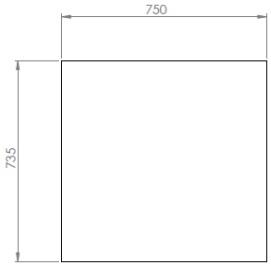
3.7 Fabrication of the Incubator

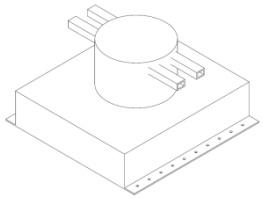
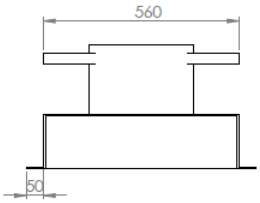
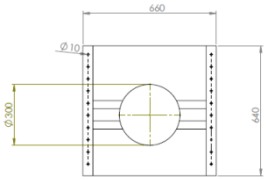
The cabinet incubator was fabricated using medium density fibre board (MDF). The incubator was separated into two compartments; the upper chamber is for the trolley and the lower chamber is housing the heat radiator.

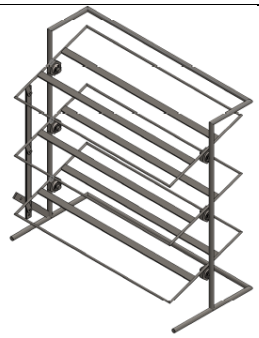
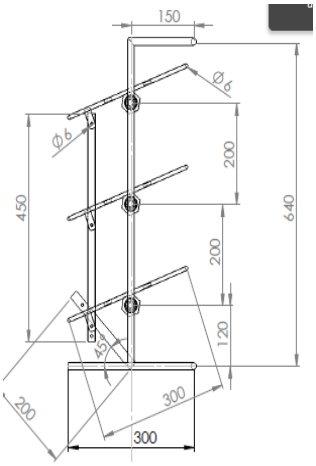
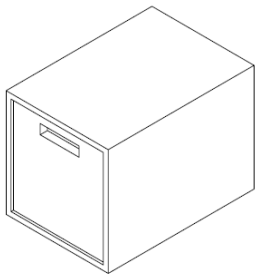
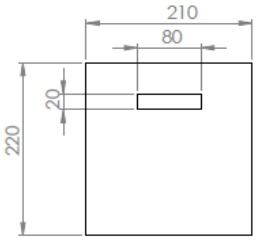
Metal steel rods and metal flat bar of were used in the construction of the trolley containing the network of egg crates.The heat radiator was constructed with metal sheet. Inside the heat chamber the system of gas burner was installed.

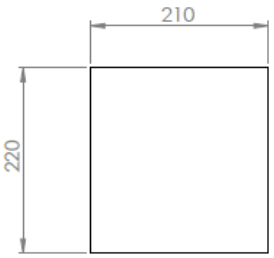
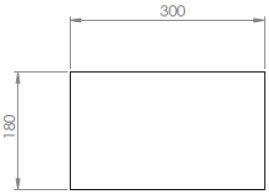
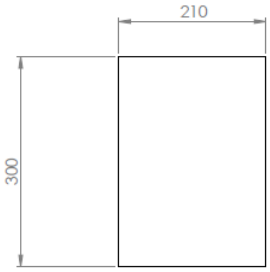
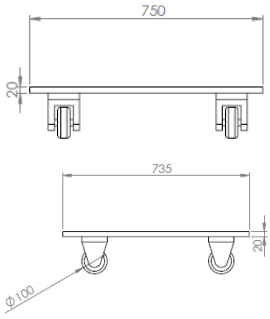
Table 3.1: Construction Process for the Incubator

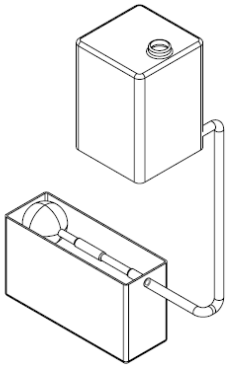
S/n	Component	Material	Process Description	Equipment Used
1	Incubator cabinet  Front view  Top view	Two sheets of white medium density fibre (MDF) board 2438mm x 1220mm x 20mm Two sheets of transparent glass 130mm x 855mm x 5mm Abro RTV silicon gum Screws, Top bond White edge tape and Evostick	Cut two pieces of 695mm x 1220mm x 20mm 750mm x 1220mm x 20mm. Cut on the rear part two circular diameter of 47mm, one circular diameter of 90mm and a rectancular hole of 70mm x 90mm20mm for vents. Use evostick to bind edging tape on cut section. Cut two pieces of 750mm x 735mm 20mm to cover the top and bottom of the cabinet incubator. A sheet of 710mm x 710mm 20mm was cut and used to demarcate the interior into Incubation and Heat chamber. On sheet of 710mm x 710mm 20mm two circular holes of	• Circular sawing machine • Tape rule • Pencil • Pair of scissors • Work bench • Portable electric screwing machine • Glass cutter • Jig saw • Hand file • Flat scraper • Punch • Drilling machine • Scriber

	 Back view  Middle demarcator  Side view  Bottom view 		diameter 47mm x 20mm were made and centrifugal fans installed. On sheet of 750mm x 1220mm x 20mm which served as the cabinet door, cut off two sheets of 130mm x 855mm x 20mm sheets to be replaced by the 130mm x 855mm x 5mm transparent glass sheet. MDF board screws with the aid of Electric screwing machine were used tofasten together the pieces of cut parts together.	

2	Heat Chamber  Front view  End view  Top view  	Sheet of mild steel 1220mm x 1220mm x 2mm. Welding electrodes	Cut sheets of 560mm x 640mm Two sheets of 640mm x 155mm One sheet of 560mm x 155mm Two sheet of 50mm x 640mm and weld together to form the shape as shown in views beside. Cut 4 pieces of hollow rectangular mild steel 30mm x 60mm x 160mm. Cut a sheet of 800mm x 200mm and bend into a circular cylinder of diameter 300mm. Weld the four 30mm x 60mm x 160mm for vent for flue gas exitinto the incubator complete the heat chamber.	• Welding machine • Hammer • Mallet • Jig saw • Hack saw • Punch • Scriber • Flat file • Chisel • Measuring Tape • Bending machine • Drilling machine
3	Egg Tray Stand	A flat bar 19mm x 5mm x 1220mm Mild steel rod of diameter 6mm x 2438mm Mild steel rod of	Cut 6 pieces of flat bar 19mm x 5mm x 620mm Cut 6 pieces of mild steel rods of diameter 6mm x 640mm Cut 6 pieces of mild steel	• Measuring Tape • Welding machine • Hammer • Hack saw

	 End view 	diameter 13mm x 2560mm 6 Ball bearings diameter 50mm	rods of diameter 6mm x 300mm Cut 2 pieces of mild steel rods of diameter 13mm x 300mm Cut 4 pieces of mild steel rods of diameter 13mm x 640mm Cut 2 pieces of mild steel rods of diameter 6mm x 150mm Cut a piece of flat bar 19mm x 5mm x 360mm Cut a piece of flat bar 19mm x 5mm x 150mm and weld together to form the egg tray stand as shown in the drawing beside.	• Scriber • Flat file • Chisel
4	Control box  Front view 	Two sheets of white medium density fibre (MDF) board 298mm x 1220mm x 20mm Two sheets of plywood of 5mm 220mm x 210mm Abro RTV silicon gum Screws, Top bond White edge tape and Evostick	Cut two pieces of 298mm x 210mm x 20mm and two pieces 298mm x 180mm x 20mm. Use evostick to bind edging tape on cut section. Cut two pieces of 210mm x 220mm x 20mm as the front control box cover and the rear cover. MDF board screws with the aid of Electric screwing machine were used to fasten together the pieces of cut parts	• Tape rule • Pencil • Work bench • Portable electric screwing machine • Jig saw • Hand file • Drilling machine • Scriber

			together.	
5	Rear view  End view  Top view  The incubator carrier  	Abro RTVsilicon gum, White paint Plywood 750mm x 750mm x 20mm. 4 roller tyres	Four roller tyres were fixed on the plywood 750mm x 750mm and screwed onto the base of the cabinet incubator	• Scraper • Scriber • Flat file • Measuring tape • Electric screwing machine

6	Humidifier system 	20 litres transparent water drum. Pvc hose, 3 elbow joints. Standard Flushing cistern. PVC gum	The drum was placed on the top of the incubator and the flushing cistern situated inside the incubator. The base of drum was bored and connected to the flushing system by means of hose and elbow joints.	• Flat file • Plier • Drilling machine
7	Ventilation holes	4 centrifugal fans, flexible wires	Drill bits holes were made and jig saw was used to cut out ventilation holes for the fans.	• Flat file • Jig saw • Saw blade • Abro gum
8	Finishing of the Cabinet Incubator	Abro RTVsilicon gum, White paint	Abro RTV silicon gel was used to seal up holes and spaces found in the assembled parts of the incubator to achieve retaintion of air flow. White paint was eventually used to paint the exposed areas.	• Portable electric screwer • Scraper • Scriber • Flat file • Measuring tape

3.8 Cost Analysis

An approximated cost of producing a typical sample of the designed incubator is summarized on Table 3.2.

Table 3.2: Cost Analysis

S/n	Description	Rate (₦)	Quantities	Amont (₦)
1.	Microcontroller	15,000:00	1	15,000:00
2.	Heat radiator	2,000:00	1	2,000:00
3.	12v d.c. fan	500:00	4	2,000:00
4.	Burner Stove	3,000:00	1	3,000:00
5.	Solenoid Valve	4,000:00	1	4,000:00
6.	Gas Cylinder and accessories	6,000:00	1	6,000:00
7.	Sparking set	4,300:00	1	4,300:00
8.	Hygrometer/Thermometer	5,000:00	3	15,000:00
9.	Hatcher Basket	1,500:00	1	1,500:00
10.	Hinges	200:00	6	1,200:00
11.	Egg Trolley	12,000:00	1	12,000:00
12.	Egg Crates	200:00	6	1,200:00
13.	Wheel roller	1,500:00	1	1,500:00
14.	Wheel	400:00	4	1600:00
15.	Transparent Glass sheet	300:00	2	600:00
16.	MDF Board	7,500:00	2	15,000:00
17.	Plywood	500	1	500:00
18	Battery	25,000:00	1	25,000:00
19.	Inverter	25,000:00	1	25,000:00
20.	Labour	20,000:00	Num	20,000:00
	Total			**156,400:00**
	5% for Contigency			7,820:00
	Sub-Total			**164,220:00**
	10% for Miscellaneous			16,422:00
	Grand Total			**180,642:00**

It takes about one hundred and eighty thousand, six hundred and fourty two naira to build a typical incubator as designed.

3.9 Experimental Procedure

Experiment was performed with the incubator to determine the hatchability rates of some fertile eggs that were obtained from National Animal Production Research Institute (NAPRI), Shika.The incubator automatically controls the supply and burning of butane gas for supply of heat as well as egg turning using digital micro-controller. The micro-controller regulates the heat inside the incubator using centrifugal fans and a temperature and a humidity sensor located inside the incubator. The humidity inside the incubator is maintained by the humidifier inside a water trough controlled by the micro-controller (flushing cistern ensures steady level of water in the water trough from the storage tank). The incubator temperature and humidity were stabilized in the incubation chamber before the quantity of fertile eggs is spread uniformly within the egg crates on the trolley. The eggs were set initially in the incubator with the large end of the eggs up.



Plate 3.1: Candler

Candler is a box with an electric bulb (200W) use for determining fertile eggs (See Plate 3.1). Candling of the fertile eggs was done on the 18^{th} day to determine potential fertile eggs for eventual hatching, the entire set of eggs transferred onto the hatcher basket and then returned back into the incubator immediately after the candling. The process of incubation of the eggs continued for remaining three (3) days when the chicks would finally come out of the egg shell. The major quantities monitored during the experiment are the incubating temperature and humidity as well as the ambient temperature. The amount of gas used during the incubation was noted which was used to determine the cost of incubating per egg.

The rate of ignition and the duration of combustion were also noted during the period of experiment. This was done to ascertain the level of compliance of the incubator with the theory of heat exchange explained in the previous section. Plate 3.2 and Plate 3.3 shows the incubator setup for performance evaluation test.

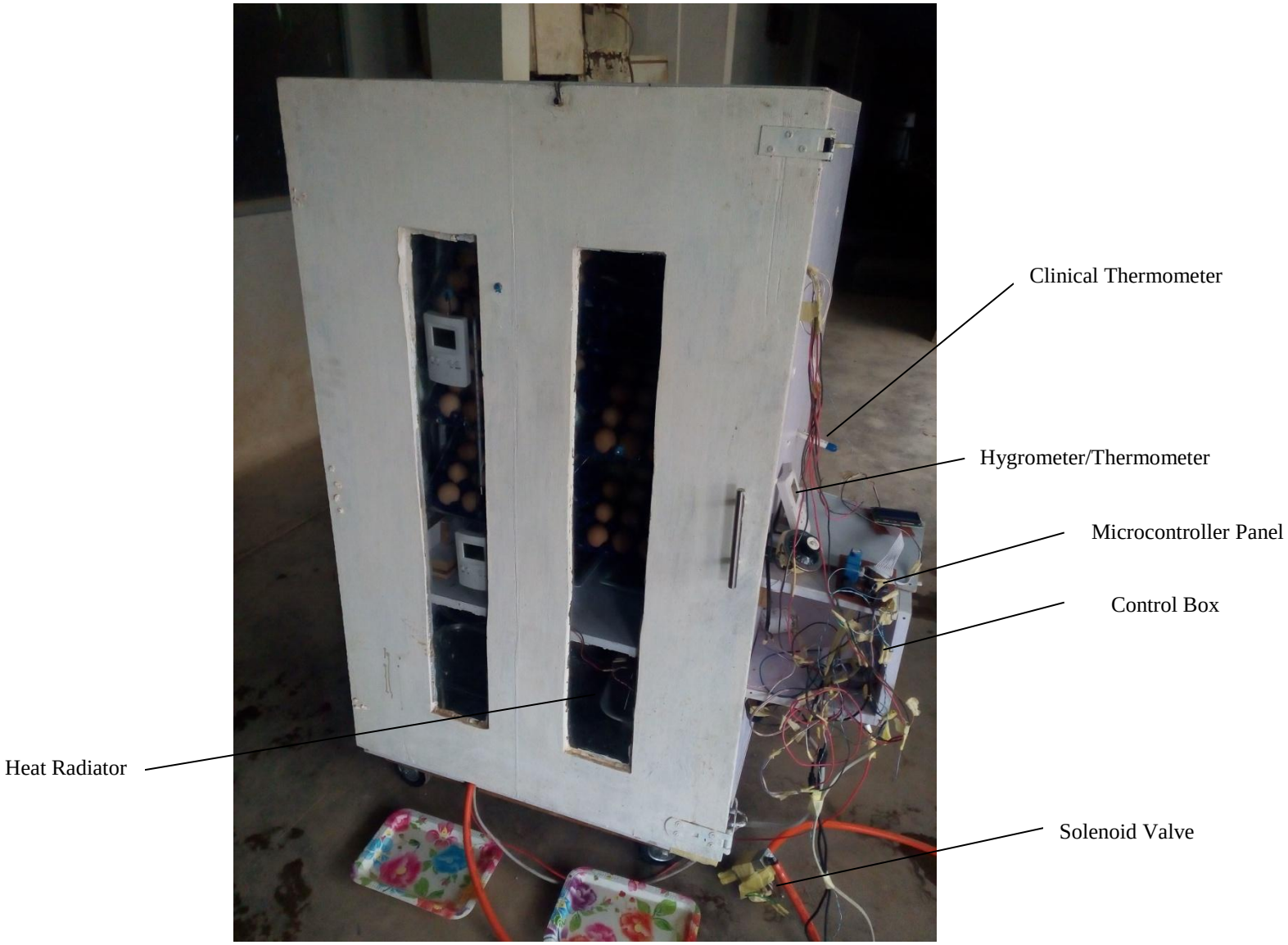


Plate 3.2: Fabricated Cabinet Incubator

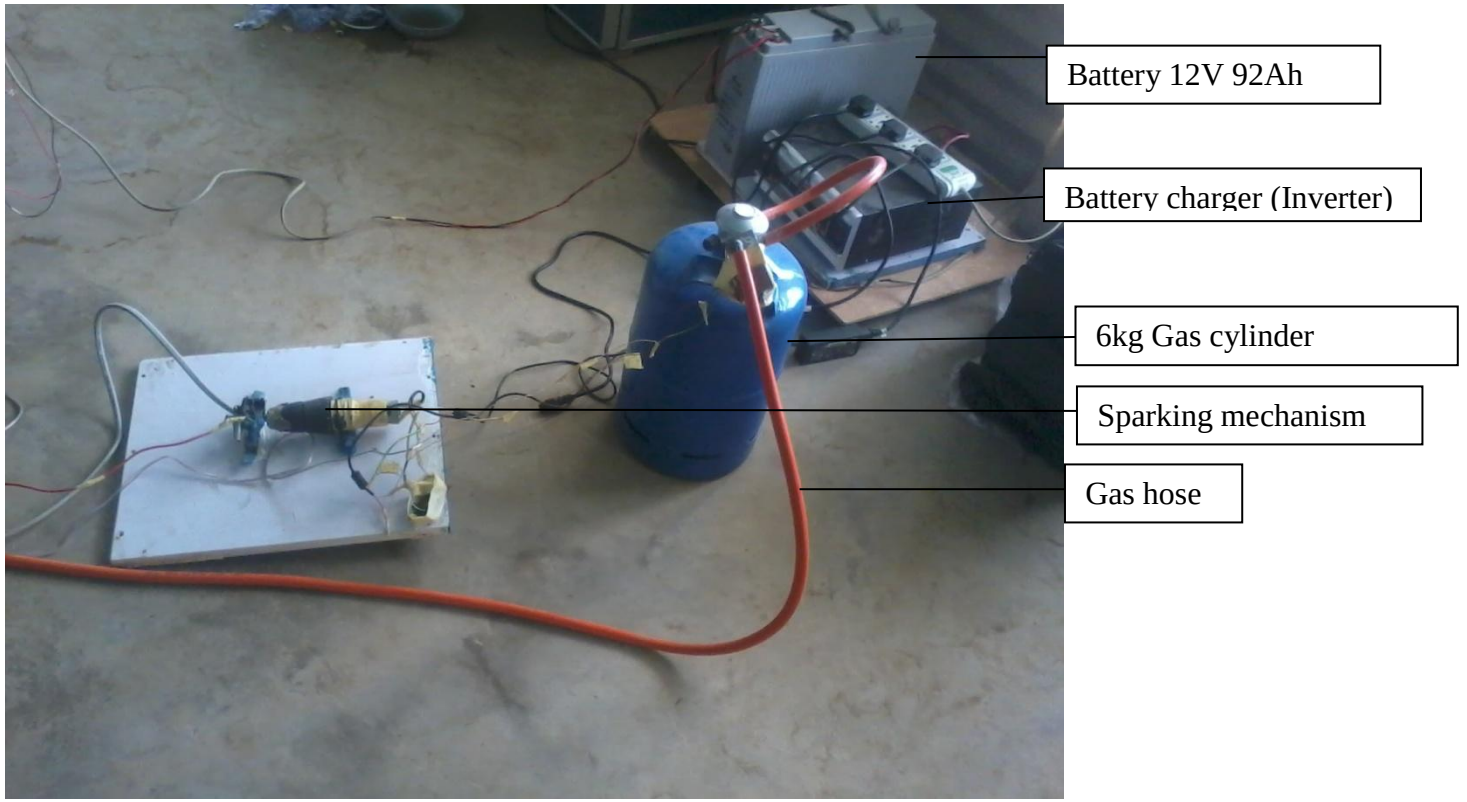


Plate 3.3: Gas cylinder, The battery and the charger

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

The results obtained from the performance evaluation done on the developed incubator are the incubating temperature and humidity as well as the ambient temperature. After the completion of incubation, the efficiency of the incubator was also determined based on the percentage hatchability.

The results obtained are presented as follows:

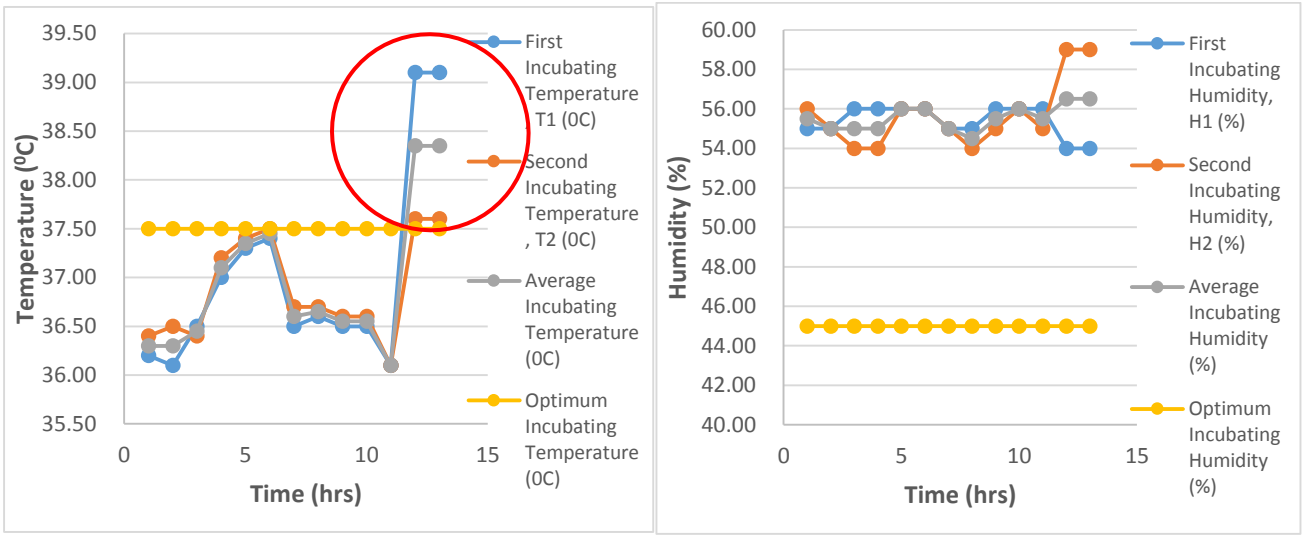


Figure 4.1: Temperature and Humidity Readings for Day 1

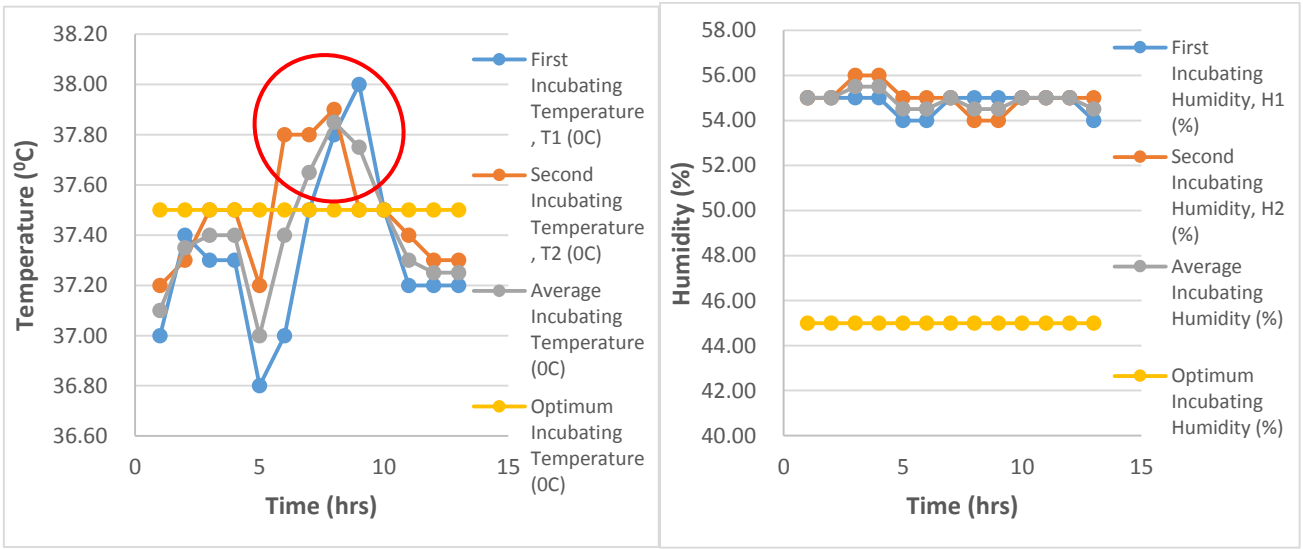


Figure 4.2: Temperature and Humidity Readings for Day 2

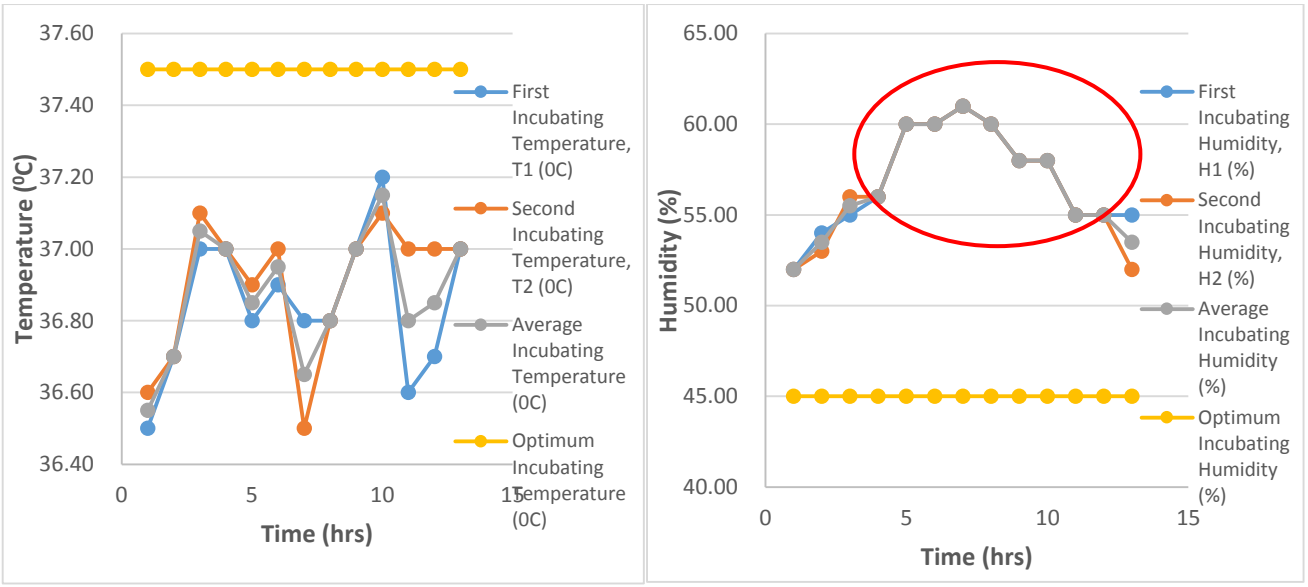


Figure 4.3: Temperature and Humidity Readings for Day 3

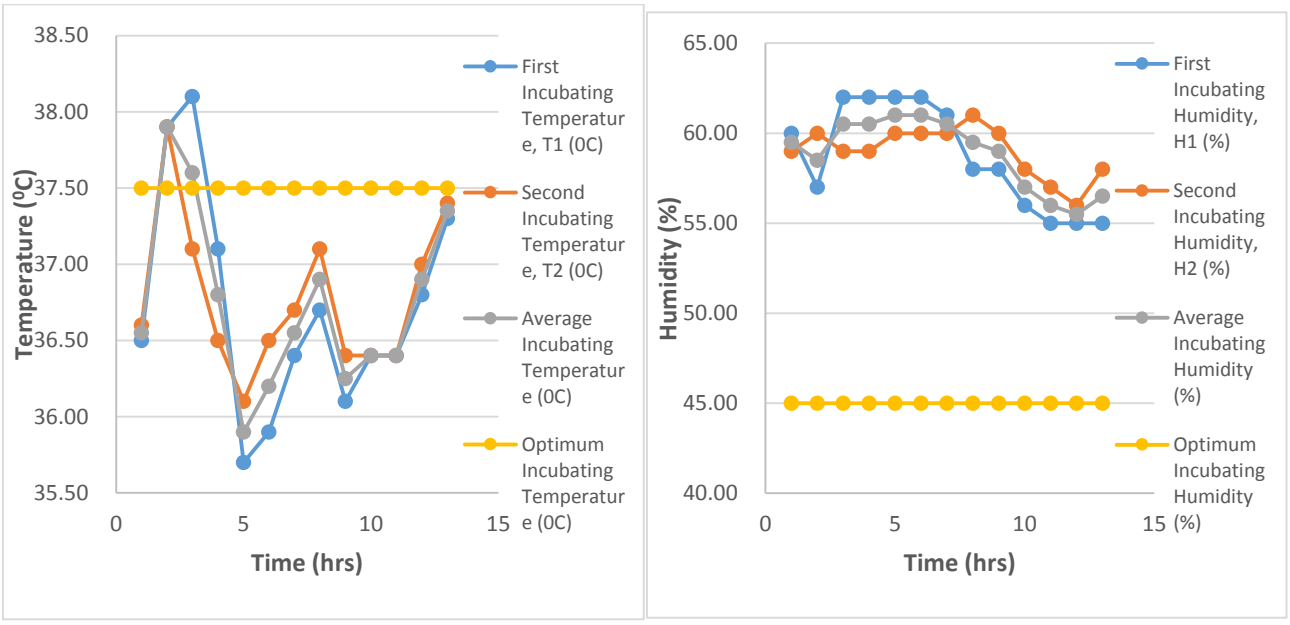


Figure 4.4: Temperature and Humidity Readings for Day 4

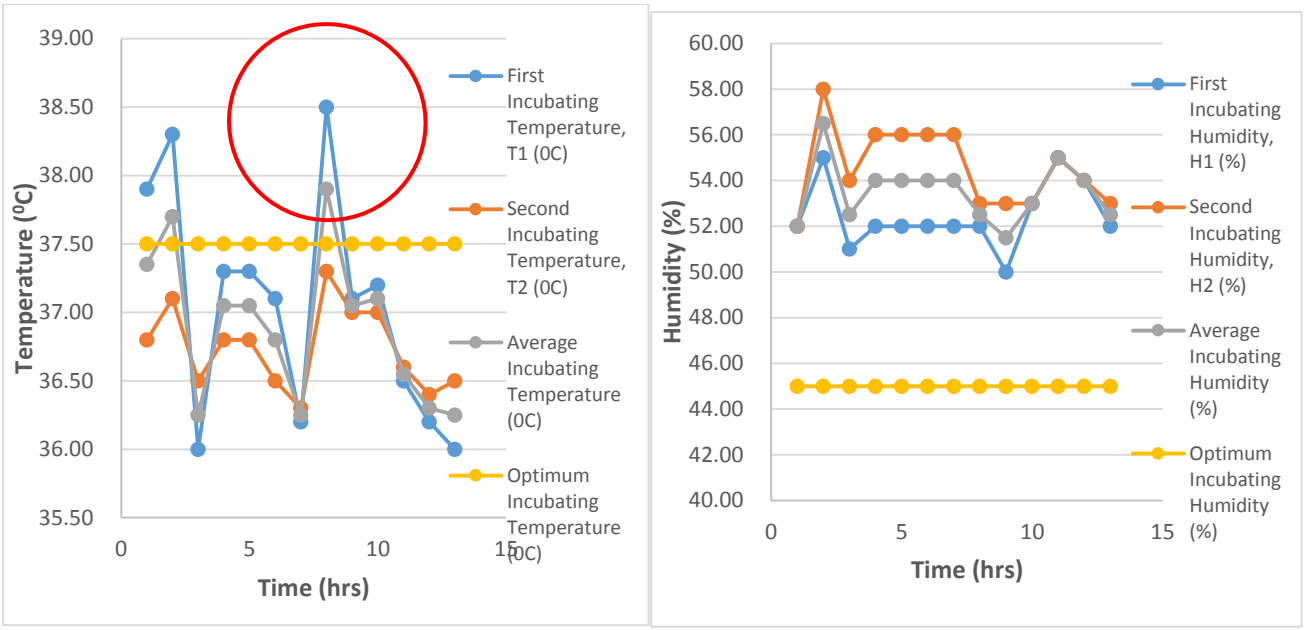


Figure 4.5: Temperature and Humidity Readings for Day 5

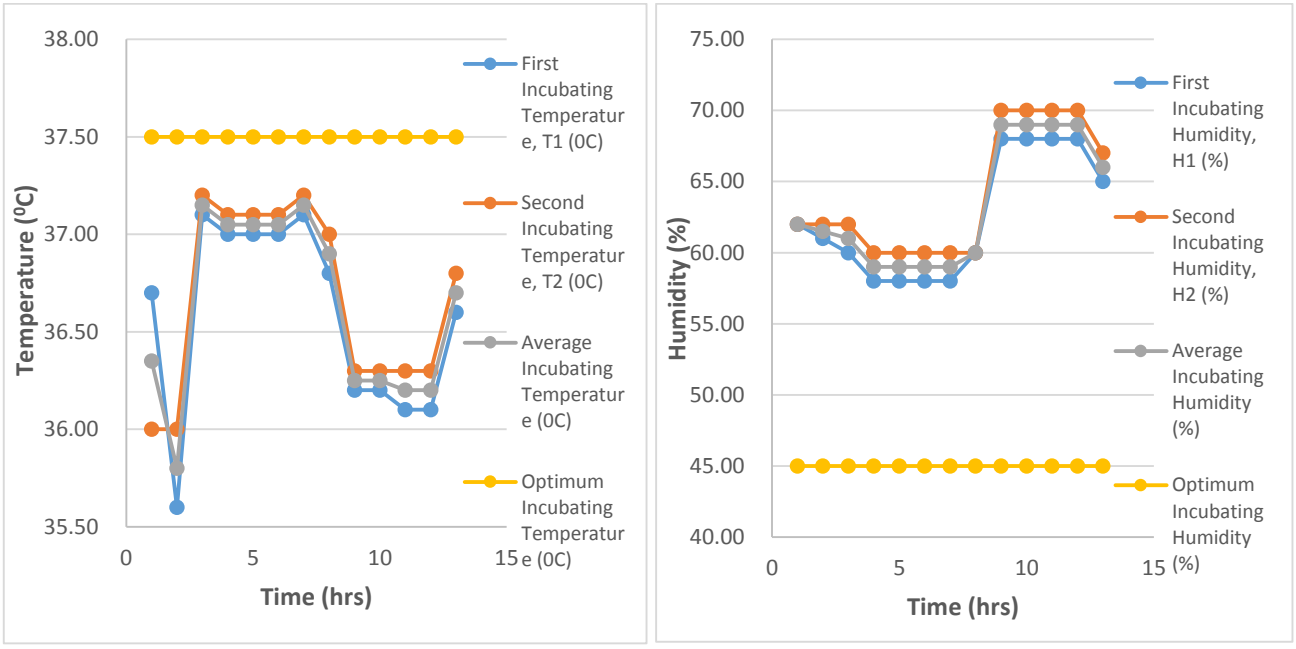


Figure 4.6: Temperature and Humidity Readings for Day 6

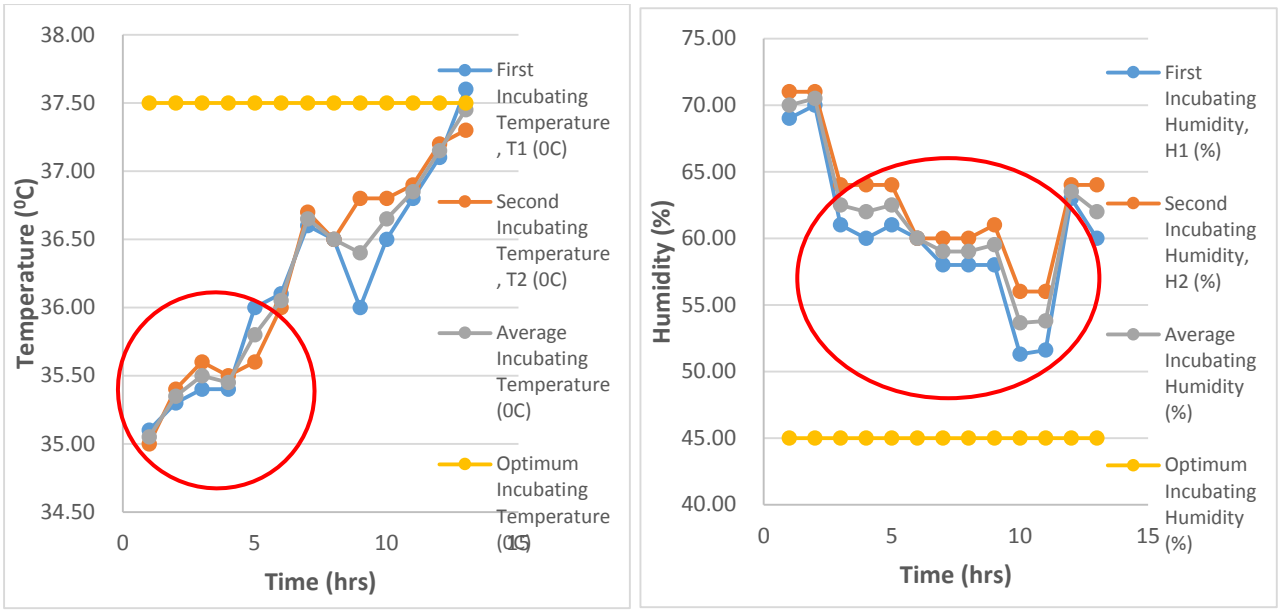


Figure 4.7: Temperature and Humidity Readings for Day 7

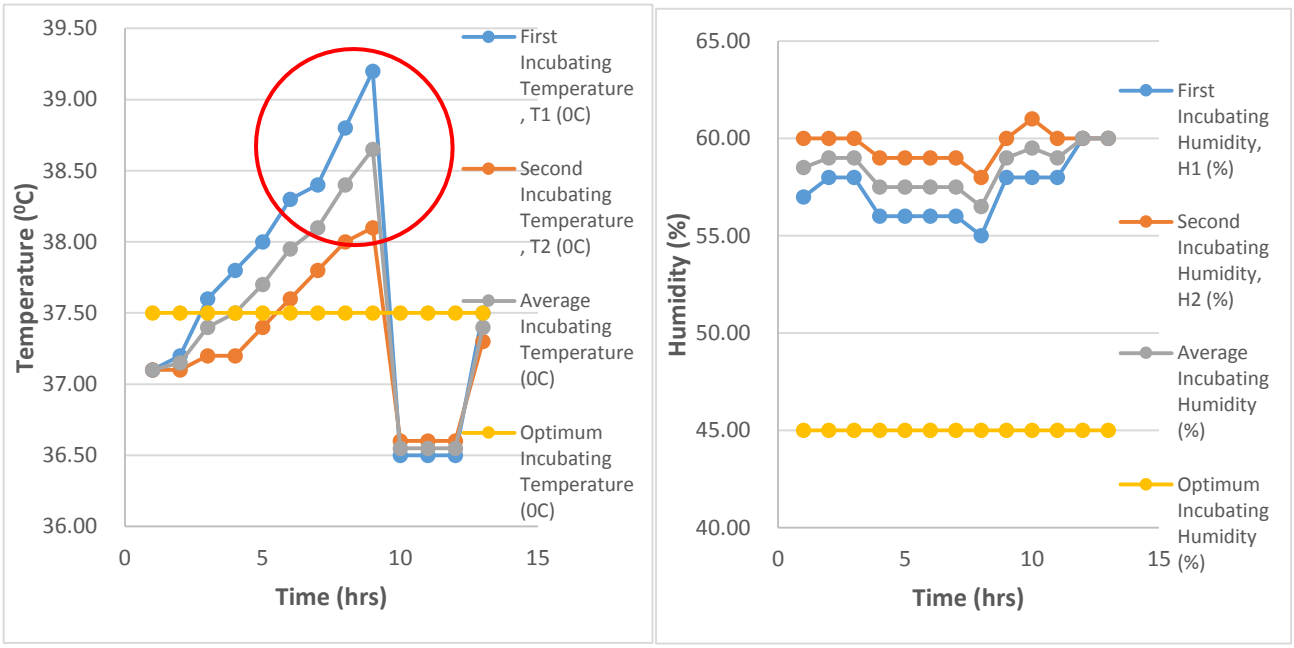


Figure 4.8: Temperature and Humidity Readings for Day 8

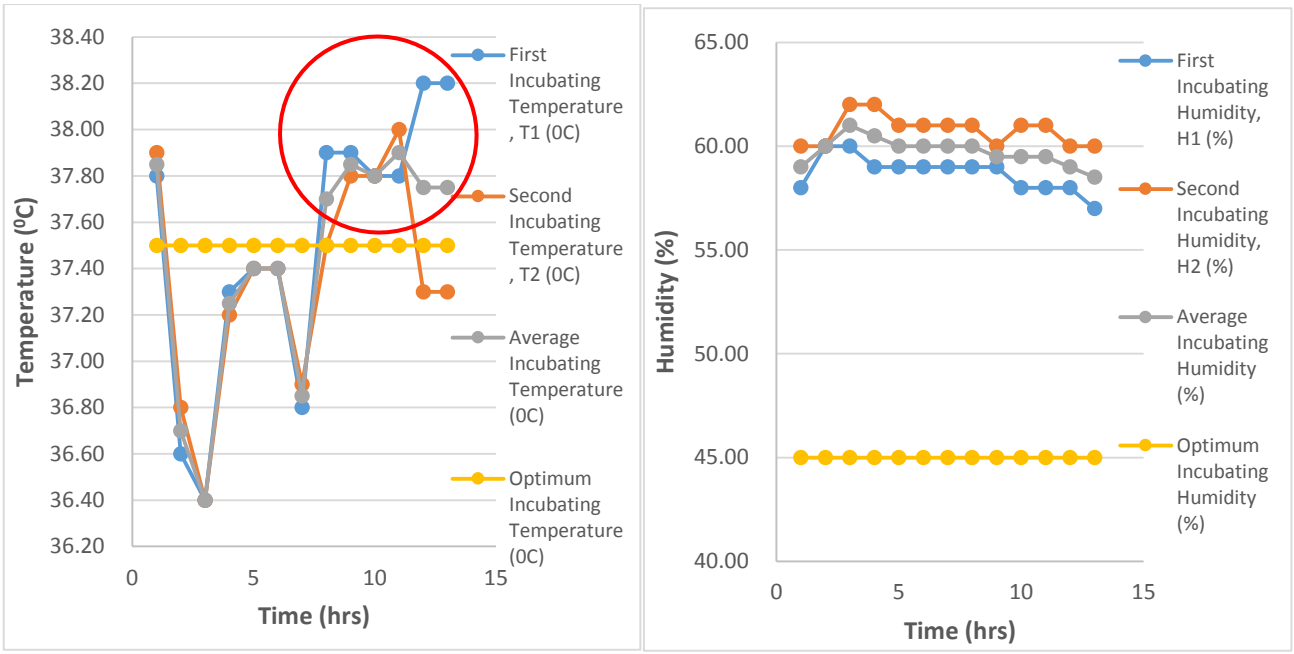


Figure 4.9: Temperature and Humidity Readings for Day 9

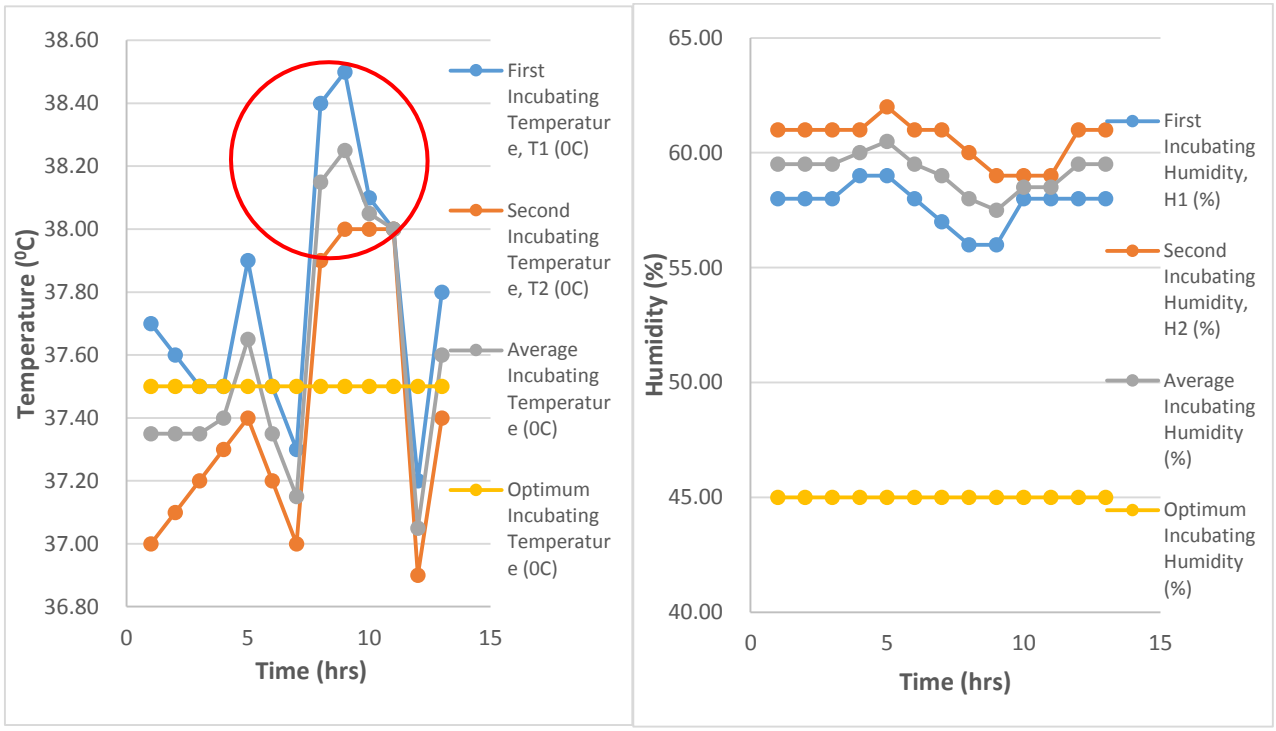


Figure 4.10: Temperature and Humidity Readings for Day 10

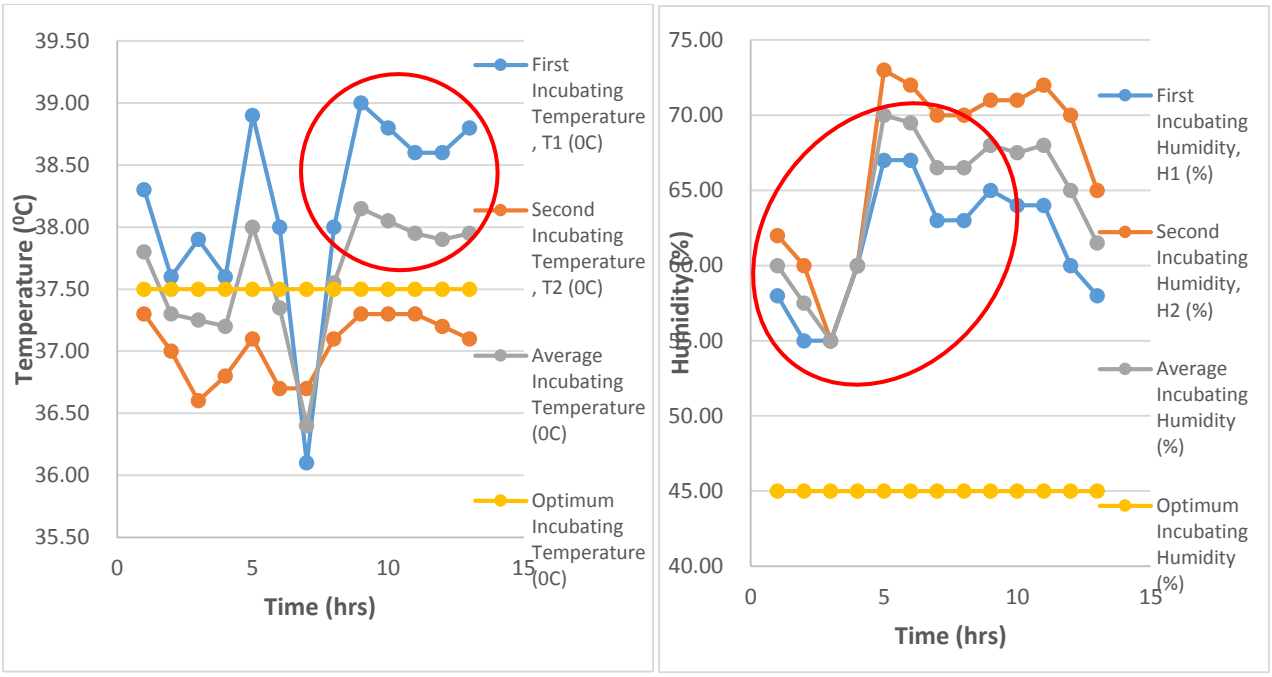


Figure 4.11: Temperature and Humidity Readings for Day 11

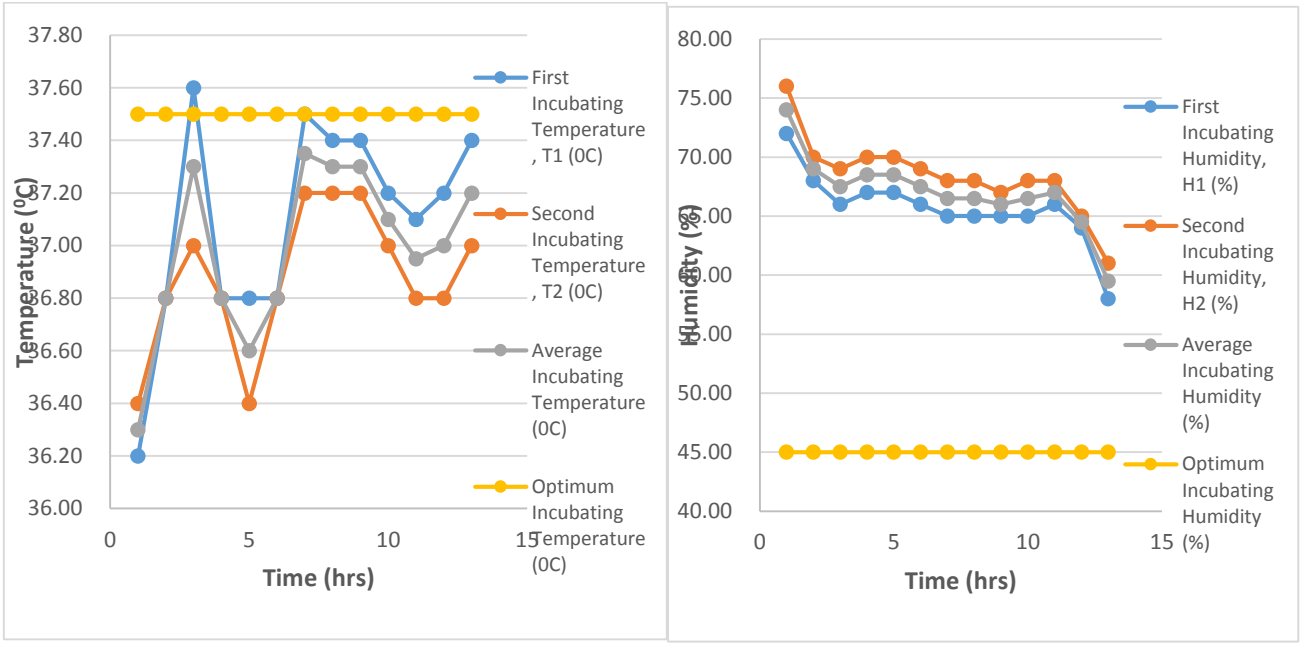


Figure 4.12: Temperature and Humidity Readings for Day 12

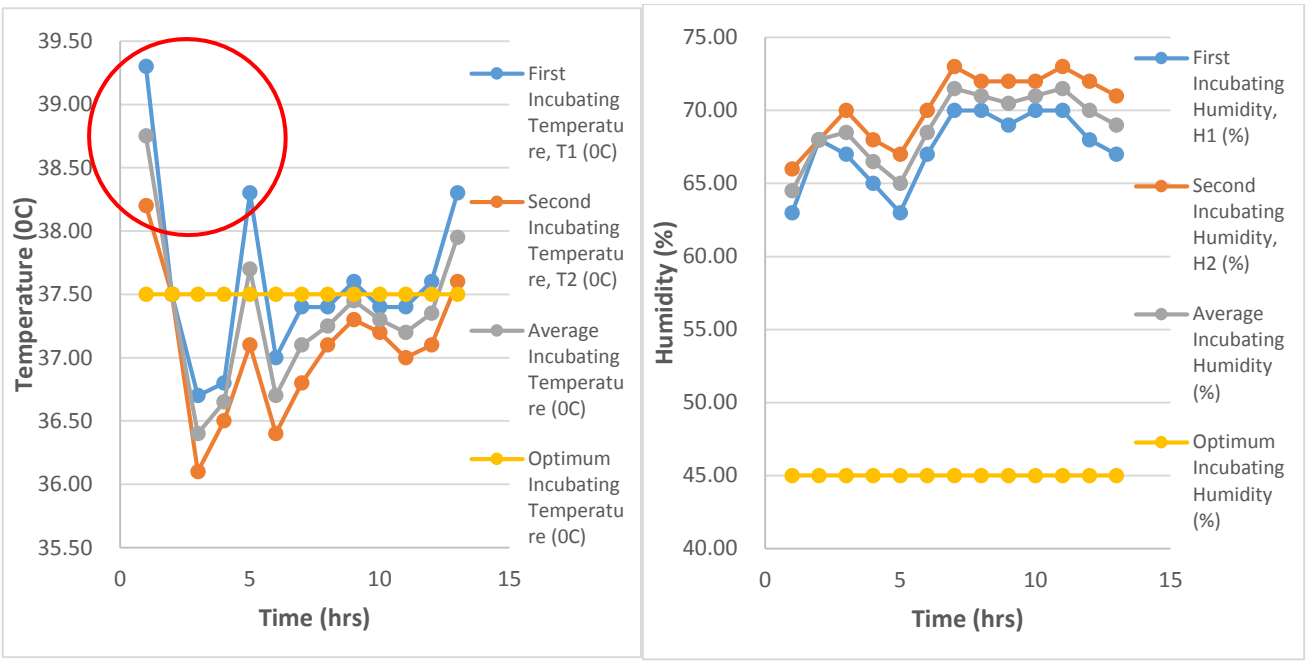


Figure 4.13: Temperature and Humidity Readings for Day 13

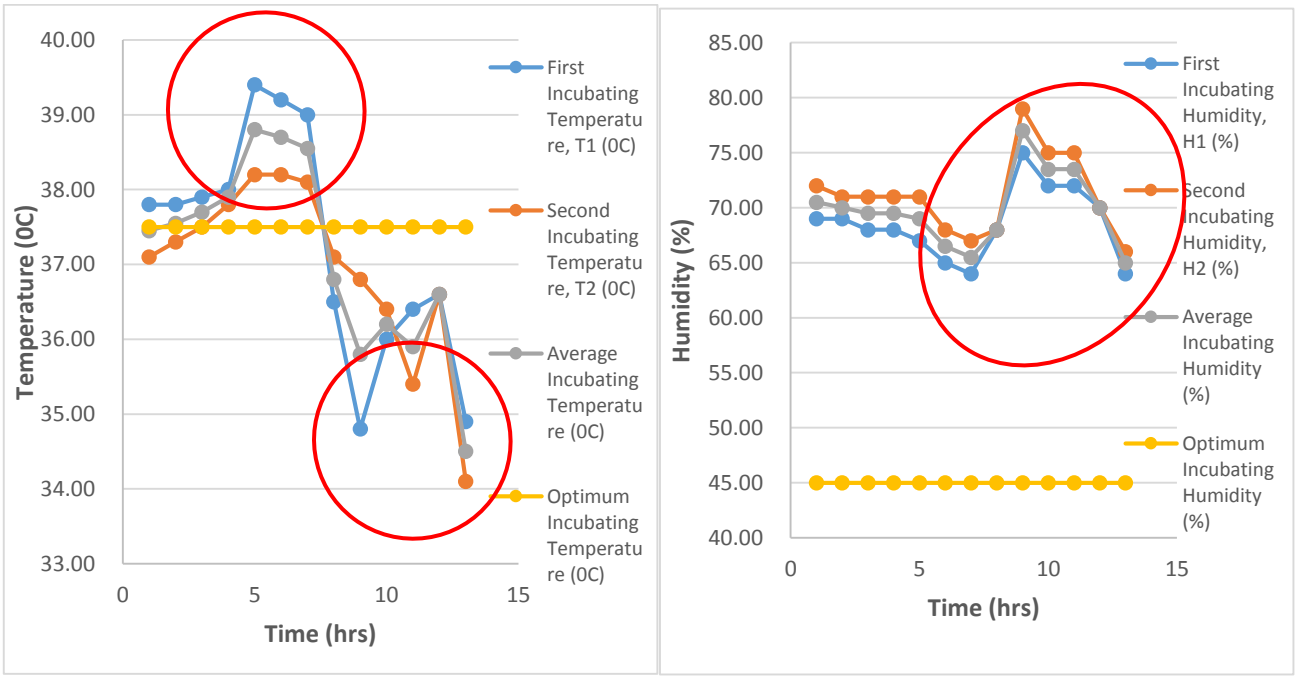


Figure 4.14: Temperature and Humidity Readings for Day 14

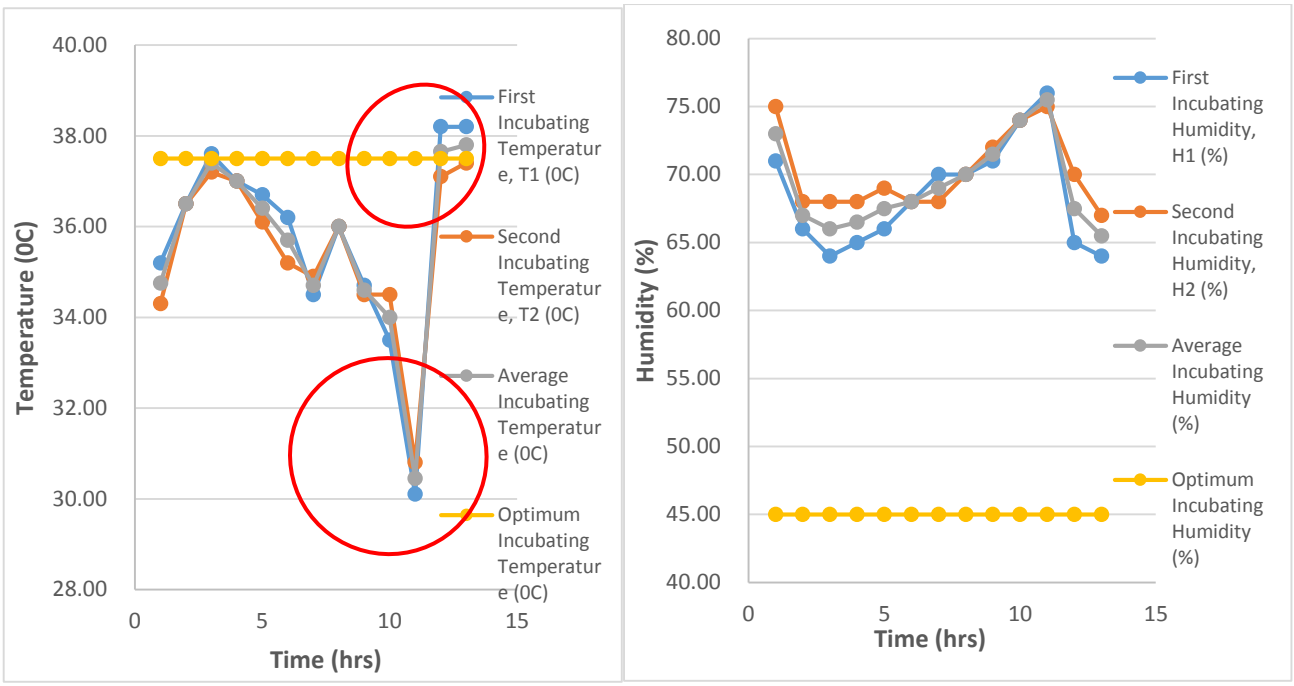


Figure 4.15: Temperature and Humidity Readings for Day 15

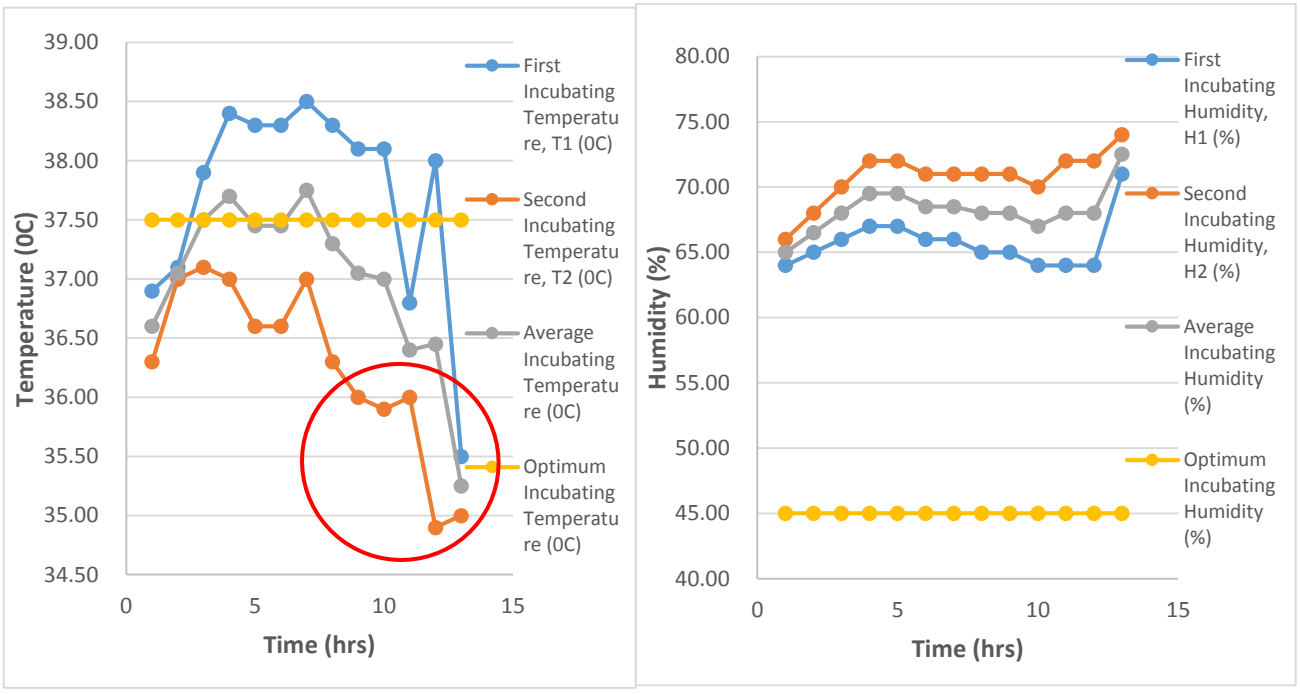


Figure 4.16: Temperature and Humidity Readings for Day 16

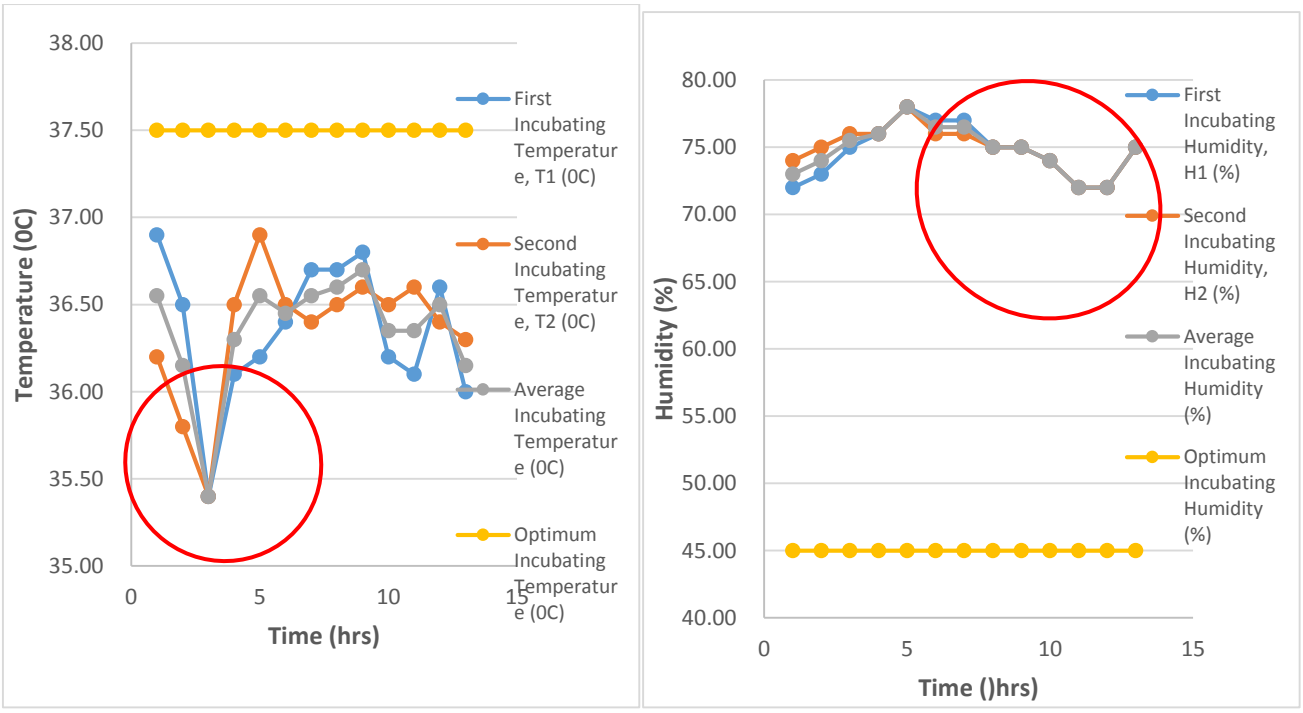


Figure 4.17: Temperature and Humidity Readings for Day 17

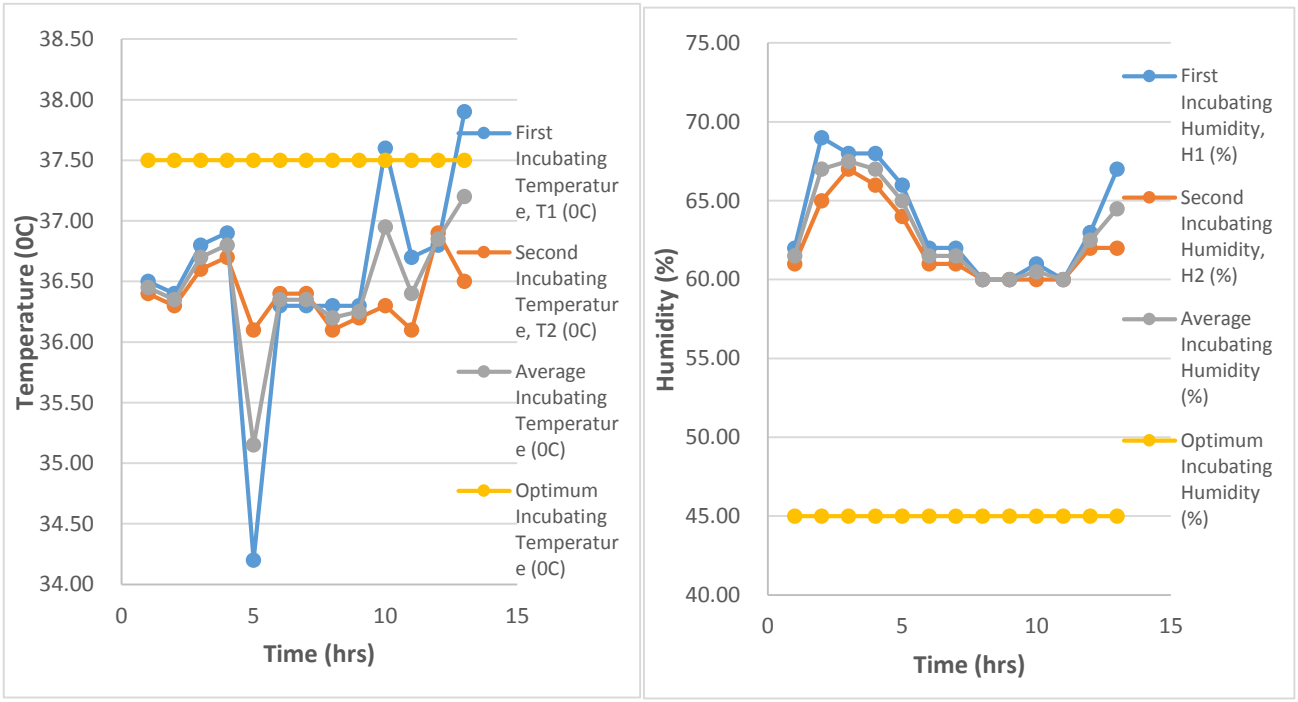


Figure 4.18: Temperature and Humidity Readings for Day 18

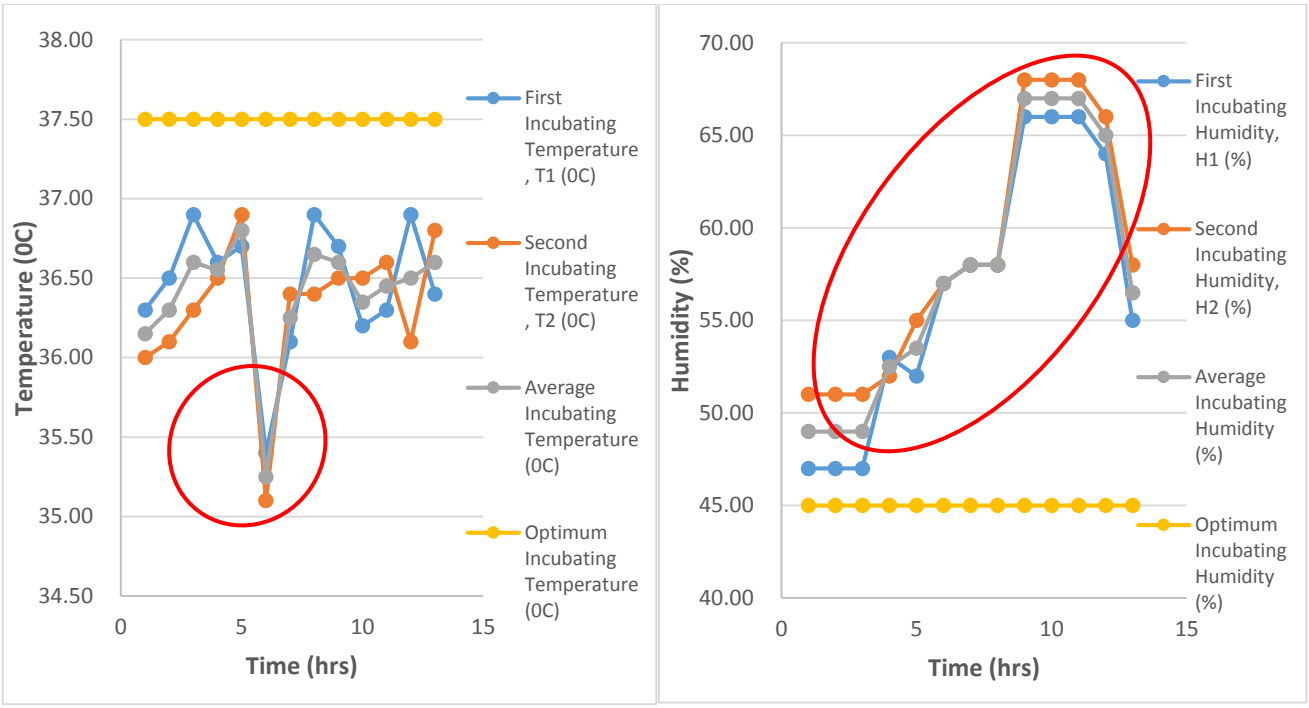


Figure 4.19: Temperature and Humidity Readings for Day 19

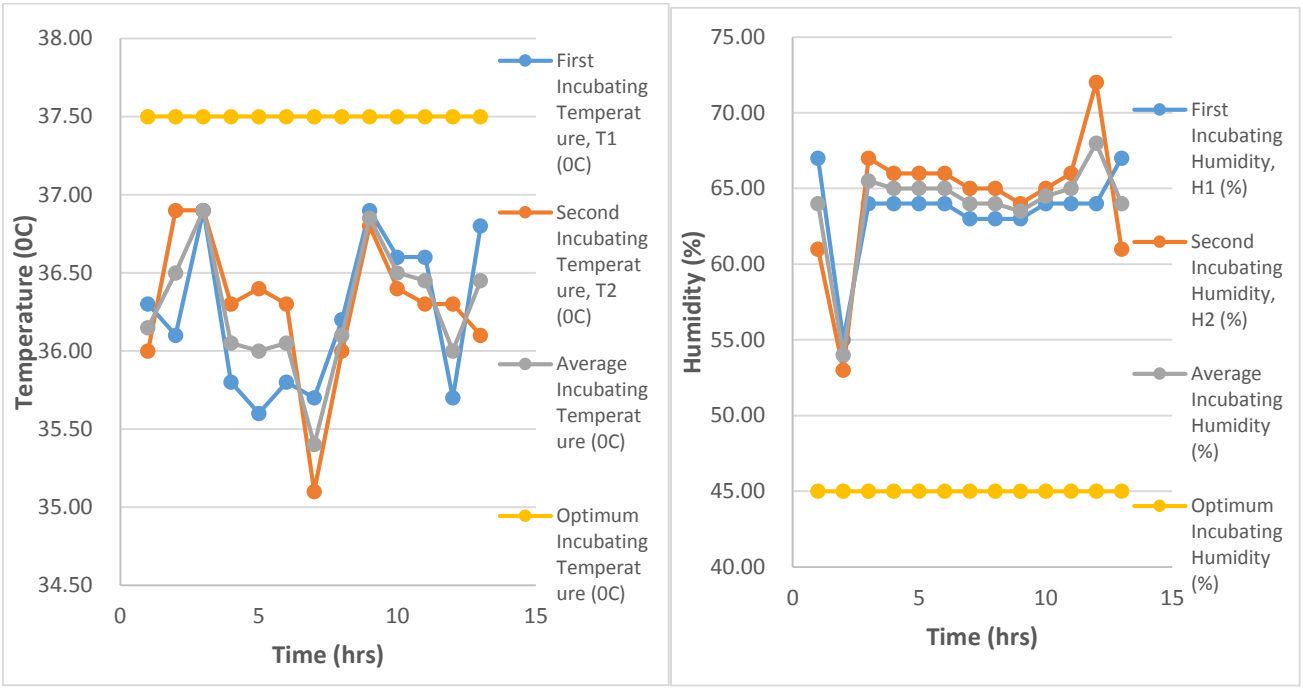


Figure 4.20: Temperature and Humidity Readings for Day 20

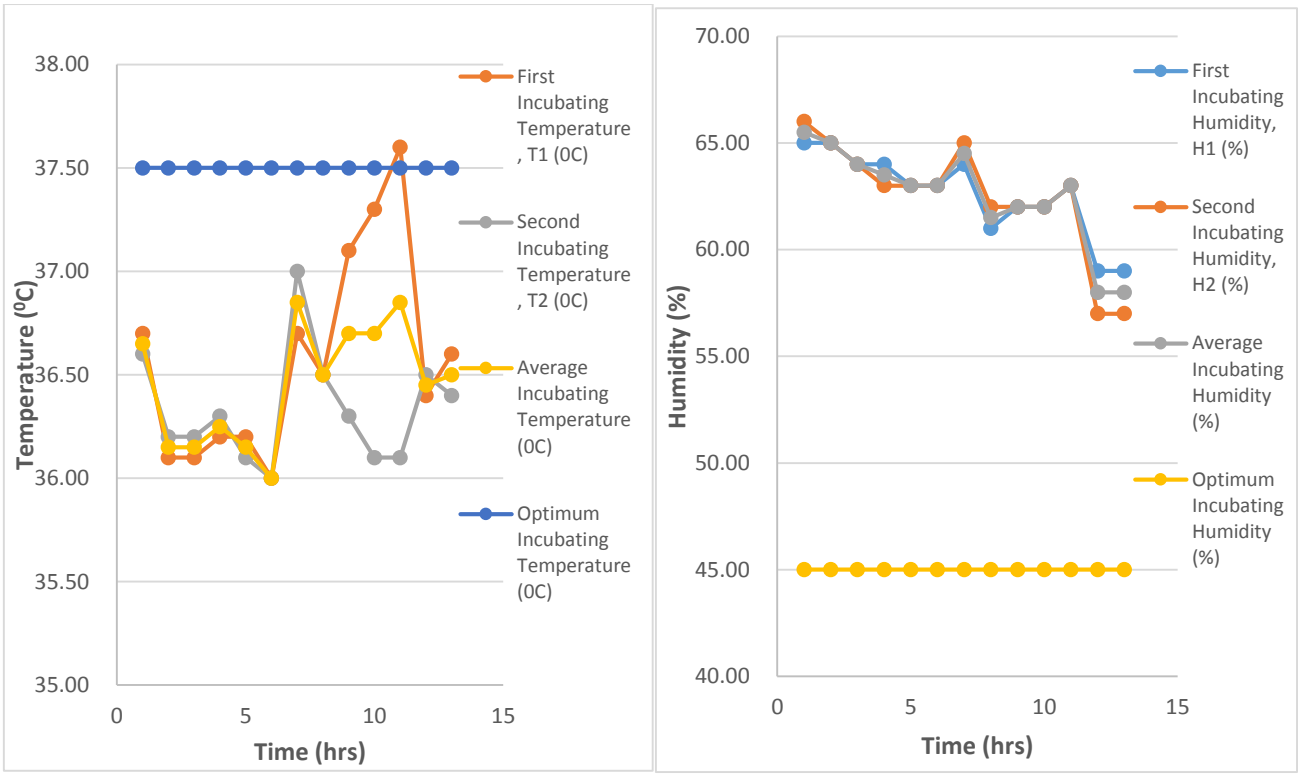


Figure 4.21: Temperature and Humidity Readings for Day 21

4.2 Discussion of Results

The performance of the incubator was based on the percentage of eggs hatched during the experiment conducted for its evaluation. At the end of incubation, seventy-nine (79) eggs hatched successfully out of one hundred and twenty (120) eggs set for hatching. This represents about 65% of the eggs set. Also fifteen kilogram (15 kg) of Liquified Petroleum Gas was consumed during incubation; this cost about four thousand and eighty naira (₦ 4,080:00). Since seventy nine (79) chicks were hatched, this translates to an incubating cost of fifty one naira sixty five kobo (₦ 51:65) per chick. Stages attained by eggs placed in the fabricated incubator from setting to hatching are presented in Plates 4.1B to Plate 4.4B.

According to literature, the most important factors that affect the performance of an incubator are the temperature and humidity level within the incubator. This forms the basis for monitoring these two parameters during the experiment. Ability of the incubator to maintain between 36 ^{0}C to 37.5 ^{0}C and relative humidity above 45% amounts into better performance of the incubator.

On day one, the incubating temperature was maintained within the recommended range until later hours when it rose to about 39 ^{0}C (see Figure 4.1). This same trend was observed for the humidity as there was a wide variation between the two humidity readings taken at the measurement point. This could be associated with variation in the humidity of air around the incubator occasioned by the atmospheric weather condition. This temperature recorded, though high is not dangerous to the eggs since they acquire heat from the environment at early stage of incubation as reported by other researchers (Tazawa and Nakagawa, 1985).

On the second day of incubation, there was sudden rise in temperature within the system but the situation was normalized by the automated control system with the aid of sensors and microcontroller (see Figure 4.2). On the other hand, the humidity was relatively stable for the period it was measured for the day. It was also observed that the value of humidity at the two points of measurement were the same for a long period of time, this is an indication that the incubator was able to maintain humidity level within it for this period.

Temperature and humidity readings for fourth to sixth day as presented on Figure 4.4 to Figure 4.6 show variations in the temperature and humidity level with time within the incubator. These temperature values recorded fall within the recommended range for incubation while those of humidity are higher than the minimum level required. On the seventh day, the temperature within the incubator was very low due to high humidity level within the system. The incubator, with the aid of automated control system was able to raise the temperature level constantly and while the humidity was constantly falling till the required level was attained (see Figure 4.7). This trend also shows the efficacy of the control system installed in the incubator.

Temperature and humidity readings for eighth to tenth day also show variation in value with time. This was due to frequent opening of incubator doors for illustration to observers especially on the eighth day which accounted for sudden fall in temperature within the incubator before the system was able to regulate itself (see Figure 4.8).

There were great variations in environmental conditions for eleventh to seventeenth day following serious rainfall recorded on these days. The rainfall was associated with very hot afternoon leading to the variation in temperature and humidity readings. The variation in weather condition accounts for high temperature and low humidity level recorded within the incubator. High temperature values recorded are not too good for the developing embryo, since the embryonic activities within this period also generate lot of heat which is expected to be evacuated from the eggs.

On the eighteenth day after the eggs were transferred to the Hatcher, the temperature readings obtained were below the upper limit of temperature range for incubation (see Figure 4.18 – Figure 4.21). This is expected because at this stage, more of cooling was done that heating of the system. The eggs generate more heat at this stage than at the beginning of incubation. This is in agreement with the submission of other researchers (Tazawa and Nakagawa, 1985)

In summary, the relative humidity maintained within the incubator throughout the period of incubation was higher than the minimum 45% required for the process. There were variations in the value of humidity recorded from time to time for the same day but wide variations occur on days 3, 7, 11, 14, and 19. There were days where steady rise or fall in the humidity was experienced while there were days that relatively uniform humidity was recorded.

The variation in the humidity from time to time could be accounted for by varying atmospheric condition around the incubator. The variation in the atmospheric condition greatly affected the condition of incubation because air was brought in from surrounding to cool the incubator when the temperature rose above 37.5 ^{0}C.

During the experiment, the temperature readings vary from time to time for the whole period of incubation. There were days where incubating temperature lesser than 36 ^{0}C were recorded for a period of time. Although that was not good for the incubation process, it is still preferable to the period when the incubating temperature was higher than 37.5 ^{0}C. Incubating at temperature higher than 37.5

^{0}C is harmful to the embryo. This was of greater concern during the experiment as it may greatly affect the performance of the incubator.

The percentage of egg hatched was higher compared to those obtained during preliminary study where thirty-eight (38) chicks hatched out of ninety (90) eggs incubated. The percentage hatch increased from about 40% recorded during preliminary study to 65% obtained in the final performance evaluation. The improvement can be associated with change in position of ignition system which was placed outside the incubator unlike its position (inside the incubator) during the preliminary study. The change in position reduces the level of shock experienced by the embryo from the noise generated by the ignition system. Also, the introduction of microcontroller based control unit which controls the ignition and maintain humidity within the incubator aided in better performance obtained.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The poultry industry will continue to grow if all the research results relevant to our environment can be put to good use. The need to introduce the use of liquefied petroleum gas (LPG or butane gas) as fuel for heat in an egg incubator is important due to the fact that other alternative fuels for it are all comparatively more expensive therefore, the major constraints to poultry production which is the high cost of energy demand will be overcome with the introduction of this easy and cheap energy supply to the hatchery.

The research into the use of butane gas powered egg incubator make invaluable input to knowledge in the field of designing cabinet incubator that will meet the most popular choice for serious hobbyists and commercial hatcheries alike. It will also satisfy those entrepreneurs that are into poultry farming as a means of livelihood, and empower as many individuals that may want to take up poultry farming as an occupation.

The following conclusions were drawn from the research work;

i. A cabinet incubator of 180 eggs capacity which is powered by heat from LPG is achievable.
ii. The developed incubator was able to hatch eggs set in it after twenty one (21) days.
iii. Percentage hatch was increased from about 40% obtained during preliminary study to 65% obtained from final performance test.
iv. Variation in atmospheric conditions led to great variation in incubating temperature and humidity recorded which in turn has great influence on the incubation process.

5.2 Recommendations

The following recommendations were made following the completion of this research work;

i. Incubator environment should be controlled to prevent wide variation in incubating condition.

ii. Noise and shock should be prevented as much as possible during incubation.

iii. Information obtained from research work should be made reaily available to direct users by relevant agencies.

iv. Sponsorship should be provided by relevant agencies for researches going on in the nation.

5.3 Contribution to Knowledge

The following were achieved during the research work which contribute to existing knowledge in hatching process.

(i) Codes were successfully developed for PIC microcontroller that controls the activities of a LPG powered incubator.

(ii) An automated ignition system that could maintain temperature within the incubator was successfully developed.

(iii) Also, equal interval of tray turning was achieved with the used of microcontroller based control unit developed.

(iv) A cabinet incubator which operates solely on power from butane gas with about 65% efficiency was sucessfuly designed, developed and tested.

REFERENCES

About-Education. (2015). *About Chemistry*. Retrieved from About.com: http://chemistry.about.com

Abraham, N. T., Mathew, S. L., and Kumar , C. A. (2014, February). Design and Implementation of Solar PV Poultry Incubator. *International Journal of Engineering and Advanced Technology (IJEAT), 3*(3), 289-291.

Agidi, G., Liberty, J. T., Gunre, O. N., and Owa , G. J. (2014). Design, Construction and Performance Evaluation of an Electric Powered Egg Incubator. *IJRET: International Journal of Research in Engineering and Technology, 3*(3), 521-526.

Ahmadu, T. O., Folayan, C. O., and Yawas, D. S. (2009). Comparative Performance of Cow dung and Chicken droppings for Bio-gas production. *Nigerian Journal of Engineering vol. 16, (1) 154-164*.

AUS-e-TUTE. (2015). Retrieved from http://www.ausetute.com.au on 16th September, 2015

Austic, R.E., and Nesheim M.C, (1990). Commercial Chicken Production. *Poultry production (13th edition).*

Benjamin, N. (2012). *IJAIEM, 1*(4), 26-31. Retrieved from www.ijaiem.org

da Silva, C. A., and Mhlanga , N. (2011). *Innovative policies and institutions to support agro-industries development.* Rome: Food and Agriculture Organization of the United Nations.

Engineeringtoolbox. (2015). *Specific Heat of Dry Air*. Retrieved from http://www.engineeringtoolbox.com on 16th September, 2015

Engineersedge. (n.d.). *Thermal Properties of Metals, Conductivity, Thermal Expansion, Specific Heat*. Retrieved from https://www.engineersedge.com/ on 16th September, 2015

Fuan, L. (1987). The pearched rice incubation technique for hatching duck eggs. (D. J. Farewell, and P. Stapleton, Eds.) *Duck Production Science and World Practise*, 178-182.

Glasson, J., Therivel, R., and Chadwick, A. (2003). *Introduction to Environmental Impact Assessment.* London and New York: Routledge Taylor and Francis group.

Illinois, U. O. (1998). *From Egg To Chick: Incubation Procedures.* Retrieved from Chickscope: http://chickscope.beckman.uiuc.edu/

Kashkin, V. V. (1961). Heat exchange of bird eggs during incubation. *Biophysica, 6*, 57–63.

Kendeigh, S. C. (1963). Thermodynamics of incubation in the House wren, Troglodytes aedon. *XIIIth International Ornithological Congress*, (pp. 884–904). Ithaca, NY.

King'ori A.M. (2011). Review of the Factors That Influence Egg Fertility and Hatchabilty in Poultry, *International Journal of Poultry Science* 10 (6): 483-492

Meijerhof, R., and van Beek, G. (1993). Mathematical modelling of temperature and moisture loss of hatching eggs. *J. Theor. Biol.*, 27–41.

Menya, E., Alokore, Y., and Ebangu, B. O. (2013). Biogas as an alternative to fuelwood for a household in Uleppi sub-county in Uganda. *Agric Eng Int: CIGR Journal, 15*(1), 50-58.

NAPRI. (2011). *5th Pan Commonwealth Veterinary Conference.* Accra, Ghana.

Olaleye, D. O. (2008). The design and construction of a solar incubator. *B. Eng Thesis*. Abeokuta, Ogun State, Nigeria: Department of Mechanical Engineering College of Engineering University of Agriculture.

Pace, J.(2006).R-com highly accurate auto egg incubator.Retrieved from www.asby.com.sg/hosoffer_Rcomhtm, 19th October 2015.

Romijin, C., and Lokhorst, W. (1960.). Foetal heat production in the fowl. *J. Physiology*, 239 –249.

RPCL. (2008). *The Rainbow Power Company Limited (RPCL).* Retrieved from Minilab Egg Incubator - 12 Volt: http://www.rpc.com.au/

Schmidt-Nielsen, K. (1975). *Animal Physiology.* New York: Cambridge University Press.

Smith, A. J. (1990). *Poultry-Tropical Agriculturalist series.* London: CTA Macmillan.

Smith, T. W. (2014). *Care and Incubation of Hatching Eggs.* Retrieved from Successful Hatching Guide For Poultry Operators - Agriculture: http://www.nairaland.com on 16th September, 2015

Sonaiya, E. B., and Swan, S. E. (2004). Incubation and Hatching. In *Small-scale Poultry Production: Technical Guide* (p. 37). Rome.

Sotherland, P. R., Spotila , J. R., and Paganelli, C. V. (1987). Avian eggs: Barriers to the exchange of heat and mass. *J. Exp.Zool. Suppl.*, 81–86.

Tazawa, H. and Nakagawa, S. (1985). Response of egg temperature, heart rate and blood pressure in the chick embryo to hypothermal stress. J. Comp. Physiol, 155B, 195-200.

Tazawa, H., Okuda, A., Nakazawa, S., and Whittow, G. C. (1989). Metabolic responses of chicken embryos to graded, prolonged alterations in ambient temperature. *Comp. Biochem. Physiol. A Physiology*, 613–617.

University of Illinois Extension Incubation and Embryology (2014). Incubation, Retrieved 12th February, 2015 from www.*riverbendschools.org*

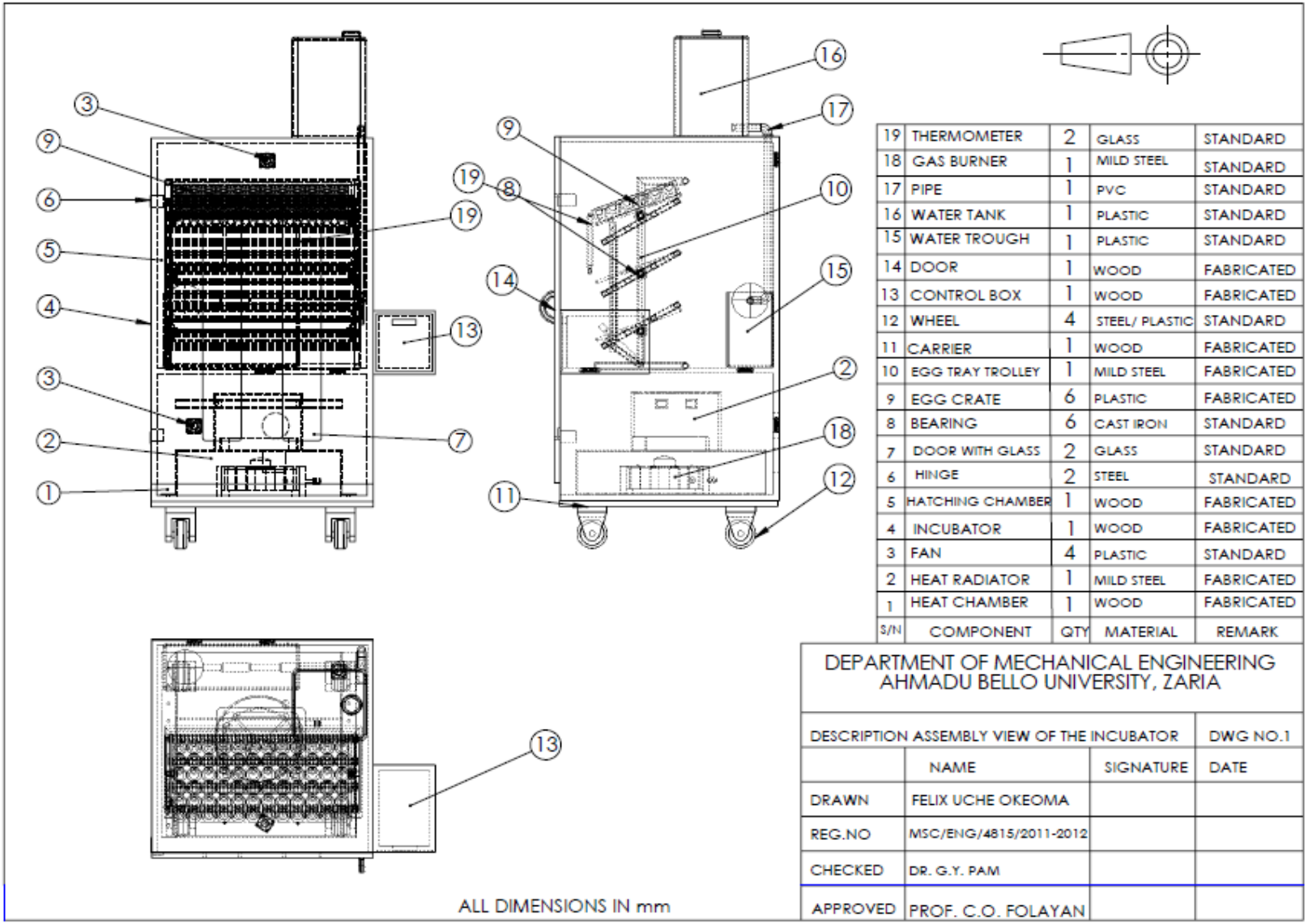
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Vleck, C. M., Vleck, D., and Hoyt, D. F. (1980). Patterns of metabolism and growth in avian embryos. *Am. Zoologist*, 405–416.

Warburton K. (2002). Integrated biosystems for sustainable development, *Proceedings of the InFoRM 2000 National Workshop on Integrated Food Production and Resource Management*

Wilson, H. R. (1991). Physiological requirements of the developing embryo: Temperature and turning. In S. G. Tullett (Ed.), *Avian Incubation* (pp. 145–156). London, UK: Butterworth-Heinemann.

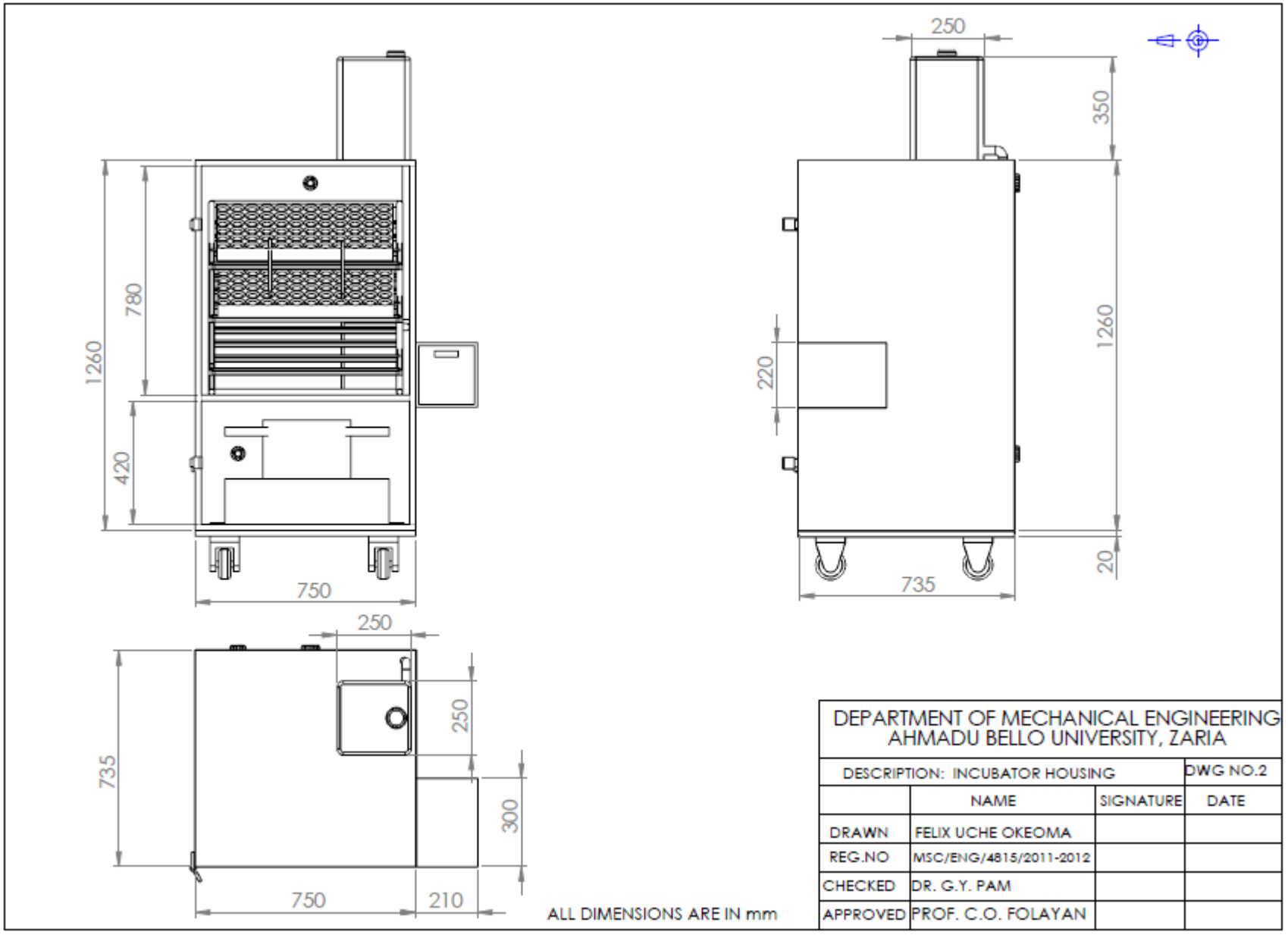
APPENDIX A : WORKING DRAWING



S/N	COMPONENT	QTY	MATERIAL	REMARK
19	THERMOMETER	2	GLASS	STANDARD
18	GAS BURNER	1	MILD STEEL	STANDARD
17	PIPE	1	PVC	STANDARD
16	WATER TANK	1	PLASTIC	STANDARD
15	WATER TROUGH	1	PLASTIC	STANDARD
14	DOOR	1	WOOD	FABRICATED
13	CONTROL BOX	1	WOOD	FABRICATED
12	WHEEL	4	STEEL/ PLASTIC	STANDARD
11	CARRIER	1	WOOD	FABRICATED
10	EGG TRAY TROLLEY	1	MILD STEEL	FABRICATED
9	EGG CRATE	6	PLASTIC	FABRICATED
8	BEARING	6	CAST IRON	STANDARD
7	DOOR WITH GLASS	2	GLASS	STANDARD
6	HINGE	2	STEEL	STANDARD
5	HATCHING CHAMBER	1	WOOD	FABRICATED
4	INCUBATOR	1	WOOD	FABRICATED
3	FAN	4	PLASTIC	STANDARD
2	HEAT RADIATOR	1	MILD STEEL	FABRICATED
1	HEAT CHAMBER	1	WOOD	FABRICATED

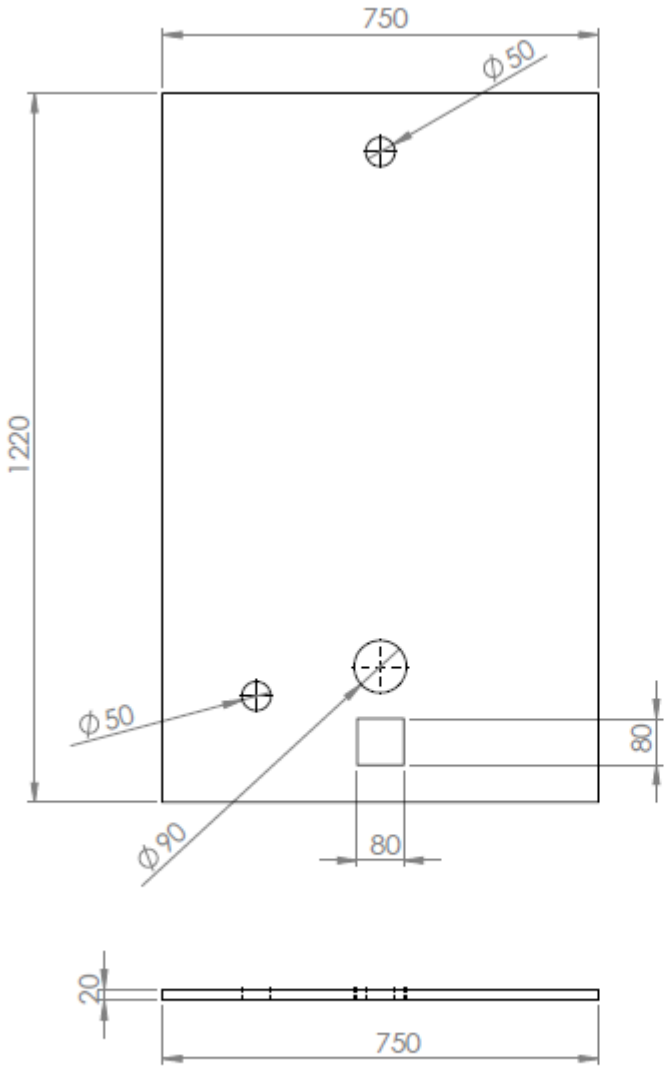
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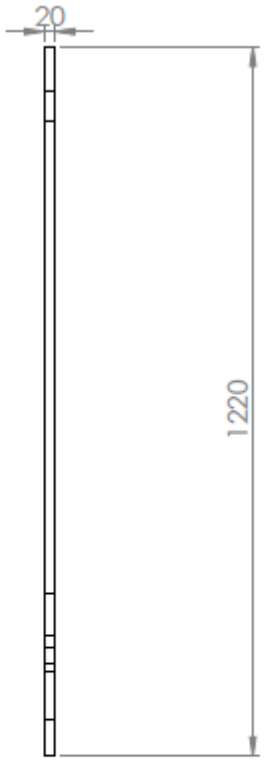
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APPROVED	PROF. C.O. FOLAYAN		



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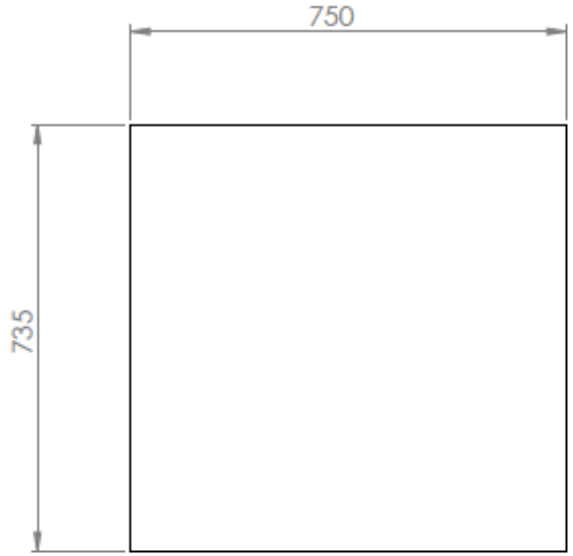
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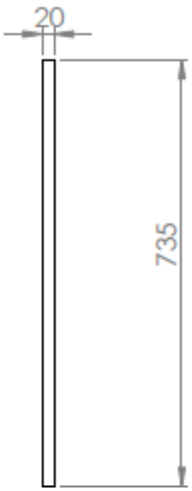


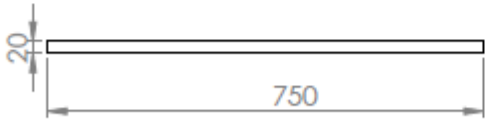


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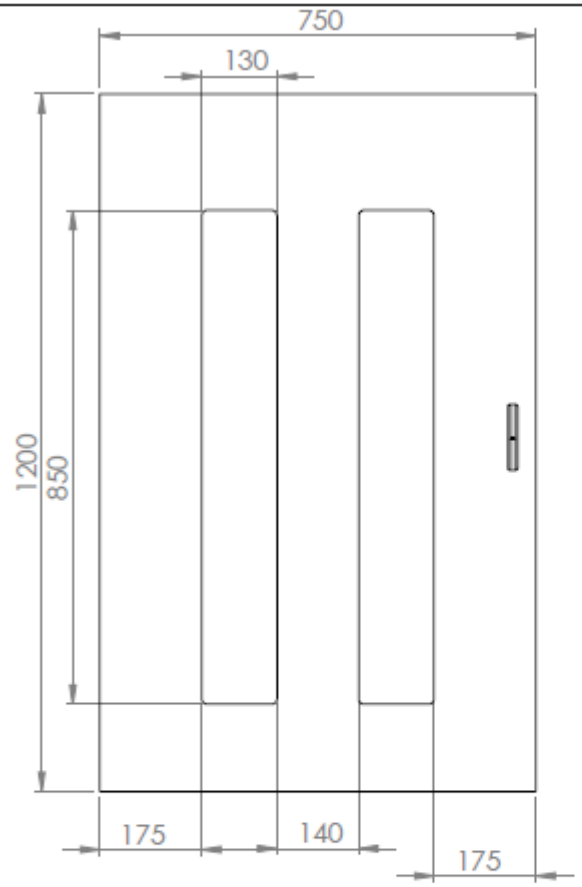


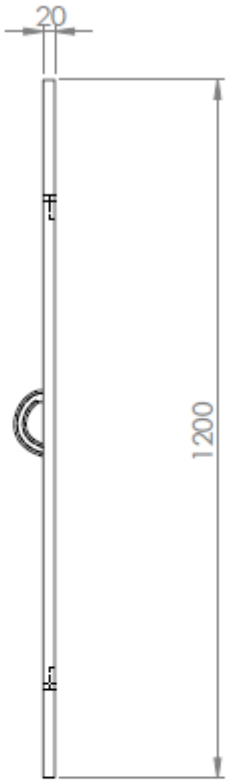


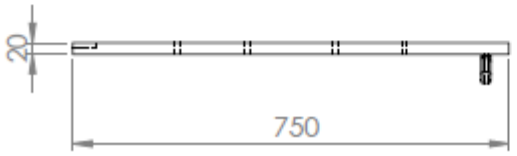


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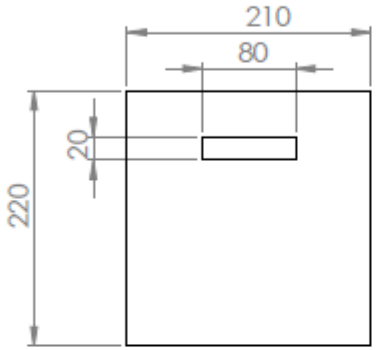


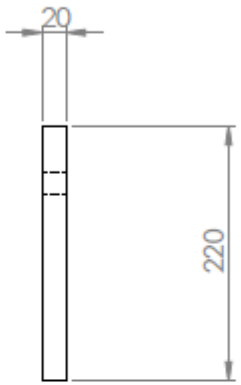


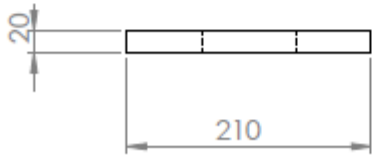
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APPROVED	PROF. C.O. FOLAYAN		

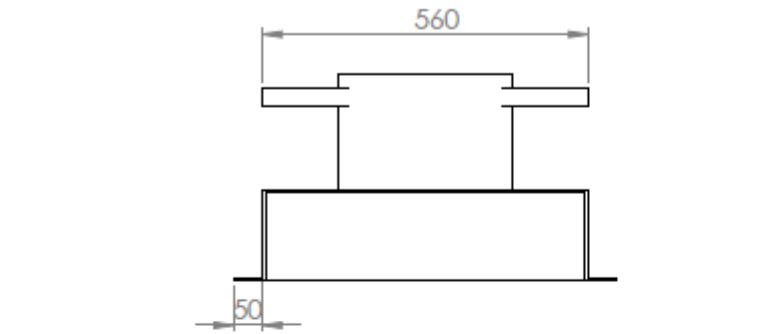




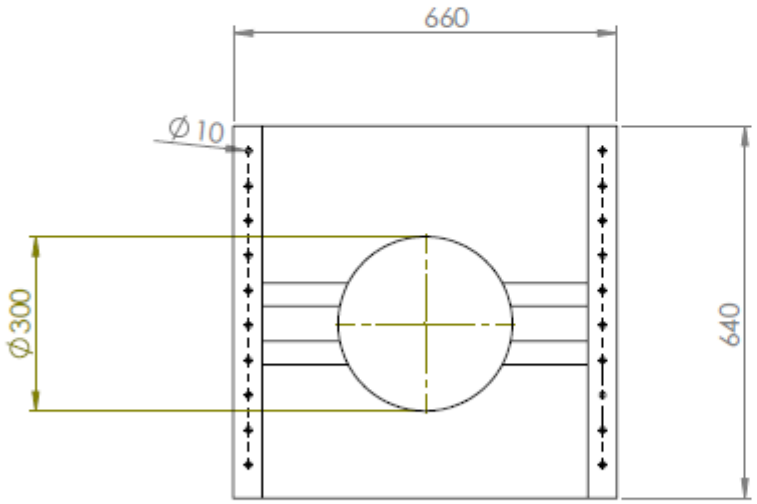


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE CONTROL BOX			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		



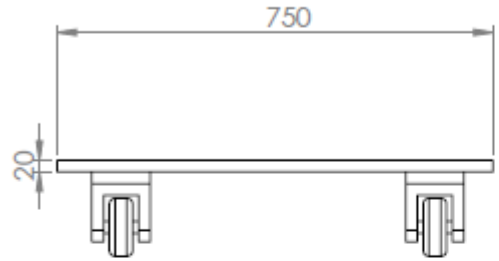


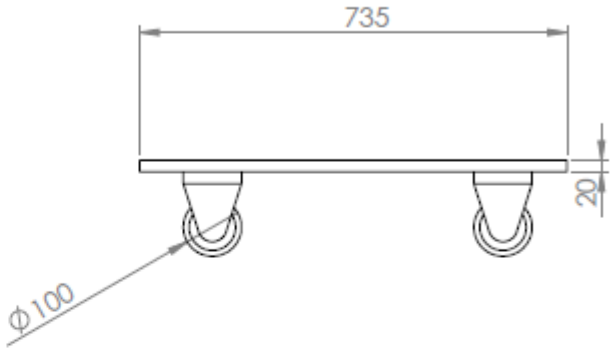


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING
AHMADU BELLO UNIVERSITY, ZARIA

DESCRIPTION: ORTHOGRAPHIC DRAWING OF THE HEAT RADIATOR			DWG NO.5
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

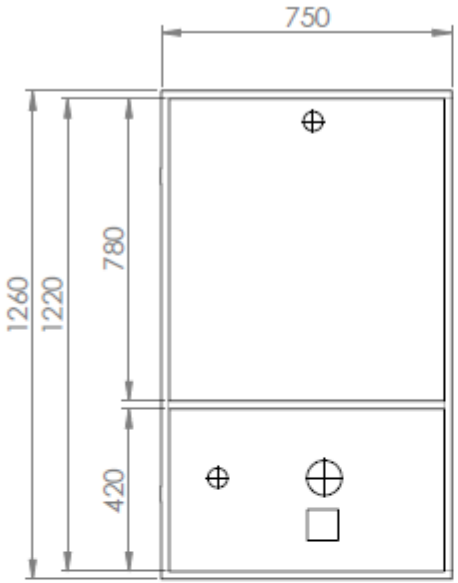


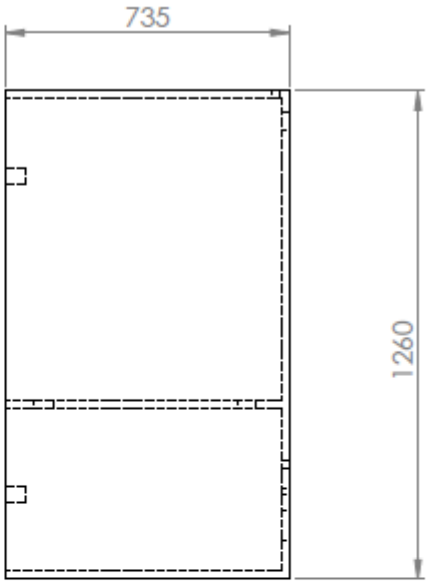


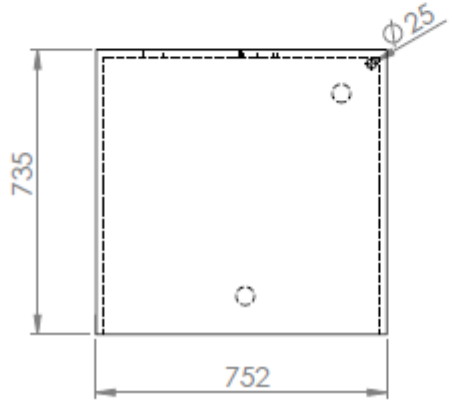


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
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	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

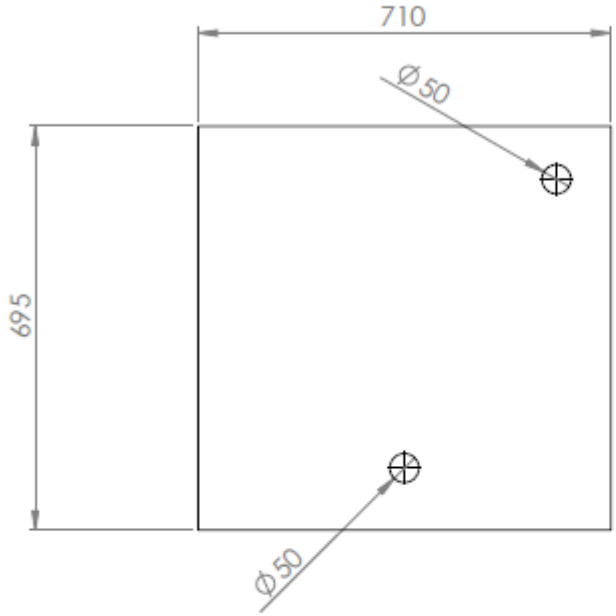


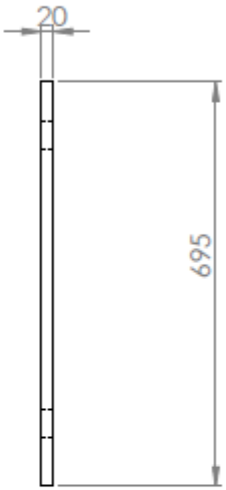


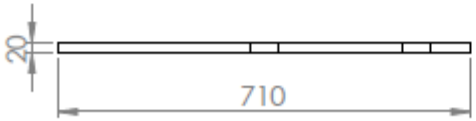


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DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE INCUBATOR			DWG NO.3
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

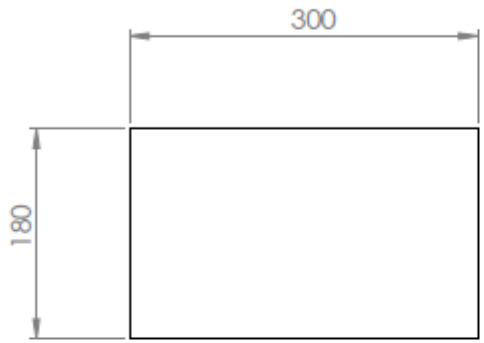


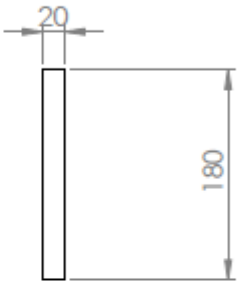


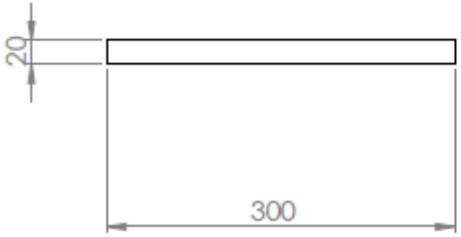


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE INCUBATOR			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

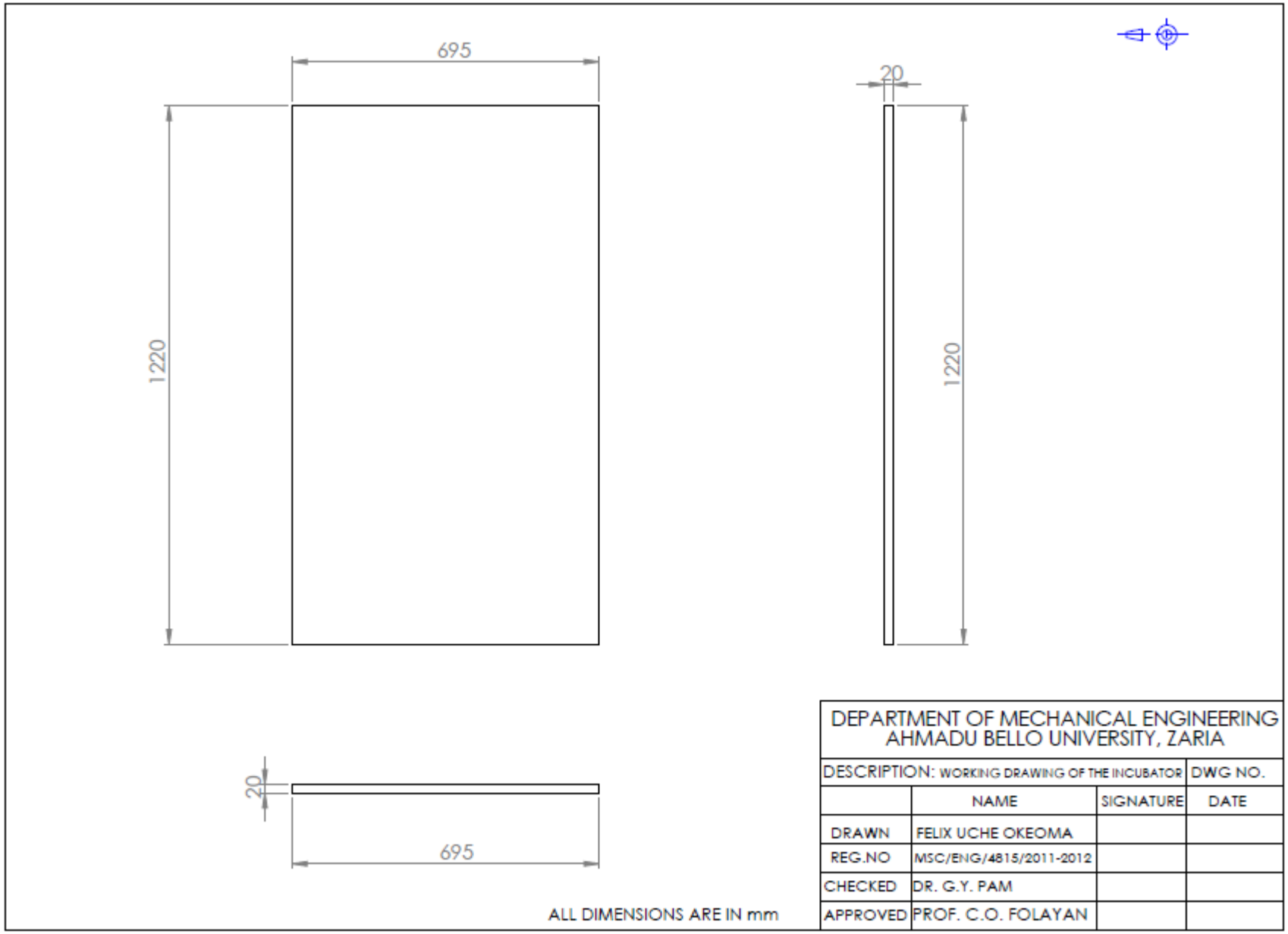






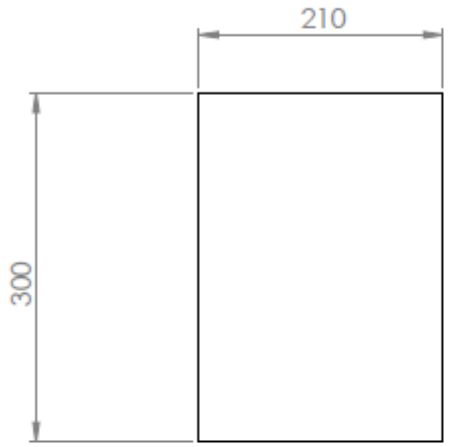
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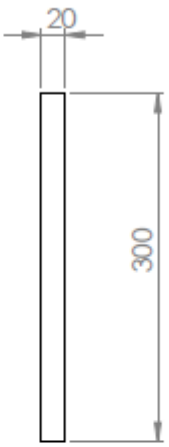
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DESCRIPTION: WORKING DRAWING OF THE CONTROL BOX			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		



DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE INCUBATOR			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

ALL DIMENSIONS ARE IN mm

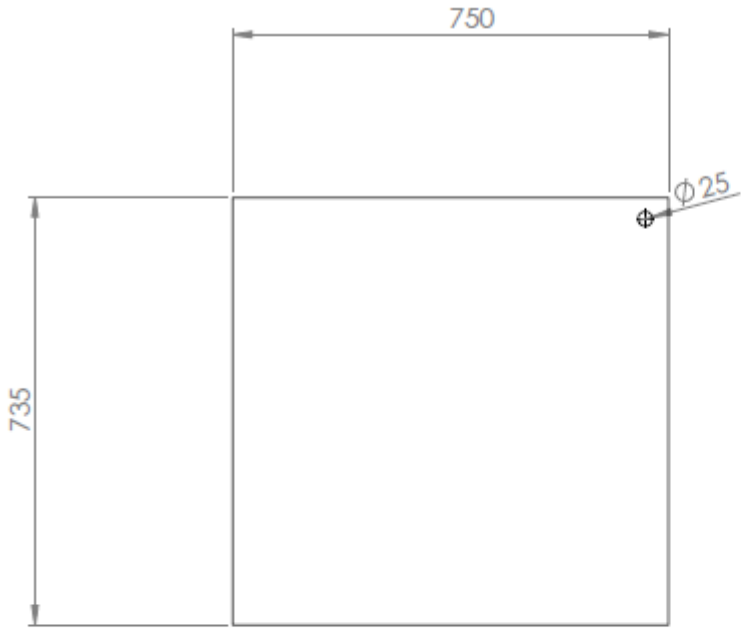


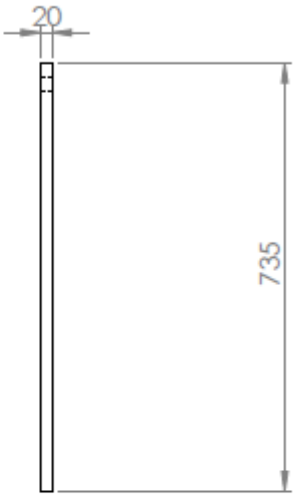


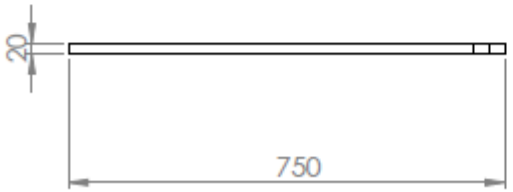


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE CONTROL BOX			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

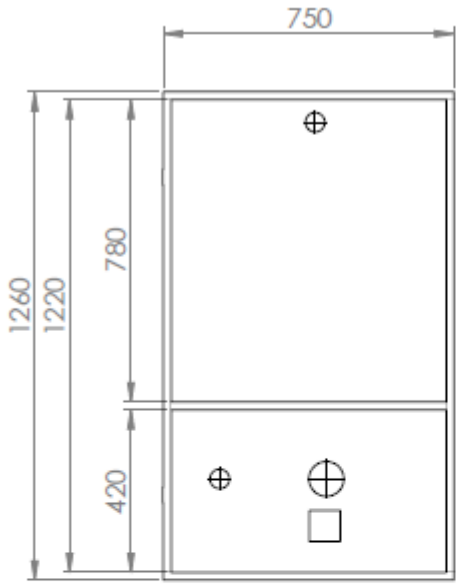


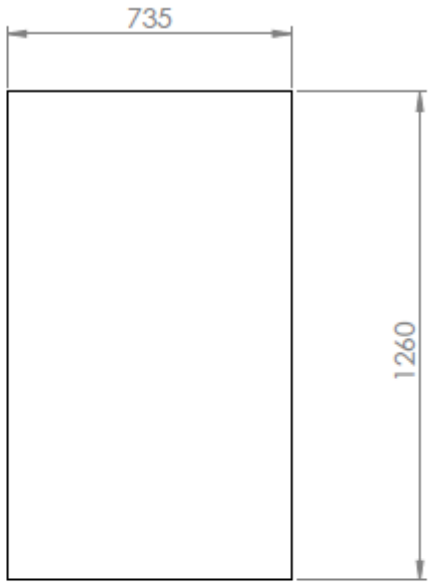


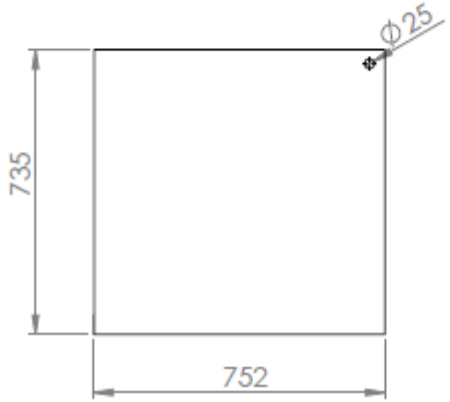


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: WORKING DRAWING OF THE INCUBATOR			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

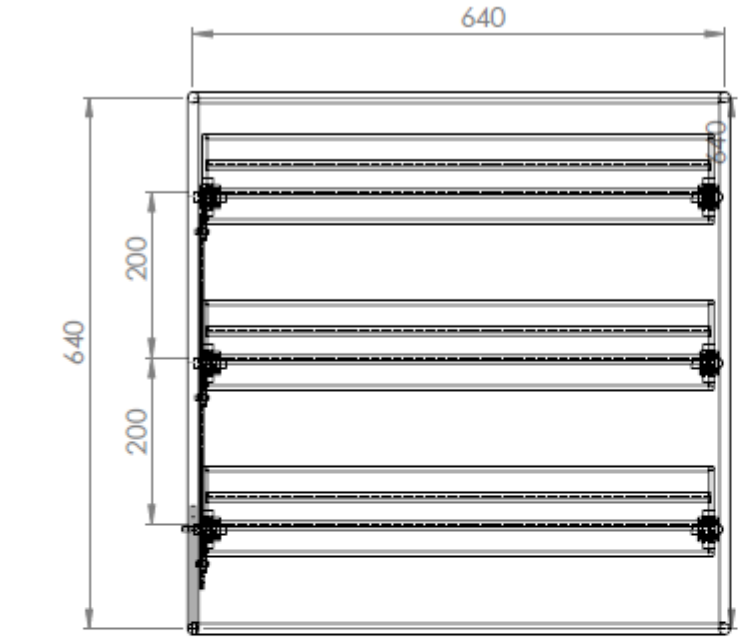


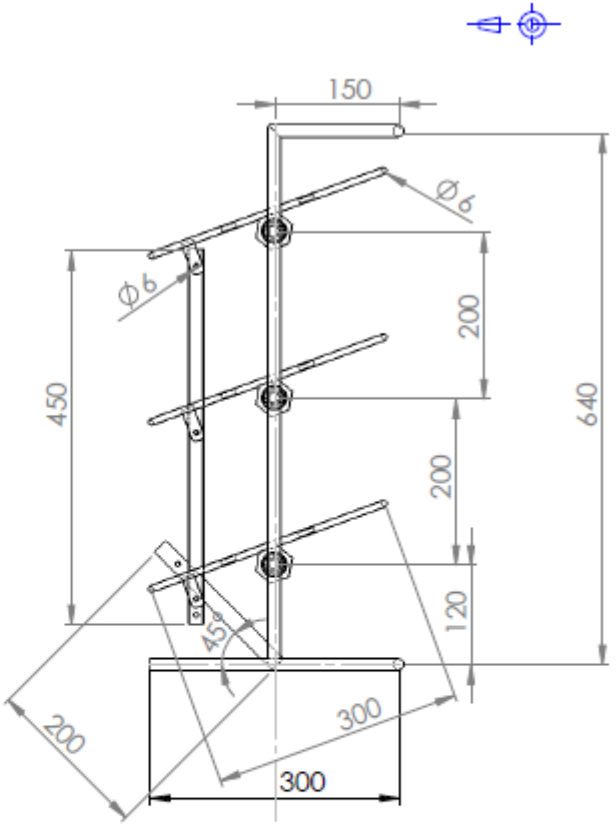


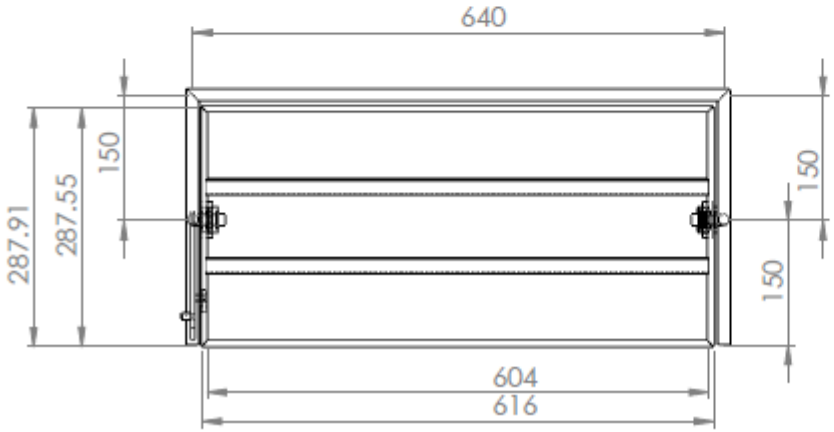


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: INCUBATOR HOUSING			DWG NO.3
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

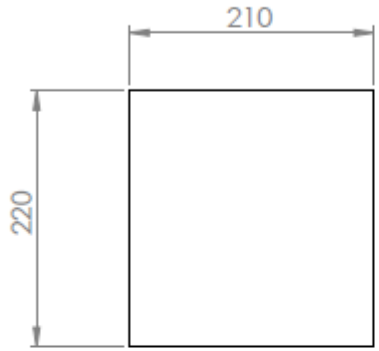


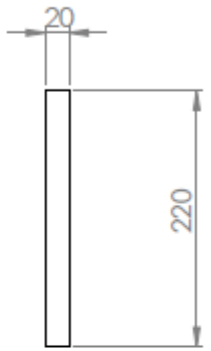




ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: EGG TRAY TROLLEY			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

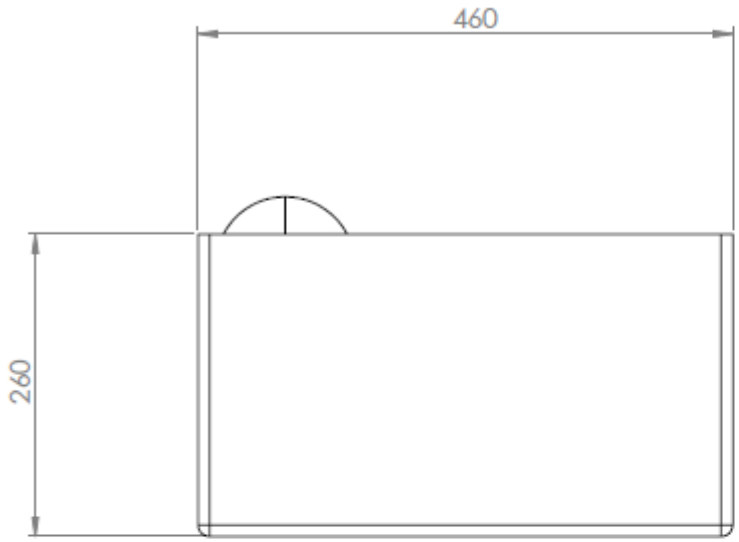


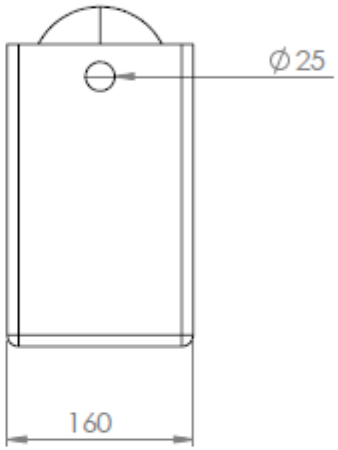


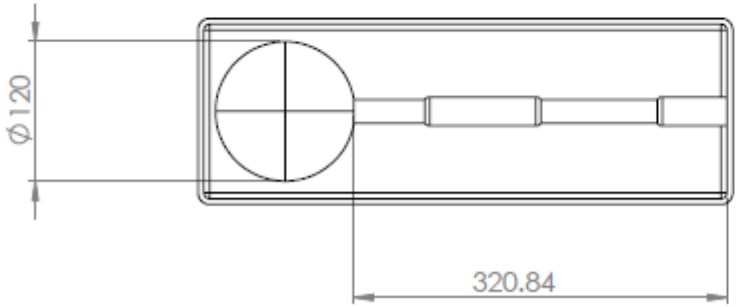


ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: BACK OF CONTROL BOX			DWG NO.
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		







ALL DIMENSIONS ARE IN mm

DEPARTMENT OF MECHANICAL ENGINEERING AHMADU BELLO UNIVERSITY, ZARIA			
DESCRIPTION: ASSEMBLY DRAWING OF THE WATER BATH			DWG NO.6
	NAME	SIGNATURE	DATE
DRAWN	FELIX UCHE OKEOMA		
REG.NO	MSC/ENG/4815/2011-2012		
CHECKED	DR. G.Y. PAM		
APPROVED	PROF. C.O. FOLAYAN		

APPENDIX B

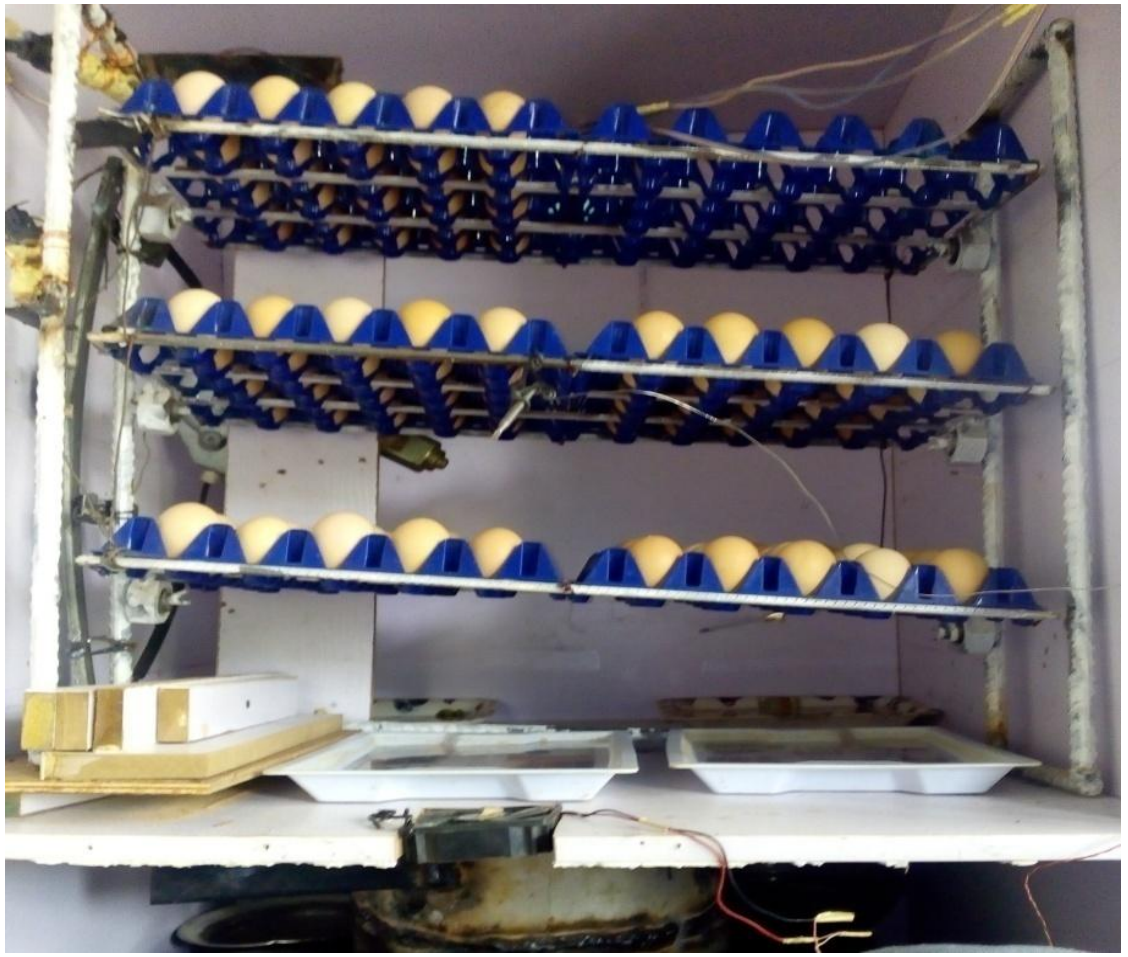


Plate 4.1B: Setting of Eggs into the Incubator

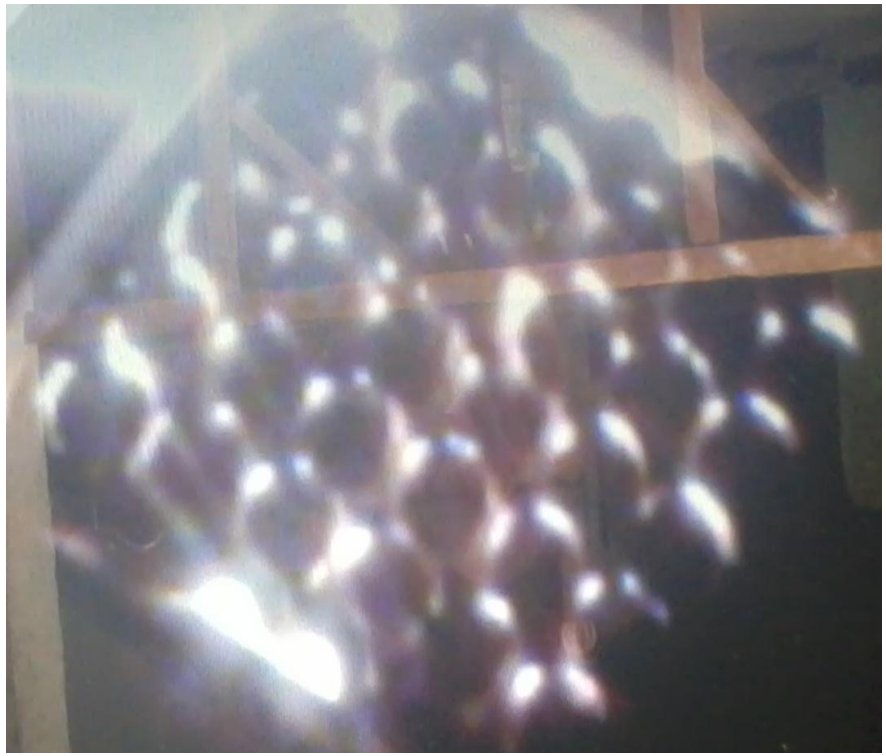


Plate 4.2B: Candling of the incubated eggs on the 18th day



Plate 4.3B: Piping of the Eggs



Plate 4.4B: Hatching of the Eggs



Plate 4.5B: Cockerels and Layers hatched from the Incubator after Four Months

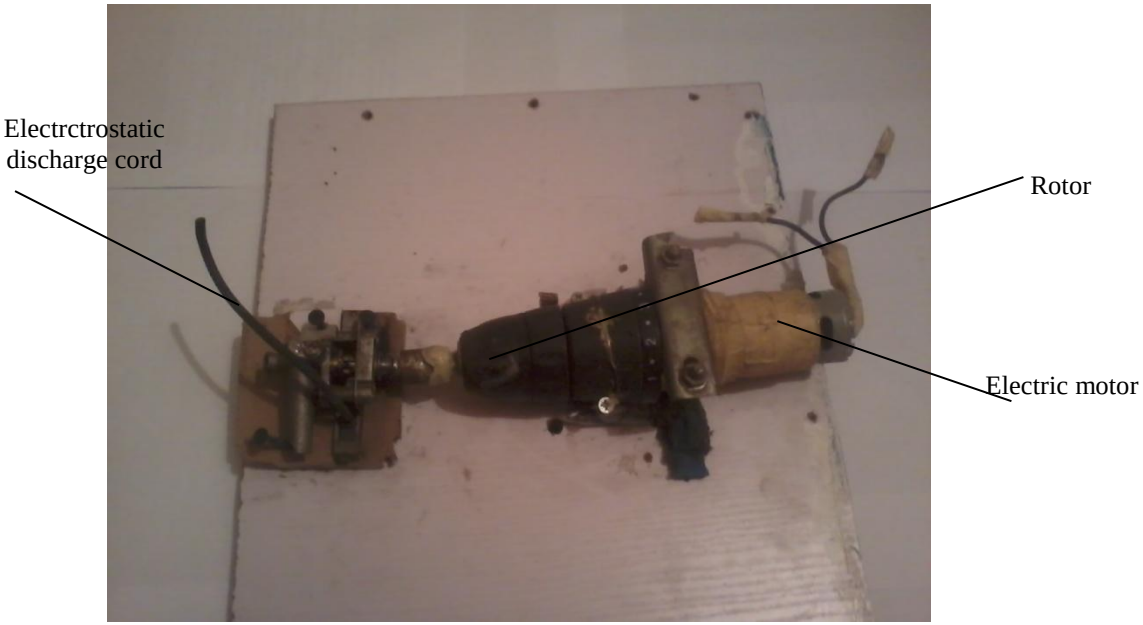


Plate 4.6B: Sparking mechanism for the gas burner



Plate 4.7B: Gas burner

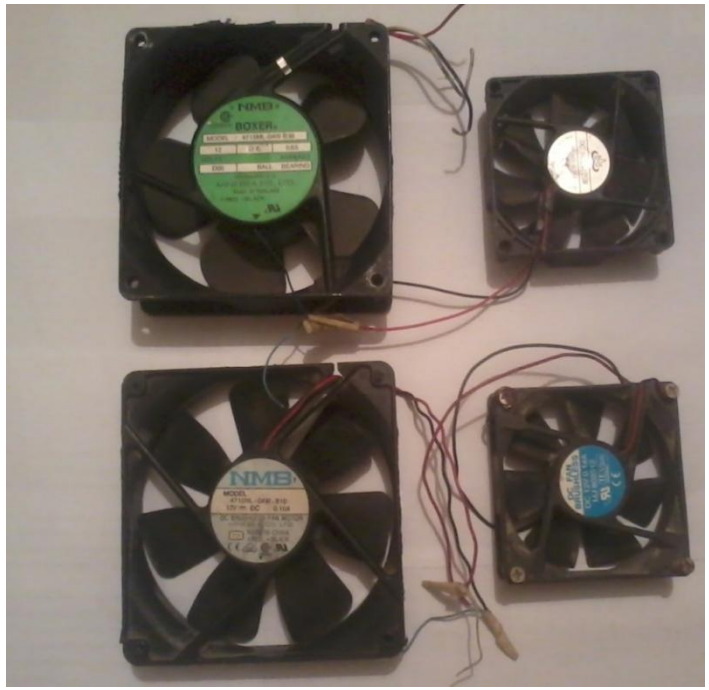


Plate 4.8B: Centrifugal fan

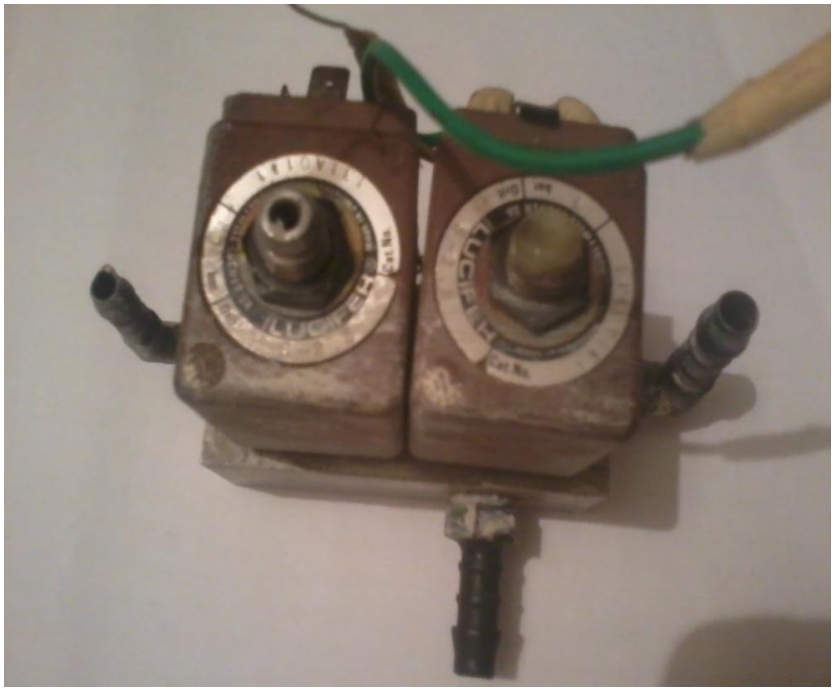


Plate 4.9B: Solenoid valve



Plate 4.10B: Micro-controller panel



Plate 4.11B: Humidifier

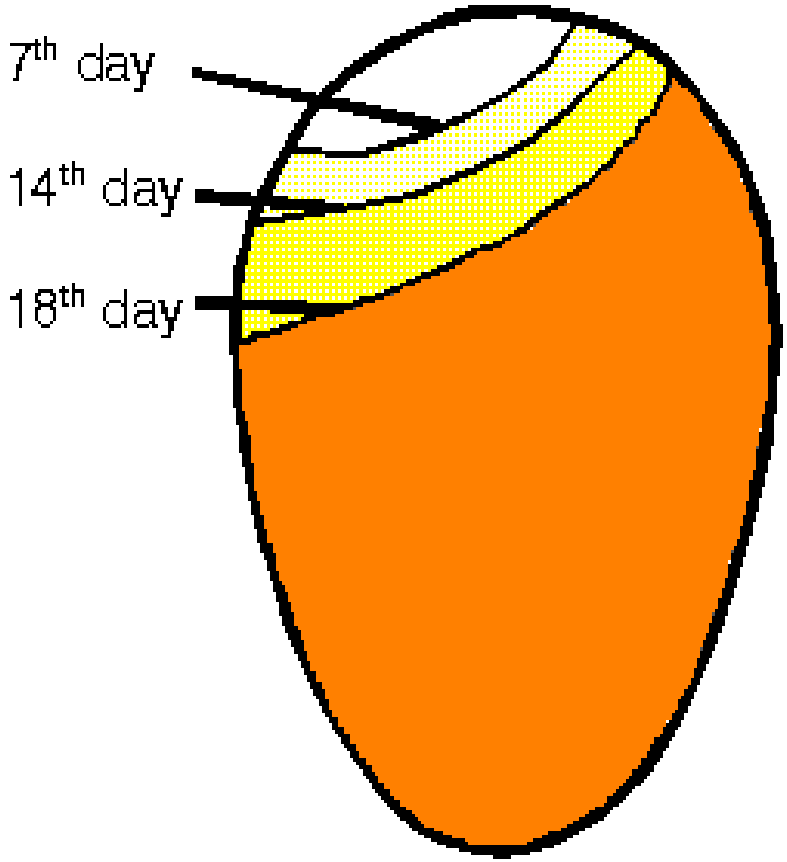


Plate 4.12B: Size of Air cell on 7th, 14th and 18th day of Incubation(University of Illinois, 1998)

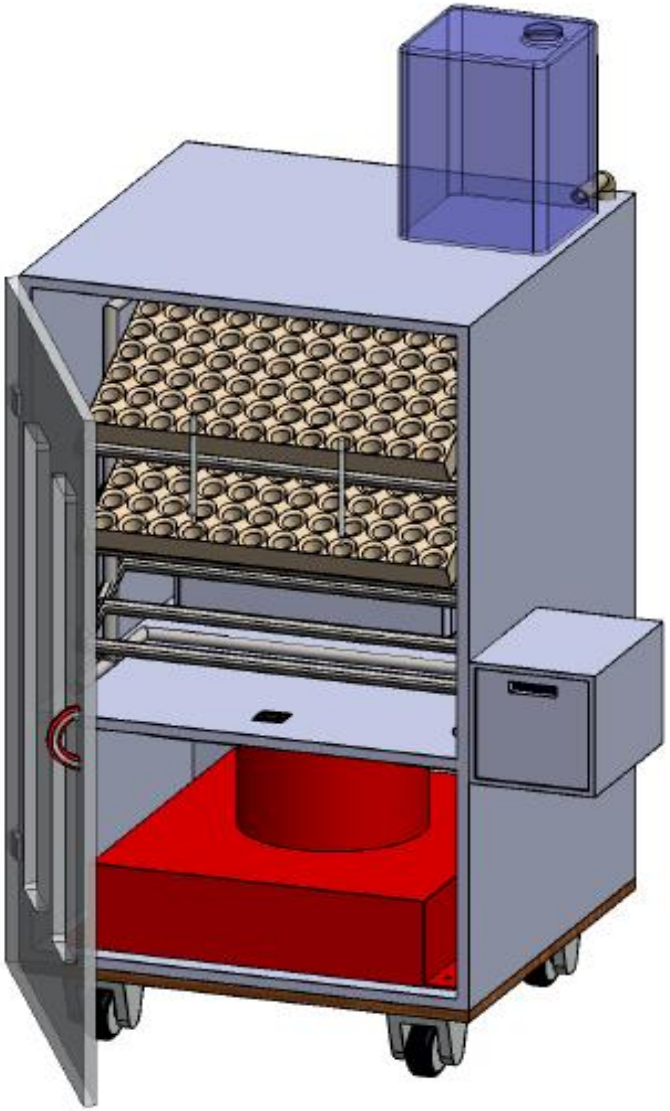


Plate 4.13B: 3D model of the incubator

APPENDIX C

EXPERIMENTAL READINGS

Day 1 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.40	29.40	29.50	29.40	29.30	29.10	29.00	29.20	29.30	29.40	29.70	30.30	30.30
First Incubating Temperature, T1 (^{0}C)	36.20	36.10	36.50	37.00	37.30	37.40	36.50	36.60	36.50	36.50	36.10	39.10	39.10
Second Incubating Temperature, T2 (^{0}C)	36.40	36.50	36.40	37.20	37.40	37.50	36.70	36.70	36.60	36.60	36.10	37.60	37.60
First Incubating Humidity, H1 (%)	55.00	55.00	56.00	56.00	56.00	56.00	55.00	55.00	56.00	56.00	56.00	54.00	54.00
Second Incubating Humidity, H2 (%)	56.00	55.00	54.00	54.00	56.00	56.00	55.00	54.00	55.00	56.00	55.00	59.00	59.00
Average Incubating Temperature (^{0}C)	36.30	36.30	36.45	37.10	37.35	37.45	36.60	36.65	36.55	36.55	36.10	38.35	38.35
Average Incubating Humidity (%)	55.50	55.00	55.00	55.00	56.00	56.00	55.00	54.50	55.50	56.00	55.50	56.50	56.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 2 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.70	27.50	28.80	29.00	29.90	29.80	30.20	31.10	31.30	31.20	30.40	30.20	29.30
First Incubating Temperature, T1 (^{0}C)	37.00	37.40	37.30	37.30	36.80	37.00	37.50	37.80	38.00	37.50	37.20	37.20	37.20
Second Incubating Temperature, T2 (^{0}C)	37.20	37.30	37.50	37.50	37.20	37.80	37.80	37.90	37.50	37.50	37.40	37.30	37.30
First Incubating Humidity, H1 (%)	55.00	55.00	55.00	55.00	54.00	54.00	55.00	55.00	55.00	55.00	55.00	55.00	54.00
Second Incubating Humidity, H2 (%)	55.00	55.00	56.00	56.00	55.00	55.00	55.00	54.00	54.00	55.00	55.00	55.00	55.00
Average Incubating Temperature (^{0}C)	37.10	37.35	37.40	37.40	37.00	37.40	37.65	37.85	37.75	37.50	37.30	37.25	37.25
Average Incubating Humidity (%)	55.00	55.00	55.50	55.50	54.50	54.50	55.00	54.50	54.50	55.00	55.00	55.00	54.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 3 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.30	28.50	28.90	29.10	29.80	30.20	30.80	30.90	30.90	31.10	31.00	30.00	30.00
First Incubating Temperature, T1 (^{0}C)	36.50	36.70	37.00	37.00	36.80	36.90	36.80	36.80	37.00	37.20	36.60	36.70	37.00
Second Incubating Temperature, T2 (^{0}C)	36.60	36.70	37.10	37.00	36.90	37.00	36.50	36.80	37.00	37.10	37.00	37.00	37.00
First Incubating Humidity, H1 (%)	52.00	54.00	55.00	56.00	60.00	60.00	61.00	60.00	58.00	58.00	55.00	55.00	55.00
Second Incubating Humidity, H2 (%)	52.00	53.00	56.00	56.00	60.00	60.00	61.00	60.00	58.00	58.00	55.00	55.00	52.00
Average Incubating Temperature (^{0}C)	36.55	36.70	37.05	37.00	36.85	36.95	36.65	36.80	37.00	37.15	36.80	36.85	37.00
Average Incubating Humidity (%)	52.00	53.50	55.50	56.00	60.00	60.00	61.00	60.00	58.00	58.00	55.00	55.00	53.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 4 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.40	29.60	29.50	29.40	29.30	29.10	29.00	28.80	30.40	30.30	30.40	30.40	30.30
First Incubating Temperature, T1 (^{0}C)	36.50	37.90	38.10	37.10	35.70	35.90	36.40	36.70	36.10	36.40	36.40	36.80	37.30
Second Incubating Temperature, T2 (^{0}C)	36.60	37.90	37.10	36.50	36.10	36.50	36.70	37.10	36.40	36.40	36.40	37.00	37.40
First Incubating Humidity, H1 (%)	60.00	57.00	62.00	62.00	62.00	62.00	61.00	58.00	58.00	56.00	55.00	55.00	55.00
Second Incubating Humidity, H2 (%)	59.00	60.00	59.00	59.00	60.00	60.00	60.00	61.00	60.00	58.00	57.00	56.00	58.00
Average Incubating Temperature (^{0}C)	36.55	37.90	37.60	36.80	35.90	36.20	36.55	36.90	36.25	36.40	36.40	36.90	37.35
Average Incubating Humidity (%)	59.50	58.50	60.50	60.50	61.00	61.00	60.50	59.50	59.00	57.00	56.00	55.50	56.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 5 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	29.10	29.20	29.30	29.30	30.40	30.90	31.00	31.60	31.90	30.00	30.10	30.00	29.70
First Incubating Temperature, T1 (^{0}C)	37.90	38.30	36.00	37.30	37.30	37.10	36.20	38.50	37.10	37.20	36.50	36.20	36.00
Second Incubating Temperature, T2 (^{0}C)	36.80	37.10	36.50	36.80	36.80	36.50	36.30	37.30	37.00	37.00	36.60	36.40	36.50
First Incubating Humidity, H1 (%)	52.00	55.00	51.00	52.00	52.00	52.00	52.00	52.00	50.00	53.00	55.00	54.00	52.00
Second Incubating Humidity, H2 (%)	52.00	58.00	54.00	56.00	56.00	56.00	56.00	53.00	53.00	53.00	55.00	54.00	53.00
Average Incubating Temperature (^{0}C)	37.35	37.70	36.25	37.05	37.05	36.80	36.25	37.90	37.05	37.10	36.55	36.30	36.25
Average Incubating Humidity (%)	52.00	56.50	52.50	54.00	54.00	54.00	54.00	52.50	51.50	53.00	55.00	54.00	52.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 6 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.90	29.20	29.60	29.80	31.00	31.30	31.60	31.20	30.10	30.90	30.10	30.10	30.00
First Incubating Temperature, T1 (^{0}C)	36.70	35.60	37.10	37.00	37.00	37.00	37.10	36.80	36.20	36.20	36.10	36.10	36.60
Second Incubating Temperature, T2 (^{0}C)	36.00	36.00	37.20	37.10	37.10	37.10	37.20	37.00	36.30	36.30	36.30	36.30	36.80
First Incubating Humidity, H1 (%)	62.00	61.00	60.00	58.00	58.00	58.00	58.00	60.00	68.00	68.00	68.00	68.00	65.00
Second Incubating Humidity, H2 (%)	62.00	62.00	62.00	60.00	60.00	60.00	60.00	60.00	70.00	70.00	70.00	70.00	67.00
Average Incubating Temperature (^{0}C)	36.35	35.80	37.15	37.05	37.05	37.05	37.15	36.90	36.25	36.25	36.20	36.20	36.70
Average Incubating Humidity (%)	62.00	61.50	61.00	59.00	59.00	59.00	59.00	60.00	69.00	69.00	69.00	69.00	66.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 7 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	26.50	27.20	28.10	28.50	29.10	29.50	30.10	30.70	31.10	31.00	31.00	30.10	30.10
First Incubating Temperature, T1 (^{0}C)	35.10	35.30	35.40	35.40	36.00	36.10	36.60	36.50	36.00	36.50	36.80	37.10	37.60
Second Incubating Temperature, T2 (^{0}C)	35.00	35.40	35.60	35.50	35.60	36.00	36.70	36.50	36.80	36.80	36.90	37.20	37.30
First Incubating Humidity, H1 (%)	69.00	70.00	61.00	60.00	61.00	60.00	58.00	58.00	58.00	51.30	51.60	63.00	60.00
Second Incubating Humidity, H2 (%)	71.00	71.00	64.00	64.00	64.00	60.00	60.00	60.00	61.00	56.00	56.00	64.00	64.00
Average Incubating Temperature (^{0}C)	35.05	35.35	35.50	35.45	35.80	36.05	36.65	36.50	36.40	36.65	36.85	37.15	37.45
Average Incubating Humidity (%)	70.00	70.50	62.50	62.00	62.50	60.00	59.00	59.00	59.50	53.65	53.80	63.50	62.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 8 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.00	28.20	28.20	28.50	29.00	29.40	29.80	30.10	30.10	29.90	29.90	29.80	29.80
First Incubating Temperature, T1 (^{0}C)	37.10	37.20	37.60	37.80	38.00	38.30	38.40	38.80	39.20	36.50	36.50	36.50	37.50
Second Incubating Temperature, T2 (^{0}C)	37.10	37.10	37.20	37.20	37.40	37.60	37.80	38.00	38.10	36.60	36.60	36.60	37.30
First Incubating Humidity, H1 (%)	57.00	58.00	58.00	56.00	56.00	56.00	56.00	55.00	58.00	58.00	58.00	60.00	60.00
Second Incubating Humidity, H2 (%)	60.00	60.00	60.00	59.00	59.00	59.00	59.00	58.00	60.00	61.00	60.00	60.00	60.00
Average Incubating Temperature (^{0}C)	37.10	37.15	37.40	37.50	37.70	37.95	38.10	38.40	38.65	36.55	36.55	36.55	37.40
Average Incubating Humidity (%)	58.50	59.00	59.00	57.50	57.50	57.50	57.50	56.50	59.00	59.50	59.00	60.00	60.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 9 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.30	28.40	28.40	28.80	30.00	30.10	30.50	30.40	30.30	30.20	30.00	29.80	29.60
First Incubating Temperature, T1 (^{0}C)	37.80	36.60	36.40	37.30	37.40	37.40	36.80	37.90	37.90	37.80	37.80	38.20	38.20
Second Incubating Temperature, T2 (^{0}C)	37.90	36.80	36.40	37.20	37.40	37.40	36.90	37.50	37.80	37.80	38.00	37.30	37.30
First Incubating Humidity, H1 (%)	58.00	60.00	60.00	59.00	59.00	59.00	59.00	59.00	59.00	58.00	58.00	58.00	57.00
Second Incubating Humidity, H2 (%)	60.00	60.00	62.00	62.00	61.00	61.00	61.00	61.00	60.00	61.00	61.00	60.00	60.00
Average Incubating Temperature (^{0}C)	37.85	36.70	36.40	37.25	37.40	37.40	36.85	37.70	37.85	37.80	37.90	37.75	37.75
Average Incubating Humidity (%)	59.00	60.00	61.00	60.50	60.00	60.00	60.00	60.00	59.50	59.50	59.50	59.00	58.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 10 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.00	28.20	28.20	29.00	29.40	29.80	30.60	31.10	31.40	31.20	31.10	30.60	30.50
First Incubating Temperature, T1 (^{0}C)	37.70	37.60	37.50	37.50	37.90	37.50	37.30	38.40	38.50	38.10	38.00	37.20	37.80
Second Incubating Temperature, T2 (^{0}C)	37.00	37.10	37.20	37.30	37.40	37.20	37.00	37.90	38.00	38.00	38.00	36.90	37.40
First Incubating Humidity, H1 (%)	58.00	58.00	58.00	59.00	59.00	58.00	57.00	56.00	56.00	58.00	58.00	58.00	58.00
Second Incubating Humidity, H2 (%)	61.00	61.00	61.00	61.00	62.00	61.00	61.00	60.00	59.00	59.00	59.00	61.00	61.00
Average Incubating Temperature (^{0}C)	37.35	37.35	37.35	37.40	37.65	37.35	37.15	38.15	38.25	38.05	38.00	37.05	37.60
Average Incubating Humidity (%)	59.50	59.50	59.50	60.00	60.50	59.50	59.00	58.00	57.50	58.50	58.50	59.50	59.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 11 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.60	28.60	28.60	28.10	27.20	27.50	28.40	28.50	29.10	29.10	29.20	29.00	28.90
First Incubating Temperature, T1 (^{0}C)	38.30	37.60	37.90	37.60	38.90	38.00	36.10	38.00	39.00	38.80	38.60	38.60	38.80
Second Incubating Temperature, T2 (^{0}C)	37.30	37.00	36.60	36.80	37.10	36.70	36.70	37.10	37.30	37.30	37.30	37.20	37.10
First Incubating Humidity, H1 (%)	58.00	55.00	55.00	60.00	67.00	67.00	63.00	63.00	65.00	64.00	64.00	60.00	58.00
Second Incubating Humidity, H2 (%)	62.00	60.00	55.00	60.00	73.00	72.00	70.00	70.00	71.00	71.00	72.00	70.00	65.00
Average Incubating Temperature (^{0}C)	37.80	37.30	37.25	37.20	38.00	37.35	36.40	37.55	38.15	38.05	37.95	37.90	37.95
Average Incubating Humidity (%)	60.00	57.50	55.00	60.00	70.00	69.50	66.50	66.50	68.00	67.50	68.00	65.00	61.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 12 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	25.40	26.20	28.60	29.00	29.40	30.00	30.40	30.40	30.30	30.30	30.30	30.10	30.20
First Incubating Temperature, T1 (^{0}C)	36.20	36.80	37.60	36.80	36.80	36.80	37.50	37.40	37.40	37.20	37.10	37.20	37.40
Second Incubating Temperature, T2 (^{0}C)	36.40	36.80	37.00	36.80	36.40	36.80	37.20	37.20	37.20	37.00	36.80	36.80	37.00
First Incubating Humidity, H1 (%)	72.00	68.00	66.00	67.00	67.00	66.00	65.00	65.00	65.00	65.00	66.00	64.00	58.00
Second Incubating Humidity, H2 (%)	76.00	70.00	69.00	70.00	70.00	69.00	68.00	68.00	67.00	68.00	68.00	65.00	61.00
Average Incubating Temperature (^{0}C)	36.30	36.80	37.30	36.80	36.60	36.80	37.35	37.30	37.30	37.10	36.95	37.00	37.20
Average Incubating Humidity (%)	74.00	69.00	67.50	68.50	68.50	67.50	66.50	66.50	66.00	66.50	67.00	64.50	59.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 13 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.00	27.00	26.90	27.60	28.20	28.50	29.00	29.30	29.30	29.10	29.10	28.00	27.30
First Incubating Temperature, T1 (^{0}C)	39.30	37.50	36.70	36.80	38.30	37.00	37.40	37.40	37.60	37.40	37.40	37.60	38.30
Second Incubating Temperature, T2 (^{0}C)	38.20	37.50	36.10	36.50	37.10	36.40	36.80	37.10	37.30	37.20	37.00	37.10	37.60
First Incubating Humidity, H1 (%)	63.00	68.00	67.00	65.00	63.00	67.00	70.00	70.00	69.00	70.00	70.00	68.00	67.00
Second Incubating Humidity, H2 (%)	66.00	68.00	70.00	68.00	67.00	70.00	73.00	72.00	72.00	72.00	73.00	72.00	71.00
Average Incubating Temperature (^{0}C)	38.75	37.50	36.40	36.65	37.70	36.70	37.10	37.25	37.45	37.30	37.20	37.35	37.95
Average Incubating Humidity (%)	64.50	68.00	68.50	66.50	65.00	68.50	71.50	71.00	70.50	71.00	71.50	70.00	69.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 14 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.00	28.50	28.90	29.10	29.60	29.80	29.90	29.50	28.60	28.30	28.30	28.30	28.30
First Incubating Temperature, T1 (^{0}C)	37.80	37.80	37.90	38.00	39.40	39.20	39.00	36.50	34.80	36.00	36.40	36.60	34.90
Second Incubating Temperature, T2 (^{0}C)	37.10	37.30	37.50	37.80	38.20	38.20	38.10	37.10	36.80	36.40	35.40	36.60	34.10
First Incubating Humidity, H1 (%)	69.00	69.00	68.00	68.00	67.00	65.00	64.00	68.00	75.00	72.00	72.00	70.00	64.00
Second Incubating Humidity, H2 (%)	72.00	71.00	71.00	71.00	71.00	68.00	67.00	68.00	79.00	75.00	75.00	70.00	66.00
Average Incubating Temperature (^{0}C)	37.45	37.55	37.70	37.90	38.80	38.70	38.55	36.80	35.80	36.20	35.90	36.60	34.50
Average Incubating Humidity (%)	70.50	70.00	69.50	69.50	69.00	66.50	65.50	68.00	77.00	73.50	73.50	70.00	65.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 15 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.30	27.80	28.60	28.80	29.20	29.00	29.60	29.60	30.10	29.80	29.60	29.90	29.90
First Incubating Temperature, T1 (^{0}C)	35.20	36.50	37.60	37.00	36.70	36.20	34.50	36.00	34.70	33.50	30.10	38.20	38.20
Second Incubating Temperature, T2 (^{0}C)	34.30	36.50	37.20	37.00	36.10	35.20	34.90	36.00	34.50	34.50	30.80	37.10	37.40
First Incubating Humidity, H1 (%)	71.00	66.00	64.00	65.00	66.00	68.00	70.00	70.00	71.00	74.00	76.00	65.00	64.00
Second Incubating Humidity, H2 (%)	75.00	68.00	68.00	68.00	69.00	68.00	68.00	70.00	72.00	74.00	75.00	70.00	67.00
Average Incubating Temperature (^{0}C)	34.75	36.50	37.40	37.00	36.40	35.70	34.70	36.00	34.60	34.00	30.45	37.65	37.80
Average Incubating Humidity (%)	73.00	67.00	66.00	66.50	67.50	68.00	69.00	70.00	71.50	74.00	75.50	67.50	65.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 16 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	28.30	28.50	28.90	29.10	29.80	29.80	30.80	30.90	30.90	31.10	30.50	30.00	29.60
First Incubating Temperature, T1 (^{0}C)	36.90	37.10	37.90	38.40	38.30	38.30	38.50	38.30	38.10	38.10	36.80	38.00	35.50
Second Incubating Temperature, T2 (^{0}C)	36.30	37.00	37.10	37.00	36.60	36.60	37.00	36.30	36.00	35.90	36.00	34.90	35.00
First Incubating Humidity, H1 (%)	64.00	65.00	66.00	67.00	67.00	66.00	66.00	65.00	65.00	64.00	64.00	64.00	71.00
Second Incubating Humidity, H2 (%)	66.00	68.00	70.00	72.00	72.00	71.00	71.00	71.00	71.00	70.00	72.00	72.00	74.00
Average Incubating Temperature (^{0}C)	36.60	37.05	37.50	37.70	37.45	37.45	37.75	37.30	37.05	37.00	36.40	36.45	35.25
Average Incubating Humidity (%)	65.00	66.50	68.00	69.50	69.50	68.50	68.50	68.00	68.00	67.00	68.00	68.00	72.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 17 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.90	28.90	29.20	29.60	29.70	30.00	30.10	30.30	31.00	30.40	30.80	30.60	30.40
First Incubating Temperature, T1 (^{0}C)	36.90	36.50	35.40	36.10	36.20	36.40	36.70	36.70	36.80	36.20	36.10	36.60	36.00
Second Incubating Temperature, T2 (^{0}C)	36.20	35.80	35.40	36.50	36.90	36.50	36.40	36.50	36.60	36.50	36.60	36.40	36.30
First Incubating Humidity, H1 (%)	72.00	73.00	75.00	76.00	78.00	77.00	77.00	75.00	75.00	74.00	72.00	72.00	75.00
Second Incubating Humidity, H2 (%)	74.00	75.00	76.00	76.00	78.00	76.00	76.00	75.00	75.00	74.00	72.00	72.00	75.00
Average Incubating Temperature (^{0}C)	36.55	36.15	35.40	36.30	36.55	36.45	36.55	36.60	36.70	36.35	36.35	36.50	36.15
Average Incubating Humidity (%)	73.00	74.00	75.50	76.00	78.00	76.50	76.50	75.00	75.00	74.00	72.00	72.00	75.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 18 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.30	27.50	28.80	29.00	29.90	29.90	30.00	31.30	31.30	31.20	30.20	30.10	29.50
First Incubating Temperature, T1 (^{0}C)	36.50	36.40	36.80	36.90	34.20	36.30	36.30	36.30	36.30	37.60	36.70	36.80	37.90
Second Incubating Temperature, T2 (^{0}C)	36.40	36.30	36.60	36.70	36.10	36.40	36.40	36.10	36.20	36.30	36.10	36.90	36.50
First Incubating Humidity, H1 (%)	62.00	69.00	68.00	68.00	66.00	62.00	62.00	60.00	60.00	61.00	60.00	63.00	67.00
Second Incubating Humidity, H2 (%)	61.00	65.00	67.00	66.00	64.00	61.00	61.00	60.00	60.00	60.00	60.00	62.00	62.00
Average Incubating Temperature (^{0}C)	36.45	36.35	36.70	36.80	35.15	36.35	36.35	36.20	36.25	36.95	36.40	36.85	37.20
Average Incubating Humidity (%)	61.50	67.00	67.50	67.00	65.00	61.50	61.50	60.00	60.00	60.50	60.00	62.50	64.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 19 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.00	27.20	27.50	27.80	28.00	28.60	29.10	29.30	29.30	29.30	29.10	28.30	27.80
First Incubating Temperature, T1 (^{0}C)	36.30	36.50	36.90	36.60	36.70	35.40	36.10	36.90	36.70	36.20	36.30	36.90	36.40
Second Incubating Temperature, T2 (^{0}C)	36.00	36.10	36.30	36.50	36.90	35.10	36.40	36.40	36.50	36.50	36.60	36.10	36.80
First Incubating Humidity, H1 (%)	47.00	47.00	47.00	53.00	52.00	57.00	58.00	58.00	66.00	66.00	66.00	64.00	55.00
Second Incubating Humidity, H2 (%)	51.00	51.00	51.00	52.00	55.00	57.00	58.00	58.00	68.00	68.00	68.00	66.00	58.00
Average Incubating Temperature (^{0}C)	36.15	36.30	36.60	36.55	36.80	35.25	36.25	36.65	36.60	36.35	36.45	36.50	36.60
Average Incubating Humidity (%)	49.00	49.00	49.00	52.50	53.50	57.00	58.00	58.00	67.00	67.00	67.00	65.00	56.50
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 20 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	27.10	27.10	27.30	28.50	28.60	28.60	29.90	29.80	29.80	28.20	27.60	29.50	29.30
First Incubating Temperature, T1 (^{0}C)	36.30	36.10	36.90	35.80	35.60	35.80	35.70	36.20	36.90	36.60	36.60	35.70	36.80
Second Incubating Temperature, T2 (^{0}C)	36.00	36.90	36.90	36.30	36.40	36.30	35.10	36.00	36.80	36.40	36.30	36.30	36.10
First Incubating Humidity, H1 (%)	67.00	55.00	64.00	64.00	64.00	64.00	63.00	63.00	63.00	64.00	64.00	64.00	67.00
Second Incubating Humidity, H2 (%)	61.00	53.00	67.00	66.00	66.00	66.00	65.00	65.00	64.00	65.00	66.00	72.00	61.00
Average Incubating Temperature (^{0}C)	36.15	36.50	36.90	36.05	36.00	36.05	35.40	36.10	36.85	36.50	36.45	36.00	36.45
Average Incubating Humidity (%)	64.00	54.00	65.50	65.00	65.00	65.00	64.00	64.00	63.50	64.50	65.00	68.00	64.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

Day 21 Readings

Quantity\Time	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm	4:00pm	5:00pm	6:00pm	7:00pm	8:00pm
Ambient Temperature (^{0}C)	26.10	26.50	27.00	27.30	27.30	27.40	27.30	27.40	27.00	27.00	27.00	27.00	26.80
First Incubating Temperature, T1 (^{0}C)	36.70	36.10	36.10	36.20	36.20	36.00	36.70	36.50	37.10	37.30	37.60	36.40	36.60
Second Incubating Temperature, T2 (^{0}C)	36.60	36.20	36.20	36.30	36.10	36.00	37.00	36.50	36.30	36.10	36.10	36.50	36.40
First Incubating Humidity, H1 (%)	65.00	65.00	64.00	64.00	63.00	63.00	64.00	61.00	62.00	62.00	63.00	59.00	59.00
Second Incubating Humidity, H2 (%)	66.00	65.00	64.00	63.00	63.00	63.00	65.00	62.00	62.00	62.00	63.00	57.00	57.00
Average Incubating Temperature (^{0}C)	36.65	36.15	36.15	36.25	36.15	36.00	36.85	36.50	36.70	36.70	36.85	36.45	36.50
Average Incubating Humidity (%)	65.50	65.00	64.00	63.50	63.00	63.00	64.50	61.50	62.00	62.00	63.00	58.00	58.00
Optimum Incubating Temperature (^{0}C)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50
Optimum Incubating Humidity (%)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00

APPENDIX D

CONTROL CODES

CODE 1:

```
;  Assembly code generated by
mikroVirtualMachine - V. 5.0.0.3
;  Date/Time: 5/24/2015 4:36:21 AM
;  Info: http://www.mikroe.com


; ADDRESS     OPCODE ASM
; ----------------------------------------
-----
$0000  $285E               GOTO   _main
$0004  $      _interrupt:
$0004  $00FF               MOVWF  STACK_15
$0005  $0E03               SWAPF  STATUS, 0
$0006  $0183               CLRF   STATUS
$0007  $00C1               MOVWF
       ?saveSTATUS
$0008  $0804               MOVF   FSR, 0
$0009  $00C0               MOVWF  ?saveFSR
$000A  $080A               MOVF   PCLATH, 0
$000B  $00C2               MOVWF
       ?savePCLATH
$000C  $018A               CLRF   PCLATH
$000D  $0870               MOVF   STACK_0, 0
$000E  $00DF               MOVWF  STSAVED_0
;UCHE_INCUBATOR_1.pbas,18 ::           Sub
procedure interrupt
;UCHE_INCUBATOR_1.pbas,23 ::
       inc(counter)
$000F  $0AA0               INCF   _counter,
1
$0010  $1903               BTFSC  STATUS, Z
$0011  $0AA1               INCF
       _counter+1, 1
;UCHE_INCUBATOR_1.pbas,25 ::           if
counter > 2800 then
$0012  $0821               MOVF
       _counter+1, 0
$0013  $3C0A               SUBLW  10
$0014  $1D03               BTFSS  STATUS, Z
$0015  $2818               GOTO
       L_interrupt_0
$0016  $0820               MOVF   _counter,
0
$0017  $3CF0               SUBLW  240
$0018  $      L_interrupt_0:
$0018  $1803               BTFSC  STATUS, C
$0019  $2829               GOTO
       UCHE_INCUBATOR_1_L_2
$001A  $      UCHE_INCUBATOR_1_L_1:
;UCHE_INCUBATOR_1.pbas,26 ::
       inc(sec)
$001A  $0AA2               INCF   _sec, 1
$001B  $1903               BTFSC  STATUS, Z
$001C  $0AA3               INCF   _sec+1, 1
;UCHE_INCUBATOR_1.pbas,27 ::
       counter = 0
$001D  $01A0               CLRF   _counter
$001E  $01A1               CLRF   _counter+1
;UCHE_INCUBATOR_1.pbas,28 ::           if
pp = 0 then
$001F  $0824               MOVF   _pp, 0
$0020  $3A00               XORLW  0
$0021  $1D03               BTFSS  STATUS, Z
$0022  $2827               GOTO
       UCHE_INCUBATOR_1_L_5
$0023  $      UCHE_INCUBATOR_1_L_4:
;UCHE_INCUBATOR_1.pbas,29 ::           pp
= 1
$0023  $3001               MOVLW  1
$0024  $00A4               MOVWF  _pp
;UCHE_INCUBATOR_1.pbas,30 ::
       blinker = 1
$0025  $      UCHE_INCUBATOR_1_L_7:
$0025  $1687               BSF    PORTC, 5
$0026  $      UCHE_INCUBATOR_1_L_8:
$0026  $2829               GOTO
       UCHE_INCUBATOR_1_L_6
;UCHE_INCUBATOR_1.pbas,31 ::
       else
$0027  $      UCHE_INCUBATOR_1_L_5:
;UCHE_INCUBATOR_1.pbas,32 ::           pp
= 0
$0027  $01A4               CLRF   _pp, 1
;UCHE_INCUBATOR_1.pbas,33 ::
       blinker = 0
$0028  $1287               BCF    PORTC, 5
$0029  $      UCHE_INCUBATOR_1_L_10:
;UCHE_INCUBATOR_1.pbas,34 ::           end
if
$0029  $      UCHE_INCUBATOR_1_L_6:
$0029  $      UCHE_INCUBATOR_1_L_2:
;UCHE_INCUBATOR_1.pbas,35 ::           end
if
$0029  $      UCHE_INCUBATOR_1_L_3:
;UCHE_INCUBATOR_1.pbas,37 ::           if
sec > 59 then
$0029  $0823               MOVF   _sec+1, 0
$002A  $3C00               SUBLW  0
$002B  $1D03               BTFSS  STATUS, Z
$002C  $282F               GOTO
       L_interrupt_1
$002D  $0822               MOVF   _sec, 0
$002E  $3C3B               SUBLW  59
$002F  $      L_interrupt_1:
$002F  $1803               BTFSC  STATUS, C
$0030  $2836               GOTO
       UCHE_INCUBATOR_1_L_12
$0031  $      UCHE_INCUBATOR_1_L_11:
;UCHE_INCUBATOR_1.pbas,38 ::
       inc(min)
$0031  $0AA5               INCF   _min, 1
$0032  $1903               BTFSC  STATUS, Z
$0033  $0AA6               INCF   _min+1, 1
;UCHE_INCUBATOR_1.pbas,39 ::           sec
= 0
$0034  $01A2               CLRF   _sec
$0035  $01A3               CLRF   _sec+1
$0036  $      UCHE_INCUBATOR_1_L_12:
;UCHE_INCUBATOR_1.pbas,40 ::           end
if
$0036  $      UCHE_INCUBATOR_1_L_13:
;UCHE_INCUBATOR_1.pbas,42 ::           if
min > 59 then
$0036  $0826               MOVF   _min+1, 0
$0037  $3C00               SUBLW  0
```

```
$0038  $1D03               BTFSS  STATUS, Z
$0039  $283C               GOTO
       L_interrupt_2
$003A  $0825               MOVF   _min, 0
$003B  $3C3B               SUBLW  59
$003C  $      L_interrupt_2:
$003C  $1803               BTFSC  STATUS, C
$003D  $2843               GOTO
       UCHE_INCUBATOR_1_L_15
$003E  $      UCHE_INCUBATOR_1_L_14:
;UCHE_INCUBATOR_1.pbas,43 ::
       inc(hr)
$003E  $0AA7               INCF   _hr, 1
$003F  $1903               BTFSC  STATUS, Z
$0040  $0AA8               INCF   _hr+1, 1
;UCHE_INCUBATOR_1.pbas,44 ::           min
= 0
$0041  $01A5               CLRF   _min
$0042  $01A6               CLRF   _min+1
$0043  $      UCHE_INCUBATOR_1_L_15:
;UCHE_INCUBATOR_1.pbas,45 ::           end
if
$0043  $      UCHE_INCUBATOR_1_L_16:
;UCHE_INCUBATOR_1.pbas,47 ::           if
hr > 1 then
$0043  $0828               MOVF   _hr+1, 0
$0044  $3C00               SUBLW  0
$0045  $1D03               BTFSS  STATUS, Z
$0046  $2849               GOTO
       L_interrupt_3
$0047  $0827               MOVF   _hr, 0
$0048  $3C01               SUBLW  1
$0049  $      L_interrupt_3:
$0049  $1803               BTFSC  STATUS, C
$004A  $284F               GOTO
       UCHE_INCUBATOR_1_L_18
$004B  $      UCHE_INCUBATOR_1_L_17:
;UCHE_INCUBATOR_1.pbas,48 ::
       confirm = 1
$004B  $3001               MOVLW  1
$004C  $00A9               MOVWF  _confirm
;UCHE_INCUBATOR_1.pbas,49 ::           hr
= 0
$004D  $01A7               CLRF   _hr
$004E  $01A8               CLRF   _hr+1
$004F  $      UCHE_INCUBATOR_1_L_18:
;UCHE_INCUBATOR_1.pbas,50 ::           end
if
$004F  $      UCHE_INCUBATOR_1_L_19:
;UCHE_INCUBATOR_1.pbas,53 ::
       TMR0 = 200
$004F  $30C8               MOVLW  200
$0050  $0081               MOVWF  TMR0
;UCHE_INCUBATOR_1.pbas,54 ::
       INTCON = $20
$0051  $3020               MOVLW  32
$0052  $008B               MOVWF  INTCON
$0053  $      UCHE_INCUBATOR_1_L_0:
$0053  $      L_Interrupt_end:
$0053  $085F               MOVF   STSAVED_0,
0
$0054  $00F0               MOVWF  STACK_0
$0055  $0842               MOVF
       ?savePCLATH, 0
$0056  $008A               MOVWF  PCLATH
$0057  $0840               MOVF   ?saveFSR,
0
$0058  $0084               MOVWF  FSR
$0059  $0E41               SWAPF
       ?saveSTATUS, 0
$005A  $0083               MOVWF  STATUS
$005B  $0EFF               SWAPF  STACK_15,
1
$005C  $0E7F               SWAPF  STACK_15,
0
$005D  $0009               RETFIE
$0958  $      _delay_1us:
;delays.pbas,9 ::          sub procedure
Delay_1us()
;delays.pbas,10 ::         Delay_us(1)
$0958  $3001               MOVLW  1
$0959  $1303               BCF    STATUS,
RP1
$095A  $1283               BCF    STATUS,
RP0
$095B  $00FA               MOVWF  STACK_10
$095C  $0BFA               DECFSZ STACK_10,
F
$095D  $295C               GOTO   $-1
$095E  $0000               NOP
$095F  $      delays_L_1:
$095F  $0008               RETURN
$093C  $      _delay_5500us:
;delays.pbas,33 ::         sub procedure
Delay_5500us()
;delays.pbas,34 ::         Delay_us(5500)
$093C  $3024               MOVLW  36
$093D  $1303               BCF    STATUS,
RP1
$093E  $1283               BCF    STATUS,
RP0
$093F  $00FB               MOVWF  STACK_11
$0940  $30FF               MOVLW  255
$0941  $00FA               MOVWF  STACK_10
$0942  $0BFB               DECFSZ STACK_11,
F
$0943  $2945               GOTO   $+2
$0944  $2948               GOTO   $+4
$0945  $0BFA               DECFSZ STACK_10,
F
$0946  $2945               GOTO   $-1
$0947  $2942               GOTO   $-5
$0948  $309E               MOVLW  158
$0949  $00FA               MOVWF  STACK_10
$094A  $0BFA               DECFSZ STACK_10,
F
$094B  $294A               GOTO   $-1
$094C  $      delays_L_7:
$094C  $0008               RETURN
$0968  $      _delay_50us:
;delays.pbas,21 ::         sub procedure
Delay_50us()
;delays.pbas,22 ::         Delay_us(50)
$0968  $3053               MOVLW  83
$0969  $1303               BCF    STATUS,
RP1
$096A  $1283               BCF    STATUS,
RP0
$096B  $00FA               MOVWF  STACK_10
$096C  $0BFA               DECFSZ STACK_10,
F
$096D  $296C               GOTO   $-1
$096E  $      delays_L_4:
$096E  $0008               RETURN
```

```
$065F $      _lcd_cmd:
;lcd.ppas,19 ::
;lcd.ppas,20 ::
$065F $1303               BCF    STATUS,
RP1
$0660 $1283               BCF    STATUS,
RP0
$0661 $082A               MOVF
      lcd_ctrlport_address, 0
$0662 $0084               MOVWF  FSR
;lcd.ppas,22 ::
$0663 $092B               COMF
      lcd____menable, W
$0664 $00F0               MOVWF  STACK_0
$0665 $0870               MOVF   STACK_0, 0
$0666 $0580               ANDWF  INDF, 1
;lcd.ppas,23 ::
$0667 $092C               COMF
      lcd____mrs, W
$0668 $00F0               MOVWF  STACK_0
$0669 $0870               MOVF   STACK_0, 0
$066A $0580               ANDWF  INDF, 1
;lcd.ppas,25 ::
$066B $082D               MOVF
      lcd_dataport_address, 0
$066C $0084               MOVWF  FSR
;lcd.ppas,26 ::
$066D $082F               MOVF
      lcd____mdb6, 0
$066E $042E               IORWF
      lcd____mdb7, 0
$066F $00F0               MOVWF  STACK_0
$0670 $0830               MOVF
      lcd____mdb5, 0
$0671 $04F0               IORWF  STACK_0, 1
$0672 $0831               MOVF
      lcd____mdb4, 0
$0673 $04F0               IORWF  STACK_0, 1
$0674 $09F0               COMF   STACK_0, F
$0675 $0870               MOVF   STACK_0, 0
$0676 $0580               ANDWF  INDF, 1
;lcd.ppas,28 ::
$0677 $3000               MOVLW  0
$0678 $1BDE               BTFSC
      FARG_Lcd_Cmd, 7
$0679 $3001               MOVLW  1
$067A $00F1               MOVWF  STACK_1
$067B $0871               MOVF   STACK_1, 0
$067C $3A01               XORLW  1
$067D $1D03               BTFSS  STATUS, Z
$067E $2E81               GOTO   lcd_L_2
$067F $      lcd_L_1:
;lcd.ppas,29 ::
$067F $082E               MOVF
      lcd____mdb7, 0
$0680 $0480               IORWF  INDF, 1
$0681 $      lcd_L_2:
$0681 $      lcd_L_3:
;lcd.ppas,30 ::
$0681 $3000               MOVLW  0
$0682 $1B5E               BTFSC
      FARG_Lcd_Cmd, 6
$0683 $3001               MOVLW  1
$0684 $00F1               MOVWF  STACK_1
$0685 $0871               MOVF   STACK_1, 0
$0686 $3A01               XORLW  1
$0687 $1D03               BTFSS  STATUS, Z
$0688 $2E8B               GOTO   lcd_L_5
$0689 $      lcd_L_4:
;lcd.ppas,31 ::
$0689 $082F               MOVF
      lcd____mdb6, 0
$068A $0480               IORWF  INDF, 1
$068B $      lcd_L_5:
$068B $      lcd_L_6:
;lcd.ppas,32 ::
$068B $3000               MOVLW  0
$068C $1ADE               BTFSC
      FARG_Lcd_Cmd, 5
$068D $3001               MOVLW  1
$068E $00F1               MOVWF  STACK_1
$068F $0871               MOVF   STACK_1, 0
$0690 $3A01               XORLW  1
$0691 $1D03               BTFSS  STATUS, Z
$0692 $2E95               GOTO   lcd_L_8
$0693 $      lcd_L_7:
;lcd.ppas,33 ::
$0693 $0830               MOVF
      lcd____mdb5, 0
$0694 $0480               IORWF  INDF, 1
$0695 $      lcd_L_8:
$0695 $      lcd_L_9:
;lcd.ppas,34 ::
$0695 $3000               MOVLW  0
$0696 $1A5E               BTFSC
      FARG_Lcd_Cmd, 4
$0697 $3001               MOVLW  1
$0698 $00F1               MOVWF  STACK_1
$0699 $0871               MOVF   STACK_1, 0
$069A $3A01               XORLW  1
$069B $1D03               BTFSS  STATUS, Z
$069C $2E9F               GOTO   lcd_L_11
$069D $      lcd_L_10:
;lcd.ppas,35 ::
$069D $0831               MOVF
      lcd____mdb4, 0
$069E $0480               IORWF  INDF, 1
$069F $      lcd_L_11:
$069F $      lcd_L_12:
;lcd.ppas,37 ::
$069F $082A               MOVF
      lcd_ctrlport_address, 0
$06A0 $0084               MOVWF  FSR
;lcd.ppas,38 ::
$06A1 $0832               MOVF
      lcd_lcdcmd_status, 0
$06A2 $3A01               XORLW  1
$06A3 $1D03               BTFSS  STATUS, Z
$06A4 $2EAA               GOTO   lcd_L_14
$06A5 $      lcd_L_13:
;lcd.ppas,39 ::
$06A5 $092C               COMF
      lcd____mrs, W
$06A6 $00F0               MOVWF  STACK_0
$06A7 $0870               MOVF   STACK_0, 0
$06A8 $0580               ANDWF  INDF, 1
$06A9 $2EAC               GOTO   lcd_L_15
;lcd.ppas,40 ::
$06AA $      lcd_L_14:
;lcd.ppas,41 ::
$06AA $082C               MOVF
      lcd____mrs, 0
$06AB $0480               IORWF  INDF, 1
$06AC $      lcd_L_15:
```

```
;lcd.ppas,43 ::
$06AC  $082B               MOVF
       lcd____menable, 0
$06AD  $0480               IORWF  INDF, 1
;lcd.ppas,44 ::
$06AE  $158A               BSF    PCLATH, 3
$06AF  $2158               CALL   _delay_1us
$06B0  $118A               BCF    PCLATH, 3
;lcd.ppas,45 ::
$06B1  $092B               COMF
       lcd____menable, W
$06B2  $00F0               MOVWF  STACK_0
$06B3  $0870               MOVF   STACK_0, 0
$06B4  $0580               ANDWF  INDF, 1
;lcd.ppas,47 ::
$06B5  $092C               COMF
       lcd____mrs, W
$06B6  $00F0               MOVWF  STACK_0
$06B7  $0870               MOVF   STACK_0, 0
$06B8  $0580               ANDWF  INDF, 1
;lcd.ppas,49 ::
$06B9  $082D               MOVF
       lcd_dataport_address, 0
$06BA  $0084               MOVWF  FSR
;lcd.ppas,50 ::
$06BB  $082F               MOVF
       lcd____mdb6, 0
$06BC  $042E               IORWF
       lcd____mdb7, 0
$06BD  $00F0               MOVWF  STACK_0
$06BE  $0830               MOVF
       lcd____mdb5, 0
$06BF  $04F0               IORWF  STACK_0, 1
$06C0  $0831               MOVF
       lcd____mdb4, 0
$06C1  $04F0               IORWF  STACK_0, 1
$06C2  $09F0               COMF   STACK_0, F
$06C3  $0870               MOVF   STACK_0, 0
$06C4  $0580               ANDWF  INDF, 1
;lcd.ppas,52 ::
$06C5  $3000               MOVLW  0
$06C6  $19DE               BTFSC
       FARG_Lcd_Cmd, 3
$06C7  $3001               MOVLW  1
$06C8  $00F1               MOVWF  STACK_1
$06C9  $0871               MOVF   STACK_1, 0
$06CA  $3A01               XORLW  1
$06CB  $1D03               BTFSS  STATUS, Z
$06CC  $2ECF               GOTO   lcd_L_17
$06CD  $      lcd_L_16:
;lcd.ppas,53 ::
$06CD  $082E               MOVF
       lcd____mdb7, 0
$06CE  $0480               IORWF  INDF, 1
$06CF  $      lcd_L_17:
$06CF  $      lcd_L_18:
;lcd.ppas,54 ::
$06CF  $3000               MOVLW  0
$06D0  $195E               BTFSC
       FARG_Lcd_Cmd, 2
$06D1  $3001               MOVLW  1
$06D2  $00F1               MOVWF  STACK_1
$06D3  $0871               MOVF   STACK_1, 0
$06D4  $3A01               XORLW  1
$06D5  $1D03               BTFSS  STATUS, Z
$06D6  $2ED9               GOTO   lcd_L_20
$06D7  $      lcd_L_19:
;lcd.ppas,55 ::
$06D7  $082F               MOVF
       lcd____mdb6, 0
$06D8  $0480               IORWF  INDF, 1
$06D9  $      lcd_L_20:
$06D9  $      lcd_L_21:
;lcd.ppas,56 ::
$06D9  $3000               MOVLW  0
$06DA  $18DE               BTFSC
       FARG_Lcd_Cmd, 1
$06DB  $3001               MOVLW  1
$06DC  $00F1               MOVWF  STACK_1
$06DD  $0871               MOVF   STACK_1, 0
$06DE  $3A01               XORLW  1
$06DF  $1D03               BTFSS  STATUS, Z
$06E0  $2EE3               GOTO   lcd_L_23
$06E1  $      lcd_L_22:
;lcd.ppas,57 ::
$06E1  $0830               MOVF
       lcd____mdb5, 0
$06E2  $0480               IORWF  INDF, 1
$06E3  $      lcd_L_23:
$06E3  $      lcd_L_24:
;lcd.ppas,58 ::
$06E3  $3001               MOVLW  1
$06E4  $055E               ANDWF
       FARG_Lcd_Cmd, 0
$06E5  $00F1               MOVWF  STACK_1
$06E6  $0871               MOVF   STACK_1, 0
$06E7  $3A01               XORLW  1
$06E8  $1D03               BTFSS  STATUS, Z
$06E9  $2EEC               GOTO   lcd_L_26
$06EA  $      lcd_L_25:
;lcd.ppas,59 ::
$06EA  $0831               MOVF
       lcd____mdb4, 0
$06EB  $0480               IORWF  INDF, 1
$06EC  $      lcd_L_26:
$06EC  $      lcd_L_27:
;lcd.ppas,61 ::
$06EC  $082A               MOVF
       lcd_ctrlport_address, 0
$06ED  $0084               MOVWF  FSR
;lcd.ppas,62 ::
$06EE  $0832               MOVF
       lcd_lcdcmd_status, 0
$06EF  $3A01               XORLW  1
$06F0  $1D03               BTFSS  STATUS, Z
$06F1  $2EF7               GOTO   lcd_L_29
$06F2  $      lcd_L_28:
;lcd.ppas,63 ::
$06F2  $092C               COMF
       lcd____mrs, W
$06F3  $00F0               MOVWF  STACK_0
$06F4  $0870               MOVF   STACK_0, 0
$06F5  $0580               ANDWF  INDF, 1
$06F6  $2EF9               GOTO   lcd_L_30
;lcd.ppas,64 ::
$06F7  $      lcd_L_29:
;lcd.ppas,65 ::
$06F7  $082C               MOVF
       lcd____mrs, 0
$06F8  $0480               IORWF  INDF, 1
$06F9  $      lcd_L_30:
;lcd.ppas,67 ::
$06F9  $082B               MOVF
       lcd____menable, 0
```

```
$06FA  $0480               IORWF  INDF, 1
;lcd.ppas,68 ::
$06FB  $158A               BSF    PCLATH, 3
$06FC  $2158               CALL   _delay_1us
$06FD  $118A               BCF    PCLATH, 3
;lcd.ppas,69 ::
$06FE  $092B               COMF
       lcd___menable, W
$06FF  $00F0               MOVWF  STACK_0
$0700  $0870               MOVF   STACK_0, 0
$0701  $0580               ANDWF  INDF, 1
;lcd.ppas,71 ::
$0702  $0832               MOVF
       lcd_lcdcmd_status, 0
$0703  $3A01               XORLW  1
$0704  $1D03               BTFSS  STATUS, Z
$0705  $2F0A               GOTO   lcd_L_32
$0706  $      lcd_L_31:
;lcd.ppas,72 ::
$0706  $158A               BSF    PCLATH, 3
$0707  $213C               CALL
       _delay_5500us
$0708  $118A               BCF    PCLATH, 3
$0709  $2F0D               GOTO   lcd_L_33
;lcd.ppas,73 ::
$070A  $      lcd_L_32:
;lcd.ppas,74 ::
$070A  $158A               BSF    PCLATH, 3
$070B  $2168               CALL
       _delay_50us
$070C  $118A               BCF    PCLATH, 3
$070D  $      lcd_L_33:
$070D  $      lcd_L_0:
;lcd.ppas,75 ::
$070D  $0008               RETURN
$052A  $      _lcd_config:
;lcd.ppas,115 ::
;lcd.ppas,116 ::
$052A  $158A               BSF    PCLATH, 3
$052B  $213C               CALL
       _delay_5500us
$052C  $118A               BCF    PCLATH, 3
;lcd.ppas,117 ::
$052D  $158A               BSF    PCLATH, 3
$052E  $213C               CALL
       _delay_5500us
$052F  $118A               BCF    PCLATH, 3
;lcd.ppas,118 ::
$0530  $158A               BSF    PCLATH, 3
$0531  $213C               CALL
       _delay_5500us
$0532  $118A               BCF    PCLATH, 3
;lcd.ppas,120 ::
$0533  $0856               MOVF
       FARG_Lcd_Config+1, 0
$0534  $00F0               MOVWF  STACK_0
$0535  $3001               MOVLW  1
$0536  $00F4               MOVWF  STACK_4
$0537  $0870               MOVF   STACK_0, 0
$0538  $      L_Lcd_Config_0:
$0538  $1903               BTFSC  STATUS, Z
$0539  $2D3E               GOTO
       L_Lcd_Config_1
$053A  $0DF4               RLF    STACK_4, 1
$053B  $1074               BCF    STACK_4, 0
$053C  $3FFF               ADDLW  255
$053D  $2D38               GOTO
       L_Lcd_Config_0
$053E  $      L_Lcd_Config_1:
$053E  $0874               MOVF   STACK_4, 0
$053F  $00AE               MOVWF
       lcd___mdb7
;lcd.ppas,121 ::
$0540  $0857               MOVF
       FARG_Lcd_Config+2, 0
$0541  $00F0               MOVWF  STACK_0
$0542  $3001               MOVLW  1
$0543  $00F3               MOVWF  STACK_3
$0544  $0870               MOVF   STACK_0, 0
$0545  $      L_Lcd_Config_2:
$0545  $1903               BTFSC  STATUS, Z
$0546  $2D4B               GOTO
       L_Lcd_Config_3
$0547  $0DF3               RLF    STACK_3, 1
$0548  $1073               BCF    STACK_3, 0
$0549  $3FFF               ADDLW  255
$054A  $2D45               GOTO
       L_Lcd_Config_2
$054B  $      L_Lcd_Config_3:
$054B  $0873               MOVF   STACK_3, 0
$054C  $00AF               MOVWF
       lcd___mdb6
;lcd.ppas,122 ::
$054D  $0858               MOVF
       FARG_Lcd_Config+3, 0
$054E  $00F0               MOVWF  STACK_0
$054F  $3001               MOVLW  1
$0550  $00F2               MOVWF  STACK_2
$0551  $0870               MOVF   STACK_0, 0
$0552  $      L_Lcd_Config_4:
$0552  $1903               BTFSC  STATUS, Z
$0553  $2D58               GOTO
       L_Lcd_Config_5
$0554  $0DF2               RLF    STACK_2, 1
$0555  $1072               BCF    STACK_2, 0
$0556  $3FFF               ADDLW  255
$0557  $2D52               GOTO
       L_Lcd_Config_4
$0558  $      L_Lcd_Config_5:
$0558  $0872               MOVF   STACK_2, 0
$0559  $00B0               MOVWF
       lcd___mdb5
;lcd.ppas,123 ::
$055A  $0859               MOVF
       FARG_Lcd_Config+4, 0
$055B  $00F0               MOVWF  STACK_0
$055C  $3001               MOVLW  1
$055D  $00F1               MOVWF  STACK_1
$055E  $0870               MOVF   STACK_0, 0
$055F  $      L_Lcd_Config_6:
$055F  $1903               BTFSC  STATUS, Z
$0560  $2D65               GOTO
       L_Lcd_Config_7
$0561  $0DF1               RLF    STACK_1, 1
$0562  $1071               BCF    STACK_1, 0
$0563  $3FFF               ADDLW  255
$0564  $2D5F               GOTO
       L_Lcd_Config_6
$0565  $      L_Lcd_Config_7:
$0565  $0871               MOVF   STACK_1, 0
$0566  $00B1               MOVWF
       lcd___mdb4
;lcd.ppas,124 ::
```

```
$0567  $085B               MOVF
       FARG_Lcd_Config+6, 0
$0568  $00F0               MOVWF  STACK_0
$0569  $3001               MOVLW  1
$056A  $00AC               MOVWF  lcd____mrs
$056B  $0870               MOVF   STACK_0, 0
$056C  $      L_Lcd_Config_8:
$056C  $1903               BTFSC  STATUS, Z
$056D  $2D72               GOTO
       L_Lcd_Config_9
$056E  $0DAC               RLF
       lcd____mrs, 1
$056F  $102C               BCF
       lcd____mrs, 0
$0570  $3FFF               ADDLW  255
$0571  $2D6C               GOTO
       L_Lcd_Config_8
$0572  $      L_Lcd_Config_9:
;lcd.ppas,125 ::
$0572  $085C               MOVF
       FARG_Lcd_Config+7, 0
$0573  $00F0               MOVWF  STACK_0
$0574  $3001               MOVLW  1
$0575  $00B3               MOVWF  lcd____mrw
$0576  $0870               MOVF   STACK_0, 0
$0577  $      L_Lcd_Config_10:
$0577  $1903               BTFSC  STATUS, Z
$0578  $2D7D               GOTO
       L_Lcd_Config_11
$0579  $0DB3               RLF
       lcd____mrw, 1
$057A  $1033               BCF
       lcd____mrw, 0
$057B  $3FFF               ADDLW  255
$057C  $2D77               GOTO
       L_Lcd_Config_10
$057D  $      L_Lcd_Config_11:
;lcd.ppas,126 ::
$057D  $085D               MOVF
       FARG_Lcd_Config+8, 0
$057E  $00F0               MOVWF  STACK_0
$057F  $3001               MOVLW  1
$0580  $00AB               MOVWF
       lcd____menable
$0581  $0870               MOVF   STACK_0, 0
$0582  $      L_Lcd_Config_12:
$0582  $1903               BTFSC  STATUS, Z
$0583  $2D88               GOTO
       L_Lcd_Config_13
$0584  $0DAB               RLF
       lcd____menable, 1
$0585  $102B               BCF
       lcd____menable, 0
$0586  $3FFF               ADDLW  255
$0587  $2D82               GOTO
       L_Lcd_Config_12
$0588  $      L_Lcd_Config_13:
;lcd.ppas,128 ::
$0588  $0855               MOVF
       FARG_Lcd_Config, 0
$0589  $00AD               MOVWF
       lcd_dataport_address
;lcd.ppas,129 ::
$058A  $085A               MOVF
       FARG_Lcd_Config+5, 0
$058B  $00AA               MOVWF
       lcd_ctrlport_address
;lcd.ppas,131 ::
$058C  $0855               MOVF
       FARG_Lcd_Config, 0
$058D  $0084               MOVWF  FSR
;lcd.ppas,133 ::
$058E  $0873               MOVF   STACK_3, 0
$058F  $0474               IORWF  STACK_4, 0
$0590  $00F0               MOVWF  STACK_0
$0591  $0872               MOVF   STACK_2, 0
$0592  $04F0               IORWF  STACK_0, 1
$0593  $0871               MOVF   STACK_1, 0
$0594  $04F0               IORWF  STACK_0, 1
$0595  $09F0               COMF   STACK_0, F
$0596  $0870               MOVF   STACK_0, 0
$0597  $0580               ANDWF  INDF, 1
;lcd.ppas,134 ::
$0598  $      lcd_L_56:
$0598  $1784               BSF    FSR, 7
$0599  $      lcd_L_57:
;lcd.ppas,135 ::
$0599  $082F               MOVF
       lcd____mdb6, 0
$059A  $042E               IORWF
       lcd____mdb7, 0
$059B  $00F0               MOVWF  STACK_0
$059C  $0830               MOVF
       lcd____mdb5, 0
$059D  $04F0               IORWF  STACK_0, 1
$059E  $0831               MOVF
       lcd____mdb4, 0
$059F  $04F0               IORWF  STACK_0, 1
$05A0  $09F0               COMF   STACK_0, F
$05A1  $0870               MOVF   STACK_0, 0
$05A2  $0580               ANDWF  INDF, 1
;lcd.ppas,136 ::
$05A3  $1384               BCF    FSR, 7
$05A4  $      lcd_L_59:
;lcd.ppas,139 ::
$05A4  $082A               MOVF
       lcd_ctrlport_address, 0
$05A5  $0084               MOVWF  FSR
;lcd.ppas,141 ::
$05A6  $0833               MOVF
       lcd____mrw, 0
$05A7  $042C               IORWF
       lcd____mrs, 0
$05A8  $00F0               MOVWF  STACK_0
$05A9  $082B               MOVF
       lcd____menable, 0
$05AA  $04F0               IORWF  STACK_0, 1
$05AB  $09F0               COMF   STACK_0, F
$05AC  $0870               MOVF   STACK_0, 0
$05AD  $0580               ANDWF  INDF, 1
;lcd.ppas,142 ::
$05AE  $      lcd_L_60:
$05AE  $1784               BSF    FSR, 7
$05AF  $      lcd_L_61:
;lcd.ppas,143 ::
$05AF  $0833               MOVF
       lcd____mrw, 0
$05B0  $042C               IORWF
       lcd____mrs, 0
$05B1  $00F0               MOVWF  STACK_0
$05B2  $082B               MOVF
       lcd____menable, 0
$05B3  $04F0               IORWF  STACK_0, 1
$05B4  $09F0               COMF   STACK_0, F
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```
$05B5  $0870               MOVF   STACK_0, 0
$05B6  $0580               ANDWF  INDF, 1
;lcd.ppas,144 ::
$05B7  $1384               BCF    FSR, 7
$05B8  $      lcd_L_63:
;lcd.ppas,148 ::
$05B8  $082D               MOVF
       lcd_dataport_address, 0
$05B9  $0084               MOVWF  FSR
;lcd.ppas,149 ::
$05BA  $0830               MOVF
       lcd____mdb5, 0
$05BB  $0400               IORWF  INDF, 0
$05BC  $00F0               MOVWF  STACK_0
$05BD  $0831               MOVF
       lcd____mdb4, 0
$05BE  $0470               IORWF  STACK_0, 0
$05BF  $0080               MOVWF  INDF
;lcd.ppas,151 ::
$05C0  $082A               MOVF
       lcd_ctrlport_address, 0
$05C1  $0084               MOVWF  FSR
;lcd.ppas,152 ::
$05C2  $082B               MOVF
       lcd____menable, 0
$05C3  $0480               IORWF  INDF, 1
;lcd.ppas,153 ::
$05C4  $092B               COMF
       lcd____menable, W
$05C5  $00F0               MOVWF  STACK_0
$05C6  $0870               MOVF   STACK_0, 0
$05C7  $0580               ANDWF  INDF, 1
;lcd.ppas,155 ::
$05C8  $158A               BSF    PCLATH, 3
$05C9  $213C               CALL
       _delay_5500us
$05CA  $118A               BCF    PCLATH, 3
;lcd.ppas,160 ::
$05CB  $082B               MOVF
       lcd____menable, 0
$05CC  $0480               IORWF  INDF, 1
;lcd.ppas,161 ::
$05CD  $092B               COMF
       lcd____menable, W
$05CE  $00F0               MOVWF  STACK_0
$05CF  $0870               MOVF   STACK_0, 0
$05D0  $0580               ANDWF  INDF, 1
;lcd.ppas,163 ::
$05D1  $158A               BSF    PCLATH, 3
$05D2  $213C               CALL
       _delay_5500us
$05D3  $118A               BCF    PCLATH, 3
;lcd.ppas,168 ::
$05D4  $082B               MOVF
       lcd____menable, 0
$05D5  $0480               IORWF  INDF, 1
;lcd.ppas,169 ::
$05D6  $092B               COMF
       lcd____menable, W
$05D7  $00F0               MOVWF  STACK_0
$05D8  $0870               MOVF   STACK_0, 0
$05D9  $0580               ANDWF  INDF, 1
;lcd.ppas,171 ::
$05DA  $158A               BSF    PCLATH, 3
$05DB  $213C               CALL
       _delay_5500us
$05DC  $118A               BCF    PCLATH, 3
;lcd.ppas,174 ::
$05DD  $082D               MOVF
       lcd_dataport_address, 0
$05DE  $0084               MOVWF  FSR
;lcd.ppas,175 ::
$05DF  $0830               MOVF
       lcd____mdb5, 0
$05E0  $0480               IORWF  INDF, 1
;lcd.ppas,176 ::
$05E1  $0931               COMF
       lcd____mdb4, W
$05E2  $00F0               MOVWF  STACK_0
$05E3  $0870               MOVF   STACK_0, 0
$05E4  $0580               ANDWF  INDF, 1
;lcd.ppas,178 ::
$05E5  $082A               MOVF
       lcd_ctrlport_address, 0
$05E6  $0084               MOVWF  FSR
;lcd.ppas,179 ::
$05E7  $082B               MOVF
       lcd____menable, 0
$05E8  $0480               IORWF  INDF, 1
;lcd.ppas,180 ::
$05E9  $092B               COMF
       lcd____menable, W
$05EA  $00F0               MOVWF  STACK_0
$05EB  $0870               MOVF   STACK_0, 0
$05EC  $0580               ANDWF  INDF, 1
;lcd.ppas,182 ::
$05ED  $158A               BSF    PCLATH, 3
$05EE  $213C               CALL
       _delay_5500us
$05EF  $118A               BCF    PCLATH, 3
;lcd.ppas,187 ::
$05F0  $082B               MOVF
       lcd____menable, 0
$05F1  $0480               IORWF  INDF, 1
;lcd.ppas,188 ::
$05F2  $092B               COMF
       lcd____menable, W
$05F3  $00F1               MOVWF  STACK_1
$05F4  $0871               MOVF   STACK_1, 0
$05F5  $0580               ANDWF  INDF, 1
;lcd.ppas,190 ::
$05F6  $082D               MOVF
       lcd_dataport_address, 0
$05F7  $0084               MOVWF  FSR
;lcd.ppas,191 ::
$05F8  $0930               COMF
       lcd____mdb5, W
$05F9  $00F0               MOVWF  STACK_0
$05FA  $0870               MOVF   STACK_0, 0
$05FB  $0580               ANDWF  INDF, 1
;lcd.ppas,192 ::
$05FC  $082E               MOVF
       lcd____mdb7, 0
$05FD  $0480               IORWF  INDF, 1
;lcd.ppas,194 ::
$05FE  $082A               MOVF
       lcd_ctrlport_address, 0
$05FF  $0084               MOVWF  FSR
;lcd.ppas,195 ::
$0600  $082B               MOVF
       lcd____menable, 0
$0601  $0480               IORWF  INDF, 1
;lcd.ppas,196 ::
$0602  $0871               MOVF   STACK_1, 0
```

```
$0603  $0580               ANDWF  INDF, 1
;lcd.ppas,198 ::
$0604  $158A               BSF    PCLATH, 3
$0605  $213C               CALL
       _delay_5500us
$0606  $118A               BCF    PCLATH, 3
;lcd.ppas,201 ::
$0607  $082D               MOVF
       lcd_dataport_address, 0
$0608  $0084               MOVWF  FSR
;lcd.ppas,202 ::
$0609  $092E               COMF
       lcd____mdb7, W
$060A  $00F0               MOVWF  STACK_0
$060B  $0870               MOVF   STACK_0, 0
$060C  $0580               ANDWF  INDF, 1
;lcd.ppas,203 ::
$060D  $0831               MOVF
       lcd____mdb4, 0
$060E  $0480               IORWF  INDF, 1
;lcd.ppas,204 ::
$060F  $082A               MOVF
       lcd_ctrlport_address, 0
$0610  $0084               MOVWF  FSR
;lcd.ppas,205 ::
$0611  $082B               MOVF
       lcd____menable, 0
$0612  $0480               IORWF  INDF, 1
;lcd.ppas,206 ::
$0613  $092B               COMF
       lcd____menable, W
$0614  $00F1               MOVWF  STACK_1
$0615  $0871               MOVF   STACK_1, 0
$0616  $0580               ANDWF  INDF, 1
;lcd.ppas,207 ::
$0617  $082D               MOVF
       lcd_dataport_address, 0
$0618  $0084               MOVWF  FSR
;lcd.ppas,208 ::
$0619  $0931               COMF
       lcd____mdb4, W
$061A  $00F0               MOVWF  STACK_0
$061B  $0870               MOVF   STACK_0, 0
$061C  $0580               ANDWF  INDF, 1
;lcd.ppas,209 ::
$061D  $082A               MOVF
       lcd_ctrlport_address, 0
$061E  $0084               MOVWF  FSR
;lcd.ppas,210 ::
$061F  $082B               MOVF
       lcd____menable, 0
$0620  $0480               IORWF  INDF, 1
;lcd.ppas,211 ::
$0621  $0871               MOVF   STACK_1, 0
$0622  $0580               ANDWF  INDF, 1
;lcd.ppas,213 ::
$0623  $158A               BSF    PCLATH, 3
$0624  $213C               CALL
       _delay_5500us
$0625  $118A               BCF    PCLATH, 3
;lcd.ppas,218 ::
$0626  $082B               MOVF
       lcd____menable, 0
$0627  $0480               IORWF  INDF, 1
;lcd.ppas,219 ::
$0628  $092B               COMF
       lcd____menable, W
$0629  $00F0               MOVWF  STACK_0
$062A  $0870               MOVF   STACK_0, 0
$062B  $0580               ANDWF  INDF, 1
;lcd.ppas,220 ::
$062C  $082D               MOVF
       lcd_dataport_address, 0
$062D  $0084               MOVWF  FSR
;lcd.ppas,221 ::
$062E  $0831               MOVF
       lcd____mdb4, 0
$062F  $0480               IORWF  INDF, 1
;lcd.ppas,222 ::
$0630  $082A               MOVF
       lcd_ctrlport_address, 0
$0631  $0084               MOVWF  FSR
;lcd.ppas,223 ::
$0632  $082B               MOVF
       lcd____menable, 0
$0633  $0480               IORWF  INDF, 1
;lcd.ppas,224 ::
$0634  $0870               MOVF   STACK_0, 0
$0635  $0580               ANDWF  INDF, 1
;lcd.ppas,226 ::
$0636  $158A               BSF    PCLATH, 3
$0637  $213C               CALL
       _delay_5500us
$0638  $118A               BCF    PCLATH, 3
;lcd.ppas,229 ::
$0639  $082D               MOVF
       lcd_dataport_address, 0
$063A  $0084               MOVWF  FSR
;lcd.ppas,230 ::
$063B  $0931               COMF
       lcd____mdb4, W
$063C  $00F0               MOVWF  STACK_0
$063D  $0870               MOVF   STACK_0, 0
$063E  $0580               ANDWF  INDF, 1
;lcd.ppas,231 ::
$063F  $082A               MOVF
       lcd_ctrlport_address, 0
$0640  $0084               MOVWF  FSR
;lcd.ppas,232 ::
$0641  $082B               MOVF
       lcd____menable, 0
$0642  $0480               IORWF  INDF, 1
;lcd.ppas,233 ::
$0643  $092B               COMF
       lcd____menable, W
$0644  $00F1               MOVWF  STACK_1
$0645  $0871               MOVF   STACK_1, 0
$0646  $0580               ANDWF  INDF, 1
;lcd.ppas,234 ::
$0647  $082D               MOVF
       lcd_dataport_address, 0
$0648  $0084               MOVWF  FSR
;lcd.ppas,235 ::
$0649  $0831               MOVF
       lcd____mdb4, 0
$064A  $0400               IORWF  INDF, 0
$064B  $00F0               MOVWF  STACK_0
$064C  $0830               MOVF
       lcd____mdb5, 0
$064D  $04F0               IORWF  STACK_0, 1
$064E  $082F               MOVF
       lcd____mdb6, 0
$064F  $04F0               IORWF  STACK_0, 1
```

```
$0650  $082E               MOVF
       lcd____mdb7, 0
$0651  $0470               IORWF  STACK_0, 0
$0652  $0080               MOVWF  INDF
;lcd.ppas,236 ::
$0653  $082A               MOVF
       lcd_ctrlport_address, 0
$0654  $0084               MOVWF  FSR
;lcd.ppas,237 ::
$0655  $082B               MOVF
       lcd____menable, 0
$0656  $0480               IORWF  INDF, 1
;lcd.ppas,238 ::
$0657  $0871               MOVF   STACK_1, 0
$0658  $0580               ANDWF  INDF, 1
;lcd.ppas,240 ::
$0659  $158A               BSF    PCLATH, 3
$065A  $213C               CALL
       _delay_5500us
$065B  $118A               BCF    PCLATH, 3
;lcd.ppas,242 ::
$065C  $3001               MOVLW  1
$065D  $00B2               MOVWF
       lcd_lcdcmd_status
$065E  $      lcd_L_55:
;lcd.ppas,243 ::
$065E  $0008               RETURN
$094D  $      _lcd_chr_cp:
;lcd.ppas,97 ::
;lcd.ppas,98 ::
$094D  $1303               BCF    STATUS,
RP1
$094E  $1283               BCF    STATUS,
RP0
$094F  $01B2               CLRF
       lcd_lcdcmd_status, 1
;lcd.ppas,99 ::
$0950  $0855               MOVF
       FARG_Lcd_Chr_CP, 0
$0951  $00DE               MOVWF
       FARG_Lcd_Cmd
$0952  $118A               BCF    PCLATH, 3
$0953  $265F               CALL   _lcd_cmd
$0954  $158A               BSF    PCLATH, 3
;lcd.ppas,100 ::
$0955  $3001               MOVLW  1
$0956  $00B2               MOVWF
       lcd_lcdcmd_status
$0957  $      lcd_L_48:
;lcd.ppas,101 ::
$0957  $0008               RETURN
$0960  $      _delay_22us:
;delays.pbas,17 ::         sub procedure
Delay_22us()
;delays.pbas,18 ::         Delay_us(22)
$0960  $3024               MOVLW  36
$0961  $1303               BCF    STATUS,
RP1
$0962  $1283               BCF    STATUS,
RP0
$0963  $00FA               MOVWF  STACK_10
$0964  $0BFA               DECFSZ STACK_10,
F
$0965  $2964               GOTO   $-1
$0966  $0000               NOP
$0967  $      delays_L_3:
$0967  $0008               RETURN
$08BC  $      _mul_32x32_u:
$08BC  $1303               BCF    STATUS,
RP1
$08BD  $1283               BCF    STATUS,
RP0
;math.ppas,1570 ::
;math.ppas,1578 ::
$08BE  $3022               MOVLW  34
;math.ppas,1579 ::
$08BF  $00FC               MOVWF  STACK_12
;math.ppas,1580 ::
$08C0  $01F8               CLRF   STACK_8
;math.ppas,1581 ::
$08C1  $01F9               CLRF   STACK_9
;math.ppas,1582 ::
$08C2  $01FA               CLRF   STACK_10
;math.ppas,1584 ::
$08C3  $01FB               CLRF   STACK_11
;math.ppas,1588 ::
$08C4  $      _NEXT:
;math.ppas,1589 ::
$08C4  $03FC               DECF   STACK_12,
F
;math.ppas,1590 ::
$08C5  $1903               BTFSC  STATUS, Z
;math.ppas,1591 ::
$08C6  $28F2               GOTO   _EXIT2
;math.ppas,1593 ::
$08C7  $1003               BCF    STATUS, C
;math.ppas,1602 ::
$08C8  $      _LOOP:
;math.ppas,1603 ::
$08C8  $0CFB               RRF    STACK_11,
F
;math.ppas,1604 ::
$08C9  $0CFA               RRF    STACK_10,
F
;math.ppas,1605 ::
$08CA  $0CF9               RRF    STACK_9, F
;math.ppas,1606 ::
$08CB  $0CF8               RRF    STACK_8, F
;math.ppas,1607 ::
$08CC  $0CF3               RRF    STACK_3, F
;math.ppas,1608 ::
$08CD  $0CF2               RRF    STACK_2, F
;math.ppas,1609 ::
$08CE  $0CF1               RRF    STACK_1, F
;math.ppas,1614 ::
$08CF  $0CF0               RRF    STACK_0, F
;math.ppas,1615 ::
$08D0  $1C03               BTFSS  STATUS, C
;math.ppas,1616 ::
$08D1  $28C4               GOTO   _NEXT
;math.ppas,1617 ::
$08D2  $03FC               DECF   STACK_12,
F
;math.ppas,1618 ::
$08D3  $1903               BTFSC  STATUS, Z
;math.ppas,1625 ::
$08D4  $28E4               GOTO   _EXIT1
;math.ppas,1626 ::
$08D5  $0874               MOVF   STACK_4, W
;math.ppas,1627 ::
$08D6  $07F8               ADDWF  STACK_8, F
;math.ppas,1628 ::
$08D7  $0875               MOVF   STACK_5, W
;math.ppas,1629 ::
```

```
$08D8  $1803              BTFSC  STATUS, C
;math.ppas,1630 ::
$08D9  $0F75              INCFSZ STACK_5, W
;math.ppas,1631 ::
$08DA  $07F9              ADDWF  STACK_9, F
;math.ppas,1632 ::
$08DB  $0876              MOVF   STACK_6, W
;math.ppas,1633 ::
$08DC  $1803              BTFSC  STATUS, C
;math.ppas,1634 ::
$08DD  $0F76              INCFSZ STACK_6, W
;math.ppas,1635 ::
$08DE  $07FA              ADDWF  STACK_10,
F
;math.ppas,1636 ::
$08DF  $0877              MOVF   STACK_7, W
;math.ppas,1637 ::
$08E0  $1803              BTFSC  STATUS, C
;math.ppas,1638 ::
$08E1  $0F77              INCFSZ STACK_7, W
;math.ppas,1640 ::
$08E2  $07FB              ADDWF  STACK_11,
F
;math.ppas,1642 ::
$08E3  $28C8              GOTO   _LOOP
;math.ppas,1647 ::
$08E4  $      _EXIT1:
;math.ppas,1648 ::
$08E4  $0874              MOVF   STACK_4, W
;math.ppas,1649 ::
$08E5  $07F8              ADDWF  STACK_8, F
;math.ppas,1650 ::
$08E6  $0875              MOVF   STACK_5, W
;math.ppas,1651 ::
$08E7  $1803              BTFSC  STATUS, C
;math.ppas,1652 ::
$08E8  $0F75              INCFSZ STACK_5, W
;math.ppas,1653 ::
$08E9  $07F9              ADDWF  STACK_9, F
;math.ppas,1654 ::
$08EA  $0876              MOVF   STACK_6, W
;math.ppas,1655 ::
$08EB  $1803              BTFSC  STATUS, C
;math.ppas,1656 ::
$08EC  $0F76              INCFSZ STACK_6, W
;math.ppas,1657 ::
$08ED  $07FA              ADDWF  STACK_10,
F
;math.ppas,1658 ::
$08EE  $0877              MOVF   STACK_7, W
;math.ppas,1659 ::
$08EF  $1803              BTFSC  STATUS, C
;math.ppas,1660 ::
$08F0  $0F77              INCFSZ STACK_7, W
;math.ppas,1663 ::
$08F1  $07FB              ADDWF  STACK_11,
F
;math.ppas,1664 ::
$08F2  $      _EXIT2:
;math.ppas,1665 ::
$08F2  $      math_L_13:
;math.ppas,1666 ::
$08F2  $0008              RETURN
$0925  $      _lcd_init:
;lcd.ppas,246 ::
;lcd.ppas,247 ::
$0925  $1303              BCF    STATUS,
RP1
$0926  $1283              BCF    STATUS,
RP0
$0927  $0851              MOVF
       FARG_Lcd_Init, 0
$0928  $00D5              MOVWF
       FARG_Lcd_Config
$0929  $3007              MOVLW  7
$092A  $00D6              MOVWF
       FARG_Lcd_Config+1
$092B  $3006              MOVLW  6
$092C  $00D7              MOVWF
       FARG_Lcd_Config+2
$092D  $3005              MOVLW  5
$092E  $00D8              MOVWF
       FARG_Lcd_Config+3
$092F  $3004              MOVLW  4
$0930  $00D9              MOVWF
       FARG_Lcd_Config+4
$0931  $0851              MOVF
       FARG_Lcd_Init, 0
$0932  $00DA              MOVWF
       FARG_Lcd_Config+5
$0933  $3002              MOVLW  2
$0934  $00DB              MOVWF
       FARG_Lcd_Config+6
$0935  $01DC              CLRF
       FARG_Lcd_Config+7, 1
$0936  $3003              MOVLW  3
$0937  $00DD              MOVWF
       FARG_Lcd_Config+8
$0938  $118A              BCF    PCLATH, 3
$0939  $252A              CALL
       _lcd_config
$093A  $158A              BSF    PCLATH, 3
$093B  $      lcd_L_64:
;lcd.ppas,248 ::
$093B  $0008              RETURN
$0845  $      _lcd_out:
;lcd.ppas,252 ::
;lcd.ppas,254 ::
$0845  $      lcd_L_68:
$0845  $1303              BCF    STATUS,
RP1
$0846  $1283              BCF    STATUS,
RP0
$0847  $0851              MOVF
       FARG_Lcd_Out, 0
$0848  $3A01              XORLW  1
$0849  $1D03              BTFSS  STATUS, Z
$084A  $284E              GOTO   lcd_L_69
$084B  $      lcd_L_67:
$084B  $3080              MOVLW  128
$084C  $00D1              MOVWF
       FARG_Lcd_Out
$084D  $2865              GOTO   lcd_L_66
$084E  $      lcd_L_69:
;lcd.ppas,255 ::
$084E  $      lcd_L_71:
$084E  $0851              MOVF
       FARG_Lcd_Out, 0
$084F  $3A02              XORLW  2
$0850  $1D03              BTFSS  STATUS, Z
$0851  $2855              GOTO   lcd_L_72
$0852  $      lcd_L_70:
$0852  $30C0              MOVLW  192
```

```
$0853  $00D1               MOVWF
       FARG_Lcd_Out
$0854  $2865               GOTO   lcd_L_66
$0855  $      lcd_L_72:
;lcd.ppas,256 ::
$0855  $      lcd_L_74:
$0855  $0851               MOVF
       FARG_Lcd_Out, 0
$0856  $3A03               XORLW  3
$0857  $1D03               BTFSS  STATUS, Z
$0858  $285C               GOTO   lcd_L_75
$0859  $      lcd_L_73:
$0859  $3094               MOVLW  148
$085A  $00D1               MOVWF
       FARG_Lcd_Out
$085B  $2865               GOTO   lcd_L_66
$085C  $      lcd_L_75:
;lcd.ppas,257 ::
$085C  $      lcd_L_77:
$085C  $0851               MOVF
       FARG_Lcd_Out, 0
$085D  $3A04               XORLW  4
$085E  $1D03               BTFSS  STATUS, Z
$085F  $2863               GOTO   lcd_L_78
$0860  $      lcd_L_76:
$0860  $30D4               MOVLW  212
$0861  $00D1               MOVWF
       FARG_Lcd_Out
;lcd.ppas,258 ::
$0862  $2865               GOTO   lcd_L_66
$0863  $      lcd_L_78:
$0863  $3080               MOVLW  128
$0864  $00D1               MOVWF
       FARG_Lcd_Out
$0865  $      lcd_L_66:
;lcd.ppas,260 ::
$0865  $0352               DECF
       FARG_Lcd_Out+1, 0
$0866  $00F0               MOVWF  STACK_0
$0867  $0851               MOVF
       FARG_Lcd_Out, 0
$0868  $07F0               ADDWF  STACK_0, 1
$0869  $0870               MOVF   STACK_0, 0
$086A  $00D1               MOVWF
       FARG_Lcd_Out
;lcd.ppas,261 ::
$086B  $0870               MOVF   STACK_0, 0
$086C  $00DE               MOVWF
       FARG_Lcd_Cmd
$086D  $118A               BCF    PCLATH, 3
$086E  $265F               CALL   _lcd_cmd
$086F  $158A               BSF    PCLATH, 3
;lcd.ppas,262 ::
$0870  $01B2               CLRF
       lcd_lcdcmd_status, 1
;lcd.ppas,263 ::
$0871  $01D4               CLRF
       _lcd_out_local_i, 1
;lcd.ppas,264 ::
$0872  $      lcd_L_80:
$0872  $0854               MOVF
       _lcd_out_local_i, 0
$0873  $0753               ADDWF
       FARG_Lcd_Out+2, 0
$0874  $0084               MOVWF  FSR
$0875  $0800               MOVF   INDF, 0
$0876  $00F2               MOVWF  STACK_2
$0877  $0872               MOVF   STACK_2, 0
$0878  $3A00               XORLW  0
$0879  $1903               BTFSC  STATUS, Z
$087A  $2883               GOTO   lcd_L_81
;lcd.ppas,266 ::
$087B  $0854               MOVF
       _lcd_out_local_i, 0
$087C  $0753               ADDWF
       FARG_Lcd_Out+2, 0
$087D  $0084               MOVWF  FSR
$087E  $0800               MOVF   INDF, 0
$087F  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0880  $214D               CALL
       _lcd_chr_cp
;lcd.ppas,267 ::
$0881  $0AD4               INCF
       _lcd_out_local_i, 1
;lcd.ppas,268 ::
$0882  $2872               GOTO   lcd_L_80
$0883  $      lcd_L_81:
;lcd.ppas,269 ::
$0883  $3001               MOVLW  1
$0884  $00B2               MOVWF
       lcd_lcdcmd_status
$0885  $      lcd_L_65:
;lcd.ppas,270 ::
$0885  $0008               RETURN
$0910  $      _lcd_out_cp:
;lcd.ppas,105 ::
;lcd.ppas,106 ::
$0910  $1303               BCF    STATUS,
RP1
$0911  $1283               BCF    STATUS,
RP0
$0912  $01D2               CLRF
       _lcd_out_cp_local_i, 1
;lcd.ppas,107 ::
$0913  $      lcd_L_51:
$0913  $0852               MOVF
       _lcd_out_cp_local_i, 0
$0914  $0751               ADDWF
       FARG_Lcd_Out_CP, 0
$0915  $0084               MOVWF  FSR
$0916  $0800               MOVF   INDF, 0
$0917  $00F1               MOVWF  STACK_1
$0918  $0871               MOVF   STACK_1, 0
$0919  $3A00               XORLW  0
$091A  $1903               BTFSC  STATUS, Z
$091B  $2924               GOTO   lcd_L_52
;lcd.ppas,109 ::
$091C  $0852               MOVF
       _lcd_out_cp_local_i, 0
$091D  $0751               ADDWF
       FARG_Lcd_Out_CP, 0
$091E  $0084               MOVWF  FSR
$091F  $0800               MOVF   INDF, 0
$0920  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0921  $214D               CALL
       _lcd_chr_cp
;lcd.ppas,110 ::
$0922  $0AD2               INCF
       _lcd_out_cp_local_i, 1
;lcd.ppas,111 ::
$0923  $2913               GOTO   lcd_L_51
$0924  $      lcd_L_52:
```

```
$0924  $      lcd_L_49:
;lcd.ppas,112 ::
$0924  $0008                RETURN
$0800  $      _adc_read:
;ADClib_A_C.ppas,12 ::
;ADClib_A_C.ppas,13 ::
$0800  $1303                BCF    STATUS,
RP1
$0801  $1283                BCF    STATUS,
RP0
$0802  $019F                CLRF   ADCON0, 1
;ADClib_A_C.ppas,14 ::
$0803  $30C0                MOVLW  192
$0804  $049F                IORWF  ADCON0, 1
;ADClib_A_C.ppas,15 ::
$0805  $3040                MOVLW  64
$0806  $1683                BSF    STATUS,
RP0
$0807  $041F                IORWF  ADCON1, 0
$0808  $1283                BCF    STATUS,
RP0
$0809  $00F0                MOVWF  STACK_0
$080A  $0870                MOVF   STACK_0, 0
$080B  $1683                BSF    STATUS,
RP0
$080C  $009F                MOVWF  ADCON1
;ADClib_A_C.ppas,17 ::
$080D  $3080                MOVLW  128
$080E  $1283                BCF    STATUS,
RP0
$080F  $0470                IORWF  STACK_0, 0
$0810  $1683                BSF    STATUS,
RP0
$0811  $009F                MOVWF  ADCON1
;ADClib_A_C.ppas,18 ::
$0812  $1283                BCF    STATUS,
RP0
$0813  $0851                MOVF
       FARG_ADC_read, 0
$0814  $00F0                MOVWF  STACK_0
$0815  $0DF0                RLF    STACK_0, 1
$0816  $1070                BCF    STACK_0, 0
$0817  $0DF0                RLF    STACK_0, 1
$0818  $1070                BCF    STACK_0, 0
$0819  $0DF0                RLF    STACK_0, 1
$081A  $1070                BCF    STACK_0, 0
$081B  $0870                MOVF   STACK_0, 0
$081C  $049F                IORWF  ADCON0, 1
;ADClib_A_C.ppas,19 ::
$081D  $141F                BSF    ADCON0, 0
;ADClib_A_C.ppas,20 ::
$081E  $2160                CALL
       _delay_22us
;ADClib_A_C.ppas,21 ::
$081F  $151F                BSF    ADCON0, 2
;ADClib_A_C.ppas,22 ::
$0820  $      ADClib_A_C_L_2:
$0820  $081F                MOVF   ADCON0, 0
$0821  $00F2                MOVWF  STACK_2
$0822  $3000                MOVLW  0
$0823  $1972                BTFSC  STACK_2, 2
$0824  $3001                MOVLW  1
$0825  $00F2                MOVWF  STACK_2
$0826  $0872                MOVF   STACK_2, 0
$0827  $3A01                XORLW  1
$0828  $1D03                BTFSS  STATUS, Z
$0829  $282C                GOTO
       ADClib_A_C_L_3
;ADClib_A_C.ppas,23 ::
$082A  $0000                NOP
$082B  $2820                GOTO
       ADClib_A_C_L_2
$082C  $      ADClib_A_C_L_3:
;ADClib_A_C.ppas,24 ::
$082C  $081E                MOVF   ADRESH, 0
$082D  $00F2                MOVWF  STACK_2
$082E  $01F3                CLRF   STACK_2+1
$082F  $0872                MOVF   STACK_2, 0
$0830  $00F3                MOVWF  STACK_2+1
$0831  $01F2                CLRF   STACK_2
$0832  $0872                MOVF   STACK_2, 0
$0833  $00D2                MOVWF
       _adc_read_local_result
$0834  $0873                MOVF   STACK_2+1,
0
$0835  $00D3                MOVWF
       _adc_read_local_result+1
;ADClib_A_C.ppas,25 ::
$0836  $1683                BSF    STATUS,
RP0
$0837  $081E                MOVF   ADRESL, 0
$0838  $1283                BCF    STATUS,
RP0
$0839  $0472                IORWF  STACK_2, 0
$083A  $00D2                MOVWF
       _adc_read_local_result
$083B  $0873                MOVF   STACK_2+1,
0
$083C  $00D3                MOVWF
       _adc_read_local_result+1
$083D  $3000                MOVLW  0
$083E  $04D3                IORWF
       _adc_read_local_result+1, 1
;ADClib_A_C.ppas,26 ::
$083F  $101F                BCF    ADCON0, 0
$0840  $      ADClib_A_C_L_0:
;ADClib_A_C.ppas,27 ::
$0840  $0852                MOVF
       _adc_read_local_result, 0
$0841  $00F0                MOVWF  STACK_0
$0842  $0853                MOVF
       _adc_read_local_result+1, 0
$0843  $00F1                MOVWF  STACK_0+1
$0844  $0008                RETURN
$0886  $      _lcd_chr:
;lcd.ppas,78 ::
;lcd.ppas,80 ::
$0886  $      lcd_L_37:
$0886  $1303                BCF    STATUS,
RP1
$0887  $1283                BCF    STATUS,
RP0
$0888  $0851                MOVF
       FARG_Lcd_Chr, 0
$0889  $3A01                XORLW  1
$088A  $1D03                BTFSS  STATUS, Z
$088B  $288F                GOTO   lcd_L_38
$088C  $      lcd_L_36:
$088C  $3080                MOVLW  128
$088D  $00D1                MOVWF
       FARG_Lcd_Chr
$088E  $28A6                GOTO   lcd_L_35
$088F  $      lcd_L_38:
```

```
;lcd.ppas,81 ::
$088F  $      lcd_L_40:
$088F  $0851               MOVF
       FARG_Lcd_Chr, 0
$0890  $3A02               XORLW  2
$0891  $1D03               BTFSS  STATUS, Z
$0892  $2896               GOTO   lcd_L_41
$0893  $      lcd_L_39:
$0893  $30C0               MOVLW  192
$0894  $00D1               MOVWF
       FARG_Lcd_Chr
$0895  $28A6               GOTO   lcd_L_35
$0896  $      lcd_L_41:
;lcd.ppas,82 ::
$0896  $      lcd_L_43:
$0896  $0851               MOVF
       FARG_Lcd_Chr, 0
$0897  $3A03               XORLW  3
$0898  $1D03               BTFSS  STATUS, Z
$0899  $289D               GOTO   lcd_L_44
$089A  $      lcd_L_42:
$089A  $3094               MOVLW  148
$089B  $00D1               MOVWF
       FARG_Lcd_Chr
$089C  $28A6               GOTO   lcd_L_35
$089D  $      lcd_L_44:
;lcd.ppas,83 ::
$089D  $      lcd_L_46:
$089D  $0851               MOVF
       FARG_Lcd_Chr, 0
$089E  $3A04               XORLW  4
$089F  $1D03               BTFSS  STATUS, Z
$08A0  $28A4               GOTO   lcd_L_47
$08A1  $      lcd_L_45:
$08A1  $30D4               MOVLW  212
$08A2  $00D1               MOVWF
       FARG_Lcd_Chr
;lcd.ppas,84 ::
$08A3  $28A6               GOTO   lcd_L_35
$08A4  $      lcd_L_47:
$08A4  $3080               MOVLW  128
$08A5  $00D1               MOVWF
       FARG_Lcd_Chr
$08A6  $      lcd_L_35:
;lcd.ppas,86 ::
$08A6  $0852               MOVF
       FARG_Lcd_Chr+1, 0
$08A7  $0751               ADDWF
       FARG_Lcd_Chr, 0
$08A8  $00F0               MOVWF  STACK_0
$08A9  $03F0               DECF   STACK_0, 1
$08AA  $0870               MOVF   STACK_0, 0
$08AB  $00D1               MOVWF
       FARG_Lcd_Chr
;lcd.ppas,88 ::
$08AC  $3001               MOVLW  1
$08AD  $00B2               MOVWF
       lcd_lcdcmd_status
;lcd.ppas,89 ::
$08AE  $0870               MOVF   STACK_0, 0
$08AF  $00DE               MOVWF
       FARG_Lcd_Cmd
$08B0  $118A               BCF    PCLATH, 3
$08B1  $265F               CALL   _lcd_cmd
$08B2  $158A               BSF    PCLATH, 3
;lcd.ppas,91 ::
$08B3  $01B2               CLRF
       lcd_lcdcmd_status, 1
;lcd.ppas,92 ::
$08B4  $0853               MOVF
       FARG_Lcd_Chr+2, 0
$08B5  $00DE               MOVWF
       FARG_Lcd_Cmd
$08B6  $118A               BCF    PCLATH, 3
$08B7  $265F               CALL   _lcd_cmd
$08B8  $158A               BSF    PCLATH, 3
;lcd.ppas,93 ::
$08B9  $3001               MOVLW  1
$08BA  $00B2               MOVWF
       lcd_lcdcmd_status
$08BB  $      lcd_L_34:
;lcd.ppas,94 ::
$08BB  $0008               RETURN
$08F3  $      _div_16x16_u:
$08F3  $1303               BCF    STATUS,
RP1
$08F4  $1283               BCF    STATUS,
RP0
;math.ppas,108 ::
;math.ppas,110 ::
$08F5  $01F8               CLRF   STACK_8
;math.ppas,111 ::
$08F6  $01F9               CLRF   STACK_9
;math.ppas,112 ::
$08F7  $3010               MOVLW  16
;math.ppas,113 ::
$08F8  $00FC               MOVWF  STACK_12
;math.ppas,114 ::
$08F9  $0D71               RLF    STACK_1, W
;math.ppas,115 ::
$08FA  $0DF8               RLF    STACK_8, F
;math.ppas,116 ::
$08FB  $0DF9               RLF    STACK_9, F
;math.ppas,117 ::
$08FC  $0874               MOVF   STACK_4, W
;math.ppas,118 ::
$08FD  $02F8               SUBWF  STACK_8, F
;math.ppas,119 ::
$08FE  $0875               MOVF   STACK_5, W
;math.ppas,120 ::
$08FF  $1C03               BTFSS  STATUS, C
;math.ppas,121 ::
$0900  $0F75               INCFSZ STACK_5, W
;math.ppas,122 ::
$0901  $02F9               SUBWF  STACK_9, F
;math.ppas,123 ::
$0902  $1803               BTFSC  STATUS, C
;math.ppas,124 ::
$0903  $290B               GOTO   $+8
;math.ppas,125 ::
$0904  $0874               MOVF   STACK_4, W
;math.ppas,126 ::
$0905  $07F8               ADDWF  STACK_8, F
;math.ppas,127 ::
$0906  $0875               MOVF   STACK_5, W
;math.ppas,128 ::
$0907  $1803               BTFSC  STATUS, C
;math.ppas,129 ::
$0908  $0F75               INCFSZ STACK_5, W
;math.ppas,130 ::
$0909  $07F9               ADDWF  STACK_9, F
;math.ppas,131 ::
$090A  $1003               BCF    STATUS, C
```

```
;math.ppas,132 ::
$090B  $0DF0               RLF    STACK_0, F
;math.ppas,133 ::
$090C  $0DF1               RLF    STACK_1, F
;math.ppas,134 ::
$090D  $0BFC               DECFSZ STACK_12,
F
;math.ppas,135 ::
$090E  $28F9               GOTO   $-21
;math.ppas,136 ::
$090F  $      math_L_3:
;math.ppas,137 ::
$090F  $0008               RETURN
$070E  $      _mul_32x32_s:
$070E  $1303               BCF    STATUS,
RP1
$070F  $1283               BCF    STATUS,
RP0
;math.ppas,1675 ::
;math.ppas,1680 ::
$0710  $01FD               CLRF   STACK_13
;math.ppas,1683 ::
$0711  $      _IF_FIRST:
;math.ppas,1684 ::
$0711  $1FF3               BTFSS  STACK_3, 7
;math.ppas,1686 ::
$0712  $2F20               GOTO   _IF_SECOND
;math.ppas,1691 ::
$0713  $      _INVERCE_FIRST:
;math.ppas,1692 ::
$0713  $09F0               COMF   STACK_0, F
;math.ppas,1693 ::
$0714  $09F1               COMF   STACK_1, F
;math.ppas,1694 ::
$0715  $09F2               COMF   STACK_2, F
;math.ppas,1701 ::
$0716  $09F3               COMF   STACK_3, F
;math.ppas,1702 ::
$0717  $0AF0               INCF   STACK_0, F
;math.ppas,1703 ::
$0718  $1903               BTFSC  STATUS, Z
;math.ppas,1704 ::
$0719  $0AF1               INCF   STACK_1, F
;math.ppas,1705 ::
$071A  $1903               BTFSC  STATUS, Z
;math.ppas,1706 ::
$071B  $0AF2               INCF   STACK_2, F
;math.ppas,1707 ::
$071C  $1903               BTFSC  STATUS, Z
;math.ppas,1708 ::
$071D  $0AF3               INCF   STACK_3, F
;math.ppas,1709 ::
$071E  $3081               MOVLW  129
;math.ppas,1711 ::
$071F  $07FD               ADDWF  STACK_13,
F
;math.ppas,1714 ::
$0720  $      _IF_SECOND:
;math.ppas,1715 ::
$0720  $1FF7               BTFSS  STACK_7, 7
;math.ppas,1717 ::
$0721  $2F2E               GOTO   _MULT
;math.ppas,1722 ::
$0722  $      _INBERSE_SECOND:
;math.ppas,1723 ::
$0722  $09F4               COMF   STACK_4, F
;math.ppas,1724 ::
$0723  $09F5               COMF   STACK_5, F
;math.ppas,1725 ::
$0724  $09F6               COMF   STACK_6, F
;math.ppas,1732 ::
$0725  $09F7               COMF   STACK_7, F
;math.ppas,1733 ::
$0726  $0AF4               INCF   STACK_4, F
;math.ppas,1734 ::
$0727  $1903               BTFSC  STATUS, Z
;math.ppas,1735 ::
$0728  $0AF5               INCF   STACK_5, F
;math.ppas,1736 ::
$0729  $1903               BTFSC  STATUS, Z
;math.ppas,1737 ::
$072A  $0AF6               INCF   STACK_6, F
;math.ppas,1738 ::
$072B  $1903               BTFSC  STATUS, Z
;math.ppas,1739 ::
$072C  $0AF7               INCF   STACK_7, F
;math.ppas,1741 ::
$072D  $0AFD               INCF   STACK_13,
F
;math.ppas,1742 ::
$072E  $      _MULT:
;math.ppas,1744 ::
$072E  $158A               BSF    PCLATH, 3
$072F  $20BC               CALL
       _mul_32x32_u
$0730  $118A               BCF    PCLATH, 3
;math.ppas,1748 ::
$0731  $1C7D               BTFSS  STACK_13,
0
;math.ppas,1754 ::
$0732  $2F4A               GOTO   _EXIT
;math.ppas,1755 ::
$0733  $09F0               COMF   STACK_0, F
;math.ppas,1756 ::
$0734  $09F1               COMF   STACK_1, F
;math.ppas,1757 ::
$0735  $09F2               COMF   STACK_2, F
;math.ppas,1763 ::
$0736  $09F3               COMF   STACK_3, F
;math.ppas,1764 ::
$0737  $09F8               COMF   STACK_8, F
;math.ppas,1765 ::
$0738  $09F9               COMF   STACK_9, F
;math.ppas,1766 ::
$0739  $09FA               COMF   STACK_10,
F
;math.ppas,1776 ::
$073A  $09FB               COMF   STACK_11,
F
;math.ppas,1777 ::
$073B  $0AF0               INCF   STACK_0, F
;math.ppas,1778 ::
$073C  $1903               BTFSC  STATUS, Z
;math.ppas,1779 ::
$073D  $0AF1               INCF   STACK_1, F
;math.ppas,1780 ::
$073E  $1903               BTFSC  STATUS, Z
;math.ppas,1781 ::
$073F  $0AF2               INCF   STACK_2, F
;math.ppas,1782 ::
$0740  $1903               BTFSC  STATUS, Z
;math.ppas,1783 ::
$0741  $0AF3               INCF   STACK_3, F
;math.ppas,1784 ::
```

```
$0742  $1903               BTFSC  STATUS, Z
;math.ppas,1785 ::
$0743  $0AF8               INCF   STACK_8, F
;math.ppas,1786 ::
$0744  $1903               BTFSC  STATUS, Z
;math.ppas,1787 ::
$0745  $0AF9               INCF   STACK_9, F
;math.ppas,1788 ::
$0746  $1903               BTFSC  STATUS, Z
;math.ppas,1789 ::
$0747  $0AFA               INCF   STACK_10,
F
;math.ppas,1790 ::
$0748  $1903               BTFSC  STATUS, Z
;math.ppas,1791 ::
$0749  $0AFB               INCF   STACK_11,
F
;math.ppas,1792 ::
$074A  $      _EXIT:
;math.ppas,1793 ::
$074A  $      math_L_14:
;math.ppas,1794 ::
$074A  $0008               RETURN
$005E  $      _main:
;UCHE_INCUBATOR_1.pbas,59 ::
      main:
$005E  $      _main_main:
;UCHE_INCUBATOR_1.pbas,61 ::
      OPTION_REG = $84
$005E  $3084               MOVLW  132
$005F  $1303               BCF    STATUS,
RP1
$0060  $1683               BSF    STATUS,
RP0
$0061  $0081               MOVWF  OPTION_REG
;UCHE_INCUBATOR_1.pbas,63 ::           pp
= 0
$0062  $1283               BCF    STATUS,
RP0
$0063  $01A4               CLRF   _pp, 1
;UCHE_INCUBATOR_1.pbas,64 ::
      TRISA = $FF
$0064  $30FF               MOVLW  255
$0065  $1683               BSF    STATUS,
RP0
$0066  $0085               MOVWF  TRISA
;UCHE_INCUBATOR_1.pbas,65 ::
      TRISB = 0
$0067  $0186               CLRF   TRISB, 1
;UCHE_INCUBATOR_1.pbas,66 ::
      TRISC = %11000000
$0068  $30C0               MOVLW  192
$0069  $0087               MOVWF  TRISC
;UCHE_INCUBATOR_1.pbas,67 ::
      PORTB = 0
$006A  $1283               BCF    STATUS,
RP0
$006B  $0186               CLRF   PORTB, 1
;UCHE_INCUBATOR_1.pbas,68 ::
      PORTC = 0
$006C  $0187               CLRF   PORTC, 1
;UCHE_INCUBATOR_1.pbas,69 ::
      ADCON1 = $80
$006D  $3080               MOVLW  128
$006E  $1683               BSF    STATUS,
RP0
$006F  $009F               MOVWF  ADCON1
;UCHE_INCUBATOR_1.pbas,70 ::
      counter = 0
$0070  $1283               BCF    STATUS,
RP0
$0071  $01A0               CLRF   _counter
$0072  $01A1               CLRF   _counter+1
;UCHE_INCUBATOR_1.pbas,71 ::           sec
= 0
$0073  $01A2               CLRF   _sec
$0074  $01A3               CLRF   _sec+1
;UCHE_INCUBATOR_1.pbas,72 ::           min
= 0
$0075  $01A5               CLRF   _min
$0076  $01A6               CLRF   _min+1
;UCHE_INCUBATOR_1.pbas,73 ::           upp
= 0
$0077  $01B4               CLRF   _upp, 1
;UCHE_INCUBATOR_1.pbas,74 ::
      downn = 0
$0078  $01B5               CLRF   _downn, 1
;UCHE_INCUBATOR_1.pbas,75 ::           hr
= 0
$0079  $01A7               CLRF   _hr
$007A  $01A8               CLRF   _hr+1
;UCHE_INCUBATOR_1.pbas,76 ::
      direction = 0
$007B  $01B6               CLRF
      _direction, 1
;UCHE_INCUBATOR_1.pbas,77 ::
      confirm = 0
$007C  $01A9               CLRF   _confirm,
1
;UCHE_INCUBATOR_1.pbas,78 ::           k =
0
$007D  $01B7               CLRF   _k
$007E  $01B8               CLRF   _k+1
;UCHE_INCUBATOR_1.pbas,79 ::
      Lcd_init(portB)
$007F  $3006               MOVLW  PORTB
$0080  $00D1               MOVWF
      FARG_Lcd_Init
$0081  $158A               BSF    PCLATH, 3
$0082  $2125               CALL   _lcd_init
$0083  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,80 ::
      lcd_cmd(lcd_cursor_off)
$0084  $300C               MOVLW  12
$0085  $00DE               MOVWF
      FARG_Lcd_Cmd
$0086  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,81 ::
      Lcd_cmd(lcd_clear)
$0087  $3001               MOVLW  1
$0088  $00DE               MOVWF
      FARG_Lcd_Cmd
$0089  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,82 ::
      Lcd_out(1,4,"WELCOME")
$008A  $3001               MOVLW  1
$008B  $00D1               MOVWF
      FARG_Lcd_Out
$008C  $3004               MOVLW  4
$008D  $00D2               MOVWF
      FARG_Lcd_Out+1
$008E  $3057               MOVLW  87
$008F  $00C3               MOVWF
      ?main_Local_Text+0
```

```
$0090  $3045               MOVLW  69
$0091  $00C4               MOVWF
       ?main_Local_Text+1
$0092  $304C               MOVLW  76
$0093  $00C5               MOVWF
       ?main_Local_Text+2
$0094  $3043               MOVLW  67
$0095  $00C6               MOVWF
       ?main_Local_Text+3
$0096  $304F               MOVLW  79
$0097  $00C7               MOVWF
       ?main_Local_Text+4
$0098  $304D               MOVLW  77
$0099  $00C8               MOVWF
       ?main_Local_Text+5
$009A  $3045               MOVLW  69
$009B  $00C9               MOVWF
       ?main_Local_Text+6
$009C  $01CA               CLRF
       ?main_Local_Text+7
$009D  $3043               MOVLW
       ?main_Local_Text
$009E  $00D3               MOVWF
       FARG_Lcd_Out+2
$009F  $158A               BSF    PCLATH, 3
$00A0  $2045               CALL   _lcd_out
$00A1  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,83 ::
       Delay_ms(2500)
$00A2  $3040               MOVLW  64
$00A3  $00FC               MOVWF  STACK_12
$00A4  $30FF               MOVLW  255
$00A5  $00FB               MOVWF  STACK_11
$00A6  $30FF               MOVLW  255
$00A7  $00FA               MOVWF  STACK_10
$00A8  $0BFC               DECFSZ STACK_12,
F
$00A9  $28AB               GOTO   $+2
$00AA  $28B2               GOTO   $+8
$00AB  $0BFB               DECFSZ STACK_11,
F
$00AC  $28AE               GOTO   $+2
$00AD  $28B1               GOTO   $+4
$00AE  $0BFA               DECFSZ STACK_10,
F
$00AF  $28AE               GOTO   $-1
$00B0  $28AB               GOTO   $-5
$00B1  $28A8               GOTO   $-9
$00B2  $30BD               MOVLW  189
$00B3  $00FB               MOVWF  STACK_11
$00B4  $30FF               MOVLW  255
$00B5  $00FA               MOVWF  STACK_10
$00B6  $0BFB               DECFSZ STACK_11,
F
$00B7  $28B9               GOTO   $+2
$00B8  $28BC               GOTO   $+4
$00B9  $0BFA               DECFSZ STACK_10,
F
$00BA  $28B9               GOTO   $-1
$00BB  $28B6               GOTO   $-5
$00BC  $30E2               MOVLW  226
$00BD  $00FA               MOVWF  STACK_10
$00BE  $0BFA               DECFSZ STACK_10,
F
$00BF  $28BE               GOTO   $-1
;UCHE_INCUBATOR_1.pbas,84 ::
       lcd_out(1,1,"MECH.ENG ABU")
$00C0  $3001               MOVLW  1
$00C1  $00D1               MOVWF
       FARG_Lcd_Out
$00C2  $3001               MOVLW  1
$00C3  $00D2               MOVWF
       FARG_Lcd_Out+1
$00C4  $304D               MOVLW  77
$00C5  $00C3               MOVWF
       ?main_Local_Text+0
$00C6  $3045               MOVLW  69
$00C7  $00C4               MOVWF
       ?main_Local_Text+1
$00C8  $3043               MOVLW  67
$00C9  $00C5               MOVWF
       ?main_Local_Text+2
$00CA  $3048               MOVLW  72
$00CB  $00C6               MOVWF
       ?main_Local_Text+3
$00CC  $302E               MOVLW  46
$00CD  $00C7               MOVWF
       ?main_Local_Text+4
$00CE  $3045               MOVLW  69
$00CF  $00C8               MOVWF
       ?main_Local_Text+5
$00D0  $304E               MOVLW  78
$00D1  $00C9               MOVWF
       ?main_Local_Text+6
$00D2  $3047               MOVLW  71
$00D3  $00CA               MOVWF
       ?main_Local_Text+7
$00D4  $3020               MOVLW  32
$00D5  $00CB               MOVWF
       ?main_Local_Text+8
$00D6  $3041               MOVLW  65
$00D7  $00CC               MOVWF
       ?main_Local_Text+9
$00D8  $3042               MOVLW  66
$00D9  $00CD               MOVWF
       ?main_Local_Text+10
$00DA  $3055               MOVLW  85
$00DB  $00CE               MOVWF
       ?main_Local_Text+11
$00DC  $01CF               CLRF
       ?main_Local_Text+12
$00DD  $3043               MOVLW
       ?main_Local_Text
$00DE  $00D3               MOVWF
       FARG_Lcd_Out+2
$00DF  $158A               BSF    PCLATH, 3
$00E0  $2045               CALL   _lcd_out
$00E1  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,85 ::
       lcd_out(2,1,"ZARIA")
$00E2  $3002               MOVLW  2
$00E3  $00D1               MOVWF
       FARG_Lcd_Out
$00E4  $3001               MOVLW  1
$00E5  $00D2               MOVWF
       FARG_Lcd_Out+1
$00E6  $305A               MOVLW  90
$00E7  $00C3               MOVWF
       ?main_Local_Text+0
$00E8  $3041               MOVLW  65
$00E9  $00C4               MOVWF
       ?main_Local_Text+1
$00EA  $3052               MOVLW  82
```

```
$00EB  $00C5               MOVWF
       ?main_Local_Text+2
$00EC  $3049               MOVLW  73
$00ED  $00C6               MOVWF
       ?main_Local_Text+3
$00EE  $3041               MOVLW  65
$00EF  $00C7               MOVWF
       ?main_Local_Text+4
$00F0  $01C8               CLRF
       ?main_Local_Text+5
$00F1  $3043               MOVLW
       ?main_Local_Text
$00F2  $00D3               MOVWF
       FARG_Lcd_Out+2
$00F3  $158A               BSF    PCLATH, 3
$00F4  $2045               CALL   _lcd_out
$00F5  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,86 ::
       delay_ms(2500)
$00F6  $3040               MOVLW  64
$00F7  $00FC               MOVWF  STACK_12
$00F8  $30FF               MOVLW  255
$00F9  $00FB               MOVWF  STACK_11
$00FA  $30FF               MOVLW  255
$00FB  $00FA               MOVWF  STACK_10
$00FC  $0BFC               DECFSZ STACK_12,
F
$00FD  $28FF               GOTO   $+2
$00FE  $2906               GOTO   $+8
$00FF  $0BFB               DECFSZ STACK_11,
F
$0100  $2902               GOTO   $+2
$0101  $2905               GOTO   $+4
$0102  $0BFA               DECFSZ STACK_10,
F
$0103  $2902               GOTO   $-1
$0104  $28FF               GOTO   $-5
$0105  $28FC               GOTO   $-9
$0106  $30BD               MOVLW  189
$0107  $00FB               MOVWF  STACK_11
$0108  $30FF               MOVLW  255
$0109  $00FA               MOVWF  STACK_10
$010A  $0BFB               DECFSZ STACK_11,
F
$010B  $290D               GOTO   $+2
$010C  $2910               GOTO   $+4
$010D  $0BFA               DECFSZ STACK_10,
F
$010E  $290D               GOTO   $-1
$010F  $290A               GOTO   $-5
$0110  $30E2               MOVLW  226
$0111  $00FA               MOVWF  STACK_10
$0112  $0BFA               DECFSZ STACK_10,
F
$0113  $2912               GOTO   $-1
;UCHE_INCUBATOR_1.pbas,87 ::
       lcd_cmd(lcd_clear)
$0114  $3001               MOVLW  1
$0115  $00DE               MOVWF
       FARG_Lcd_Cmd
$0116  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,88 ::
       lcd_out(1,1,"M.Sc/ENG/4815" )
$0117  $3001               MOVLW  1
$0118  $00D1               MOVWF
       FARG_Lcd_Out
$0119  $3001               MOVLW  1
$011A  $00D2               MOVWF
       FARG_Lcd_Out+1
$011B  $304D               MOVLW  77
$011C  $00C3               MOVWF
       ?main_Local_Text+0
$011D  $302E               MOVLW  46
$011E  $00C4               MOVWF
       ?main_Local_Text+1
$011F  $3053               MOVLW  83
$0120  $00C5               MOVWF
       ?main_Local_Text+2
$0121  $3063               MOVLW  99
$0122  $00C6               MOVWF
       ?main_Local_Text+3
$0123  $302F               MOVLW  47
$0124  $00C7               MOVWF
       ?main_Local_Text+4
$0125  $3045               MOVLW  69
$0126  $00C8               MOVWF
       ?main_Local_Text+5
$0127  $304E               MOVLW  78
$0128  $00C9               MOVWF
       ?main_Local_Text+6
$0129  $3047               MOVLW  71
$012A  $00CA               MOVWF
       ?main_Local_Text+7
$012B  $302F               MOVLW  47
$012C  $00CB               MOVWF
       ?main_Local_Text+8
$012D  $3034               MOVLW  52
$012E  $00CC               MOVWF
       ?main_Local_Text+9
$012F  $3038               MOVLW  56
$0130  $00CD               MOVWF
       ?main_Local_Text+10
$0131  $3031               MOVLW  49
$0132  $00CE               MOVWF
       ?main_Local_Text+11
$0133  $3035               MOVLW  53
$0134  $00CF               MOVWF
       ?main_Local_Text+12
$0135  $01D0               CLRF
       ?main_Local_Text+13
$0136  $3043               MOVLW
       ?main_Local_Text
$0137  $00D3               MOVWF
       FARG_Lcd_Out+2
$0138  $158A               BSF    PCLATH, 3
$0139  $2045               CALL   _lcd_out
$013A  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,89 ::
       lcd_out(2,1,"2011-2012")
$013B  $3002               MOVLW  2
$013C  $00D1               MOVWF
       FARG_Lcd_Out
$013D  $3001               MOVLW  1
$013E  $00D2               MOVWF
       FARG_Lcd_Out+1
$013F  $3032               MOVLW  50
$0140  $00C3               MOVWF
       ?main_Local_Text+0
$0141  $3030               MOVLW  48
$0142  $00C4               MOVWF
       ?main_Local_Text+1
$0143  $3031               MOVLW  49
$0144  $00C5               MOVWF
       ?main_Local_Text+2
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```
$0145  $3031               MOVLW  49
$0146  $00C6               MOVWF
       ?main_Local_Text+3
$0147  $302D               MOVLW  45
$0148  $00C7               MOVWF
       ?main_Local_Text+4
$0149  $3032               MOVLW  50
$014A  $00C8               MOVWF
       ?main_Local_Text+5
$014B  $3030               MOVLW  48
$014C  $00C9               MOVWF
       ?main_Local_Text+6
$014D  $3031               MOVLW  49
$014E  $00CA               MOVWF
       ?main_Local_Text+7
$014F  $3032               MOVLW  50
$0150  $00CB               MOVWF
       ?main_Local_Text+8
$0151  $01CC               CLRF
       ?main_Local_Text+9
$0152  $3043               MOVLW
       ?main_Local_Text
$0153  $00D3               MOVWF
       FARG_Lcd_Out+2
$0154  $158A               BSF    PCLATH, 3
$0155  $2045               CALL   _lcd_out
$0156  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,90 ::
       delay_ms(2500)
$0157  $3040               MOVLW  64
$0158  $00FC               MOVWF  STACK_12
$0159  $30FF               MOVLW  255
$015A  $00FB               MOVWF  STACK_11
$015B  $30FF               MOVLW  255
$015C  $00FA               MOVWF  STACK_10
$015D  $0BFC               DECFSZ STACK_12,
F
$015E  $2960               GOTO   $+2
$015F  $2967               GOTO   $+8
$0160  $0BFB               DECFSZ STACK_11,
F
$0161  $2963               GOTO   $+2
$0162  $2966               GOTO   $+4
$0163  $0BFA               DECFSZ STACK_10,
F
$0164  $2963               GOTO   $-1
$0165  $2960               GOTO   $-5
$0166  $295D               GOTO   $-9
$0167  $30BD               MOVLW  189
$0168  $00FB               MOVWF  STACK_11
$0169  $30FF               MOVLW  255
$016A  $00FA               MOVWF  STACK_10
$016B  $0BFB               DECFSZ STACK_11,
F
$016C  $296E               GOTO   $+2
$016D  $2971               GOTO   $+4
$016E  $0BFA               DECFSZ STACK_10,
F
$016F  $296E               GOTO   $-1
$0170  $296B               GOTO   $-5
$0171  $30E2               MOVLW  226
$0172  $00FA               MOVWF  STACK_10
$0173  $0BFA               DECFSZ STACK_10,
F
$0174  $2973               GOTO   $-1
;UCHE_INCUBATOR_1.pbas,91 ::
       lcd_cmd(lcd_clear)
$0175  $3001               MOVLW  1
$0176  $00DE               MOVWF
       FARG_Lcd_Cmd
$0177  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,92 ::
       lcd_out(1,1,"PROJECT " )
$0178  $3001               MOVLW  1
$0179  $00D1               MOVWF
       FARG_Lcd_Out
$017A  $3001               MOVLW  1
$017B  $00D2               MOVWF
       FARG_Lcd_Out+1
$017C  $3050               MOVLW  80
$017D  $00C3               MOVWF
       ?main_Local_Text+0
$017E  $3052               MOVLW  82
$017F  $00C4               MOVWF
       ?main_Local_Text+1
$0180  $304F               MOVLW  79
$0181  $00C5               MOVWF
       ?main_Local_Text+2
$0182  $304A               MOVLW  74
$0183  $00C6               MOVWF
       ?main_Local_Text+3
$0184  $3045               MOVLW  69
$0185  $00C7               MOVWF
       ?main_Local_Text+4
$0186  $3043               MOVLW  67
$0187  $00C8               MOVWF
       ?main_Local_Text+5
$0188  $3054               MOVLW  84
$0189  $00C9               MOVWF
       ?main_Local_Text+6
$018A  $3020               MOVLW  32
$018B  $00CA               MOVWF
       ?main_Local_Text+7
$018C  $01CB               CLRF
       ?main_Local_Text+8
$018D  $3043               MOVLW
       ?main_Local_Text
$018E  $00D3               MOVWF
       FARG_Lcd_Out+2
$018F  $158A               BSF    PCLATH, 3
$0190  $2045               CALL   _lcd_out
$0191  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,93 ::
       lcd_out(2,1,"DONE BY")
$0192  $3002               MOVLW  2
$0193  $00D1               MOVWF
       FARG_Lcd_Out
$0194  $3001               MOVLW  1
$0195  $00D2               MOVWF
       FARG_Lcd_Out+1
$0196  $3044               MOVLW  68
$0197  $00C3               MOVWF
       ?main_Local_Text+0
$0198  $304F               MOVLW  79
$0199  $00C4               MOVWF
       ?main_Local_Text+1
$019A  $304E               MOVLW  78
$019B  $00C5               MOVWF
       ?main_Local_Text+2
$019C  $3045               MOVLW  69
$019D  $00C6               MOVWF
       ?main_Local_Text+3
$019E  $3020               MOVLW  32
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$019F  $00C7               MOVWF
       ?main_Local_Text+4
$01A0  $3042               MOVLW  66
$01A1  $00C8               MOVWF
       ?main_Local_Text+5
$01A2  $3059               MOVLW  89
$01A3  $00C9               MOVWF
       ?main_Local_Text+6
$01A4  $01CA               CLRF
       ?main_Local_Text+7
$01A5  $3043               MOVLW
       ?main_Local_Text
$01A6  $00D3               MOVWF
       FARG_Lcd_Out+2
$01A7  $158A               BSF    PCLATH, 3
$01A8  $2045               CALL   _lcd_out
$01A9  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,94 ::
       delay_ms(2500)
$01AA  $3040               MOVLW  64
$01AB  $00FC               MOVWF  STACK_12
$01AC  $30FF               MOVLW  255
$01AD  $00FB               MOVWF  STACK_11
$01AE  $30FF               MOVLW  255
$01AF  $00FA               MOVWF  STACK_10
$01B0  $0BFC               DECFSZ STACK_12,
F
$01B1  $29B3               GOTO   $+2
$01B2  $29BA               GOTO   $+8
$01B3  $0BFB               DECFSZ STACK_11,
F
$01B4  $29B6               GOTO   $+2
$01B5  $29B9               GOTO   $+4
$01B6  $0BFA               DECFSZ STACK_10,
F
$01B7  $29B6               GOTO   $-1
$01B8  $29B3               GOTO   $-5
$01B9  $29B0               GOTO   $-9
$01BA  $30BD               MOVLW  189
$01BB  $00FB               MOVWF  STACK_11
$01BC  $30FF               MOVLW  255
$01BD  $00FA               MOVWF  STACK_10
$01BE  $0BFB               DECFSZ STACK_11,
F
$01BF  $29C1               GOTO   $+2
$01C0  $29C4               GOTO   $+4
$01C1  $0BFA               DECFSZ STACK_10,
F
$01C2  $29C1               GOTO   $-1
$01C3  $29BE               GOTO   $-5
$01C4  $30E2               MOVLW  226
$01C5  $00FA               MOVWF  STACK_10
$01C6  $0BFA               DECFSZ STACK_10,
F
$01C7  $29C6               GOTO   $-1
;UCHE_INCUBATOR_1.pbas,95 ::
       lcd_cmd(lcd_clear)
$01C8  $3001               MOVLW  1
$01C9  $00DE               MOVWF
       FARG_Lcd_Cmd
$01CA  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,96 ::
       lcd_out(1,1,"OKEOMA FELIX" )
$01CB  $3001               MOVLW  1
$01CC  $00D1               MOVWF
       FARG_Lcd_Out
$01CD  $3001               MOVLW  1
$01CE  $00D2               MOVWF
       FARG_Lcd_Out+1
$01CF  $304F               MOVLW  79
$01D0  $00C3               MOVWF
       ?main_Local_Text+0
$01D1  $304B               MOVLW  75
$01D2  $00C4               MOVWF
       ?main_Local_Text+1
$01D3  $3045               MOVLW  69
$01D4  $00C5               MOVWF
       ?main_Local_Text+2
$01D5  $304F               MOVLW  79
$01D6  $00C6               MOVWF
       ?main_Local_Text+3
$01D7  $304D               MOVLW  77
$01D8  $00C7               MOVWF
       ?main_Local_Text+4
$01D9  $3041               MOVLW  65
$01DA  $00C8               MOVWF
       ?main_Local_Text+5
$01DB  $3020               MOVLW  32
$01DC  $00C9               MOVWF
       ?main_Local_Text+6
$01DD  $3046               MOVLW  70
$01DE  $00CA               MOVWF
       ?main_Local_Text+7
$01DF  $3045               MOVLW  69
$01E0  $00CB               MOVWF
       ?main_Local_Text+8
$01E1  $304C               MOVLW  76
$01E2  $00CC               MOVWF
       ?main_Local_Text+9
$01E3  $3049               MOVLW  73
$01E4  $00CD               MOVWF
       ?main_Local_Text+10
$01E5  $3058               MOVLW  88
$01E6  $00CE               MOVWF
       ?main_Local_Text+11
$01E7  $01CF               CLRF
       ?main_Local_Text+12
$01E8  $3043               MOVLW
       ?main_Local_Text
$01E9  $00D3               MOVWF
       FARG_Lcd_Out+2
$01EA  $158A               BSF    PCLATH, 3
$01EB  $2045               CALL   _lcd_out
$01EC  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,97 ::
       lcd_out(2,1,"UCHE")
$01ED  $3002               MOVLW  2
$01EE  $00D1               MOVWF
       FARG_Lcd_Out
$01EF  $3001               MOVLW  1
$01F0  $00D2               MOVWF
       FARG_Lcd_Out+1
$01F1  $3055               MOVLW  85
$01F2  $00C3               MOVWF
       ?main_Local_Text+0
$01F3  $3043               MOVLW  67
$01F4  $00C4               MOVWF
       ?main_Local_Text+1
$01F5  $3048               MOVLW  72
$01F6  $00C5               MOVWF
       ?main_Local_Text+2
$01F7  $3045               MOVLW  69
$01F8  $00C6               MOVWF
       ?main_Local_Text+3
```

```
$01F9  $01C7               CLRF
       ?main_Local_Text+4
$01FA  $3043               MOVLW
       ?main_Local_Text
$01FB  $00D3               MOVWF
       FARG_Lcd_Out+2
$01FC  $158A               BSF    PCLATH, 3
$01FD  $2045               CALL   _lcd_out
$01FE  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,98 ::
       delay_ms(2500)
$01FF  $3040               MOVLW  64
$0200  $00FC               MOVWF  STACK_12
$0201  $30FF               MOVLW  255
$0202  $00FB               MOVWF  STACK_11
$0203  $30FF               MOVLW  255
$0204  $00FA               MOVWF  STACK_10
$0205  $0BFC               DECFSZ STACK_12,
F
$0206  $2A08               GOTO   $+2
$0207  $2A0F               GOTO   $+8
$0208  $0BFB               DECFSZ STACK_11,
F
$0209  $2A0B               GOTO   $+2
$020A  $2A0E               GOTO   $+4
$020B  $0BFA               DECFSZ STACK_10,
F
$020C  $2A0B               GOTO   $-1
$020D  $2A08               GOTO   $-5
$020E  $2A05               GOTO   $-9
$020F  $30BD               MOVLW  189
$0210  $00FB               MOVWF  STACK_11
$0211  $30FF               MOVLW  255
$0212  $00FA               MOVWF  STACK_10
$0213  $0BFB               DECFSZ STACK_11,
F
$0214  $2A16               GOTO   $+2
$0215  $2A19               GOTO   $+4
$0216  $0BFA               DECFSZ STACK_10,
F
$0217  $2A16               GOTO   $-1
$0218  $2A13               GOTO   $-5
$0219  $30E2               MOVLW  226
$021A  $00FA               MOVWF  STACK_10
$021B  $0BFA               DECFSZ STACK_10,
F
$021C  $2A1B               GOTO   $-1
;UCHE_INCUBATOR_1.pbas,99 ::
       lcd_cmd(lcd_clear)
$021D  $3001               MOVLW  1
$021E  $00DE               MOVWF
       FARG_Lcd_Cmd
$021F  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,100 ::
       INTCON = $A0
$0220  $30A0               MOVLW  160
$0221  $008B               MOVWF  INTCON
;UCHE_INCUBATOR_1.pbas,102 ::
       start:
$0222  $      _main_start:
;UCHE_INCUBATOR_1.pbas,105 ::
       lcd_out(1,1,"Timer = ")
$0222  $3001               MOVLW  1
$0223  $00D1               MOVWF
       FARG_Lcd_Out
$0224  $3001               MOVLW  1
$0225  $00D2               MOVWF
       FARG_Lcd_Out+1
$0226  $3054               MOVLW  84
$0227  $00C3               MOVWF
       ?main_Local_Text+0
$0228  $3069               MOVLW  105
$0229  $00C4               MOVWF
       ?main_Local_Text+1
$022A  $306D               MOVLW  109
$022B  $00C5               MOVWF
       ?main_Local_Text+2
$022C  $3065               MOVLW  101
$022D  $00C6               MOVWF
       ?main_Local_Text+3
$022E  $3072               MOVLW  114
$022F  $00C7               MOVWF
       ?main_Local_Text+4
$0230  $3020               MOVLW  32
$0231  $00C8               MOVWF
       ?main_Local_Text+5
$0232  $303D               MOVLW  61
$0233  $00C9               MOVWF
       ?main_Local_Text+6
$0234  $3020               MOVLW  32
$0235  $00CA               MOVWF
       ?main_Local_Text+7
$0236  $01CB               CLRF
       ?main_Local_Text+8
$0237  $3043               MOVLW
       ?main_Local_Text
$0238  $00D3               MOVWF
       FARG_Lcd_Out+2
$0239  $158A               BSF    PCLATH, 3
$023A  $2045               CALL   _lcd_out
$023B  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,106 ::           ch
= hr mod 10
$023C  $300A               MOVLW  10
$023D  $00F4               MOVWF  STACK_4
$023E  $01F5               CLRF   STACK_4+1
$023F  $0827               MOVF   _hr, 0
$0240  $00F0               MOVWF  STACK_0
$0241  $0828               MOVF   _hr+1, 0
$0242  $00F1               MOVWF  STACK_0+1
$0243  $158A               BSF    PCLATH, 3
$0244  $20F3               CALL
       _div_16x16_u
$0245  $118A               BCF    PCLATH, 3
$0246  $0878               MOVF   STACK_8, 0
$0247  $00F0               MOVWF  STACK_0
$0248  $0879               MOVF   STACK_9, 0
$0249  $00F1               MOVWF  STACK_1
$024A  $0870               MOVF   STACK_0, 0
$024B  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,107 ::
       lcd_chr_cp(48+ch)
$024C  $0870               MOVF   STACK_0, 0
$024D  $3F30               ADDLW  48
$024E  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$024F  $158A               BSF    PCLATH, 3
$0250  $214D               CALL
       _lcd_chr_cp
$0251  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,108 ::
       lcd_out_cp(":")
$0252  $303A               MOVLW  58
```

```
$0253  $00C3               MOVWF
       ?main_Local_Text+0
$0254  $01C4               CLRF
       ?main_Local_Text+1
$0255  $3043               MOVLW
       ?main_Local_Text
$0256  $00D1               MOVWF
       FARG_Lcd_Out_CP
$0257  $158A               BSF    PCLATH, 3
$0258  $2110               CALL
       _lcd_out_cp
$0259  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,109 ::          ch
= (min div 10) mod 10
$025A  $300A               MOVLW  10
$025B  $00F4               MOVWF  STACK_4
$025C  $01F5               CLRF   STACK_4+1
$025D  $0825               MOVF   _min, 0
$025E  $00F0               MOVWF  STACK_0
$025F  $0826               MOVF   _min+1, 0
$0260  $00F1               MOVWF  STACK_0+1
$0261  $158A               BSF    PCLATH, 3
$0262  $20F3               CALL
       _div_16x16_u
$0263  $118A               BCF    PCLATH, 3
$0264  $300A               MOVLW  10
$0265  $00F4               MOVWF  STACK_4
$0266  $01F5               CLRF   STACK_4+1
$0267  $158A               BSF    PCLATH, 3
$0268  $20F3               CALL
       _div_16x16_u
$0269  $118A               BCF    PCLATH, 3
$026A  $0878               MOVF   STACK_8, 0
$026B  $00F0               MOVWF  STACK_0
$026C  $0879               MOVF   STACK_9, 0
$026D  $00F1               MOVWF  STACK_1
$026E  $0870               MOVF   STACK_0, 0
$026F  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,110 ::
       lcd_chr_cp(48+ch)
$0270  $0870               MOVF   STACK_0, 0
$0271  $3F30               ADDLW  48
$0272  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0273  $158A               BSF    PCLATH, 3
$0274  $214D               CALL
       _lcd_chr_cp
$0275  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,111 ::          ch
= min mod 10
$0276  $300A               MOVLW  10
$0277  $00F4               MOVWF  STACK_4
$0278  $01F5               CLRF   STACK_4+1
$0279  $0825               MOVF   _min, 0
$027A  $00F0               MOVWF  STACK_0
$027B  $0826               MOVF   _min+1, 0
$027C  $00F1               MOVWF  STACK_0+1
$027D  $158A               BSF    PCLATH, 3
$027E  $20F3               CALL
       _div_16x16_u
$027F  $118A               BCF    PCLATH, 3
$0280  $0878               MOVF   STACK_8, 0
$0281  $00F0               MOVWF  STACK_0
$0282  $0879               MOVF   STACK_9, 0
$0283  $00F1               MOVWF  STACK_1
$0284  $0870               MOVF   STACK_0, 0
$0285  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,112 ::
       lcd_chr_cp(48+ch)
$0286  $0870               MOVF   STACK_0, 0
$0287  $3F30               ADDLW  48
$0288  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0289  $158A               BSF    PCLATH, 3
$028A  $214D               CALL
       _lcd_chr_cp
$028B  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,113 ::
       lcd_out_cp(":")
$028C  $303A               MOVLW  58
$028D  $00C3               MOVWF
       ?main_Local_Text+0
$028E  $01C4               CLRF
       ?main_Local_Text+1
$028F  $3043               MOVLW
       ?main_Local_Text
$0290  $00D1               MOVWF
       FARG_Lcd_Out_CP
$0291  $158A               BSF    PCLATH, 3
$0292  $2110               CALL
       _lcd_out_cp
$0293  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,114 ::          ch
= (sec div 10) mod 10
$0294  $300A               MOVLW  10
$0295  $00F4               MOVWF  STACK_4
$0296  $01F5               CLRF   STACK_4+1
$0297  $0822               MOVF   _sec, 0
$0298  $00F0               MOVWF  STACK_0
$0299  $0823               MOVF   _sec+1, 0
$029A  $00F1               MOVWF  STACK_0+1
$029B  $158A               BSF    PCLATH, 3
$029C  $20F3               CALL
       _div_16x16_u
$029D  $118A               BCF    PCLATH, 3
$029E  $300A               MOVLW  10
$029F  $00F4               MOVWF  STACK_4
$02A0  $01F5               CLRF   STACK_4+1
$02A1  $158A               BSF    PCLATH, 3
$02A2  $20F3               CALL
       _div_16x16_u
$02A3  $118A               BCF    PCLATH, 3
$02A4  $0878               MOVF   STACK_8, 0
$02A5  $00F0               MOVWF  STACK_0
$02A6  $0879               MOVF   STACK_9, 0
$02A7  $00F1               MOVWF  STACK_1
$02A8  $0870               MOVF   STACK_0, 0
$02A9  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,115 ::
       lcd_chr_cp(48+ch)
$02AA  $0870               MOVF   STACK_0, 0
$02AB  $3F30               ADDLW  48
$02AC  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$02AD  $158A               BSF    PCLATH, 3
$02AE  $214D               CALL
       _lcd_chr_cp
$02AF  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,116 ::          ch
= sec mod 10
$02B0  $300A               MOVLW  10
$02B1  $00F4               MOVWF  STACK_4
$02B2  $01F5               CLRF   STACK_4+1
$02B3  $0822               MOVF   _sec, 0
```

```
$02B4  $00F0               MOVWF  STACK_0
$02B5  $0823               MOVF   _sec+1, 0
$02B6  $00F1               MOVWF  STACK_0+1
$02B7  $158A               BSF    PCLATH, 3
$02B8  $20F3               CALL
       _div_16x16_u
$02B9  $118A               BCF    PCLATH, 3
$02BA  $0878               MOVF   STACK_8, 0
$02BB  $00F0               MOVWF  STACK_0
$02BC  $0879               MOVF   STACK_9, 0
$02BD  $00F1               MOVWF  STACK_1
$02BE  $0870               MOVF   STACK_0, 0
$02BF  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,117 ::
       lcd_chr_cp(48+ch)
$02C0  $0870               MOVF   STACK_0, 0
$02C1  $3F30               ADDLW  48
$02C2  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$02C3  $158A               BSF    PCLATH, 3
$02C4  $214D               CALL
       _lcd_chr_cp
$02C5  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,119 ::           if
confirm = 1 then
$02C6  $0829               MOVF   _confirm,
0
$02C7  $3A01               XORLW  1
$02C8  $1D03               BTFSS  STATUS, Z
$02C9  $2ACE               GOTO
       UCHE_INCUBATOR_1_L_22
$02CA  $      UCHE_INCUBATOR_1_L_21:
;UCHE_INCUBATOR_1.pbas,120 ::
       lcd_cmd(lcd_clear)
$02CA  $3001               MOVLW  1
$02CB  $00DE               MOVWF
       FARG_Lcd_Cmd
$02CC  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,121 ::
       goto turn
$02CD  $2BCF               GOTO   _main_turn
$02CE  $      UCHE_INCUBATOR_1_L_22:
;UCHE_INCUBATOR_1.pbas,122 ::           end
if
$02CE  $      UCHE_INCUBATOR_1_L_23:
;UCHE_INCUBATOR_1.pbas,124 ::
       Temp = adc_read(0)
$02CE  $01D1               CLRF
       FARG_ADC_read, 1
$02CF  $158A               BSF    PCLATH, 3
$02D0  $2000               CALL   _adc_read
$02D1  $118A               BCF    PCLATH, 3
$02D2  $0870               MOVF   STACK_0, 0
$02D3  $00BA               MOVWF  _temp
$02D4  $0871               MOVF   STACK_0+1,
0
$02D5  $00BB               MOVWF  _temp+1
;UCHE_INCUBATOR_1.pbas,125 ::
       telong = Temp * 5000
$02D6  $3000               MOVLW  0
$02D7  $00F2               MOVWF  STACK_0+2
$02D8  $00F3               MOVWF  STACK_0+3
$02D9  $3088               MOVLW  136
$02DA  $00F4               MOVWF  STACK_4
$02DB  $3013               MOVLW  19
$02DC  $00F5               MOVWF  STACK_4+1
$02DD  $01F6               CLRF   STACK_4+2
$02DE  $01F7               CLRF   STACK_4+3
$02DF  $270E               CALL
       _mul_32x32_s
$02E0  $0870               MOVF   STACK_0, 0
$02E1  $00BC               MOVWF  _telong
$02E2  $0871               MOVF   STACK_0+1,
0
$02E3  $00BD               MOVWF  _telong+1
$02E4  $0872               MOVF   STACK_0+2,
0
$02E5  $00BE               MOVWF  _telong+2
$02E6  $0873               MOVF   STACK_0+3,
0
$02E7  $00BF               MOVWF  _telong+3
;UCHE_INCUBATOR_1.pbas,126 ::
       Temp = telong >> 10
$02E8  $300A               MOVLW  10
$02E9  $00F8               MOVWF  STACK_8
$02EA  $0870               MOVF   STACK_0, 0
$02EB  $00F4               MOVWF  STACK_4
$02EC  $0871               MOVF   STACK_0+1,
0
$02ED  $00F5               MOVWF  STACK_4+1
$02EE  $0872               MOVF   STACK_0+2,
0
$02EF  $00F6               MOVWF  STACK_4+2
$02F0  $0873               MOVF   STACK_0+3,
0
$02F1  $00F7               MOVWF  STACK_4+3
$02F2  $0878               MOVF   STACK_8, 0
$02F3  $      L_main_4:
$02F3  $1903               BTFSC  STATUS, Z
$02F4  $2AFE               GOTO   L_main_5
$02F5  $0CF7               RRF    STACK_4+3,
1
$02F6  $0CF6               RRF    STACK_4+2,
1
$02F7  $0CF5               RRF    STACK_4+1,
1
$02F8  $0CF4               RRF    STACK_4, 1
$02F9  $13F7               BCF    STACK_4+3,
7
$02FA  $1B77               BTFSC  STACK_4+3,
6
$02FB  $17F7               BSF    STACK_4+3,
7
$02FC  $3FFF               ADDLW  255
$02FD  $2AF3               GOTO   L_main_4
$02FE  $      L_main_5:
$02FE  $0874               MOVF   STACK_4, 0
$02FF  $00BA               MOVWF  _temp
$0300  $0875               MOVF   STACK_4+1,
0
$0301  $00BB               MOVWF  _temp+1
;UCHE_INCUBATOR_1.pbas,129 ::
       Lcd_out(2,1,"Temp  = ")
$0302  $3002               MOVLW  2
$0303  $00D1               MOVWF
       FARG_Lcd_Out
$0304  $3001               MOVLW  1
$0305  $00D2               MOVWF
       FARG_Lcd_Out+1
$0306  $3054               MOVLW  84
$0307  $00C3               MOVWF
       ?main_Local_Text+0
$0308  $3065               MOVLW  101
```

```
$0309  $00C4               MOVWF
       ?main_Local_Text+1
$030A  $306D               MOVLW  109
$030B  $00C5               MOVWF
       ?main_Local_Text+2
$030C  $3070               MOVLW  112
$030D  $00C6               MOVWF
       ?main_Local_Text+3
$030E  $3020               MOVLW  32
$030F  $00C7               MOVWF
       ?main_Local_Text+4
$0310  $3020               MOVLW  32
$0311  $00C8               MOVWF
       ?main_Local_Text+5
$0312  $303D               MOVLW  61
$0313  $00C9               MOVWF
       ?main_Local_Text+6
$0314  $3020               MOVLW  32
$0315  $00CA               MOVWF
       ?main_Local_Text+7
$0316  $01CB               CLRF
       ?main_Local_Text+8
$0317  $3043               MOVLW
       ?main_Local_Text
$0318  $00D3               MOVWF
       FARG_Lcd_Out+2
$0319  $158A               BSF    PCLATH, 3
$031A  $2045               CALL   _lcd_out
$031B  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,130 ::           ch
= (temp div 100) mod 10
$031C  $3064               MOVLW  100
$031D  $00F4               MOVWF  STACK_4
$031E  $01F5               CLRF   STACK_4+1
$031F  $083A               MOVF   _temp, 0
$0320  $00F0               MOVWF  STACK_0
$0321  $083B               MOVF   _temp+1, 0
$0322  $00F1               MOVWF  STACK_0+1
$0323  $158A               BSF    PCLATH, 3
$0324  $20F3               CALL
       _div_16x16_u
$0325  $118A               BCF    PCLATH, 3
$0326  $300A               MOVLW  10
$0327  $00F4               MOVWF  STACK_4
$0328  $01F5               CLRF   STACK_4+1
$0329  $158A               BSF    PCLATH, 3
$032A  $20F3               CALL
       _div_16x16_u
$032B  $118A               BCF    PCLATH, 3
$032C  $0878               MOVF   STACK_8, 0
$032D  $00F0               MOVWF  STACK_0
$032E  $0879               MOVF   STACK_9, 0
$032F  $00F1               MOVWF  STACK_1
$0330  $0870               MOVF   STACK_0, 0
$0331  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,131 ::
       lcd_chr_cp(48+ch)
$0332  $0870               MOVF   STACK_0, 0
$0333  $3F30               ADDLW  48
$0334  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0335  $158A               BSF    PCLATH, 3
$0336  $214D               CALL
       _lcd_chr_cp
$0337  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,132 ::           ch
= (temp div 10) mod 10
$0338  $300A               MOVLW  10
$0339  $00F4               MOVWF  STACK_4
$033A  $01F5               CLRF   STACK_4+1
$033B  $083A               MOVF   _temp, 0
$033C  $00F0               MOVWF  STACK_0
$033D  $083B               MOVF   _temp+1, 0
$033E  $00F1               MOVWF  STACK_0+1
$033F  $158A               BSF    PCLATH, 3
$0340  $20F3               CALL
       _div_16x16_u
$0341  $118A               BCF    PCLATH, 3
$0342  $300A               MOVLW  10
$0343  $00F4               MOVWF  STACK_4
$0344  $01F5               CLRF   STACK_4+1
$0345  $158A               BSF    PCLATH, 3
$0346  $20F3               CALL
       _div_16x16_u
$0347  $118A               BCF    PCLATH, 3
$0348  $0878               MOVF   STACK_8, 0
$0349  $00F0               MOVWF  STACK_0
$034A  $0879               MOVF   STACK_9, 0
$034B  $00F1               MOVWF  STACK_1
$034C  $0870               MOVF   STACK_0, 0
$034D  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,133 ::
       lcd_chr_cp(48+ch)
$034E  $0870               MOVF   STACK_0, 0
$034F  $3F30               ADDLW  48
$0350  $00D5               MOVWF
       FARG_Lcd_Chr_CP
$0351  $158A               BSF    PCLATH, 3
$0352  $214D               CALL
       _lcd_chr_cp
$0353  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,134 ::
       lcd_out_cp(".")
$0354  $302E               MOVLW  46
$0355  $00C3               MOVWF
       ?main_Local_Text+0
$0356  $01C4               CLRF
       ?main_Local_Text+1
$0357  $3043               MOVLW
       ?main_Local_Text
$0358  $00D1               MOVWF
       FARG_Lcd_Out_CP
$0359  $158A               BSF    PCLATH, 3
$035A  $2110               CALL
       _lcd_out_cp
$035B  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,135 ::           ch
= Temp mod 10
$035C  $300A               MOVLW  10
$035D  $00F4               MOVWF  STACK_4
$035E  $01F5               CLRF   STACK_4+1
$035F  $083A               MOVF   _temp, 0
$0360  $00F0               MOVWF  STACK_0
$0361  $083B               MOVF   _temp+1, 0
$0362  $00F1               MOVWF  STACK_0+1
$0363  $158A               BSF    PCLATH, 3
$0364  $20F3               CALL
       _div_16x16_u
$0365  $118A               BCF    PCLATH, 3
$0366  $0878               MOVF   STACK_8, 0
$0367  $00F0               MOVWF  STACK_0
$0368  $0879               MOVF   STACK_9, 0
$0369  $00F1               MOVWF  STACK_1
$036A  $0870               MOVF   STACK_0, 0
```

```
$036B  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,136 ::
      lcd_chr_cp(48+ch)
$036C  $0870               MOVF   STACK_0, 0
$036D  $3F30               ADDLW  48
$036E  $00D5               MOVWF
      FARG_Lcd_Chr_CP
$036F  $158A               BSF    PCLATH, 3
$0370  $214D               CALL
      _lcd_chr_cp
$0371  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,137 ::
      lcd_chr(2,13,223)
$0372  $3002               MOVLW  2
$0373  $00D1               MOVWF
      FARG_Lcd_Chr
$0374  $300D               MOVLW  13
$0375  $00D2               MOVWF
      FARG_Lcd_Chr+1
$0376  $30DF               MOVLW  223
$0377  $00D3               MOVWF
      FARG_Lcd_Chr+2
$0378  $158A               BSF    PCLATH, 3
$0379  $2086               CALL   _lcd_chr
$037A  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,138 ::
      lcd_out_cp("C")
$037B  $3043               MOVLW  67
$037C  $00C3               MOVWF
      ?main_Local_Text+0
$037D  $01C4               CLRF
      ?main_Local_Text+1
$037E  $3043               MOVLW
      ?main_Local_Text
$037F  $00D1               MOVWF
      FARG_Lcd_Out_CP
$0380  $158A               BSF    PCLATH, 3
$0381  $2110               CALL
      _lcd_out_cp
$0382  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,142 ::          if
k > 0 then
$0383  $0838               MOVF   _k+1, 0
$0384  $3C00               SUBLW  0
$0385  $1D03               BTFSS  STATUS, Z
$0386  $2B89               GOTO   L_main_6
$0387  $0837               MOVF   _k, 0
$0388  $3C00               SUBLW  0
$0389  $      L_main_6:
$0389  $1803               BTFSC  STATUS, C
$038A  $2B90               GOTO
      UCHE_INCUBATOR_1_L_25
$038B  $      UCHE_INCUBATOR_1_L_24:
;UCHE_INCUBATOR_1.pbas,143 ::
      dec(k)
$038B  $3001               MOVLW  1
$038C  $02B7               SUBWF  _k, 1
$038D  $1C03               BTFSS  STATUS, C
$038E  $03B8               DECF   _k+1, 1
$038F  $2B91               GOTO
      UCHE_INCUBATOR_1_L_26
;UCHE_INCUBATOR_1.pbas,144 ::
      else
$0390  $      UCHE_INCUBATOR_1_L_25:
;UCHE_INCUBATOR_1.pbas,145 ::
      cool = 0
$0390  $1187               BCF    PORTC, 3
$0391  $      UCHE_INCUBATOR_1_L_28:
;UCHE_INCUBATOR_1.pbas,146 ::          end
if
$0391  $      UCHE_INCUBATOR_1_L_26:
;UCHE_INCUBATOR_1.pbas,149 ::          if
Temp < 360 then
$0391  $3001               MOVLW  1
$0392  $023B               SUBWF  _temp+1, 0
$0393  $1D03               BTFSS  STATUS, Z
$0394  $2B97               GOTO   L_main_7
$0395  $3068               MOVLW  104
$0396  $023A               SUBWF  _temp, 0
$0397  $      L_main_7:
$0397  $1803               BTFSC  STATUS, C
$0398  $2B9A               GOTO
      UCHE_INCUBATOR_1_L_30
$0399  $      UCHE_INCUBATOR_1_L_29:
;UCHE_INCUBATOR_1.pbas,150 ::
      heat = 1
$0399  $      UCHE_INCUBATOR_1_L_32:
$0399  $1507               BSF    PORTC, 2
$039A  $      UCHE_INCUBATOR_1_L_33:
$039A  $      UCHE_INCUBATOR_1_L_30:
;UCHE_INCUBATOR_1.pbas,151 ::          end
if
$039A  $      UCHE_INCUBATOR_1_L_31:
;UCHE_INCUBATOR_1.pbas,153 ::          if
Temp > 365 then
$039A  $083B               MOVF   _temp+1, 0
$039B  $3C01               SUBLW  1
$039C  $1D03               BTFSS  STATUS, Z
$039D  $2BA0               GOTO   L_main_8
$039E  $083A               MOVF   _temp, 0
$039F  $3C6D               SUBLW  109
$03A0  $      L_main_8:
$03A0  $1803               BTFSC  STATUS, C
$03A1  $2BA3               GOTO
      UCHE_INCUBATOR_1_L_35
$03A2  $      UCHE_INCUBATOR_1_L_34:
;UCHE_INCUBATOR_1.pbas,154 ::
      heat = 0
$03A2  $1107               BCF    PORTC, 2
$03A3  $      UCHE_INCUBATOR_1_L_38:
$03A3  $      UCHE_INCUBATOR_1_L_35:
;UCHE_INCUBATOR_1.pbas,155 ::          end
if
$03A3  $      UCHE_INCUBATOR_1_L_36:
;UCHE_INCUBATOR_1.pbas,157 ::          if
Temp >= 385 then
$03A3  $3001               MOVLW  1
$03A4  $023B               SUBWF  _temp+1, 0
$03A5  $1D03               BTFSS  STATUS, Z
$03A6  $2BA9               GOTO   L_main_9
$03A7  $3081               MOVLW  129
$03A8  $023A               SUBWF  _temp, 0
$03A9  $      L_main_9:
$03A9  $1C03               BTFSS  STATUS, C
$03AA  $2BAF               GOTO
      UCHE_INCUBATOR_1_L_40
$03AB  $      UCHE_INCUBATOR_1_L_39:
;UCHE_INCUBATOR_1.pbas,158 ::          k =
30
$03AB  $301E               MOVLW  30
$03AC  $00B7               MOVWF  _k
$03AD  $01B8               CLRF   _k+1
;UCHE_INCUBATOR_1.pbas,159 ::
      cool = 1
```

```
$03AE  $      UCHE_INCUBATOR_1_L_42:
$03AE  $1587               BSF    PORTC, 3
$03AF  $      UCHE_INCUBATOR_1_L_43:
$03AF  $      UCHE_INCUBATOR_1_L_40:
;UCHE_INCUBATOR_1.pbas,160 ::           end
if
$03AF  $      UCHE_INCUBATOR_1_L_41:
;UCHE_INCUBATOR_1.pbas,163 ::
       delay_ms(100)
$03AF  $3003               MOVLW  3
$03B0  $00FC               MOVWF  STACK_12
$03B1  $30FF               MOVLW  255
$03B2  $00FB               MOVWF  STACK_11
$03B3  $30FF               MOVLW  255
$03B4  $00FA               MOVWF  STACK_10
$03B5  $0BFC               DECFSZ STACK_12,
F
$03B6  $2BB8               GOTO   $+2
$03B7  $2BBF               GOTO   $+8
$03B8  $0BFB               DECFSZ STACK_11,
F
$03B9  $2BBB               GOTO   $+2
$03BA  $2BBE               GOTO   $+4
$03BB  $0BFA               DECFSZ STACK_10,
F
$03BC  $2BBB               GOTO   $-1
$03BD  $2BB8               GOTO   $-5
$03BE  $2BB5               GOTO   $-9
$03BF  $308C               MOVLW  140
$03C0  $00FB               MOVWF  STACK_11
$03C1  $30FF               MOVLW  255
$03C2  $00FA               MOVWF  STACK_10
$03C3  $0BFB               DECFSZ STACK_11,
F
$03C4  $2BC6               GOTO   $+2
$03C5  $2BC9               GOTO   $+4
$03C6  $0BFA               DECFSZ STACK_10,
F
$03C7  $2BC6               GOTO   $-1
$03C8  $2BC3               GOTO   $-5
$03C9  $30A1               MOVLW  161
$03CA  $00FA               MOVWF  STACK_10
$03CB  $0BFA               DECFSZ STACK_10,
F
$03CC  $2BCB               GOTO   $-1
$03CD  $0000               NOP
;UCHE_INCUBATOR_1.pbas,164 ::
       goto start
$03CE  $2A22               GOTO
       _main_start
;UCHE_INCUBATOR_1.pbas,166 ::
       turn:
$03CF  $      _main_turn:
;UCHE_INCUBATOR_1.pbas,168 ::           hr
= 0
$03CF  $01A7               CLRF   _hr
$03D0  $01A8               CLRF   _hr+1
;UCHE_INCUBATOR_1.pbas,169 ::           min
= 0
$03D1  $01A5               CLRF   _min
$03D2  $01A6               CLRF   _min+1
;UCHE_INCUBATOR_1.pbas,170 ::           sec
= 0
$03D3  $01A2               CLRF   _sec
$03D4  $01A3               CLRF   _sec+1
;UCHE_INCUBATOR_1.pbas,172 ::
       lcd_out(1,1,"Turning Tray")
$03D5  $3001               MOVLW  1
$03D6  $00D1               MOVWF
       FARG_Lcd_Out
$03D7  $3001               MOVLW  1
$03D8  $00D2               MOVWF
       FARG_Lcd_Out+1
$03D9  $3054               MOVLW  84
$03DA  $00C3               MOVWF
       ?main_Local_Text+0
$03DB  $3075               MOVLW  117
$03DC  $00C4               MOVWF
       ?main_Local_Text+1
$03DD  $3072               MOVLW  114
$03DE  $00C5               MOVWF
       ?main_Local_Text+2
$03DF  $306E               MOVLW  110
$03E0  $00C6               MOVWF
       ?main_Local_Text+3
$03E1  $3069               MOVLW  105
$03E2  $00C7               MOVWF
       ?main_Local_Text+4
$03E3  $306E               MOVLW  110
$03E4  $00C8               MOVWF
       ?main_Local_Text+5
$03E5  $3067               MOVLW  103
$03E6  $00C9               MOVWF
       ?main_Local_Text+6
$03E7  $3020               MOVLW  32
$03E8  $00CA               MOVWF
       ?main_Local_Text+7
$03E9  $3054               MOVLW  84
$03EA  $00CB               MOVWF
       ?main_Local_Text+8
$03EB  $3072               MOVLW  114
$03EC  $00CC               MOVWF
       ?main_Local_Text+9
$03ED  $3061               MOVLW  97
$03EE  $00CD               MOVWF
       ?main_Local_Text+10
$03EF  $3079               MOVLW  121
$03F0  $00CE               MOVWF
       ?main_Local_Text+11
$03F1  $01CF               CLRF
       ?main_Local_Text+12
$03F2  $3043               MOVLW
       ?main_Local_Text
$03F3  $00D3               MOVWF
       FARG_Lcd_Out+2
$03F4  $158A               BSF    PCLATH, 3
$03F5  $2045               CALL   _lcd_out
$03F6  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,175 ::           if
direction = 0 then
$03F7  $0836               MOVF
       _direction, 0
$03F8  $3A00               XORLW  0
$03F9  $1D03               BTFSS  STATUS, Z
$03FA  $2BFD               GOTO
       UCHE_INCUBATOR_1_L_45
$03FB  $      UCHE_INCUBATOR_1_L_44:
;UCHE_INCUBATOR_1.pbas,176 ::
       directionn = 0
$03FB  $1007               BCF    PORTC, 0
$03FC  $      UCHE_INCUBATOR_1_L_48:
$03FC  $2BFE               GOTO
       UCHE_INCUBATOR_1_L_46
```

```
;UCHE_INCUBATOR_1.pbas,177 ::
      else
$03FD  $      UCHE_INCUBATOR_1_L_45:
;UCHE_INCUBATOR_1.pbas,178 ::
      directionn = 1
$03FD  $      UCHE_INCUBATOR_1_L_49:
$03FD  $1407               BSF    PORTC, 0
$03FE  $      UCHE_INCUBATOR_1_L_50:
;UCHE_INCUBATOR_1.pbas,179 ::           end
if
$03FE  $      UCHE_INCUBATOR_1_L_46:
;UCHE_INCUBATOR_1.pbas,183 ::
      enablee = 1
$03FE  $      UCHE_INCUBATOR_1_L_51:
$03FE  $1487               BSF    PORTC, 1
$03FF  $      UCHE_INCUBATOR_1_L_52:
;UCHE_INCUBATOR_1.pbas,185 ::           if
direction = 0 then
$03FF  $0836               MOVF
       _direction, 0
$0400  $3A00               XORLW  0
$0401  $1D03               BTFSS  STATUS, Z
$0402  $2C14               GOTO
       UCHE_INCUBATOR_1_L_54
$0403  $      UCHE_INCUBATOR_1_L_53:
;UCHE_INCUBATOR_1.pbas,186 ::           if
down = 0 then
$0403  $3000               MOVLW  0
$0404  $1B07               BTFSC  PORTC, 6
$0405  $3001               MOVLW  1
$0406  $00F4               MOVWF  STACK_4
$0407  $0874               MOVF   STACK_4, 0
$0408  $3A00               XORLW  0
$0409  $1D03               BTFSS  STATUS, Z
$040A  $2C14               GOTO
       UCHE_INCUBATOR_1_L_57
$040B  $      UCHE_INCUBATOR_1_L_56:
;UCHE_INCUBATOR_1.pbas,187 ::
      enablee = 0
$040B  $1087               BCF    PORTC, 1
$040C  $      UCHE_INCUBATOR_1_L_60:
;UCHE_INCUBATOR_1.pbas,188 ::
      directionn = 0
$040C  $1007               BCF    PORTC, 0
$040D  $      UCHE_INCUBATOR_1_L_62:
;UCHE_INCUBATOR_1.pbas,189 ::
      direction = 1
$040D  $3001               MOVLW  1
$040E  $00B6               MOVWF  _direction
;UCHE_INCUBATOR_1.pbas,190 ::
      confirm = 0
$040F  $01A9               CLRF   _confirm,
1
;UCHE_INCUBATOR_1.pbas,191 ::
      lcd_cmd(lcd_clear)
$0410  $3001               MOVLW  1
$0411  $00DE               MOVWF
       FARG_Lcd_Cmd
$0412  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,192 ::
      goto start
$0413  $2A22               GOTO
       _main_start
$0414  $      UCHE_INCUBATOR_1_L_57:
;UCHE_INCUBATOR_1.pbas,193 ::           end
if
$0414  $      UCHE_INCUBATOR_1_L_58:
$0414  $      UCHE_INCUBATOR_1_L_54:
;UCHE_INCUBATOR_1.pbas,194 ::           end
if
$0414  $      UCHE_INCUBATOR_1_L_55:
;UCHE_INCUBATOR_1.pbas,196 ::           if
direction = 1 then
$0414  $0836               MOVF
       _direction, 0
$0415  $3A01               XORLW  1
$0416  $1D03               BTFSS  STATUS, Z
$0417  $2C28               GOTO
       UCHE_INCUBATOR_1_L_64
$0418  $      UCHE_INCUBATOR_1_L_63:
;UCHE_INCUBATOR_1.pbas,197 ::           if
up = 0 then
$0418  $3000               MOVLW  0
$0419  $1B87               BTFSC  PORTC, 7
$041A  $3001               MOVLW  1
$041B  $00F4               MOVWF  STACK_4
$041C  $0874               MOVF   STACK_4, 0
$041D  $3A00               XORLW  0
$041E  $1D03               BTFSS  STATUS, Z
$041F  $2C28               GOTO
       UCHE_INCUBATOR_1_L_67
$0420  $      UCHE_INCUBATOR_1_L_66:
;UCHE_INCUBATOR_1.pbas,198 ::
      enablee = 0
$0420  $1087               BCF    PORTC, 1
$0421  $      UCHE_INCUBATOR_1_L_70:
;UCHE_INCUBATOR_1.pbas,199 ::
      directionn = 0
$0421  $1007               BCF    PORTC, 0
$0422  $      UCHE_INCUBATOR_1_L_72:
;UCHE_INCUBATOR_1.pbas,200 ::
      direction = 0
$0422  $01B6               CLRF
       _direction, 1
;UCHE_INCUBATOR_1.pbas,201 ::
      confirm = 0
$0423  $01A9               CLRF   _confirm,
1
;UCHE_INCUBATOR_1.pbas,202 ::
      lcd_cmd(lcd_clear)
$0424  $3001               MOVLW  1
$0425  $00DE               MOVWF
       FARG_Lcd_Cmd
$0426  $265F               CALL   _lcd_cmd
;UCHE_INCUBATOR_1.pbas,203 ::
      goto start
$0427  $2A22               GOTO
       _main_start
$0428  $      UCHE_INCUBATOR_1_L_67:
;UCHE_INCUBATOR_1.pbas,204 ::           end
if
$0428  $      UCHE_INCUBATOR_1_L_68:
$0428  $      UCHE_INCUBATOR_1_L_64:
;UCHE_INCUBATOR_1.pbas,205 ::           end
if
$0428  $      UCHE_INCUBATOR_1_L_65:
;UCHE_INCUBATOR_1.pbas,207 ::
      Temp = adc_read(0)
$0428  $01D1               CLRF
       FARG_ADC_read, 1
$0429  $158A               BSF    PCLATH, 3
$042A  $2000               CALL   _adc_read
$042B  $118A               BCF    PCLATH, 3
$042C  $0870               MOVF   STACK_0, 0
```

```
$042D  $00BA               MOVWF  _temp
$042E  $0871               MOVF   STACK_0+1,
0
$042F  $00BB               MOVWF  _temp+1
;UCHE_INCUBATOR_1.pbas,208 ::
       telong = Temp * 5000
$0430  $3000               MOVLW  0
$0431  $00F2               MOVWF  STACK_0+2
$0432  $00F3               MOVWF  STACK_0+3
$0433  $3088               MOVLW  136
$0434  $00F4               MOVWF  STACK_4
$0435  $3013               MOVLW  19
$0436  $00F5               MOVWF  STACK_4+1
$0437  $01F6               CLRF   STACK_4+2
$0438  $01F7               CLRF   STACK_4+3
$0439  $270E               CALL
       _mul_32x32_s
$043A  $0870               MOVF   STACK_0, 0
$043B  $00BC               MOVWF  _telong
$043C  $0871               MOVF   STACK_0+1,
0
$043D  $00BD               MOVWF  _telong+1
$043E  $0872               MOVF   STACK_0+2,
0
$043F  $00BE               MOVWF  _telong+2
$0440  $0873               MOVF   STACK_0+3,
0
$0441  $00BF               MOVWF  _telong+3
;UCHE_INCUBATOR_1.pbas,209 ::
       Temp = telong >> 10
$0442  $300A               MOVLW  10
$0443  $00F8               MOVWF  STACK_8
$0444  $0870               MOVF   STACK_0, 0
$0445  $00F4               MOVWF  STACK_4
$0446  $0871               MOVF   STACK_0+1,
0
$0447  $00F5               MOVWF  STACK_4+1
$0448  $0872               MOVF   STACK_0+2,
0
$0449  $00F6               MOVWF  STACK_4+2
$044A  $0873               MOVF   STACK_0+3,
0
$044B  $00F7               MOVWF  STACK_4+3
$044C  $0878               MOVF   STACK_8, 0
$044D  $      L_main_10:
$044D  $1903               BTFSC  STATUS, Z
$044E  $2C58               GOTO   L_main_11
$044F  $0CF7               RRF    STACK_4+3,
1
$0450  $0CF6               RRF    STACK_4+2,
1
$0451  $0CF5               RRF    STACK_4+1,
1
$0452  $0CF4               RRF    STACK_4, 1
$0453  $13F7               BCF    STACK_4+3,
7
$0454  $1B77               BTFSC  STACK_4+3,
6
$0455  $17F7               BSF    STACK_4+3,
7
$0456  $3FFF               ADDLW  255
$0457  $2C4D               GOTO   L_main_10
$0458  $      L_main_11:
$0458  $0874               MOVF   STACK_4, 0
$0459  $00BA               MOVWF  _temp
$045A  $0875               MOVF   STACK_4+1,
0
$045B  $00BB               MOVWF  _temp+1
;UCHE_INCUBATOR_1.pbas,212 ::
       Lcd_out(2,1,"Temp  = ")
$045C  $3002               MOVLW  2
$045D  $00D1               MOVWF
       FARG_Lcd_Out
$045E  $3001               MOVLW  1
$045F  $00D2               MOVWF
       FARG_Lcd_Out+1
$0460  $3054               MOVLW  84
$0461  $00C3               MOVWF
       ?main_Local_Text+0
$0462  $3065               MOVLW  101
$0463  $00C4               MOVWF
       ?main_Local_Text+1
$0464  $306D               MOVLW  109
$0465  $00C5               MOVWF
       ?main_Local_Text+2
$0466  $3070               MOVLW  112
$0467  $00C6               MOVWF
       ?main_Local_Text+3
$0468  $3020               MOVLW  32
$0469  $00C7               MOVWF
       ?main_Local_Text+4
$046A  $3020               MOVLW  32
$046B  $00C8               MOVWF
       ?main_Local_Text+5
$046C  $303D               MOVLW  61
$046D  $00C9               MOVWF
       ?main_Local_Text+6
$046E  $3020               MOVLW  32
$046F  $00CA               MOVWF
       ?main_Local_Text+7
$0470  $01CB               CLRF
       ?main_Local_Text+8
$0471  $3043               MOVLW
       ?main_Local_Text
$0472  $00D3               MOVWF
       FARG_Lcd_Out+2
$0473  $158A               BSF    PCLATH, 3
$0474  $2045               CALL   _lcd_out
$0475  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,213 ::           ch
= (temp div 100) mod 10
$0476  $3064               MOVLW  100
$0477  $00F4               MOVWF  STACK_4
$0478  $01F5               CLRF   STACK_4+1
$0479  $083A               MOVF   _temp, 0
$047A  $00F0               MOVWF  STACK_0
$047B  $083B               MOVF   _temp+1, 0
$047C  $00F1               MOVWF  STACK_0+1
$047D  $158A               BSF    PCLATH, 3
$047E  $20F3               CALL
       _div_16x16_u
$047F  $118A               BCF    PCLATH, 3
$0480  $300A               MOVLW  10
$0481  $00F4               MOVWF  STACK_4
$0482  $01F5               CLRF   STACK_4+1
$0483  $158A               BSF    PCLATH, 3
$0484  $20F3               CALL
       _div_16x16_u
$0485  $118A               BCF    PCLATH, 3
$0486  $0878               MOVF   STACK_8, 0
$0487  $00F0               MOVWF  STACK_0
$0488  $0879               MOVF   STACK_9, 0
$0489  $00F1               MOVWF  STACK_1
$048A  $0870               MOVF   STACK_0, 0
```

```
$048B  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,214 ::
      lcd_chr_cp(48+ch)
$048C  $0870               MOVF   STACK_0, 0
$048D  $3F30               ADDLW  48
$048E  $00D5               MOVWF
      FARG_Lcd_Chr_CP
$048F  $158A               BSF    PCLATH, 3
$0490  $214D               CALL
      _lcd_chr_cp
$0491  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,215 ::          ch
= (temp div 10) mod 10
$0492  $300A               MOVLW  10
$0493  $00F4               MOVWF  STACK_4
$0494  $01F5               CLRF   STACK_4+1
$0495  $083A               MOVF   _temp, 0
$0496  $00F0               MOVWF  STACK_0
$0497  $083B               MOVF   _temp+1, 0
$0498  $00F1               MOVWF  STACK_0+1
$0499  $158A               BSF    PCLATH, 3
$049A  $20F3               CALL
      _div_16x16_u
$049B  $118A               BCF    PCLATH, 3
$049C  $300A               MOVLW  10
$049D  $00F4               MOVWF  STACK_4
$049E  $01F5               CLRF   STACK_4+1
$049F  $158A               BSF    PCLATH, 3
$04A0  $20F3               CALL
      _div_16x16_u
$04A1  $118A               BCF    PCLATH, 3
$04A2  $0878               MOVF   STACK_8, 0
$04A3  $00F0               MOVWF  STACK_0
$04A4  $0879               MOVF   STACK_9, 0
$04A5  $00F1               MOVWF  STACK_1
$04A6  $0870               MOVF   STACK_0, 0
$04A7  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,216 ::
      lcd_chr_cp(48+ch)
$04A8  $0870               MOVF   STACK_0, 0
$04A9  $3F30               ADDLW  48
$04AA  $00D5               MOVWF
      FARG_Lcd_Chr_CP
$04AB  $158A               BSF    PCLATH, 3
$04AC  $214D               CALL
      _lcd_chr_cp
$04AD  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,217 ::
      lcd_out_cp(".")
$04AE  $302E               MOVLW  46
$04AF  $00C3               MOVWF
      ?main_Local_Text+0
$04B0  $01C4               CLRF
      ?main_Local_Text+1
$04B1  $3043               MOVLW
      ?main_Local_Text
$04B2  $00D1               MOVWF
      FARG_Lcd_Out_CP
$04B3  $158A               BSF    PCLATH, 3
$04B4  $2110               CALL
      _lcd_out_cp
$04B5  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,218 ::          ch
= Temp mod 10
$04B6  $300A               MOVLW  10
$04B7  $00F4               MOVWF  STACK_4
$04B8  $01F5               CLRF   STACK_4+1
$04B9  $083A               MOVF   _temp, 0
$04BA  $00F0               MOVWF  STACK_0
$04BB  $083B               MOVF   _temp+1, 0
$04BC  $00F1               MOVWF  STACK_0+1
$04BD  $158A               BSF    PCLATH, 3
$04BE  $20F3               CALL
      _div_16x16_u
$04BF  $118A               BCF    PCLATH, 3
$04C0  $0878               MOVF   STACK_8, 0
$04C1  $00F0               MOVWF  STACK_0
$04C2  $0879               MOVF   STACK_9, 0
$04C3  $00F1               MOVWF  STACK_1
$04C4  $0870               MOVF   STACK_0, 0
$04C5  $00B9               MOVWF  _ch
;UCHE_INCUBATOR_1.pbas,219 ::
      lcd_chr_cp(48+ch)
$04C6  $0870               MOVF   STACK_0, 0
$04C7  $3F30               ADDLW  48
$04C8  $00D5               MOVWF
      FARG_Lcd_Chr_CP
$04C9  $158A               BSF    PCLATH, 3
$04CA  $214D               CALL
      _lcd_chr_cp
$04CB  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,220 ::
      lcd_chr(2,13,223)
$04CC  $3002               MOVLW  2
$04CD  $00D1               MOVWF
      FARG_Lcd_Chr
$04CE  $300D               MOVLW  13
$04CF  $00D2               MOVWF
      FARG_Lcd_Chr+1
$04D0  $30DF               MOVLW  223
$04D1  $00D3               MOVWF
      FARG_Lcd_Chr+2
$04D2  $158A               BSF    PCLATH, 3
$04D3  $2086               CALL   _lcd_chr
$04D4  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,221 ::
      lcd_out_cp("C")
$04D5  $3043               MOVLW  67
$04D6  $00C3               MOVWF
      ?main_Local_Text+0
$04D7  $01C4               CLRF
      ?main_Local_Text+1
$04D8  $3043               MOVLW
      ?main_Local_Text
$04D9  $00D1               MOVWF
      FARG_Lcd_Out_CP
$04DA  $158A               BSF    PCLATH, 3
$04DB  $2110               CALL
      _lcd_out_cp
$04DC  $118A               BCF    PCLATH, 3
;UCHE_INCUBATOR_1.pbas,225 ::          if
k > 0 then
$04DD  $0838               MOVF   _k+1, 0
$04DE  $3C00               SUBLW  0
$04DF  $1D03               BTFSS  STATUS, Z
$04E0  $2CE3               GOTO   L_main_12
$04E1  $0837               MOVF   _k, 0
$04E2  $3C00               SUBLW  0
$04E3  $     L_main_12:
$04E3  $1803               BTFSC  STATUS, C
$04E4  $2CEA               GOTO
      UCHE_INCUBATOR_1_L_74
$04E5  $     UCHE_INCUBATOR_1_L_73:
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;UCHE_INCUBATOR_1.pbas,226 ::
      dec(k)
$04E5  $3001               MOVLW  1
$04E6  $02B7               SUBWF  _k, 1
$04E7  $1C03               BTFSS  STATUS, C
$04E8  $03B8               DECF   _k+1, 1
$04E9  $2CEB               GOTO
      UCHE_INCUBATOR_1_L_75
;UCHE_INCUBATOR_1.pbas,227 ::
      else
$04EA  $      UCHE_INCUBATOR_1_L_74:
;UCHE_INCUBATOR_1.pbas,228 ::
      cool = 0
$04EA  $1187               BCF    PORTC, 3
$04EB  $      UCHE_INCUBATOR_1_L_77:
;UCHE_INCUBATOR_1.pbas,229 ::           end
if
$04EB  $      UCHE_INCUBATOR_1_L_75:
;UCHE_INCUBATOR_1.pbas,231 ::           if
Temp < 360 then
$04EB  $3001               MOVLW  1
$04EC  $023B               SUBWF  _temp+1, 0
$04ED  $1D03               BTFSS  STATUS, Z
$04EE  $2CF1               GOTO   L_main_13
$04EF  $3068               MOVLW  104
$04F0  $023A               SUBWF  _temp, 0
$04F1  $      L_main_13:
$04F1  $1803               BTFSC  STATUS, C
$04F2  $2CF4               GOTO
      UCHE_INCUBATOR_1_L_79
$04F3  $      UCHE_INCUBATOR_1_L_78:
;UCHE_INCUBATOR_1.pbas,232 ::
      heat = 1
$04F3  $      UCHE_INCUBATOR_1_L_81:
$04F3  $1507               BSF    PORTC, 2
$04F4  $      UCHE_INCUBATOR_1_L_82:
$04F4  $      UCHE_INCUBATOR_1_L_79:
;UCHE_INCUBATOR_1.pbas,233 ::           end
if
$04F4  $      UCHE_INCUBATOR_1_L_80:
;UCHE_INCUBATOR_1.pbas,235 ::           if
Temp > 365 then
$04F4  $083B               MOVF   _temp+1, 0
$04F5  $3C01               SUBLW  1
$04F6  $1D03               BTFSS  STATUS, Z
$04F7  $2CFA               GOTO   L_main_14
$04F8  $083A               MOVF   _temp, 0
$04F9  $3C6D               SUBLW  109
$04FA  $      L_main_14:
$04FA  $1803               BTFSC  STATUS, C
$04FB  $2CFD               GOTO
      UCHE_INCUBATOR_1_L_84
$04FC  $      UCHE_INCUBATOR_1_L_83:
;UCHE_INCUBATOR_1.pbas,236 ::
      heat = 0
$04FC  $1107               BCF    PORTC, 2
$04FD  $      UCHE_INCUBATOR_1_L_87:
$04FD  $      UCHE_INCUBATOR_1_L_84:
;UCHE_INCUBATOR_1.pbas,237 ::           end
if
$04FD  $      UCHE_INCUBATOR_1_L_85:
;UCHE_INCUBATOR_1.pbas,239 ::           if
Temp >= 380 then
$04FD  $3001               MOVLW  1
$04FE  $023B               SUBWF  _temp+1, 0
$04FF  $1D03               BTFSS  STATUS, Z
$0500  $2D03               GOTO   L_main_15
$0501  $307C               MOVLW  124
$0502  $023A               SUBWF  _temp, 0
$0503  $      L_main_15:
$0503  $1C03               BTFSS  STATUS, C
$0504  $2D09               GOTO
      UCHE_INCUBATOR_1_L_89
$0505  $      UCHE_INCUBATOR_1_L_88:
;UCHE_INCUBATOR_1.pbas,240 ::           k =
30
$0505  $301E               MOVLW  30
$0506  $00B7               MOVWF  _k
$0507  $01B8               CLRF   _k+1
;UCHE_INCUBATOR_1.pbas,241 ::
      cool = 1
$0508  $      UCHE_INCUBATOR_1_L_91:
$0508  $1587               BSF    PORTC, 3
$0509  $      UCHE_INCUBATOR_1_L_92:
$0509  $      UCHE_INCUBATOR_1_L_89:
;UCHE_INCUBATOR_1.pbas,242 ::           end
if
$0509  $      UCHE_INCUBATOR_1_L_90:
;UCHE_INCUBATOR_1.pbas,244 ::
      delay_ms(100)
$0509  $3003               MOVLW  3
$050A  $00FC               MOVWF  STACK_12
$050B  $30FF               MOVLW  255
$050C  $00FB               MOVWF  STACK_11
$050D  $30FF               MOVLW  255
$050E  $00FA               MOVWF  STACK_10
$050F  $0BFC               DECFSZ STACK_12,
F
$0510  $2D12               GOTO   $+2
$0511  $2D19               GOTO   $+8
$0512  $0BFB               DECFSZ STACK_11,
F
$0513  $2D15               GOTO   $+2
$0514  $2D18               GOTO   $+4
$0515  $0BFA               DECFSZ STACK_10,
F
$0516  $2D15               GOTO   $-1
$0517  $2D12               GOTO   $-5
$0518  $2D0F               GOTO   $-9
$0519  $308C               MOVLW  140
$051A  $00FB               MOVWF  STACK_11
$051B  $30FF               MOVLW  255
$051C  $00FA               MOVWF  STACK_10
$051D  $0BFB               DECFSZ STACK_11,
F
$051E  $2D20               GOTO   $+2
$051F  $2D23               GOTO   $+4
$0520  $0BFA               DECFSZ STACK_10,
F
$0521  $2D20               GOTO   $-1
$0522  $2D1D               GOTO   $-5
$0523  $30A1               MOVLW  161
$0524  $00FA               MOVWF  STACK_10
$0525  $0BFA               DECFSZ STACK_10,
F
$0526  $2D25               GOTO   $-1
$0527  $0000               NOP
;UCHE_INCUBATOR_1.pbas,245 ::
      goto turn
$0528  $2BCF               GOTO   _main_turn
$0529  $2D29               GOTO   $
```