

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA**SECONDARY EDUCATION CERTIFICATE LEVEL****SPECIMEN PAPER****MAY 2019 SESSION**

SUBJECT:	Design and Technology
PAPER NUMBER:	IIA SPECIMEN PAPER
DATE:	2019
TIME:	xx

Answer **ALL THREE** Sections.

Section A: Core Design and Technology Principles	20 marks
Section B: Design Aspect	25 marks
Section C: Technology Aspect	55 marks

READ carefully the Theme and Situation of this paper: (Reference will be made in all sections)

Theme: Cultural Displays

Situation: The idea of celebrating history and culture in our country has led to the development of various museum spaces. These spaces are also a meeting place where people create new ideas. A new Maltese museum requires ideas and designs for various needs it encounters. The museum will have 3 wings, each covering one of these categories: Toy Design, Local Inventions and Luxury Products Design.

The name of the museum is '*CREATE*' and is aimed at people of all ages and cultures.

Useful Information:

Non-programmable calculators are allowed.

Useful formulae:

Gear Ratio: $\frac{\text{Number of Teeth on driven gear}}{\text{Number of Teeth on driver gear}}$

DO NOT WRITE ABOVE THIS LINE

SECTION A: Core Design & Technology Principles**Read carefully the Situation presented on page 1.****Question 1: Underline the correct answer**

- a. Identify a **keyword/phrase** in the following sentence from the given situation: (underline)

‘A new Maltese museum requires ideas and designs for various needs it encountered’

1 mark

- b. Choose which of these lists best describes some of the main areas of **research** you could explore in this situation:

- i. Archaeology, hirographs and papyrus
- ii. Display cabinets, lights and information signs.
- iii. Popular antiques, storage and lights

1 mark

- c. Which list best describes ways to gather information about what users want to see in a museum:

- i. Interview historians, news reporters, watch a quiz show.
- ii. Observe people, questionnaires in schools , hire an investigator.
- iii. Questionnaires to different people, observe a similar museum, research online.

1 mark

- d. Which of these is **NOT** a way of modelling ideas in a design project.

- i. writing the design brief
- ii. cardboard modelling
- iii. circuit simulation on breadboard

1 mark

- e. Which components / materials listed are best suited for an illuminated **outdoor museum sign**:

- i. Mild steel, softwood and smart materials
- ii. Corrugated board, glass and circuits with exposed copper wires
- iii. Stainless steel, thermoplastic sheets and low voltage LED lights.

1 mark

Question 2: Fill in the blanks

a. Mention ONE thermosetting plastic:

1 mark

b. Mention ONE mechanism that produces reciprocating motion:

1 mark

c. Name ONE material that can be purchased in a pipe standard form:

1 mark

d. Mention ONE electronic component that is polarised:

1 mark

Question 3: Select the correct answer/s with a tick (✓):

Look carefully at some of the images which were researched for the Situation on page 1.

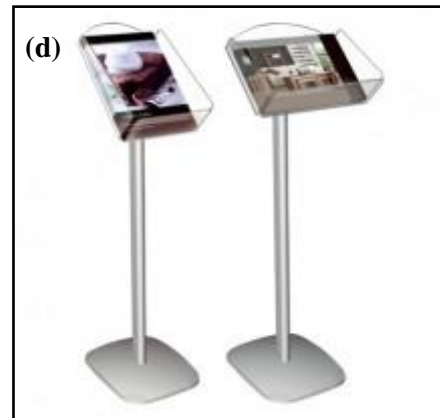
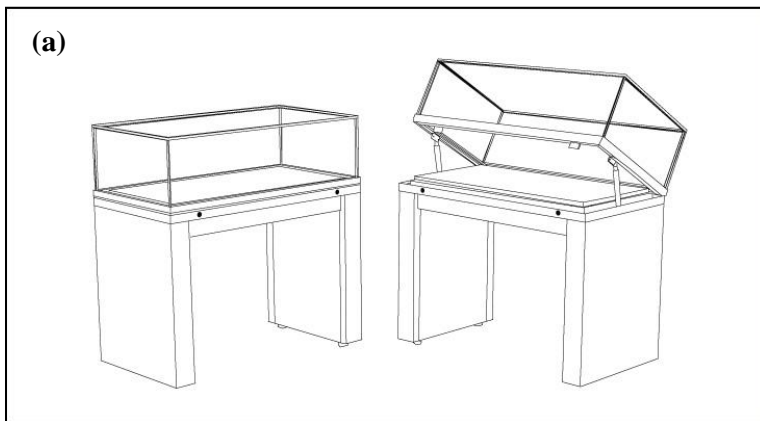


Figure A

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a. Which of the image in Figure A shows a revolving display base.

a	b	c	d

1 mark

b. Which image in Figure A shows a hinge mechanism?

a	b	c	d

1 mark

c. Which image in Figure A shows a display case that could best be manufactured as 'one-off'?

a	b	c	d

1 mark

Question 4: Look carefully at the following Figure B.

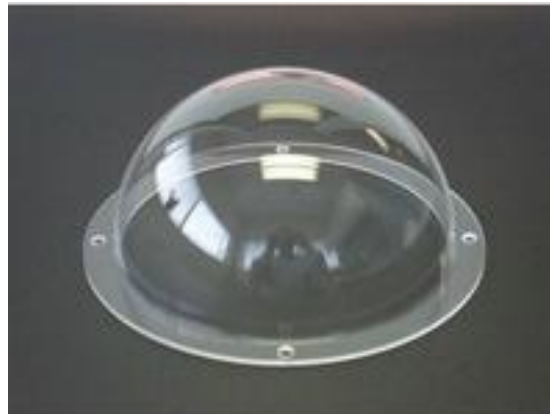


Figure B

a. Which type (name and classification) of polymer could be used to produce the shown hemispheric polymer case?

name: _____ classification: _____ .

2 marks

b. What process could be used to achieve the dome shape shown in Figure B?





1 mark

c. What type of structure is the one shown in the Figure B?

1 mark

Question 5

a. Fill in the table by naming the components shown.

Component				
Name				

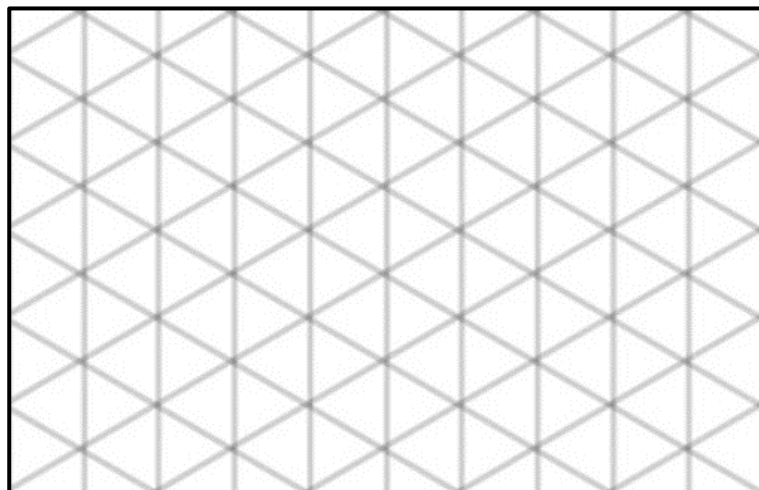
2 marks

b. Draw the schematic symbol for one of the above components. Name again the chosen components.

SYMBOL	
NAME	

1 mark

c. Sketch a 2 x 2 CUBE in 3D isometric view using the grid below:



1 mark

DO NOT WRITE ABOVE THIS LINE

SECTION B: DESIGN ASPECT

Read carefully the situation presented on page 1.

Underline ONE of the three museum wings listed in the situation which you would like to select in order to answer parts of this section.

- **Toy Design**
- **Local Inventions**
- **Luxury Product Design**

Question 1

In the space below, DRAW a sketch of **ONE item** which could be displayed in the museum wing you have selected. On your 3D sketch label 3 main parts and 2 materials.

3 marks

Question 2

a. Complete the DESIGN BRIEF given for the design of a showcase that will display one main attraction item in your selected museum wing. Mention (i) what the item is and where the display will be used, (ii) at least ONE important aesthetic requirement and (iii) ONE additional feature.

i. Design and make _____
_____.

ii. This needs to be _____
_____.

iii. The showcase needs to feature _____
_____.

3 marks

DO NOT WRITE ABOVE THIS LINE

b. Read the following specification list which were developed for a similar showcase to the above design brief. Complete the list by suggesting ONE other design specification.

1. *Dimensions and Form factors : The display case needs to have a geometric shape and must not exceed 25cm x 25 cm x 25 cm (LxBxH).*

2. *A see-through, clear polymer material shall be used at least for the front side of the display.*

3. _____

_____ **1 mark**

c. Propose and sketch TWO different Ideas for the museum display showcase, according to the information discussed above. *Marks will be awarded for: realistic and effective design, graphic techniques, presentation, annotations, dimensions and innovation. You may divide the space as required or give more prominence to ONE idea compared to the other.*

Idea 1



DO NOT WRITE ABOVE THIS LINE

Idea 2

7 marks

Question 3

- a. Two important aspects required by the museum are SECURITY and AESTHETICS. Write suitable feature suggestions, combining the domain listed in the first column, with the given aspect in the second column, as shown in the example.

Domain	Aspect	Feature Suggestion
Textiles	AESTHETIC	<i>A felt material under the exhibit item for visual contrast.</i>
Electronics	AESTHETIC	
Electronics	SECURITY	
Mechanism	SECURITY	

3 marks

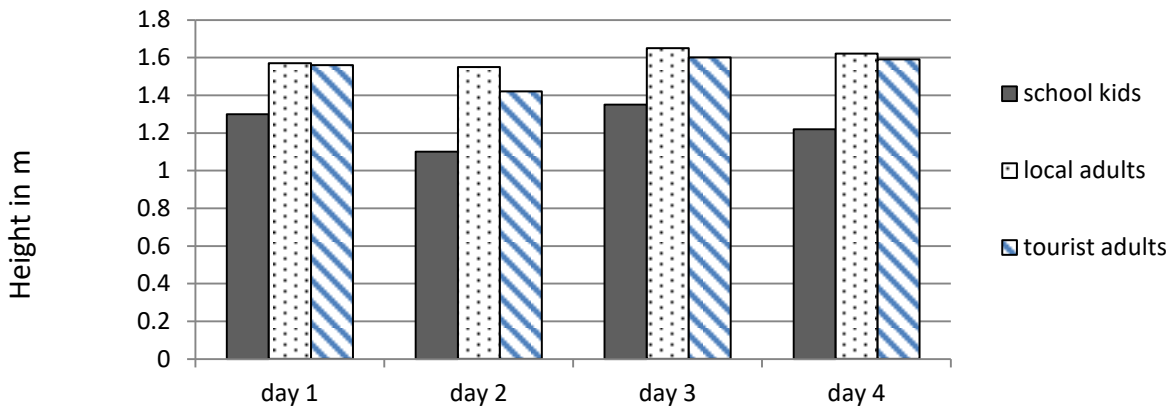
- b. The museum requires every item on display to be illuminated. Describe suitable advantages and disadvantages of this choice to the following stakeholders:

	Advantage	Disadvantage
display designer		
museum owners		

2 marks

Question 4

The following data shows the height of 3 categories of visitors, who visited a similar museum displaying items similar to the one you selected on 4 different days. The item is of interest to all people visiting.



a. Would it be appropriate if the item being displayed is placed at a height of 1.4m? Give a reason for your answer.

3 marks

b. Mention ONE minority group/category that was not considered when recording this data but that would significantly reduce the average minimum height of visitors.

1 mark

c. During a peer review, the following feedback was collected.

- (a) *“too colourful”*
- (b) *“did not help me understand the item being displayed”*
- (c) *“very elegant”*
- (d) *“could be simpler”*
- (e) *“very original”*
- (f) *“does not appeal at all to adult visitors”*

Identify which of the above comments can be considered as:

i. a positive comment: _____

ii. constructive criticism: _____

2 marks

SECTION C: TECHNOLOGY ASPECT

Question 1

- a. The materials used for a bench in the museum need to be durable and strong. Define each of the TWO material properties.

DURABILITY	
STRENGTH	

2 marks

- b. Complete the grid below by filling the two missing columns based on the first column.

Material type	Material Class	Material Name
Metals	<i>Ferrous</i>	<i>Cast Iron</i>
Textiles		
Woods		

4 marks

Question 2

Figure C explains a particular manufacturing process used to make certain standard forms of metals and plastics.

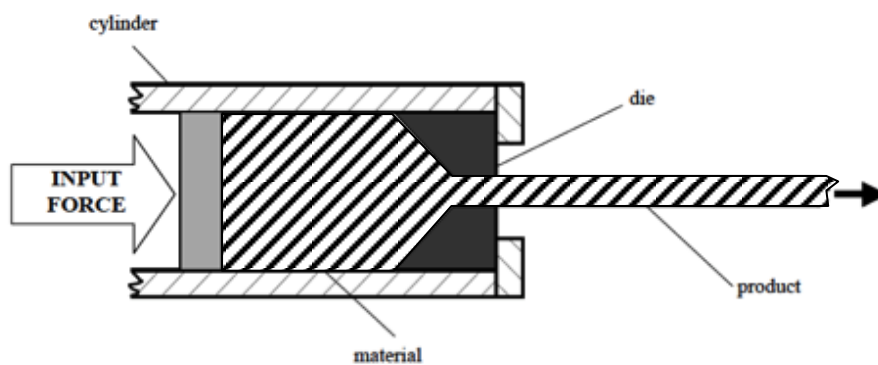


Figure C

- a. Give the name of the manufacturing process shown in Figure C.

1 mark

DO NOT WRITE ABOVE THIS LINE

b. Fill in the blanks to explain how this process works.

A material inside a cylinder is forced through a die to produce a _____ profile of particular _____-section. Examples of objects manufactured by this process include: _____ and _____.

2 marks

c. Give ONE explanation for each of the following statements.

i. The process shown in Figure C can be applied on malleable metals.

ii. Thermoplastics can be manufactured by the process shown in Figure C more than once.

2 marks

d. Describe the process of vacuum forming in FOUR steps.

Step 1:

Step 2:

Step 3:

Step 4:

4 marks

e. A pattern of a chocolate tray needs to be made.

i. Suggest a suitable materials for the pattern to be made of.

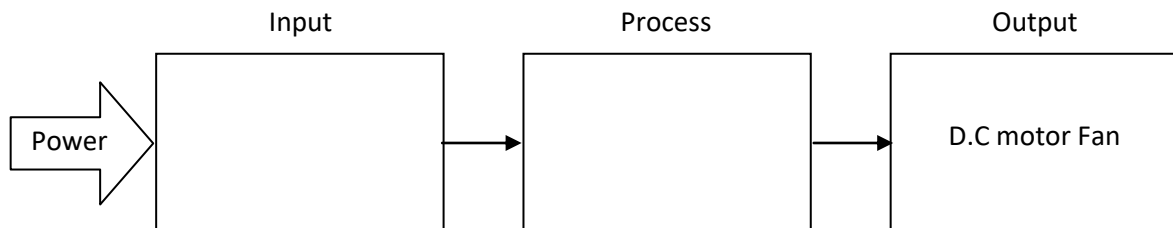
ii. Give a reason for your answer.

2 marks

Question 3

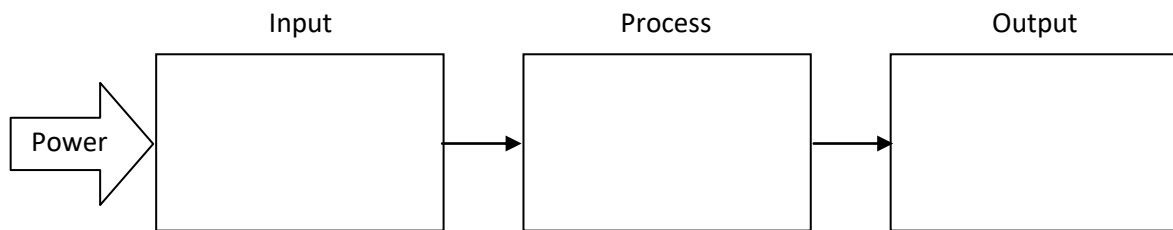
- a. Some particularly heat sensitive items might be displayed in one of the museum’s display cases. It is required that the internal temperature is kept constant all the time. This could be achieved with a temperature control forced ventilation system (e.g. a d.c. motor fan).

Complete the system block diagram below, that will lead to the design of an electronic circuit which can be switched on automatically when heat is sensed.



2 marks

- b. Illustrate a typical example of a feedback loop in the diagram below (draw required connectors):



2 marks

Question 4.

- a. Mention an application for the following mechanical system, stating the type of movement involved:

	(Toothed) Belt and Pulley system
Application	
Input movement	
Output movement	

2 marks

DO NOT WRITE ABOVE THIS LINE

b. Figure D shows a **Gear train**. Gear A = 12 teeth, B = 8 teeth, C = 24 teeth.

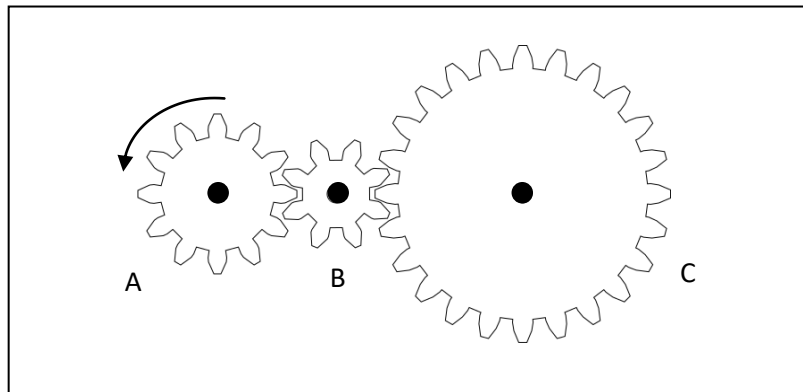



Figure D

- i. Given that gear A is the driver of this mechanism, draw the direction of gear C. **1 mark**
- ii. Calculate the gear ratio between gear A and B.

2 marks

Question 5.

a) Complete the truth table for the NAND gate.

		
A	B	Output Y
0	1	
0	0	
1	1	
1	0	

2 marks

b) Describe the functions of the following components in circuits

(i) Transistor

_____.

(ii) Potentiometer

_____.

2 marks

Question 6

In the Toy Design museum wing, a toy robot attraction shall greet visitors. This robot’s jaw constantly moves up and down. Figure E shows the internal mechanism which controls the movement of the robot’s jaw. The input force is generated by a d.c. motor.

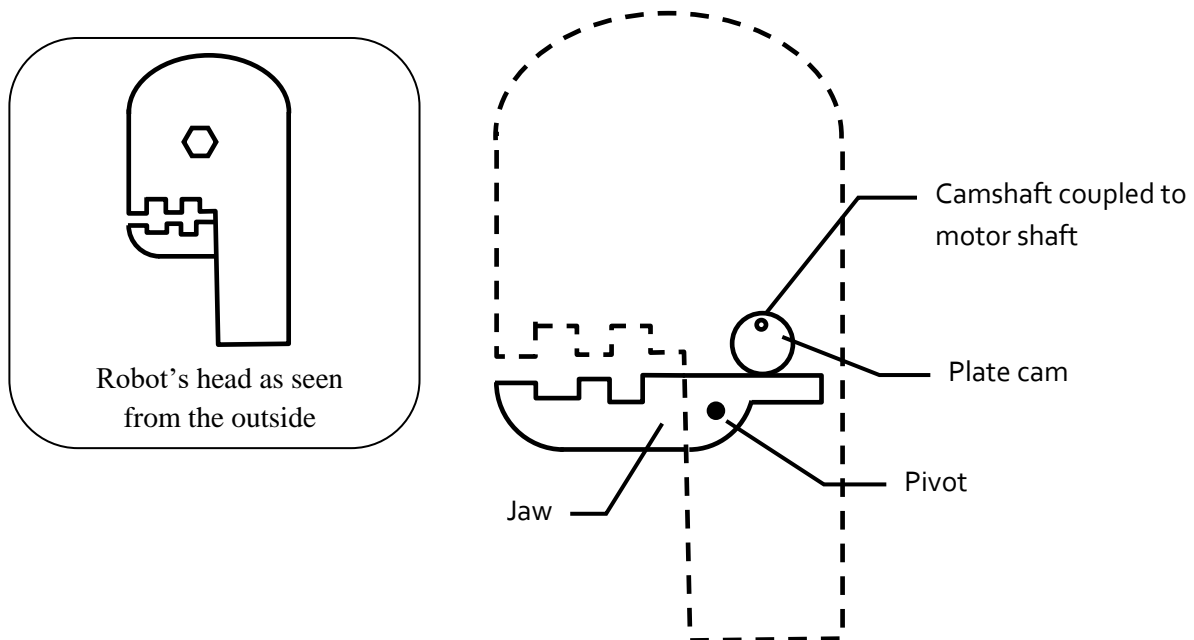


Figure E:

a. Name another mechanism shown in Figure E apart from cams.

1 mark

b. On Figure E, add arrows to show the movement of the INPUT and OUTPUT mechanisms. Label the arrows you draw.

2 marks

c. Give the name of the plate cam profile shown in Figure E.

1 mark

Question 7

A company that specialises in bicycle safety equipment is designing a new device with continuous flashing LEDs using the NE555.

a. Why is an NE555 used in this circuit?

1 mark

DO NOT WRITE ABOVE THIS LINE

b. The circuit in Figure F shows only one LED connected to the output lead of the NE555. On Figure F, **DRAW** a second LED that will light alternately to LED 1 (when LED1 is off LED 2 is on, and when LED 1 is on LED 2 is off)

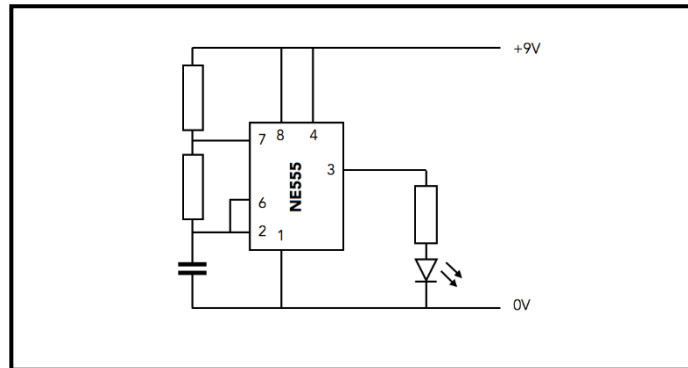


Figure F

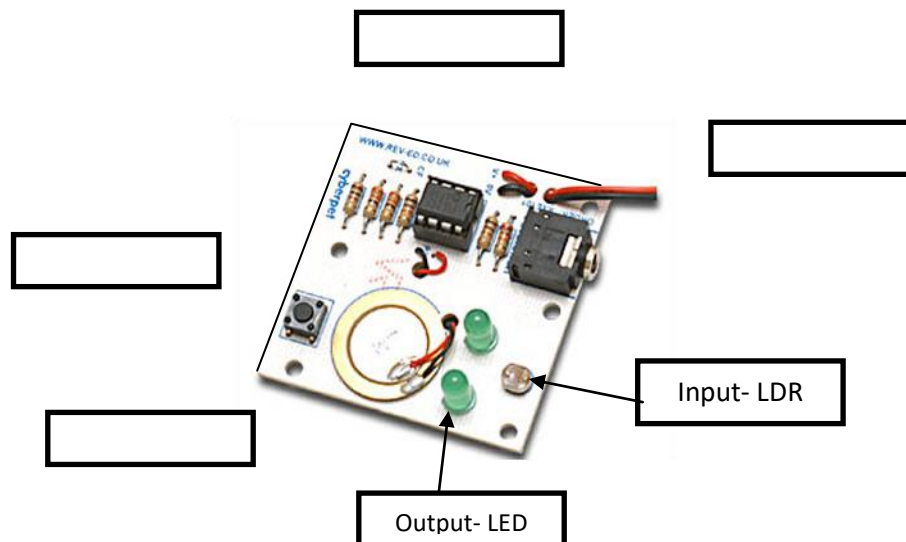
2 marks

Question 8

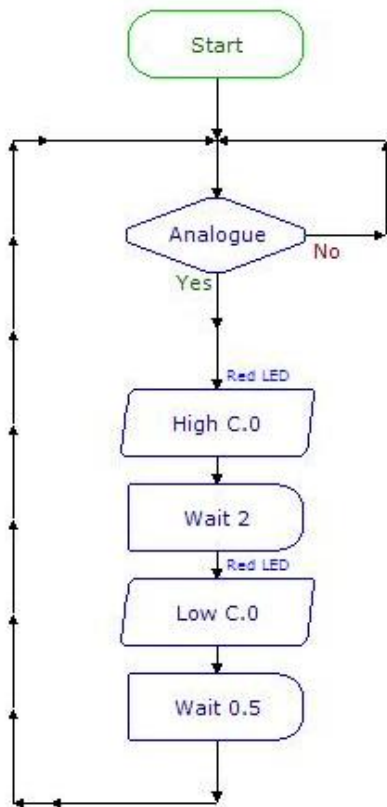
An interactive area in the museum will let preschool kids play with an electronic shape sorter which works with a microcontroller circuit. The device flashes LEDs when a solid shape is placed correctly on the input switch, in the slot provided. When removed, the switch is off.

a. The image below shows a circuit which includes a microcontroller. Identify and name the input, the output, the supply and the microcontroller IC and indicate by using arrows where they are placed on the given PCB. 2 examples have been given.

4 marks



b. Figure G shows a simple programme in a flow chart format.



Note: code C.O. on the flow chart refers to I output pin in the circuit. Other units are standard time units in seconds.

- i. How long the Red LED would stays ON when the input is high? _____
- ii. How long the Red LED would stays OFF when the input is high? _____
- iii. If you have to increase the flashing rate time, what would you change from the given flow chart?

- iv. What happens when you keep pressing the analogue input? _____

4 mark

Figure G

c. Describe the advantages of using a microcontroller instead of using discrete components in a circuit.

2 marks

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Question 9

The Museum's management needs a new logo for the museum to help send the message to prospective visitors that their exhibit focuses on innovation, ideas and design.

- a. In the space provided below, sketch two different logos, which include a symbol and "CREATE", the name of the museum.

Sketch 1



Sketch 2

**4 marks**

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Figure H shows a brochure holder, which is usually placed on the Museum’s counter.

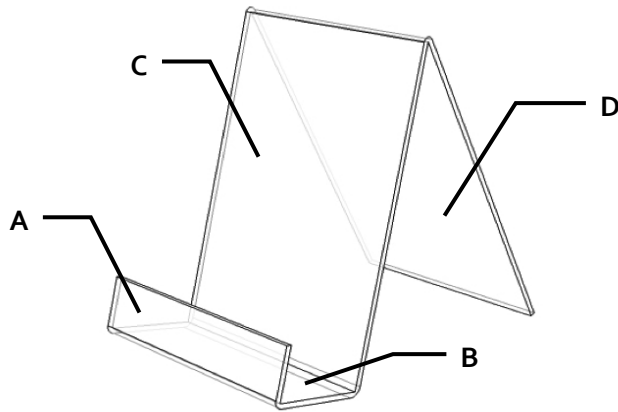
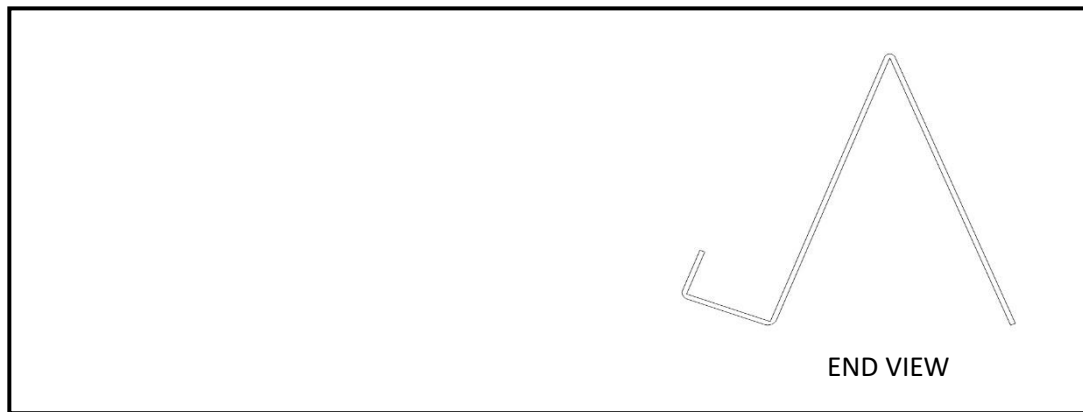


Figure H

b. From the given end view, draw freehand the front view of the brochure holder.



2 marks

c. From the options below select the appropriate net needed, to be produced the brochure holder shown in figure H.

<input type="checkbox"/>	A	B	C	D
<input type="checkbox"/>	A	B	C	D
<input type="checkbox"/>	A	B	C	D