GCSE

4121/01

DESIGN AND TECHNOLOGY

UNIT 1

FOCUS AREA: Systems and Control Technology

A.M. TUESDAY, 24 May 2016

2 hours plus your additional time allowance

Surname _____

Other Names _____

Centre Number _____

Candidate Number 0 _____

	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1.	15	
	2.	10	
	3.	10	
	4.	25	
Section B	5.	10	
	6.	15	
	7.	20	
	8.	15	
	Total	120	

ADDITIONAL MATERIALS

You will need basic drawing equipment, coloured pencils and a calculator for this examination.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. Where the space is not sufficient for your answer, continue at the back of the book, taking care to number the continuation correctly.

You are reminded of the necessity for good English and orderly presentation in your answers.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

SECTION A

MARKED OUT OF 60 60 MINUTES

1. This question is about Product Analysis. It is worth a total of 15 marks.

The mechanical nutcracker opposite has been designed and made to be different from other existing nutcrackers on the market.

PRODUCT FEATURES

- **Material: mirror polished stainless steel body with beech base**
- **Dimensions: 12 cm x 7 cm x 24 cm in height**
- **Weight: 550 g**
- **Ability to use with different sized / type nuts**
- **RRP £69.99**

1(a) Before designing the mechanical nutcracker, a design specification was written. Study the THREE specification points below and explain how these have been met by the product.

(i) The mechanical nutcracker must be a portable and durable product. [2]

Explanation: _____

(ii) The mechanical nutcracker must include a fun or entertaining theme. [2]

Explanation: _____

1(a) (iii) **The mechanical nutcracker must be safe to use. [2]**

Explanation: _____

_____

_____

_____

_____

_____

(b) **The mechanical nutcracker was designed to be purchased as a gift or part of a collectable suite of products. Describe the features that support this idea. [2]**

_____

_____

_____

_____

1(c) A retailer requires the manufacturer to make 600 identical mechanical nutcrackers to sell at the launch of the new product.

(i) State the correct scale of production that the manufacturer will employ. [1]

Scale of production: _____

_____

_____

(ii) Describe the reasons why 600 mechanical nutcrackers are ordered for the product launch. [2]

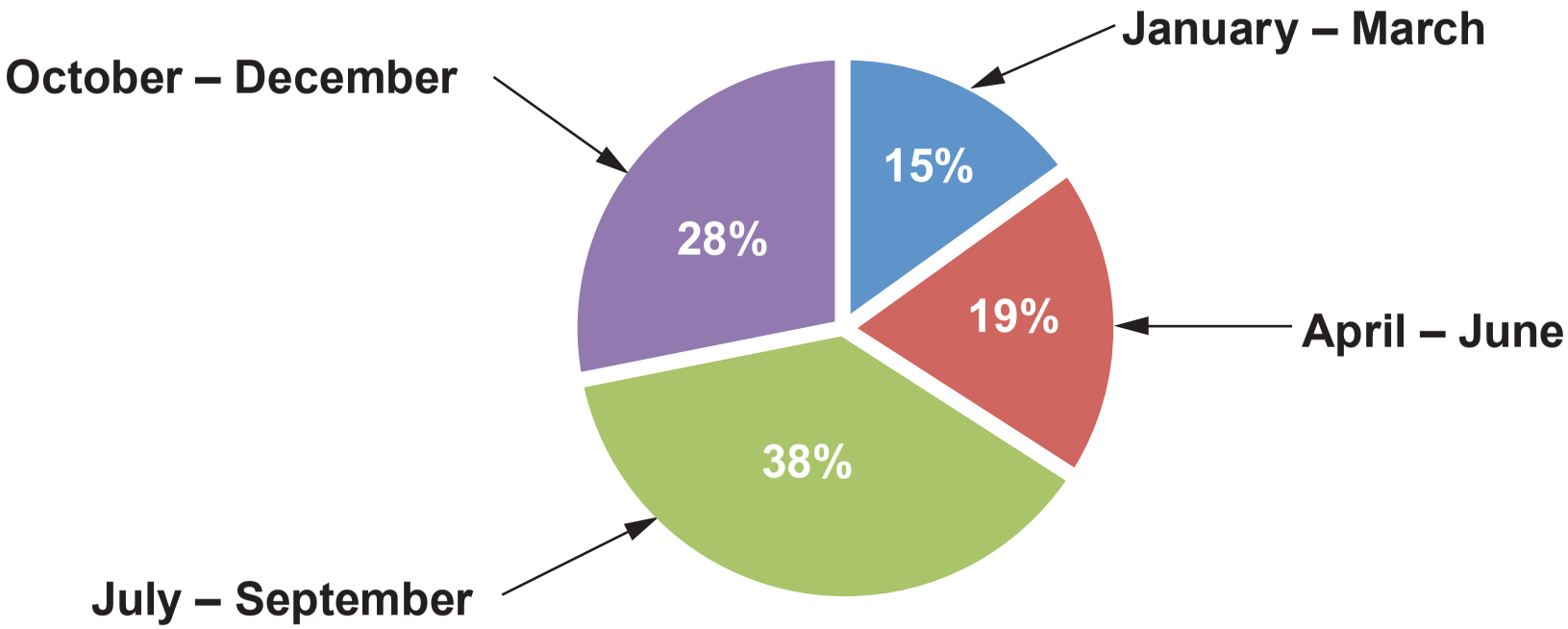
_____

_____

_____

_____

SALES OF MECHANICAL NUTCRACKER 2015



1(d) **The pie chart opposite shows the percentage of mechanical nutcrackers sold each quarter for 2015.**

(i) **State the quarter with the highest sales. [1]**

(ii) **Give a reason why the January – March quarter shows the lowest sales. [1]**

(iii) **A total of 5600 mechanical nutcrackers were sold in 2015. Calculate how many are sold in the October – December quarter. [2] (SHOW ALL YOUR WORKINGS.)**

2. This question is about the general issues of Design and Technology. It is worth a total of 10 marks.

(a) State the correct R for EACH of the statements shown below. [2]

A material or component is taken from one product and used in another.

_____

A material is reprocessed and used to make another product.

_____

2(b) State the meaning of the logo shown below. [2]

Meaning: _____

_____

_____

_____

2(c) Describe how considering 'Life Cycle Analysis' can give the designer a clear understanding of the environmental impact of a product. [3]

2(d) Many homeowners have fitted solar panels to their property. Discuss how fitting solar panels can create winners and losers. [3]

3. This question is about the Designers that you have studied. It is worth a total of 10 marks.

During your course you have studied the work of Shigeru Miyamoto and James Dyson.

(a) Write the name of the correct designer under EACH of the descriptions below. 2 x [1]

- **Born in Norfolk in 1947**
- **Produced 5127 prototypes**
- **Obtained his first Patent in 1986**
- **Winner of 1991 International Design Fair Prize**

Designer: _____

- **Born in Sonobe in 1952**
- **Converted 'Radar Scope'**
- **Designed the first wireless console**
- **His most recent 'project' is 'Star Fox'**

Designer: _____

3(b) **For EITHER Shigeru Miyamoto OR James Dyson, write a short essay in the space below describing his work and identifying the features that make his products innovative. [8]**

Marks will be awarded for the content of the answer and the quality of written communication.

Name of Designer: _____

4. This question is about the Design Process and how it is used. It is worth a total of 25 marks.

(a) Draw a line to connect EACH design term to the relevant statement. 3 x [1]

DESIGN TERM	STATEMENT
Final Solution	Analysing whether the specification has been met fully.
Evaluation	A statement of the designer's intent at the start of the project.
Design Brief	A set of graphical and technical details.

(b) Describe the important features that should be included in a plan for manufacture. [2]

_____

_____

_____

_____

4(c) Explain why it is important to test materials and components during the development stage of a project. [2]

4(d) **A manufacturer needs you to design an innovative device that attaches to laptops, tablets and monitors which cools the user when the room temperature gets too hot.**

Specification

THE DEVICE MUST:

- **be powered by USB connection from the host device (12 volts);**
- **automatically cool the user when the temperature is above 26 degrees;**
- **illuminate ONE green LED to show when the device is powered via USB;**
- **include a method of attaching to laptops, tablets and monitors.**

4(d) MARKS WILL BE AWARDED FOR:

(i) fully labelled details of the overall look of the device; [4]

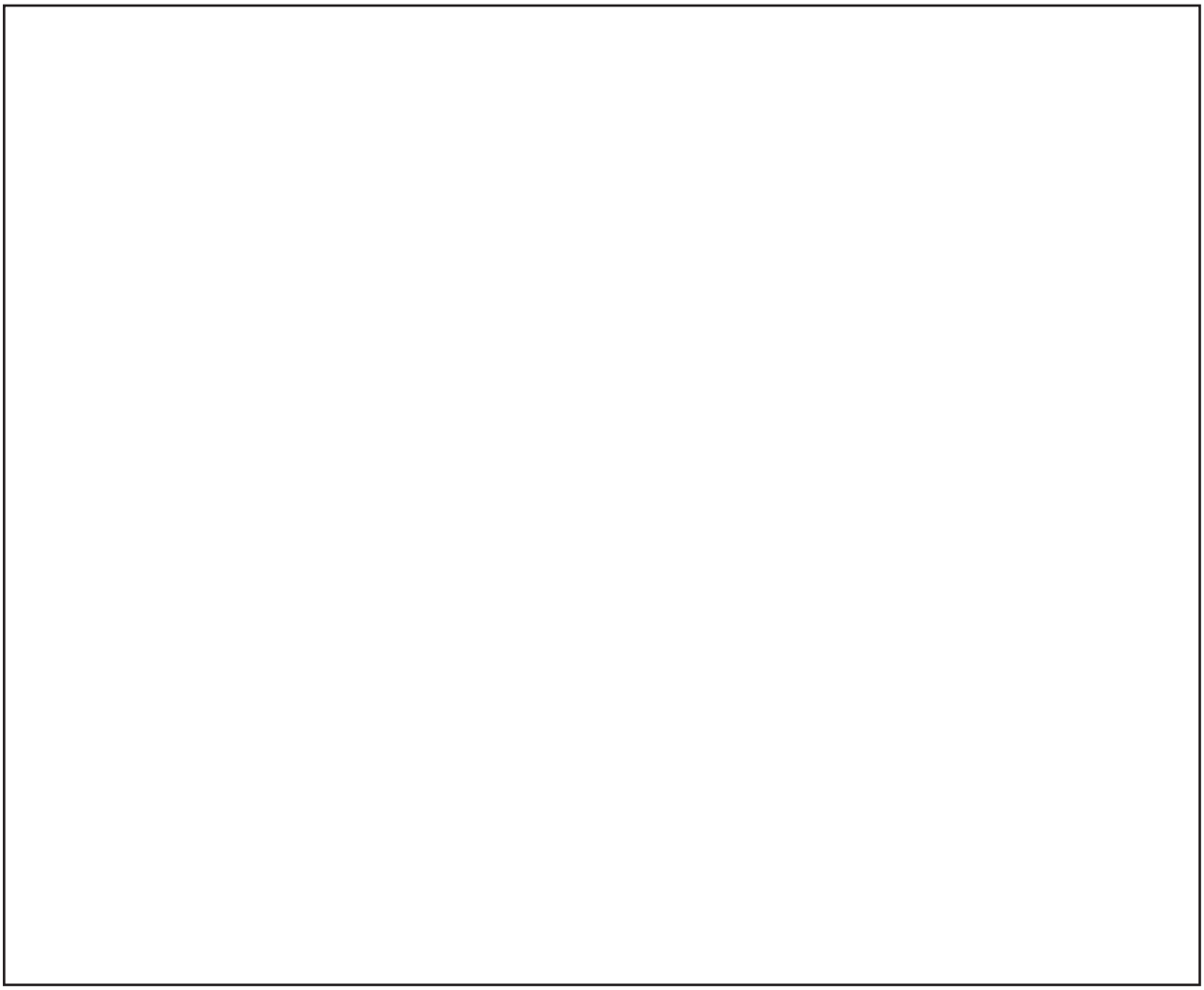
(ii) a block diagram of the electronic system used; [3]

(iii) details of the electronic circuit used in the device; [5]

(iv) details of how the device is attached to laptops, tablets and monitors; [2]

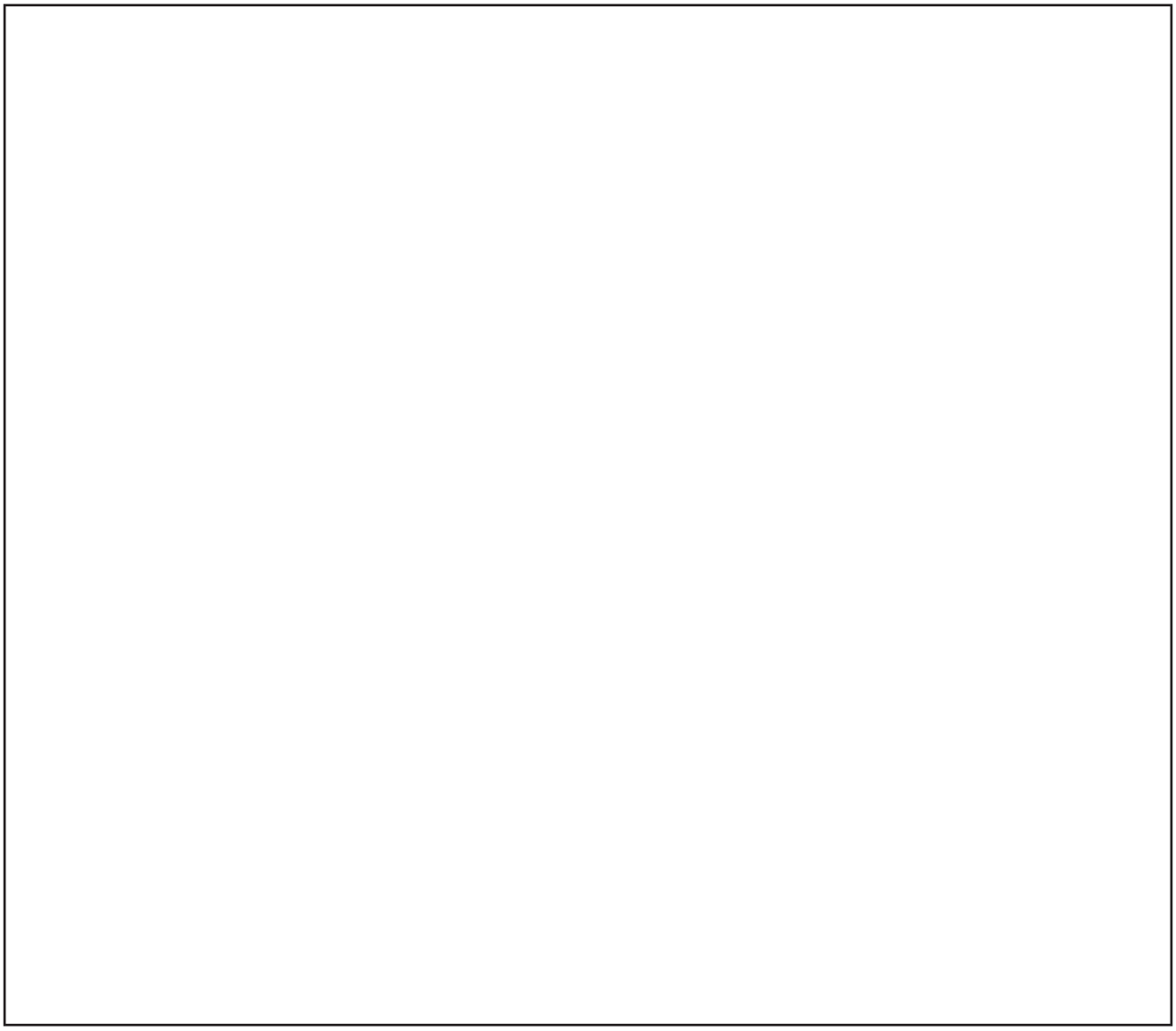
(v) sizes, materials and quality of communication. [4]

Draw fully labelled details of the overall look of the device in the box opposite.



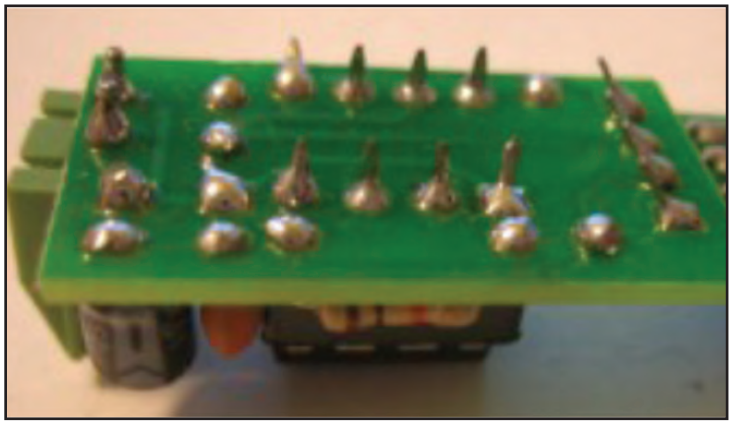
21

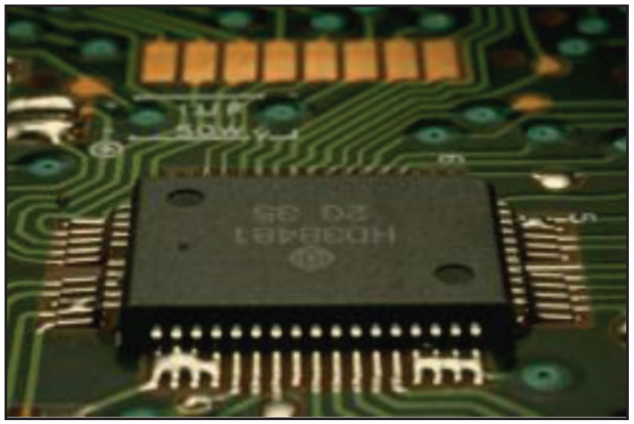
Draw a block diagram of the electronic system in the box below.



Draw details of the electronic circuit used in the box below, including details of triggering the device.

SURFACE MOUNT TECHNOLOGY **STRIPBOARD CONSTRUCTION** **THROUGH HOLE SOLDERING**





_____ [1]

_____ [1]

SECTION B

MARKED OUT OF 60 60 MINUTES

5. This question is about Commercial Manufacturing Processes. It is worth a total of 10 marks.

(a) (i) Select the correct term to describe EACH of the images shown opposite.

(ii) When commercial electronic systems are produced, quality control must be used during production. Explain the term 'quality control'. [2]

5(b) In industry, pick and place machines automatically position components onto printed circuit boards. Describe the advantages to the manufacturer of using pick and place machinery. [2]

5(c) Describe what happens during STAGES 2 AND 3 when a printed circuit board (PCB) is populated using reflow soldering. [2]

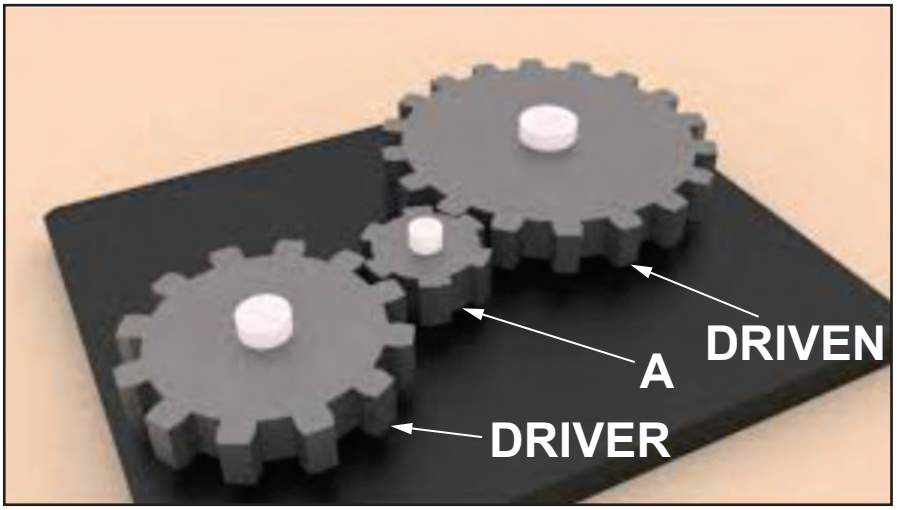
STAGE 1	STAGE 2	STAGE 3	STAGE 4
Solder paste is placed onto the PCB pads.			Populated PCB is cooled preventing thermal shock.

5(d) Explain what is meant by the term ‘Moore’s Law’.

[2]

6. This question is about Materials and Components. It is worth a total of 15 marks.

(a) Study the model of a simple gear train shown below.



(i) State the name of the component marked A. [1]

_____

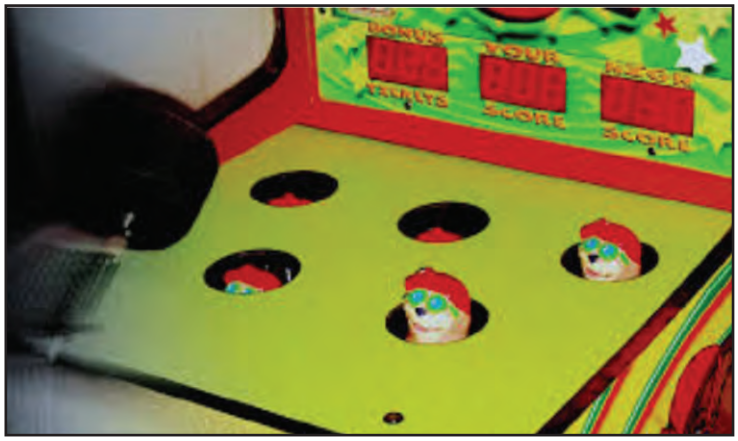
(ii) Give ONE reason for using the component marked A in this system. [1]

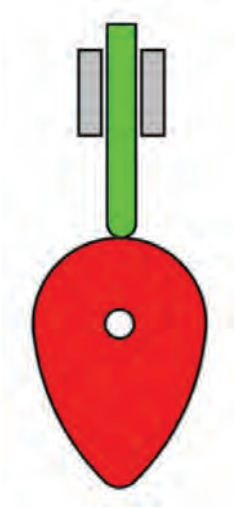
_____

_____

6(a) (iii) **Calculate the rotational velocity (RV) of the driven gear, if the driver rotates at 33rpm. (SHOW ALL YOUR WORKINGS.) [2]**

6(b) **The game below uses a cam and follower so that characters pop up and can be hit with a soft mallet.**



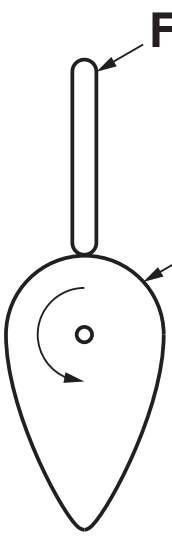


(i) **Complete the statement below by adding the missing terms.** **[2]**

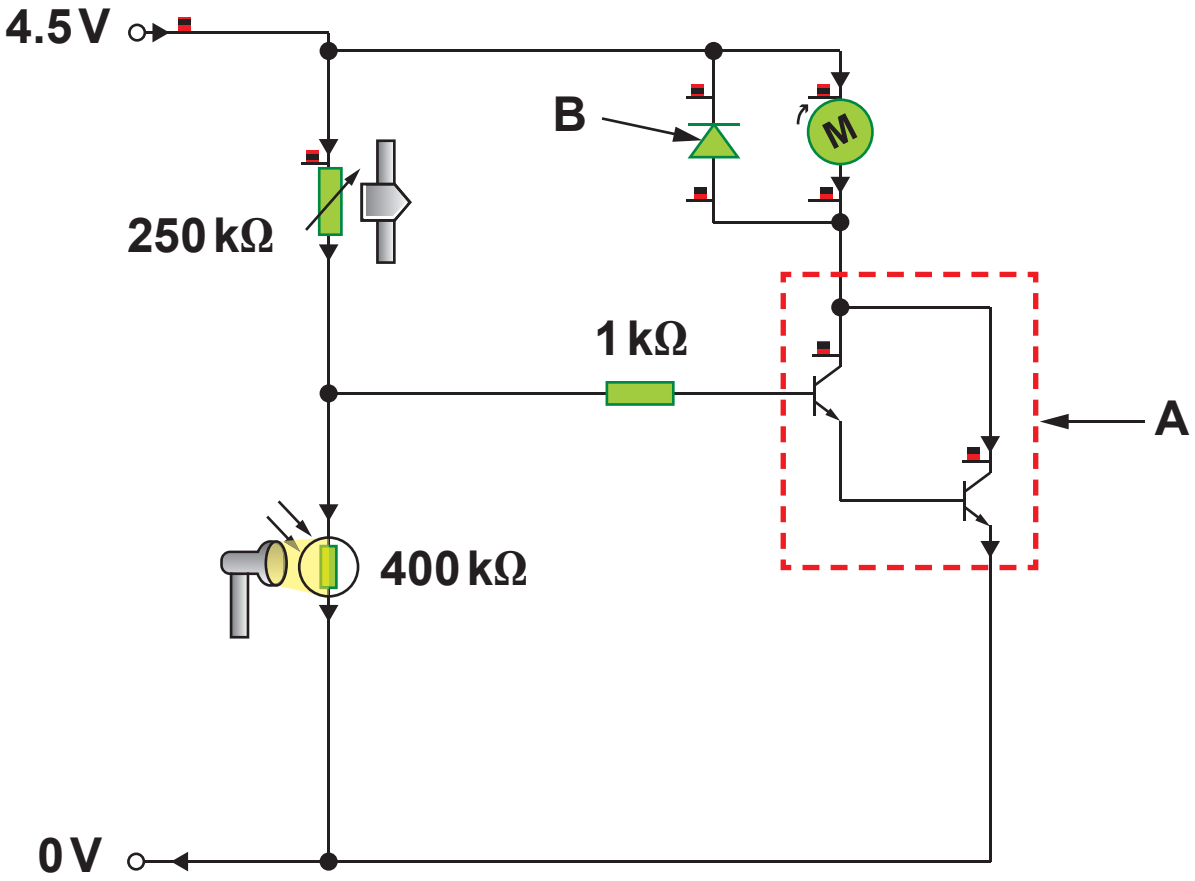
The cam and follower converts _____

motion to _____ **motion.**

6(b) (ii) **Explain what happens to the follower shown opposite as the cam turns through 90 degree stages anticlockwise.**
(0 – 90 degrees has been done for you.)

Start position 0 - 90 degrees	Second stage 90 – 180 degrees	Third stage 180 – 270 degrees	Fourth stage 270 – 360 degrees
			
As the cam turns 90 degrees anticlockwise the follower dwells in the same position.	[1]	[1]	[1]

6(c) Study the circuit below.



(i) State the name of the arrangement of the components in box **A**. [1]

(ii) Explain the importance of the component labelled **B**. [2]

6(c) (iii) Describe in detail how this circuit functions as light levels drop. [3]

7. This question is about Tools, Equipment and Making. It is worth a total of 20 marks.

(a) (i) From the list below, insert the correct terms for the workshop equipment shown. 3 x [1]

PILLAR DRILL DISC SANDER LASER CUTTER

VACUUM FORMER POWER SUPPLY UNIT

PICTURE A	PICTURE B	PICTURE C
		
_____	_____	_____

7(a) (ii) Describe ONE safety rule when working with the equipment in PICTURE B. [2]

(iii) Describe ONE potential hazard when using the equipment in PICTURE C. [2]

7(b) (i) Name the THREE different units a digital multimeter can be used to measure. 3 x [1]

I. _____

II. _____

III. _____

(ii) A digital multimeter can also be used for continuity testing. Describe how this test is carried out. [2]

_____

_____

_____

_____

_____

_____

7(c) **A student has made the mp3 speaker system shown below.**

Front panel

Top

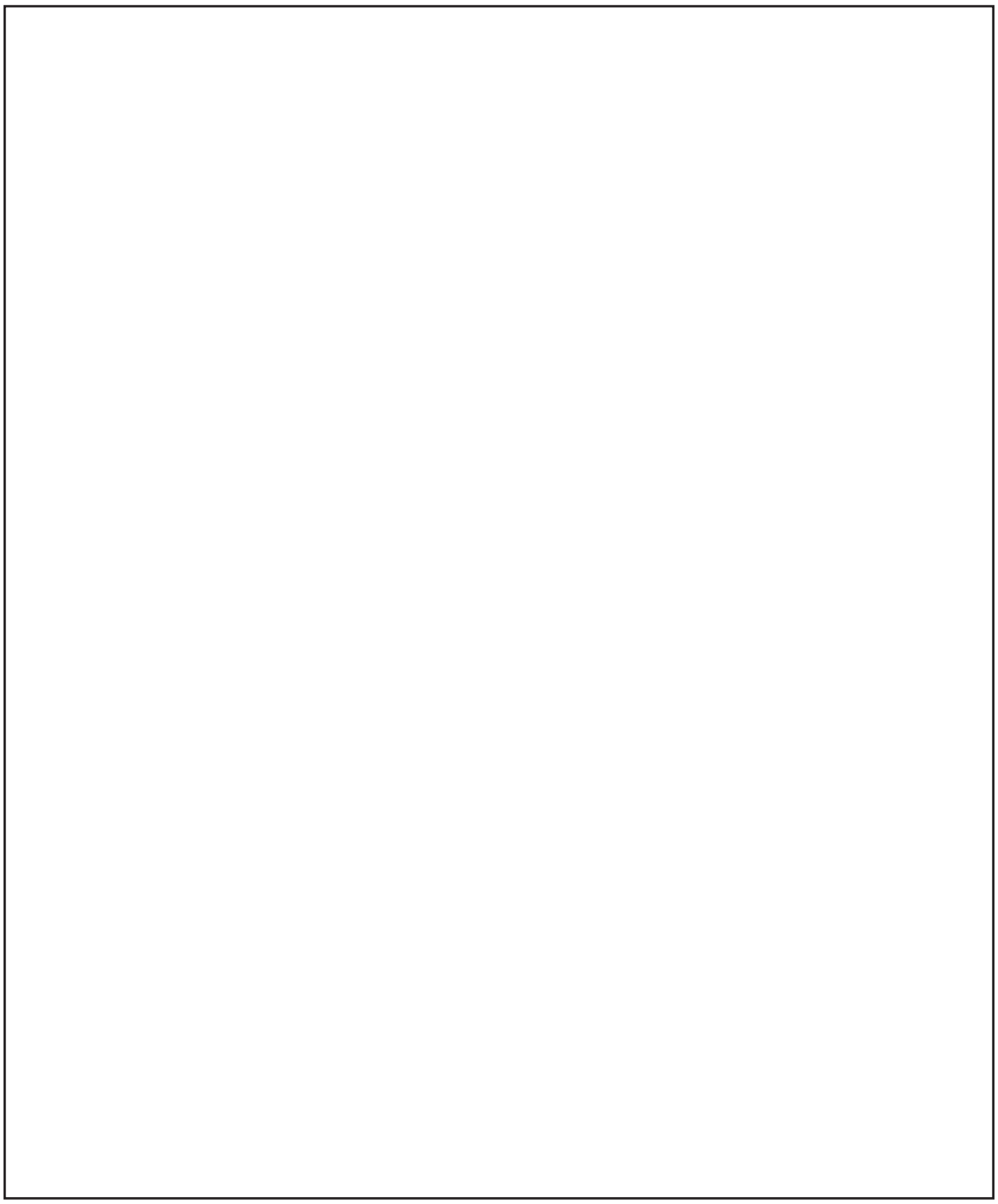
Inside with the back removed

(i) **Name a suitable softwood to make the main box.** **[1]**

(ii) **Name a suitable plastic material to make the front panel.** **[1]**

(iii) **Describe how the detail on top of the speaker system has been applied, naming the equipment needed.** **[2]**

7(c) (iv) **The circuit board and battery are left loosely inside the product. Using notes and sketches, show how the circuit board AND battery could be held securely. [4]**
(NAME THE EQUIPMENT AND MATERIALS USED.)



8. **This question is about ICT, CAD, CAM, Systems and Processes. It is worth a total of 15 marks.**

(a) **The pet feeder shown below allows one portion of food to be dispensed every 6 hours if the food tray is less than half full. When the food hopper is empty a buzzer sounds to alert the pet owner to refill the hopper with food.**

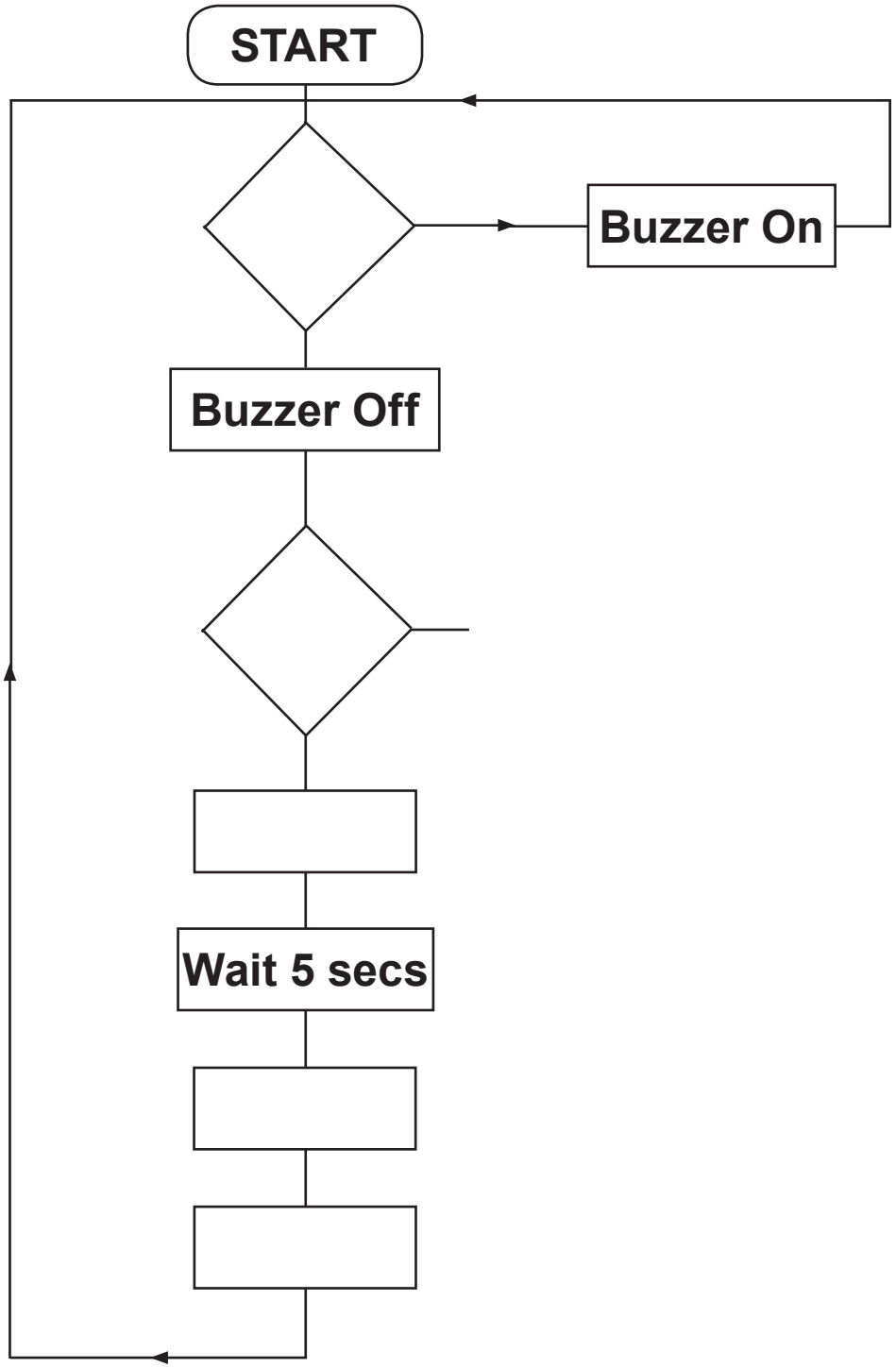
Complete the table below by placing a TICK (✓) to show whether the statement is true or false. [2]

STATEMENT	TRUE	FALSE
The LCD display is a digital output device.		
The buzzer is an output of the system.		

8(b) The flowchart below shows how the pet feeder is controlled.

(i) Complete the flowchart opposite by placing the statements in the correct positions and adding any missing feedback loops. [6]

(ii) Explain ONE problem that might arise if the flowchart opposite is used for the control system. [2]



STATEMENTS
Wait 6 hours
Is food tray less than half full?
Is food hopper empty?
Close Hopper
Open Hopper

8(c) A programmable interface controller (PIC) is used to control the pet feeder. Describe the stages when programming a PIC. [3]

STAGE 1	STAGE 2	STAGE 3

(d) Explain in detail why a programmable interface controller (PIC) is a suitable component to control the pet feeder. [2]

END OF PAPER

FOR CONTINUATION ONLY.