



L-Università
ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION**

SUBJECT:	Design and Technology
PAPER NUMBER:	IIA
DATE:	30 th April 2019
TIME:	9:00 a.m. to 11:05 a.m.

Instructions

Answer **ALL** questions in **ALL** sections.

Non-programmable calculators are allowed.

Coloured pencils or markers may be used for sketches.

Useful Information

Formula:

$$V_{\text{OUT}} = \frac{R_2}{R_1 + R_2} (V_{\text{IN}})$$

$$\text{Velocity (Gear) Ratio} = \frac{\text{speed of input}}{\text{speed of output}} = \frac{\text{diameter of output}}{\text{diameter of input}}$$

READ the following theme and situation carefully before answering this paper.

Theme: Retail along the Coast

Situation: Increased activity along the coast, including tourism, has led to an increase of demand for beach side kiosks. Interested entrepreneurs need to find creative ways to display and sell particular products, such as food and beverage, beach accessories, personal care products, etc.

SECTION A: Core Design & Technology Principles

1. Underline **ONE** correct answer from the given selection following each question below.
 - a. 'Interested entrepreneurs need to find creative ways to display and sell particular products'. This statement describes:
 - i. a needy person.
 - ii. a solution.
 - iii. the problem. (1)
 - b. The context of this situation suggests that the mentioned kiosk must be:
 - i. good for underwater and boat cruises.
 - ii. a souvenir kiosk.
 - iii. suitable for beach side weather conditions. (1)
 - c. It would help to know what needs to be sold in this kiosk because:
 - i. the designer makes products nicer.
 - ii. we need to develop specifications that help to make these products appealing.
 - iii. the specifications of the design brief are less important than the products. (1)
 - d. Two materials which are suitable for long lasting outdoor furniture are:
 - i. GRP and MDF.
 - ii. PVC and Expanded Polystyrene.
 - iii. Aluminium and GRP. (1)
 - e. When analysing the following products, which of them is typically a one-off production?
 - i. Plastic Sunglasses (without lenses).
 - ii. Glass sunglasses with a lens to aid an individual's eyesight.
 - iii. Beach towel with images of Malta. (1)

(Total: 5 marks)

2. Sketch the following in the spaces provided below:

- a. a symbol for a pulley in 2D. (1)
- b. a scribe marking tool. (1)
- c. the symbol of a polarised capacitor. (1)

a.	b.	c.
----	----	----

(Total: 3 marks)

3. Tick with a '✓' whether the following are True or False.

- | | True | False |
|-------------------------------------------------------------------|--------------------------|--------------------------|
| a. A dovetail joint is used to join mild steel metal permanently. | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Reciprocating motion is a type of rotary motion. | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Brass is a non-Ferrous metal. | <input type="checkbox"/> | <input type="checkbox"/> |

(Total: 3 marks)

4. Figure A shows orthographic views of a sun-cream container that may be sold on a mobile kiosk. On figure A below, estimate and draw the outside diameter and overall length in millimetres of the sun-cream container below. Figure A is not to scale.

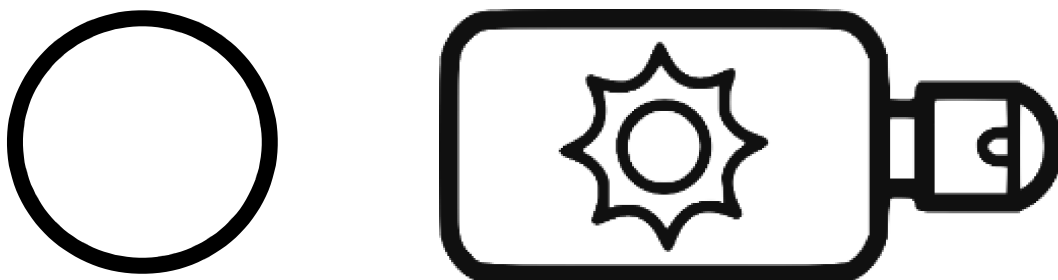


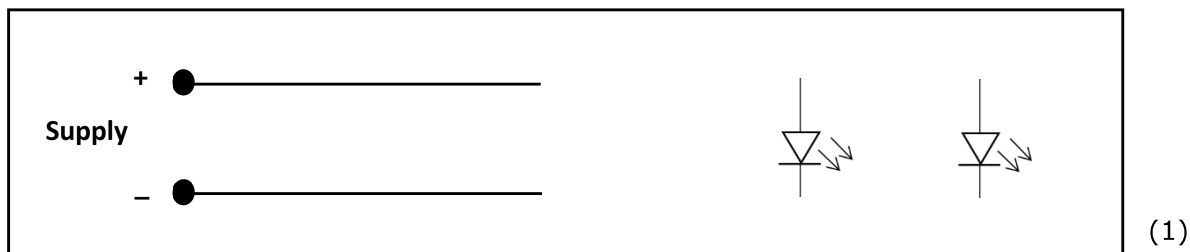
Figure A

(Total: 2 marks)

Please turn the page.

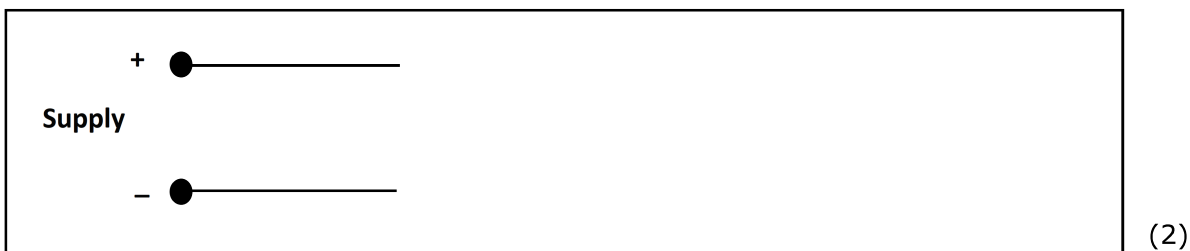
5. Complete the following electronic circuits to obtain the desired output/s:

a. Two LEDs wired in parallel directly to the supply:



(1)

b. A SPDT switch controlling two LEDs directly from the supply:



(2)

c. A buzzer controlled by a normally-open push switch:



(1)

d. Circle **TWO** pins from the IC shown in Figure B which can be connected to an analogue output.

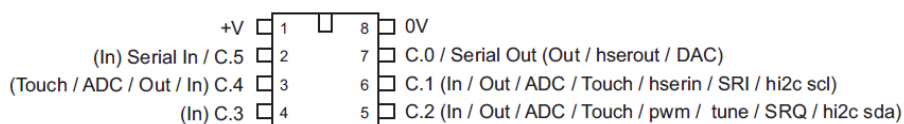


Figure B

(1)

(Total: 5 marks)

6. Mention **TWO** different types of structures and give an example of each.

Type of Structure	Example
(1/2)	(1/2)
(1/2)	(1/2)

(Total: 2 marks)

SECTION B: Design Aspect

7. Refer to the situation on page 2.

a. Other than the designer and the entrepreneurs, identify **TWO** key stakeholders.

(1)

b. Describe in which way the two stakeholders you identified in (a) above may influence your design.

(2)

(Total: 3 marks)

8. Figure C shows last summer’s sales for a number of products that a particular entrepreneur sells. The entrepreneur would like a small, temporary and movable display suitable for a kiosk, to boost the sales of the two least popular items.

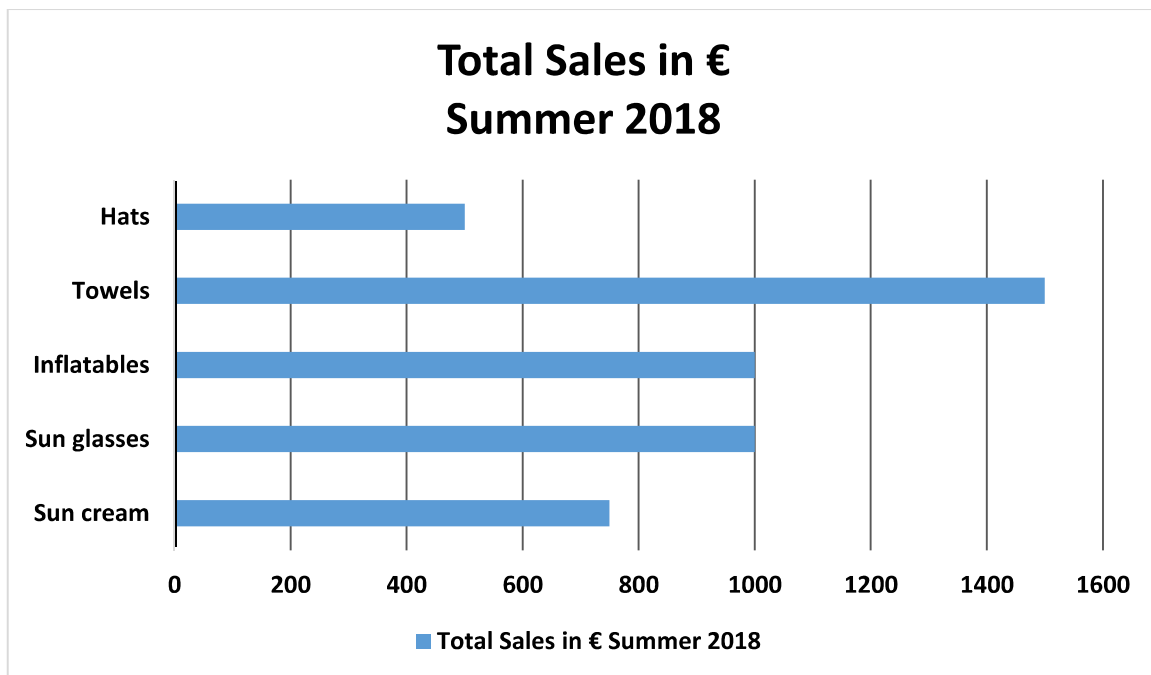


Figure C: Sales in 2018

a. List **TWO** key pieces of information that the designer needs, to be able to design such a display.

(1)

This question continues on next page.

b. Other than the internet, mention **TWO** research tools the designer can use to obtain the information in the chart.

(1)

c. Write a suitable brief for the situation identified in question 8, by this entrepreneur.

(2)

(Total: 4 marks)

9. Sketch **TWO** different ideas for the brief you have written above, including dimensions and annotations.

Idea 1

(5)

Idea 2

(5)

(Total: 10 marks)

Please turn the page.

10. Choose **ONE** idea from those sketched in Question 9, by ticking one of the boxes below.
(Tick ✓)

- Idea 1 Idea 2

a. Evaluate your idea based on its environmental sustainability through **ONE** advantage and **ONE** disadvantage.

(2)

b. Describe a possible improvement to your chosen idea to cater for a further specification which you would add and was not listed in the situation. You may choose to sketch and/or write the answer.

(2)

c. Suggest **TWO** effective ways to present your design ideas to an audience.

(1)

d. Plan the making of your chosen design by using the Gantt chart below. Break down the making by completing a minimum of **THREE** other processes and their timeline, in addition to the first process which has already been done for you.

	Timeline (e.g. Hours/Lessons/days)										
Processes:											
Planning project											

(3)

(Total: 8 marks)

SECTION C: Technology aspect

11. Figure D shows an idea of a temporary portable kiosk. The six plastic pipes making up the structure are made up of two pipes connected with a bent plastic rod which is thermoformed.

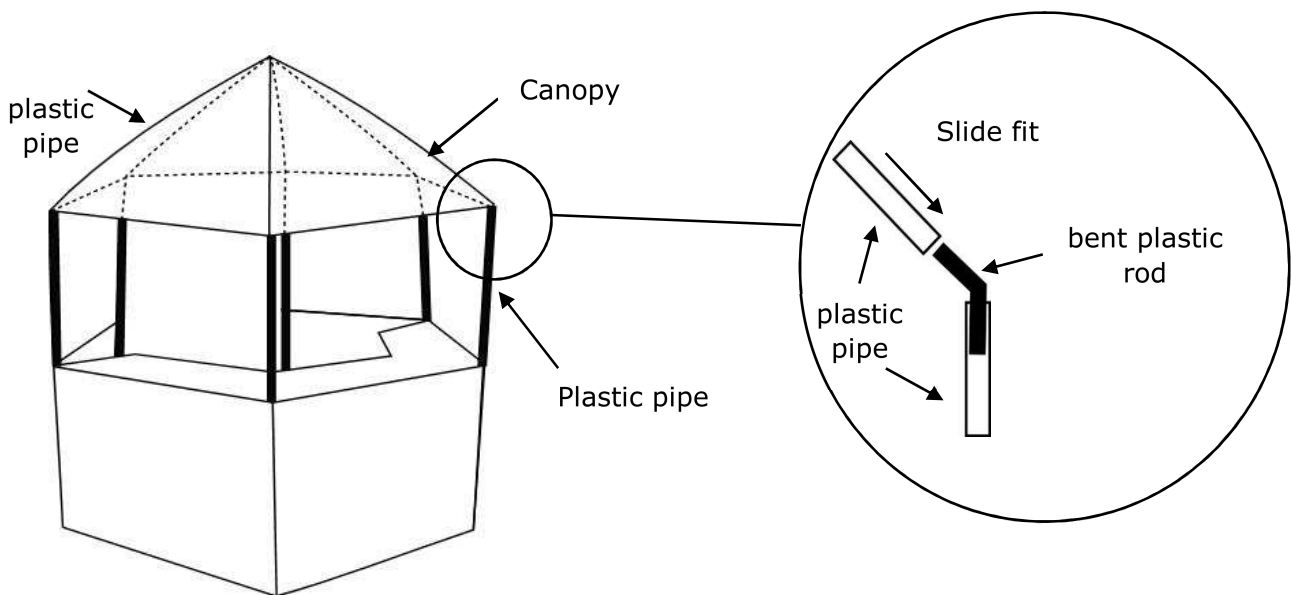


Figure D: Temporary portable kiosk

This question continues on next page.

a. In the space below describe how to carry out the following processes, including tools needed for:

i. Marking out the correct length of the plastic pipes:

(2)

ii. Bending the six plastic rod connectors to the correct angle:

(3)

b. Write **TWO** safety precautions that should be observed while following the thermoforming process mentioned above.

(1)

c. A piece of textile material is used for the kiosk’s canopy.

i. Mention a polymer based fibre which is waterproof.

(1)

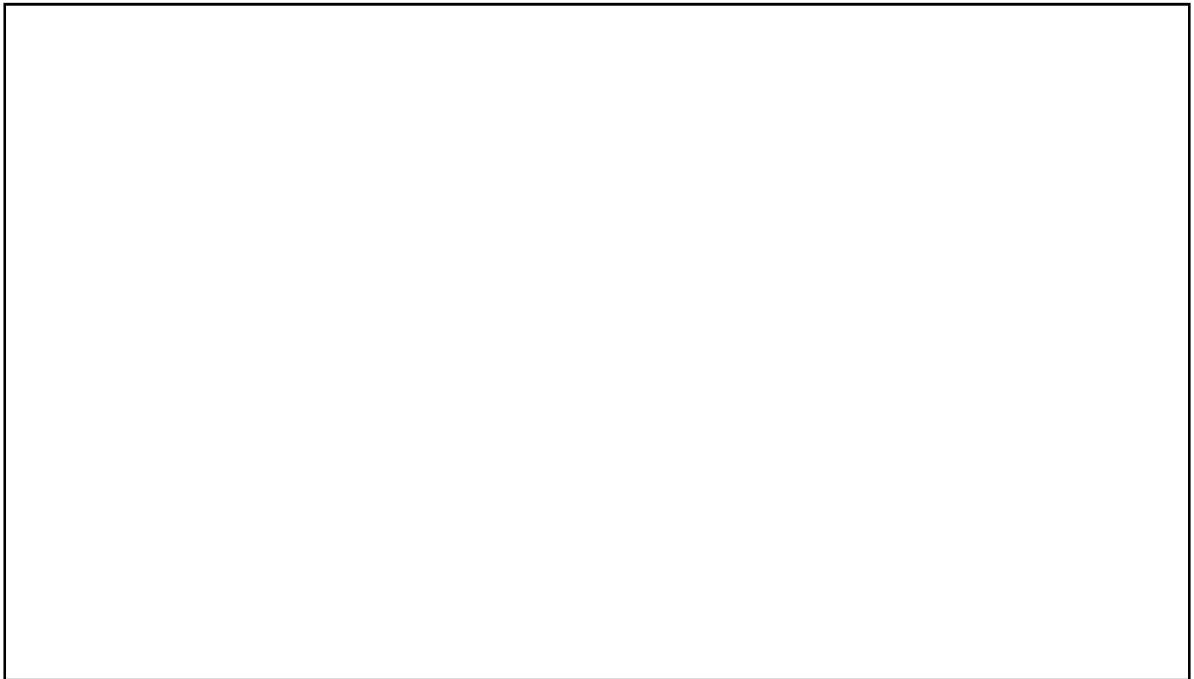
ii. State **ONE** reason, other than water resistance, to justify why a textile material is suitable for this kiosk canopy.

(1)

iii. Mention **TWO** fastening methods which are suitable to assemble and disassemble the textile material with the plastic pipe.

(1)

- iv. Choose **ONE** of the fastening methods mentioned in Question 11c(iii) and in the space provided below sketch the fastener and how it is applied to the plastic pipe and the textile material. Add annotations. (4)



(Total: 13 marks)

12. Sketch a proportionate 2D surface geometrical net of the kiosk's canopy shown in Figure D.



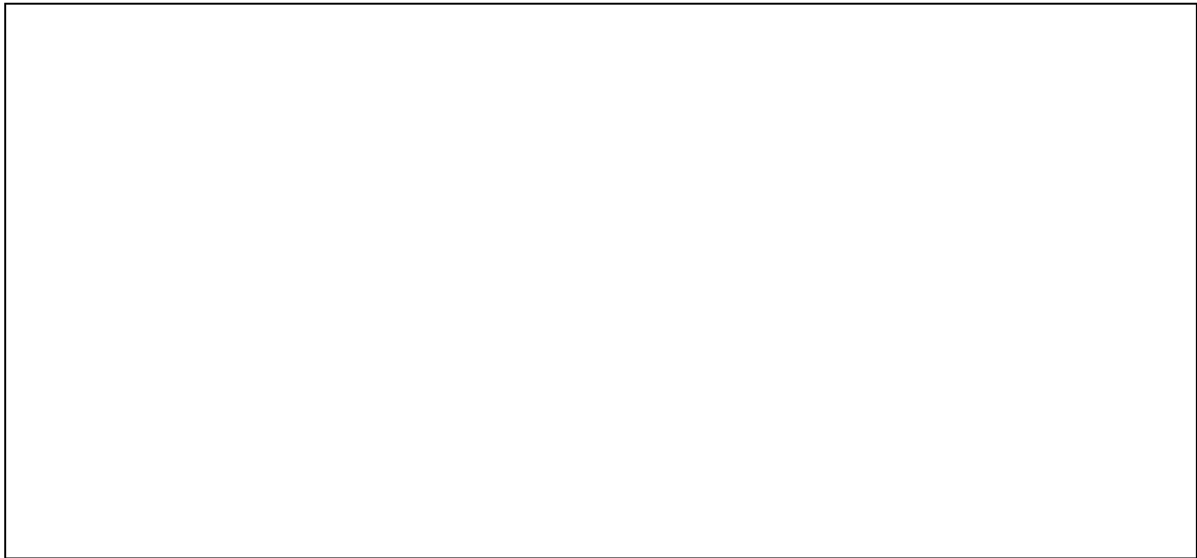
(Total: 3 marks)

Please turn the page.

13. The designer of the kiosk shown in Figure D (on page 9), added a lighting feature so as to make it more effective when there is darkness. This lighting feature switches on automatically only when both of the following conditions are achieved:

**It is dark
AND
The attendant is inside the kiosk**

a. In the space provided below, draw a block diagram to describe how such a system can work. Organise your diagram through INPUT, PROCESS and OUTPUT stages.



(4)

b. Figure E shows one possible electronic circuit for one of the inputs.

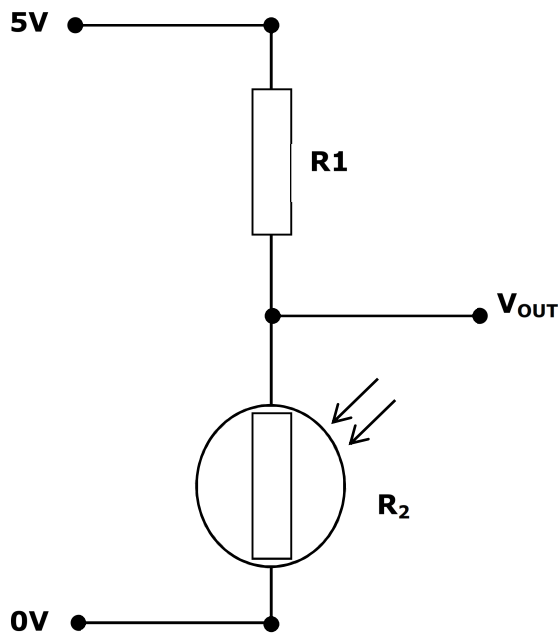


Figure E

i. Give the name of the circuit configuration shown in Figure E.

(1)

ii. Explain the function of component R_2 in the circuit shown in Figure E.

(1)

c. Figure F shows the readings for component R_2 at different times during a particular evening.

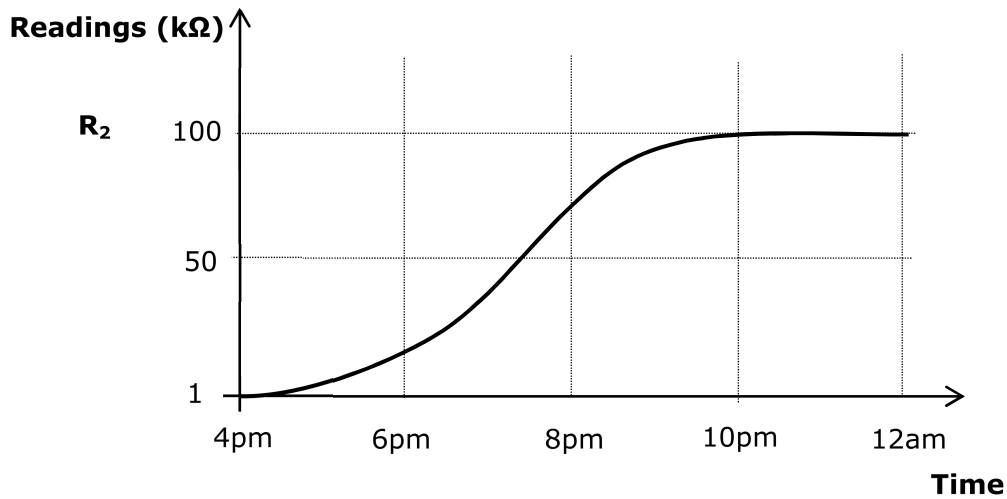


Figure F: Readings for component R_2 at different time during an evening

Calculate, using Figure E and F, the value of R_1 so that V_{OUT} is 1V when maximum darkness is reached.

(3)

d. Suggest a modification for the circuit shown in Figure E that enables reaching an output of 1V at different times in the evening, even when it is dark, keeping R2 in the circuit. Justify your answer.

Modification	<hr/> <hr/> <p style="text-align: right;">(1)</p>
Reason	<hr/> <hr/> <p style="text-align: right;">(1)</p>

(Total: 11 marks)

14. A designer found that RGB LED units (Red[R], Green[G], Blue[B]) are suitable to obtain colour changing light output for kiosks. Such LED units are made from three differently coloured LEDs having a common cathode as shown in Figure G.

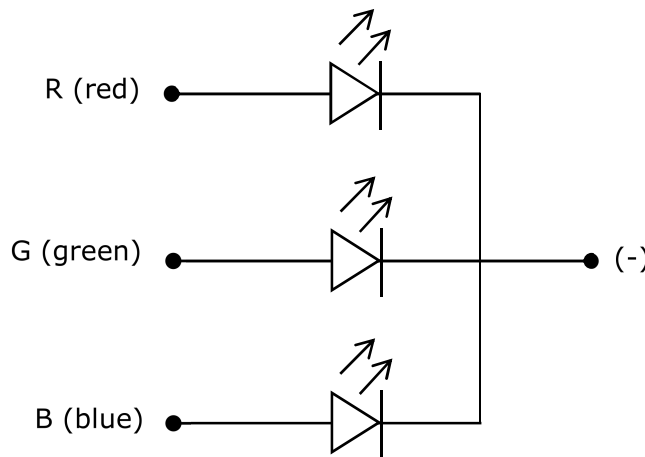


Figure G: RGB LED unit

a. The LED changes colours depending on whether there is a voltage signal at the different anodes. Complete Table 1 so as to map how to obtain the different colours. ON means that there is maximum voltage signal at the anode, while OFF means that there is no voltage signal at the anode.

Table 1

Output Colour	Anode		
	R (red)	G (green)	B (blue)
Red	ON	OFF	OFF
Green		ON	
Blue	OFF		
Magenta (Red + Blue)	ON	OFF	ON
Yellow (Red + Green)		ON	
Cyan (Green + Blue)	OFF		
White (Red + Green + Blue)	ON	ON	ON

(2)

b. The colour changing system shall be controlled by a programmable microcontroller. Figure H shows a flowchart program which makes the RGB LED unit output white light. The Red anode is connected to pin C.0, the Green anode is connected to pin C.1 while the Blue anode is connected to pin C.2.

In the space provide below, write a new flowchart program to control the RGB LED unit to emit red light for 1 second and then emit magenta light for another second. This sequence should be repeated continuously.

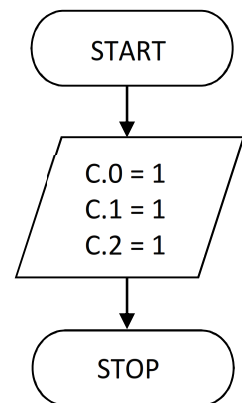


Figure H

(4)

(Total: 6 marks)

15. A portable seating product is needed for the kiosk attendant to rest while there are no customers around. Figure I shows a drawing of a foldable chair which can be used by the kiosk attendant. The chair’s material should be strong and lightweight.

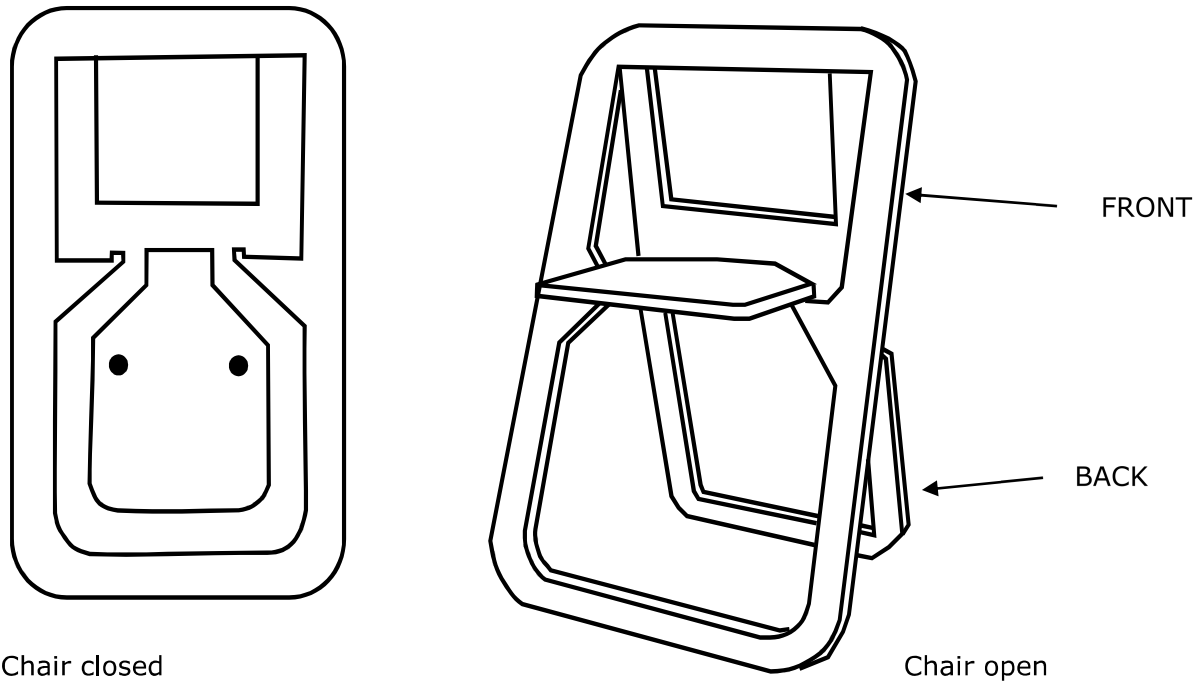


Figure I: Foldable chair

a. Name a manufactured wooden board which would be suitable to produce this product.

_____ (1)

b. Mention **TWO** advantages of using manufactured wooden boards.

_____ (1)

c. Answer the following questions about the fabrication process.

i. Mention **ONE** step in the fabrication process, to obtain a smooth surface before applying the finishing product.

_____ (1)

ii. Mention **ONE** suitable finishing product that protects wood from moisture.

_____ (1)

d. Name **ONE** hand-held power tool to cut the design of this chair.

_____ (1)

e. Give **TWO** reasons why in industry such a chair is typically produced using a CAD/ CAM process.

(2)

f. Mention a mechanical fastener that can be used to fold and unfold this chair.

(1)

g. Draw the mechanical fastener on the given cross-sectional view in Figure J. Include additional fastening components to fix the back and front of the foldable chair to the mechanical fastener. Add annotations to support your answer. (2)

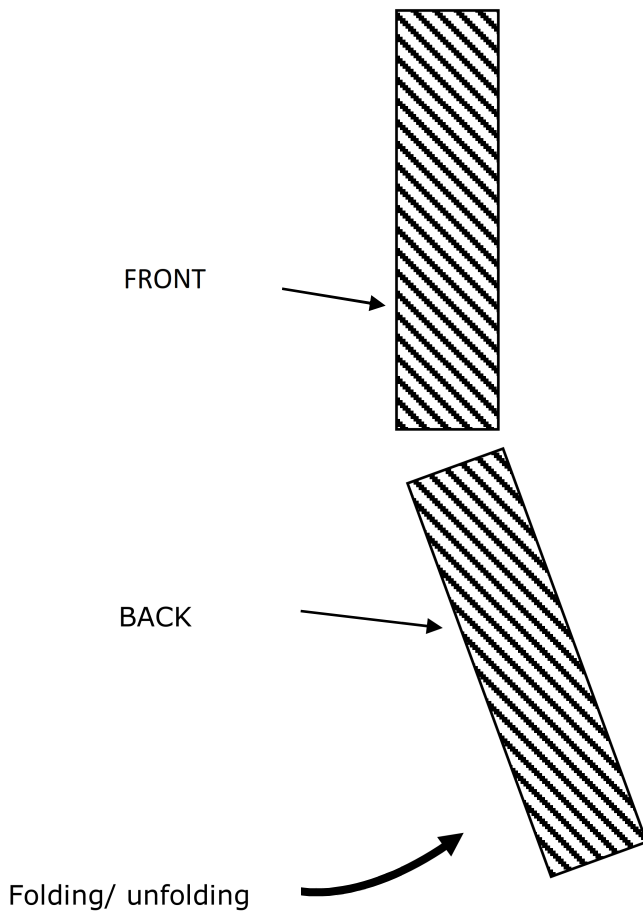


Figure J: Cross-sectional view

(Total: 10 marks)

Please turn the page.

16. Figure K shows a pedal-power ice cream stall which can be used by the coast.

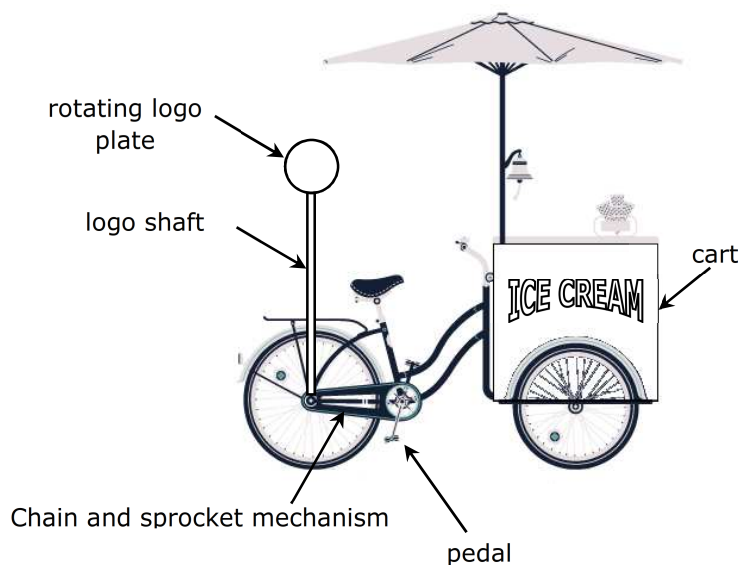


Figure K: Ice cream stall

- a. The ice cream cart can have various colour schemes.
 - i. Colour the following carts to suggest **TWO** possible colour schemes. One scheme should use warm hues, while the other should use cool hues.

Warm Hues

Cool Hues



(2)

- ii. Choose **ONE** of the colour schemes you have drawn and explain the design criteria for choosing that particular scheme.

(1)

b. Figure L shows a simplified drawing of the chain and sprocket mechanism of the stall. The system has sprockets of various diameters in order to change the velocity ratio.

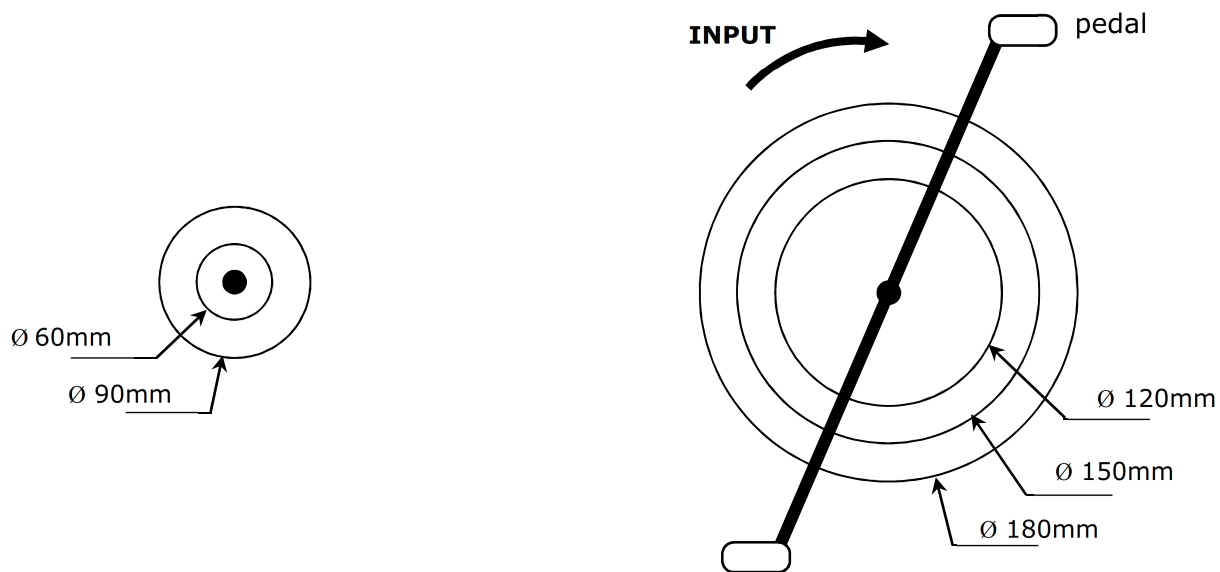


Figure L: Chain and sprocket mechanism

- i. On Figure L, draw an arrow to show the direction of rotation of the output of the mechanism and label it as output. (1)
- ii. On Figure L, add a line to represent the chain showing how to obtain the highest possible speed on the output shaft. (1)
- iii. Calculate the velocity (gear) ratios when there is the highest and lowest possible speeds on the output shaft.

HIGHEST OUTPUT SPEED	LOWEST OUTPUT SPEED

(4)

This question continues on next page.

- c. Figure M shows a close-up elevation of the rear wheel axle and logo shaft as seen from the back. Complete the diagram by designing a suitable mechanism which transfers force and motion from the rear wheel axle to the logo shaft. Annotate your answer.

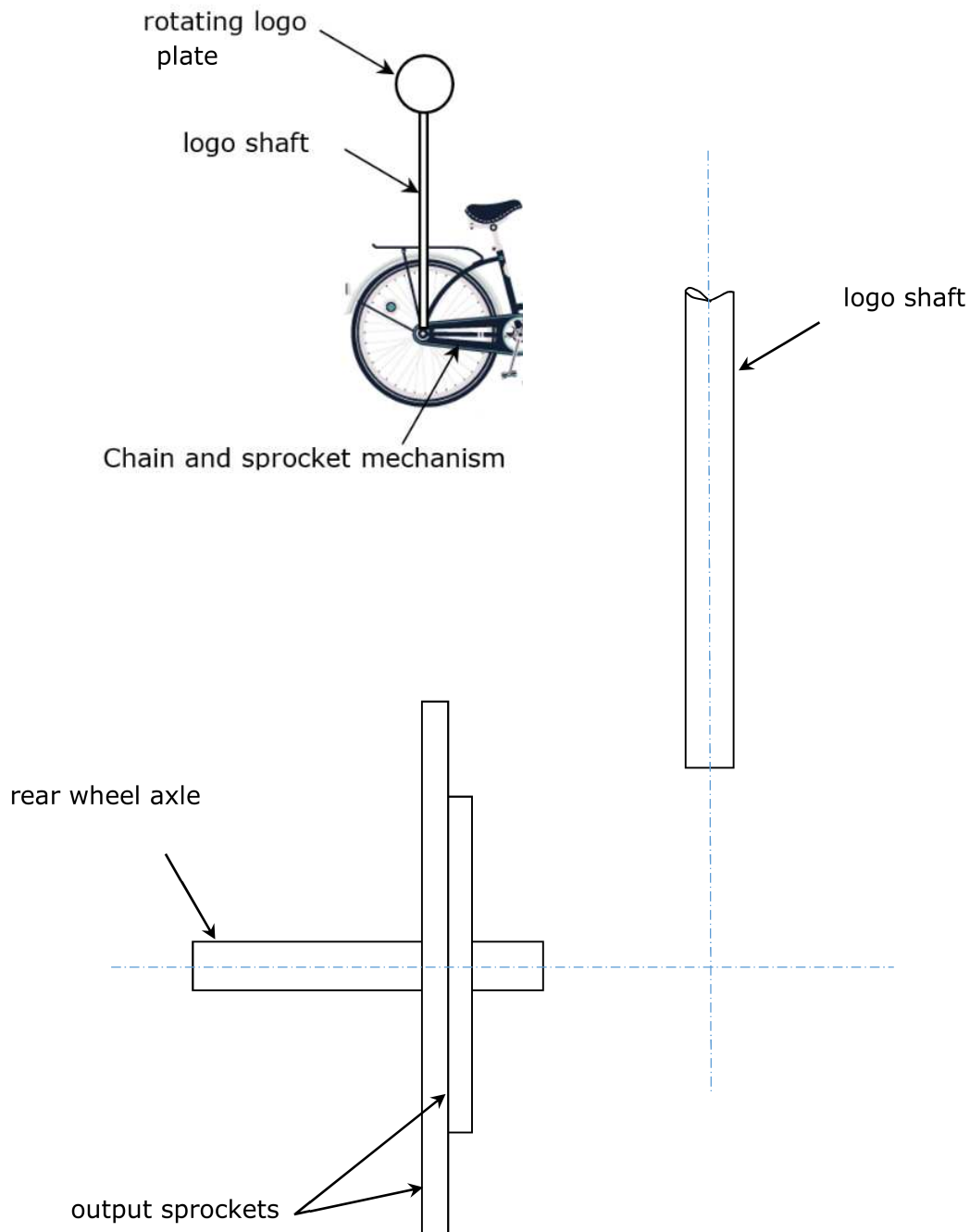


Figure M: Partial back view of rotating logo mechanism

(3)
(Total: 12 marks)



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SUBJECT:	Design and Technology
PAPER NUMBER:	IIB
DATE:	30 th April 2019
TIME:	9:00 a.m. to 11:05 a.m.

Instructions

Answer **ALL** questions in **ALL** sections.

Non-programmable calculators are allowed.

Coloured pencils or markers may be used for sketches.

Useful Information

Formula:

$$V_{\text{OUT}} = \frac{R_2}{R_1 + R_2} (V_{\text{IN}})$$

$$\text{Velocity (Gear) Ratio} = \frac{\text{diameter of output}}{\text{diameter of input}}$$

READ the following theme and situation carefully before answering this paper.

Theme: Retail along the Coast

Situation: Increased activity along the coast, including tourism, has led to an increase of demand for beach side kiosks. Interested entrepreneurs need to find creative ways to display and sell particular products, such as food and beverage, beach accessories, personal care products, etc.

SECTION A: Core Design & Technology Principles

1. Underline **ONE** correct answer from the given selection following each question below.
- a. 'Interested entrepreneurs need to find creative ways to display and sell particular products'. This statement describes:
- i. a needy person.
 - ii. a solution.
 - iii. the problem. (1)
- b. The context of this situation suggests that the mentioned kiosk must be:
- i. good for underwater and boat cruises.
 - ii. a souvenir kiosk.
 - iii. suitable for beach side weather conditions. (1)
- c. It would help to know what needs to be sold in this kiosk because:
- i. the designer makes products nicer.
 - ii. we need to develop specifications that help make these products appealing.
 - iii. the specifications of the design brief are less important than the products. (1)
- d. Two materials which are suitable for long lasting outdoor furniture are:
- i. GRP and MDF.
 - ii. PVC and Expanded Polystyrene.
 - iii. Aluminium and GRP. (1)
- e. When analysing the following products, which of them is typically a one-off production?
- i. Plastic Sunglasses (without lenses).
 - ii. Glass sunglasses with a lens to aid an individual's eyesight.
 - iii. Beach towel with images of Malta. (1)

(Total: 5 marks)

2. Sketch the following in the spaces provided below:

- a. a symbol for a pulley in 2D. (1)
- b. a scribe marking tool. (1)
- c. the symbol of a polarised capacitor. (1)

a.	b.	c.
----	----	----

(Total: 3 marks)

3. Tick with a '✓' whether the following are True or False.

- | | True | False |
|-------------------------------------------------------------------|--------------------------|--------------------------|
| a. A dovetail joint is used to join mild steel metal permanently. | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Reciprocating motion is a type of rotary motion. | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Brass is a non-Ferrous metal. | <input type="checkbox"/> | <input type="checkbox"/> |

(Total: 3 marks)

4. Figure A shows orthographic views of a sun-cream container that may be sold on a mobile kiosk. On figure A below, estimate and draw the outside diameter and overall length in millimetres of the sun-cream container below. Figure A is not to scale.

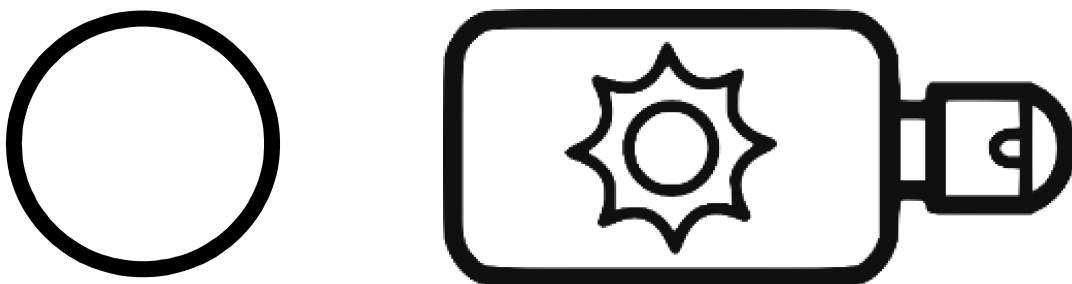


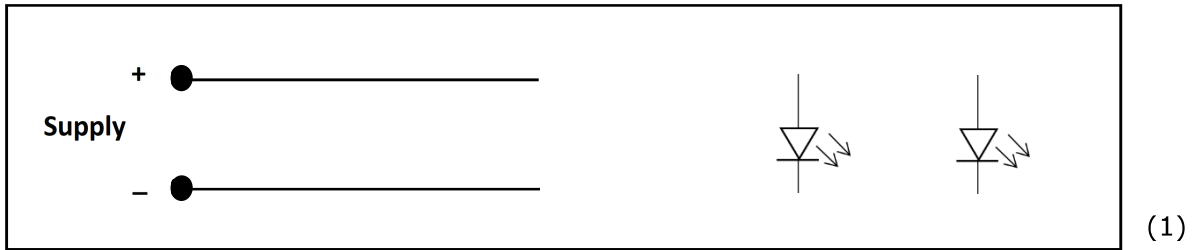
Figure A

(Total: 2 marks)

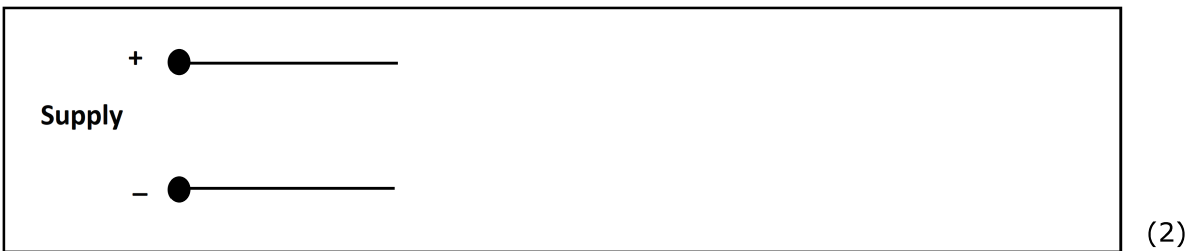
Please turn the page.

5. Complete the following electronic circuits to obtain the desired output/s:

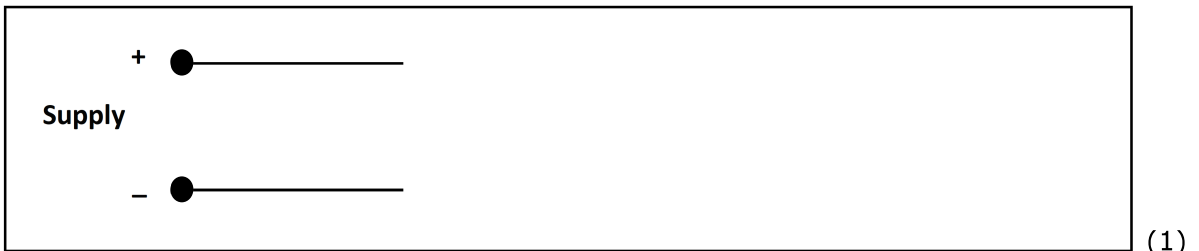
a. Two LEDs wired in parallel directly to the supply:



b. A SPDT switch controlling two LEDs directly from the supply:



c. A buzzer controlled by a normally-open push switch:



d. Circle **TWO** pins from the IC shown in Figure B which can be connected to an analogue output.

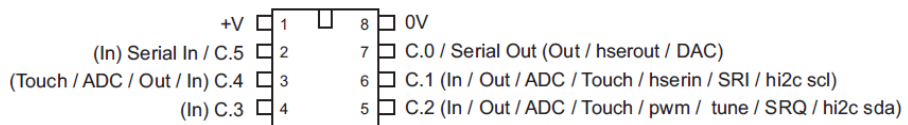


Figure B

(1)

(Total: 5 marks)

6. Mention **TWO** different types of structures and give an example of each.

Type of Structure	Example
(1/2)	(1/2)
(1/2)	(1/2)

(Total: 2 marks)

SECTION B: Design Aspect

7. Refer to the situation on Page 2.

a. Identify **TWO** key stakeholders.

(2)

b. Describe **ONE** way how each of the stakeholders named previously influences your design.

STAKEHOLDER 1	<hr/> <hr/> <div style="text-align: right;">(1)</div>
STAKEHOLDER 2	<hr/> <hr/> <div style="text-align: right;">(1)</div>

(Total: 4 marks)

8. Figure C shows last summer’s sales of a number of products that a particular entrepreneur sells. The entrepreneur would like a small, temporary and movable display suitable for a kiosk, to boost the sales of the least popular item.

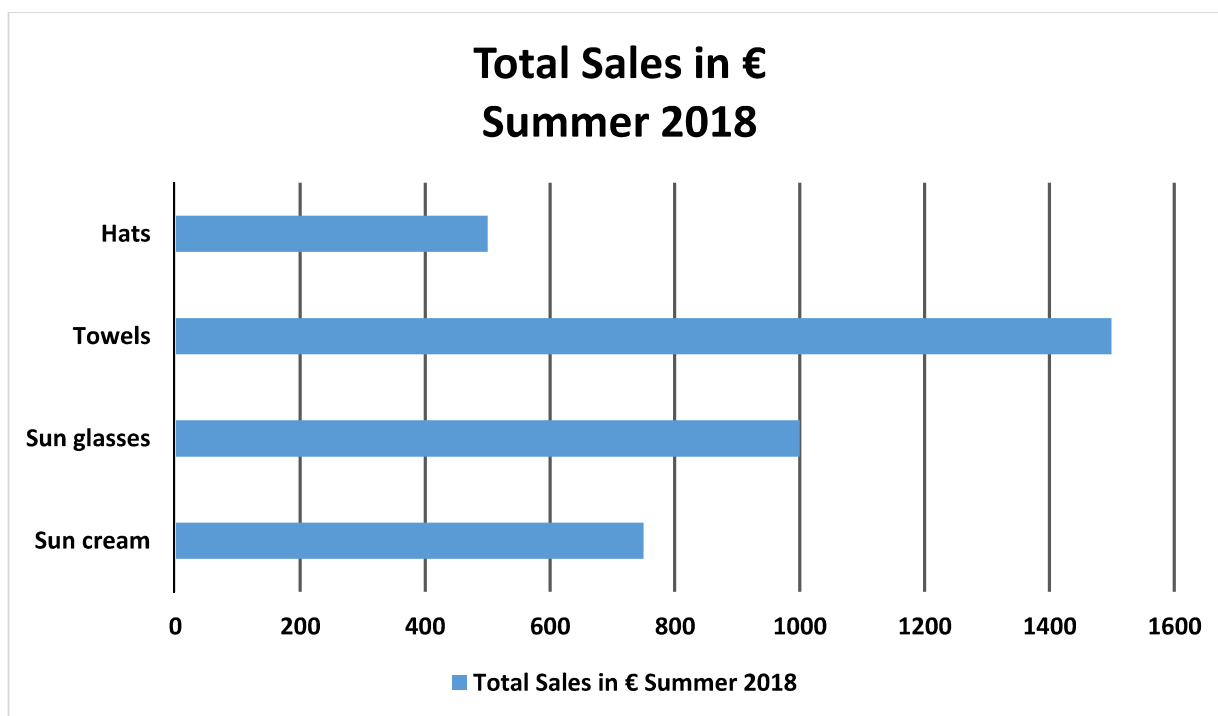


Figure C: Chart showing sales of summer 2018

This question continues on next page.

Idea 2	
--------	--

(5)

(Total: 13 marks)

10. Choose **ONE** idea from those sketched in Question 9, by ticking one of the boxes below.
(Tick ✓)

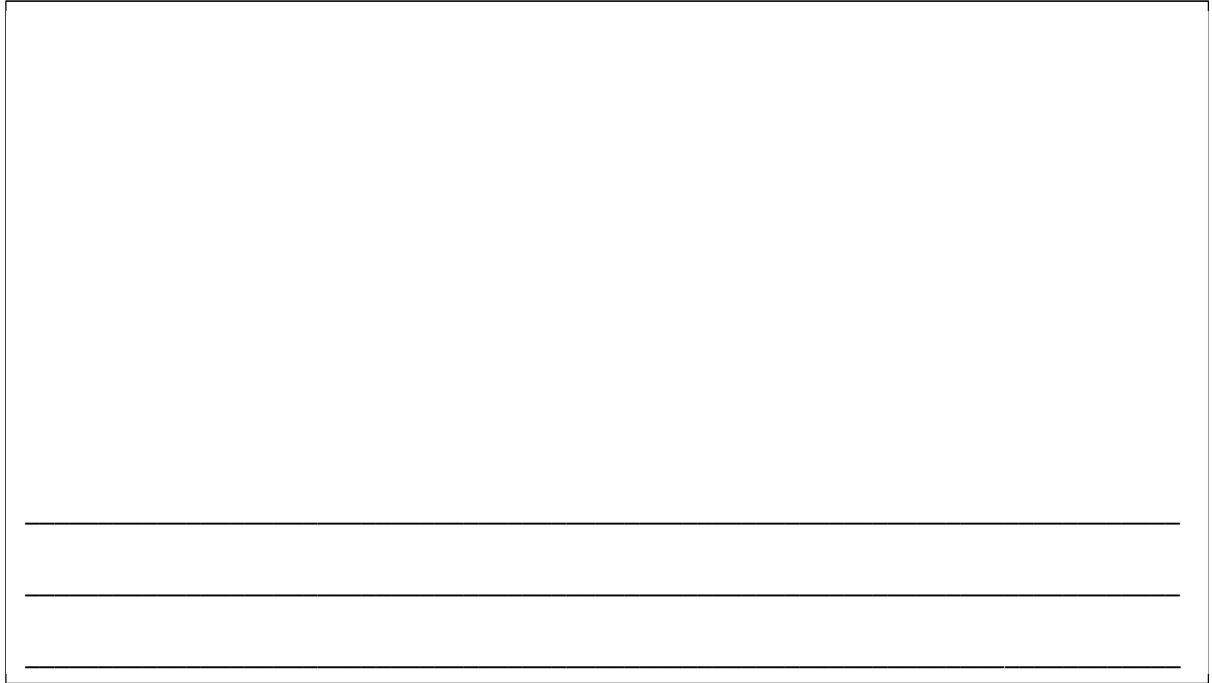
Idea 1

Idea 2

a. Mention **ONE** advantage and **ONE** disadvantage of your chosen idea with respect to its environmental sustainability.

ADVANTAGE	(1)
DISADVANTAGE	(1)

- b. After seeing your chosen idea, the entrepreneur asked you to add a feature whereby the display can be easily dragged on a sandy beach. In the space below present an improved version of your chosen sketch, to include this specification. You may choose to sketch and/or write the answer.



(2)

- c. Suggest **ONE** effective way to present your design ideas to an audience.

(1)

(Total: 5 marks)

SECTION C: Technology Aspect

11. Figure D shows an idea of a temporary portable kiosk that can be used on a sea front promenade. The six plastic pipes making up the structure are made up of two pipes connected with a bent plastic rod which is thermoformed.

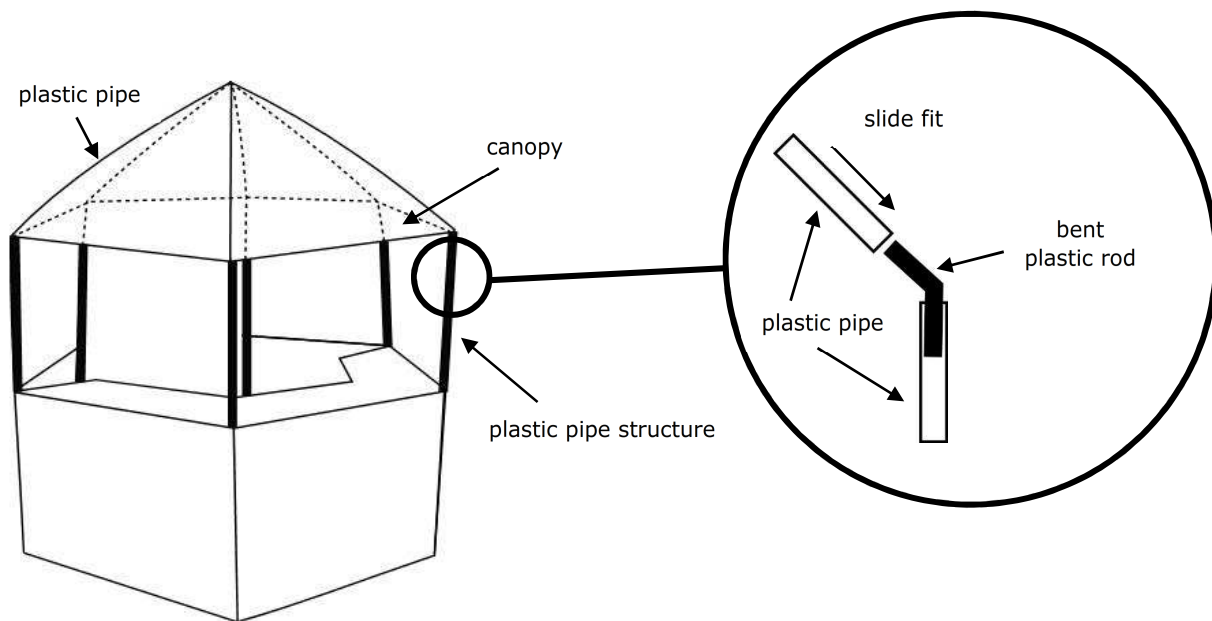


Figure D: Temporary portable kiosk

a. In the space below name the tools needed to carry out the following processes:

i. Marking, holding, cutting and filing the plastic pipes to the correct length:

(2)

ii. Bending the six plastic rod connectors to the correct angle:

(3)

b. Write **ONE** safety precaution that should be observed while following the thermoforming process mentioned above.

(1)

c. A piece of textile material is used for the kiosk's canopy.

i. Mention a polymer based fibre which is waterproof.

(1)

ii. State **ONE** reason, other than water resistance, to justify why a textile material is suitable for this kiosk canopy.

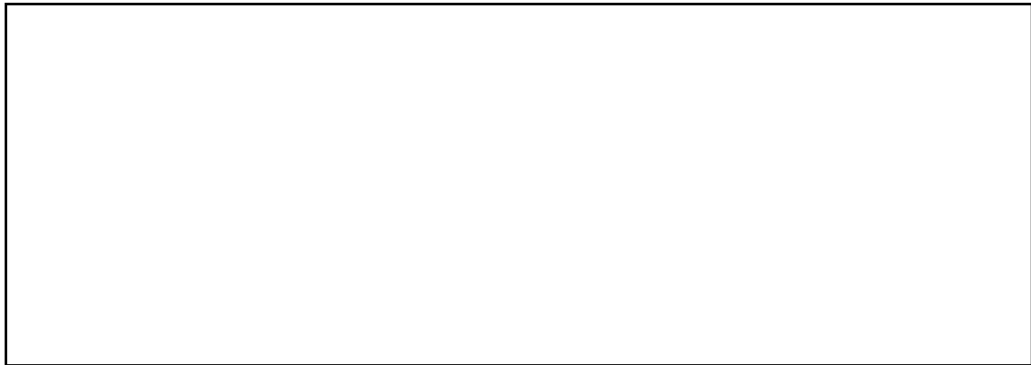
(1)

This question continues on next page.

iii. Mention **ONE** fastening method which is suitable to join the textile material to the plastic pipe.

(1)

iv. In the space provided below sketch the fastener mentioned in Question 11c.iii.



(1)

v. Figure E shows a drawing of the plastic pipe kiosk structure and the plastic connector. Draw how the fastener drawn above is applied to the plastic pipe and the textile material. Add annotations.

(3)

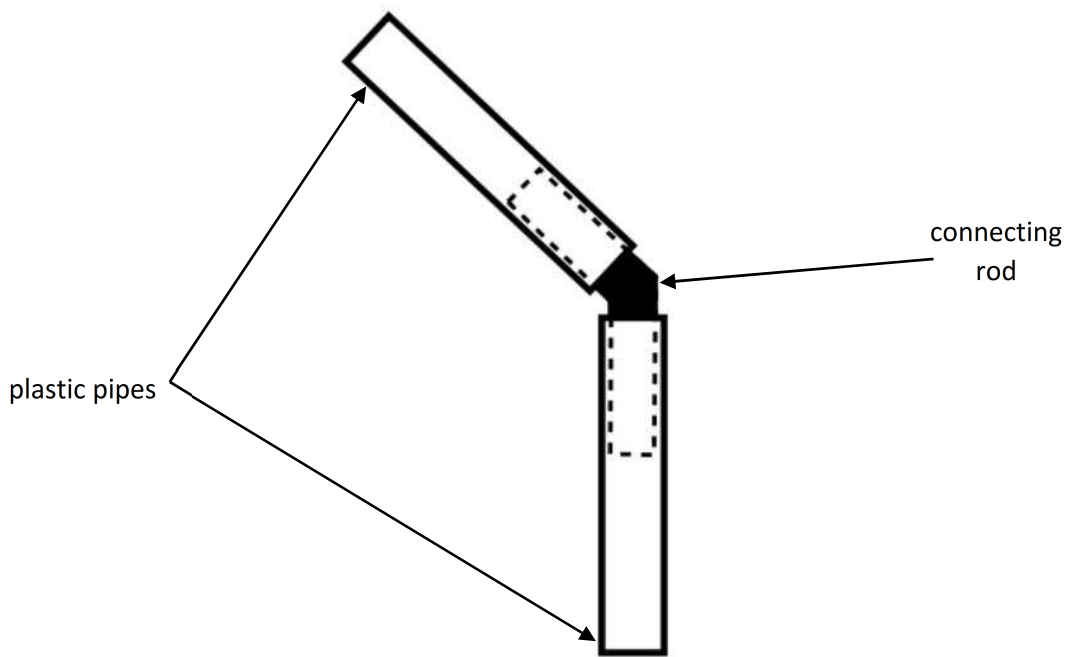
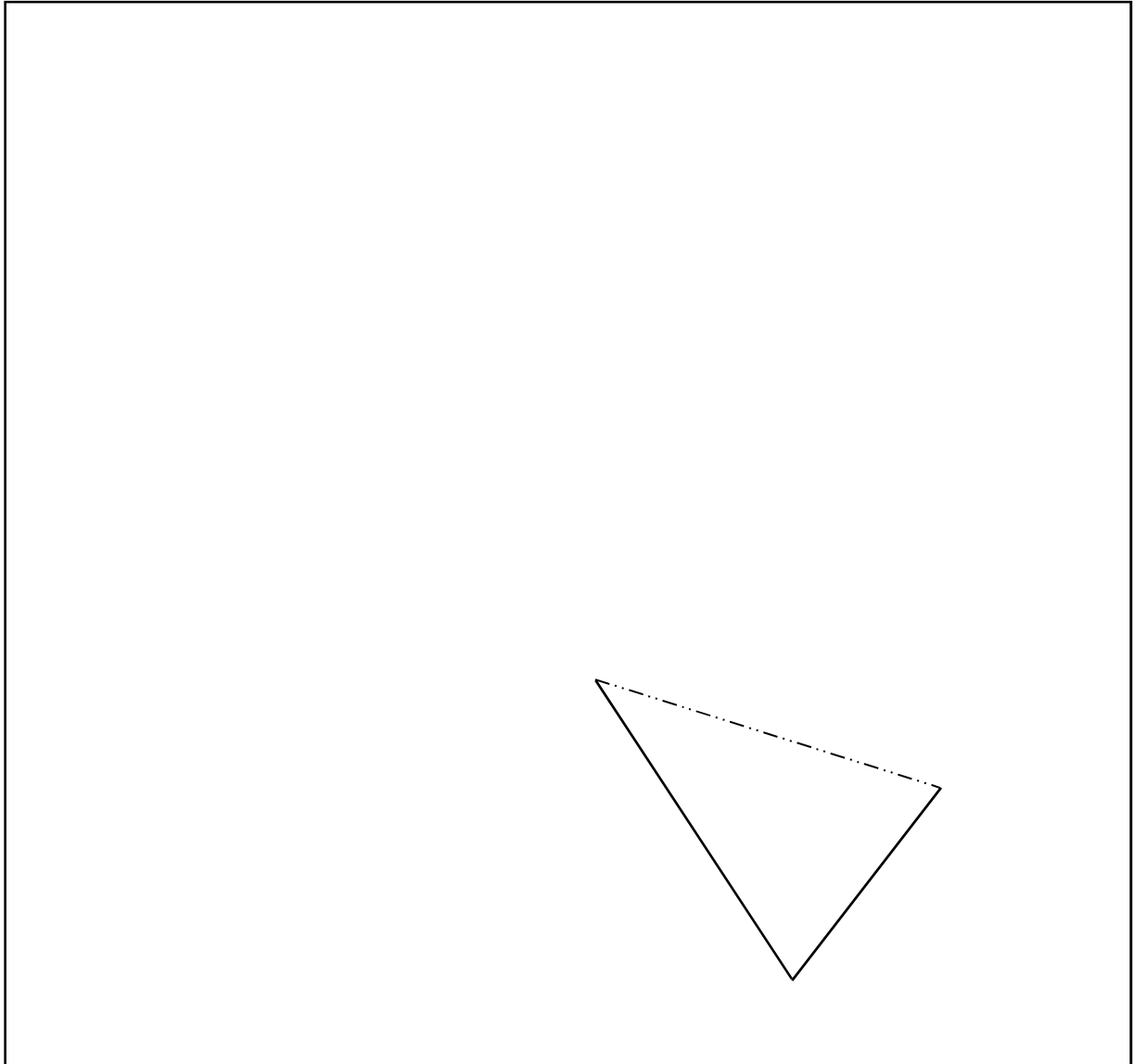


Figure E: Enlargement of joint

(Total: 13 marks)

12. Complete the following drawing to draw a proportionate 2D surface geometrical net of the kiosk's canopy shown in Figure D.



(Total: 3 marks)

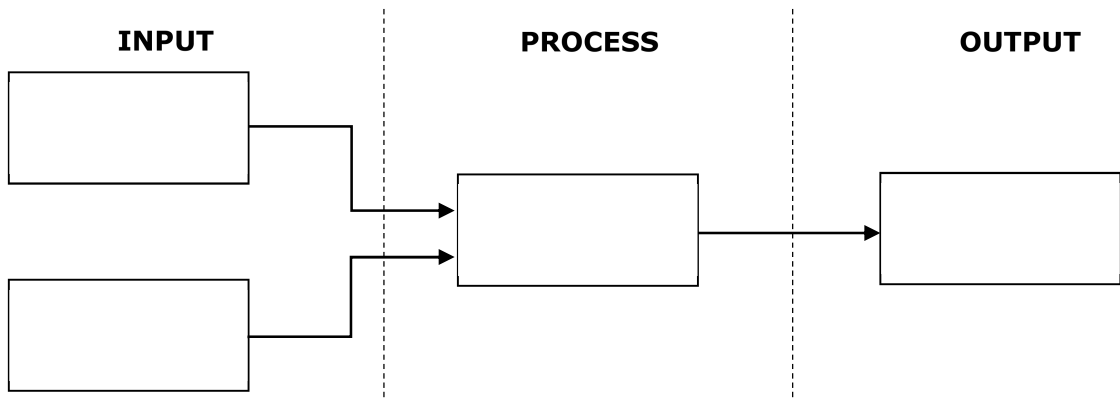
13. The designer of the kiosk shown in Figure D (on page 9), added a lighting feature so as to make it more effective when there is darkness. This lighting feature switches on automatically only when both of the following conditions are achieved:

**It is dark
AND
The attendant is inside the kiosk**

This question continues on next page.

a. Describe how such a system can work by filling in the block diagram using all the words in the word-bank.

light sensor	AND gate	LED unit	infrared sensor
--------------	----------	----------	-----------------



(4)

b. Figure F shows one possible electronic circuit for the light sensor.

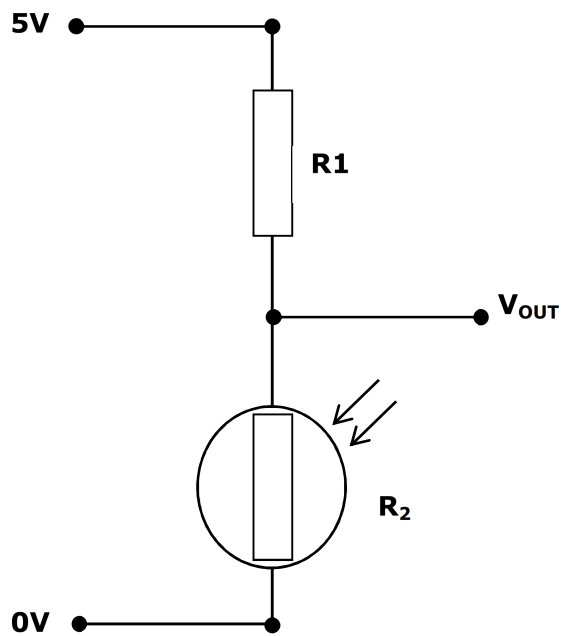


Figure F

i. Give the name of the circuit configuration shown in Figure F.

(1)

ii. Give the full name of component R₂.

(1)

c. Figure G shows the readings for component R_2 at different times during a particular evening.

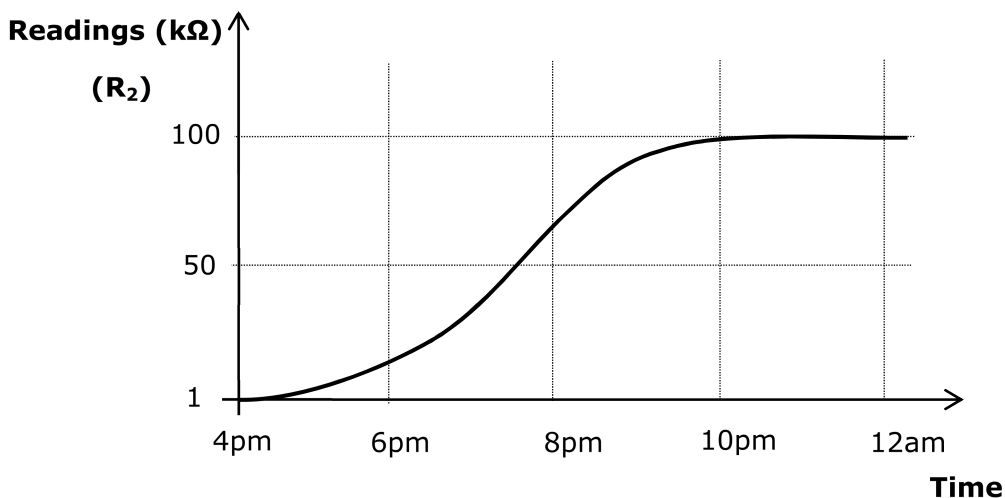


Figure G: Readings for component R_2 at different time during an evening

i. Using the given graph, find the maximum value of component R_2 .

(1)

ii. Calculate, using Figure F and G the value of V_{OUT} if R_1 is $400k\Omega$ when maximum darkness is reached.

(3)

d. Component R_1 was replaced by the component shown in Figure H.

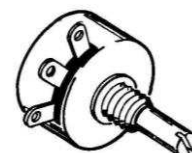


Figure H

i. Give the name of the component shown in Figure H.

(1)

ii. Suggest a reason why this component was chosen to replace R_1 .

(1)

(Total: 12 marks)

14. A designer found that RGB LED units (Red[R], Green[G], Blue[B]) are suitable to obtain colour changing light output for kiosks. Such LED units are made from three differently coloured LEDs having a common cathode as shown in Figure I.

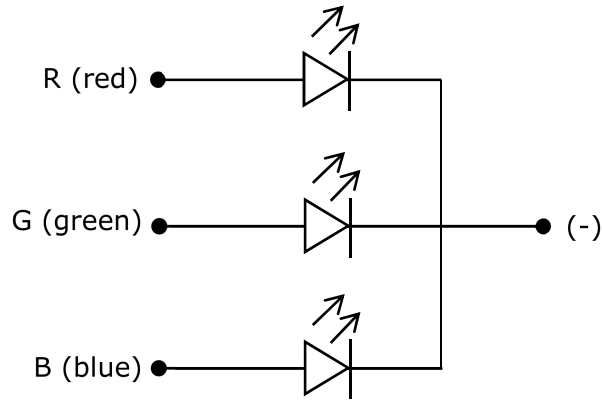


Figure I: RGB LED unit

a. The LED changes colours depending on whether there is a voltage signal at the different anodes. Complete Table 1 so as to map how to obtain the different colours. ON means that there is maximum voltage signal at the anode, while OFF means that there is no voltage signal at the anode.

Table 1

Output Colour	Anode		
	R (red)	G (green)	B (blue)
Red	ON	OFF	OFF
Green		ON	
Blue	OFF		
White (Red + Green + Blue)	ON	ON	ON

(2)

b. The colour changing system shall be controlled by a programmable microcontroller. Figure J shows a flowchart program which makes the RGB LED unit output white light. The Red anode is connected to pin C.0, the Green anode is connected to pin C.1 while the Blue anode is connected to pin C.2.

In the space provided below, complete the new flowchart program to control the RGB LED unit to emit white light for 1 second and then emit red light for another second. This sequence should be repeated continuously.

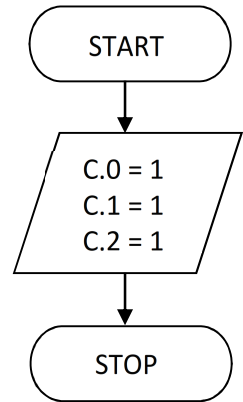
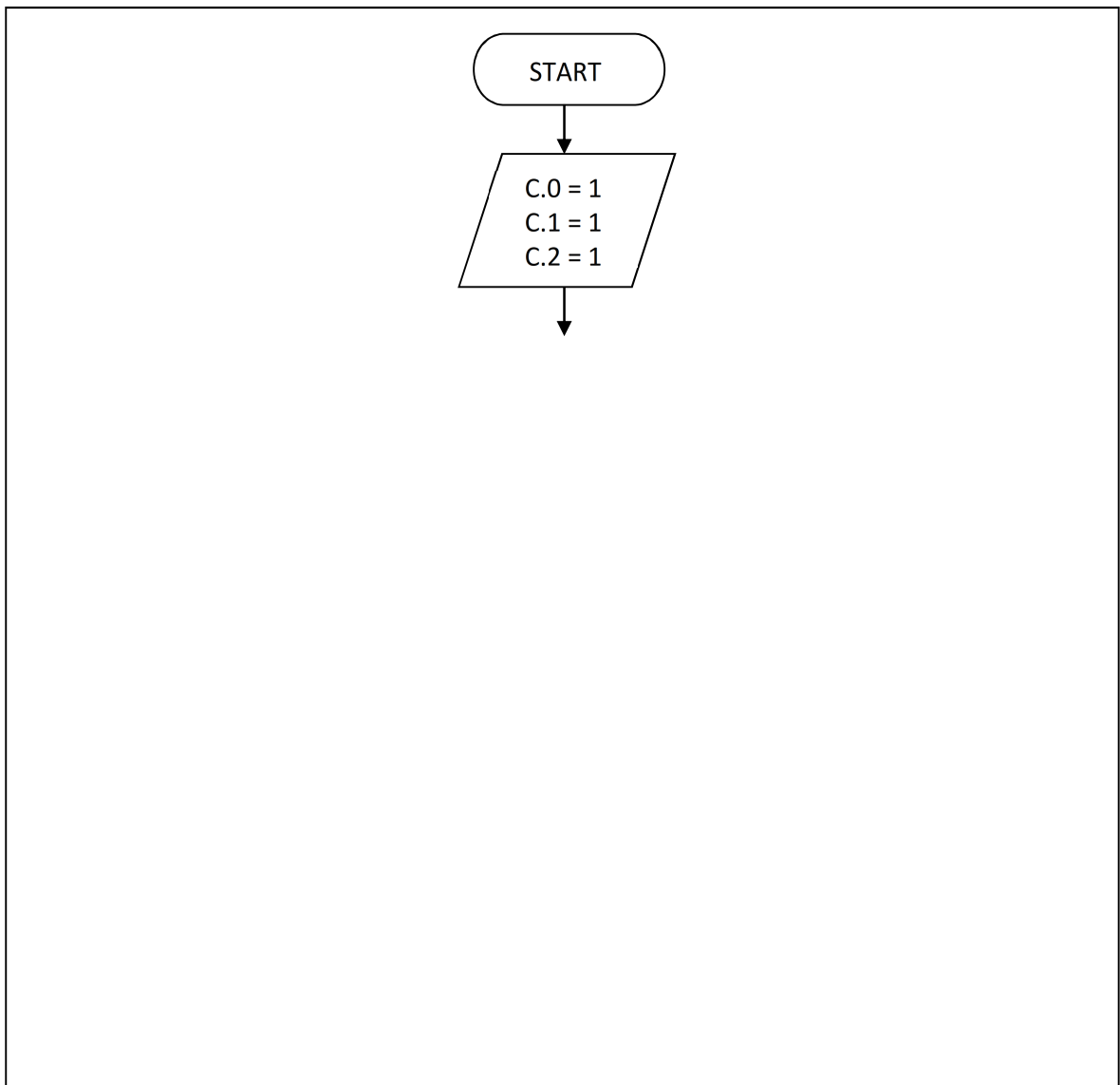


Figure J



(4)

(Total: 6 marks)

15. Portable seating could be needed for a kiosk attendant to rest while there are no customers around. Figure K shows a drawing of a foldable chair which can be used by the kiosk attendant. The chair’s material should be strong and lightweight.

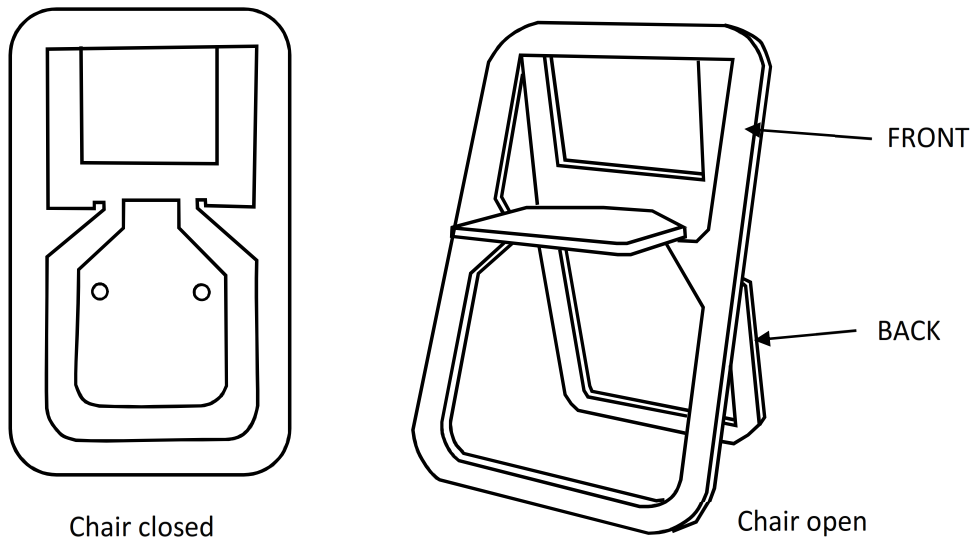


Figure K: Folding chair

a. Name a manufactured wooden board which would be suitable to produce this product.

_____ (1)

b. Mention **ONE** advantage of using manufactured wooden boards.

_____ (1)

c. Answer the following questions about the fabrication process.

i. Mention **ONE** step in the fabrication process, to obtain a smooth surface before applying the finishing product.

_____ (1)

ii. Mention **ONE** suitable finishing product that protects wood from moisture.

_____ (1)

d. Name **ONE** hand-held power tool to cut the design of this chair.

_____ (1)

e. Give **ONE** reason why in industry such a chair is typically produced using a CAD/ CAM process.

_____ (1)

f. The mechanical fastener shown in Figure L was used to fold and unfold this chair.

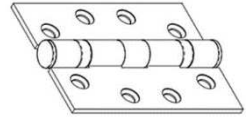


Figure L

i. Give the name of this mechanical fastener.

(1)

ii. Draw the mechanical fastener on the given cross-sectional view in Figure M. Include additional fastening components to fix the back and front of the foldable chair to the mechanical fastener. Add annotations to support your answer. (2)

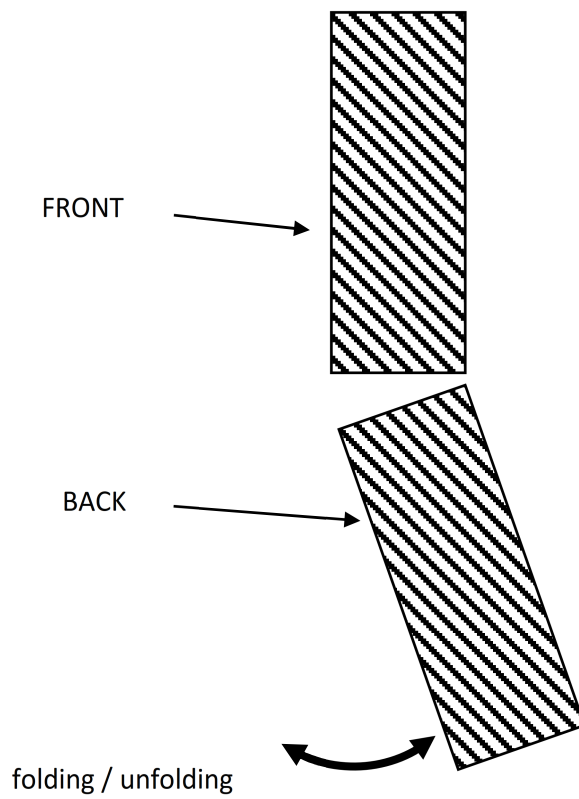


Figure M- Cross-sectional view

(Total: 9 marks)

16. Figure N shows a pedal-power ice cream stall which can be used by the coast.

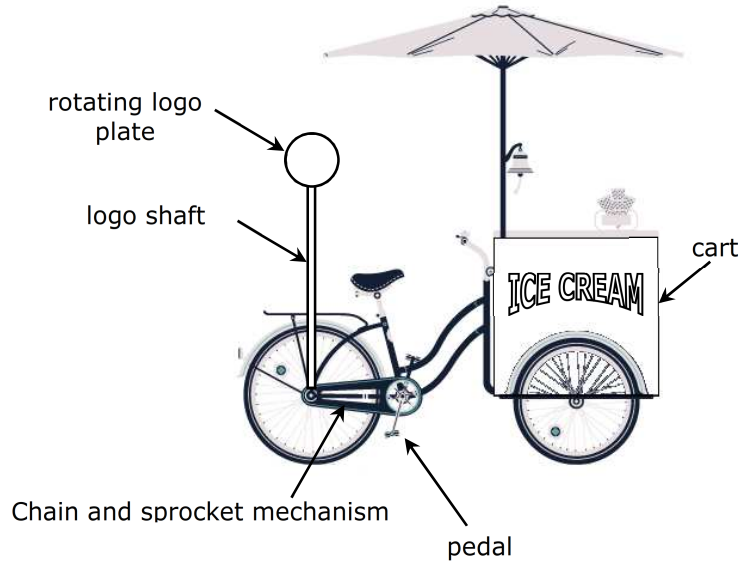


Figure N: Ice cream stall

- a. The ice cream cart can have various colour schemes.
- i. Colour the following carts to suggest **TWO** possible colour schemes. One scheme should use warm hues, while the other should use cool hues.

Warm Hues

Cool Hues



(2)

- ii. Choose **ONE** of the colour schemes you have drawn and explain the design criteria for choosing that particular scheme.

(1)

b. Figure O shows a simplified drawing of the chain and sprocket mechanism of the stall. The system has sprockets of various diameters in order to change the velocity ratio.

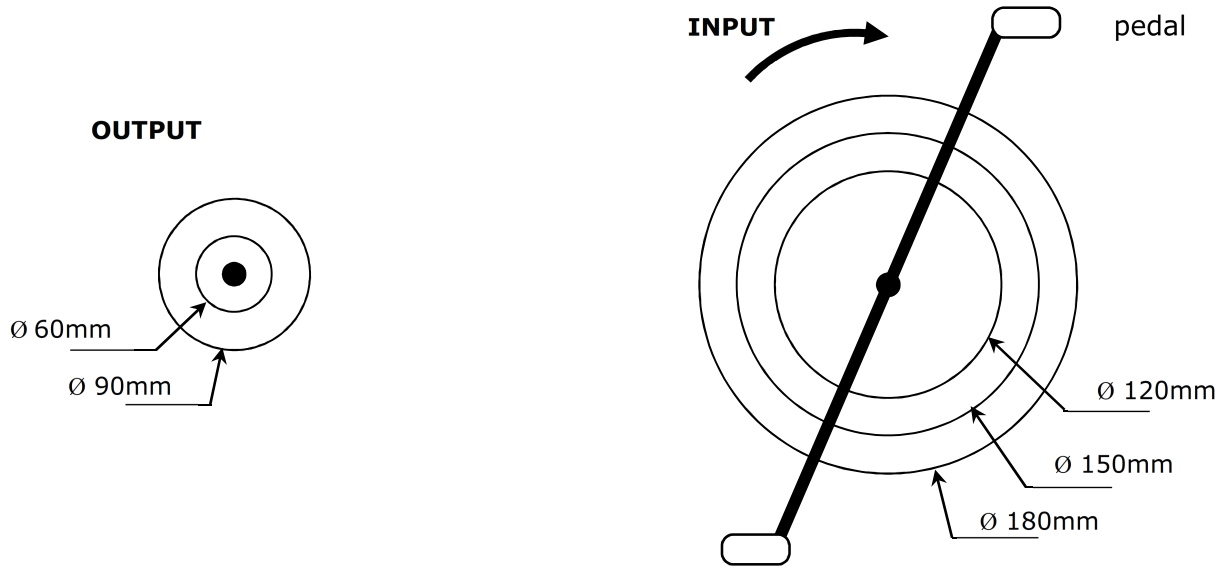


Figure O: Chain and sprocket mechanism

- i. On Figure O, draw an arrow to show the direction of rotation of the output of the mechanism. (1)
- ii. On Figure O, add a line to represent a chain to show how to obtain the highest possible speed at the output. (1)
- iii. Calculate the velocity (gear) ratio when the chain is connected as you have drawn in Question 16bii.

(3)

c. Figure P shows a close-up elevation of the rear wheel axle and logo shaft as seen from the back.

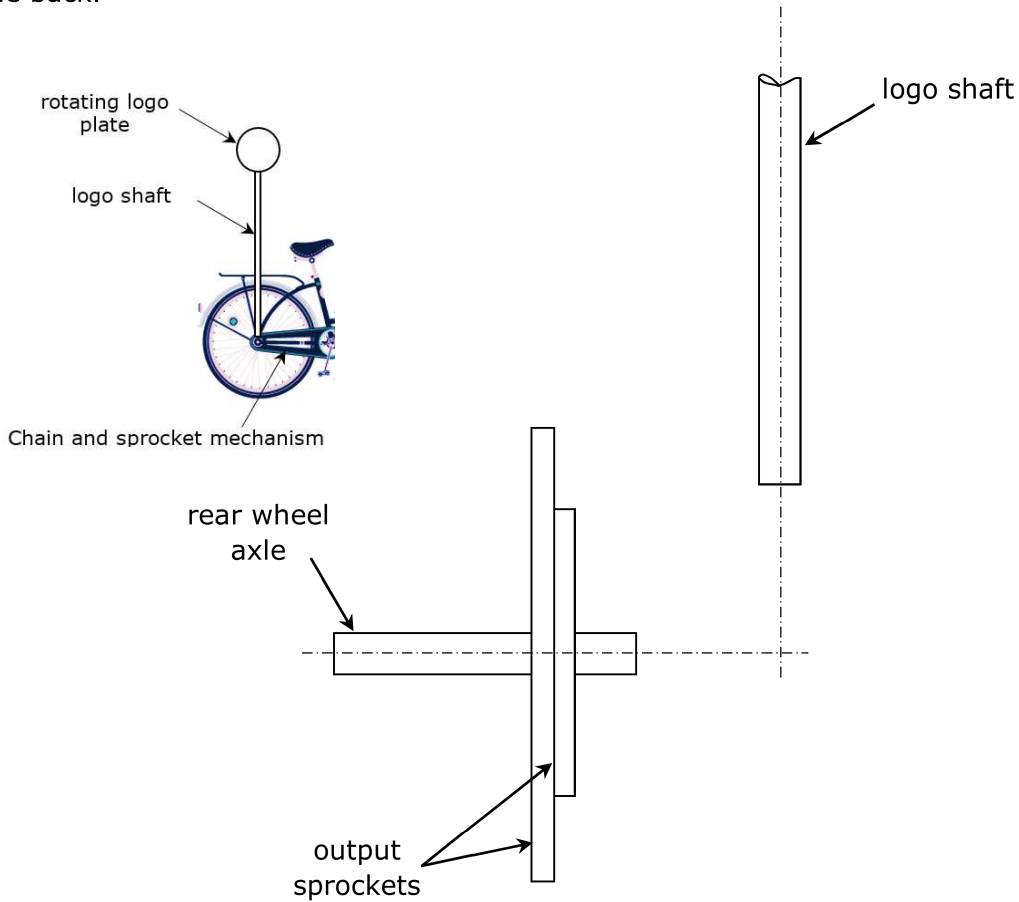


Figure P: Partial back view of rotating logo mechanism

i. Name **ONE** mechanism which can be used to transfer force and motion from the rear wheel axle to the logo shaft.

(1)

ii. Complete Figure P above, by adding the mechanism you have suggested in Question 16ci.

(3)

(Total: 12 marks)