



L-Università
ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2022 MAIN SESSION**

SUBJECT:	Design and Technology
PAPER NUMBER:	IIA
DATE:	10 th May 2022
TIME:	9:00 a.m. to 11:05 a.m.

Instructions

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

Non-programmable calculators and drawing instruments are allowed.

Show **ALL** the working for mathematical calculations.

Coloured pencils and/or markers may be used for sketches.

Useful Information

Formulae:

$$P = V \times I$$

$$V = I \times R$$

$$\text{Velocity Ratio} = \frac{\text{No. of teeth of Driver}}{\text{No. of teeth of Driven}} = \frac{\text{Speed of Driven}}{\text{Speed of Driver}}$$

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

Theme: Enjoying an Accessible Lifestyle

Situation: Accessibility in buildings such as shopping centres is controlled by regulations in order to achieve equality for everyone. Therefore, shop owners must consider the needs of all customers when planning the layout and display of their shops.

SECTION A: Core Design & Technology Principles

1. Underline the correct answer for each question:

- a. Which of the following can be **both** considered as stakeholders for the above situation?
- i. Interior designers and customers using wheelchairs.
 - ii. Policemen and firefighters.
 - iii. Clothes manufacturers and computer manufacturers.
 - iv. Tile layers and curtain makers.
- b. Which of the following statements is a design specification?
- i. Do not obstruct the passageway.
 - ii. Some customers commented that the entrance of the shopping centre is too narrow.
 - iii. The shopkeeper paid €1000 for a marketing campaign.
 - iv. The door of the shop should have a minimum width of 1m.
- c. Which of the following are parts of a belt-sanding machine?
- i. Foot pedal and hand wheel.
 - ii. Motor and guard.
 - iii. Chuck and jaws.
 - iv. Blade and handle.
- d. Which of the following is **not** a renewable energy source?
- i. Hydroelectric energy.
 - ii. Biofuels.
 - iii. Petroleum.
 - iv. Solar energy.

(Total: 4 marks)



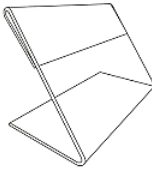
2. Write what the following acronyms stand for:

- a. CAM: C _____ A _____ M _____
- b. PPE: P _____ P _____ E _____
- c. PCB: P _____ C _____ B _____

(Total: 3 marks)

3. Name the manufacturing/fabrication process used to make the products shown in Table 1.

Table 1

<p>Product</p>	<p>Aluminium pipes</p> 	<p>Yoghurt tubs</p> 	<p>Plastic desktop display</p> 
<p>Manufacturing/ fabrication process</p>			

(Total: 3 marks)

4. Fill in the missing information in Chart 1 below.

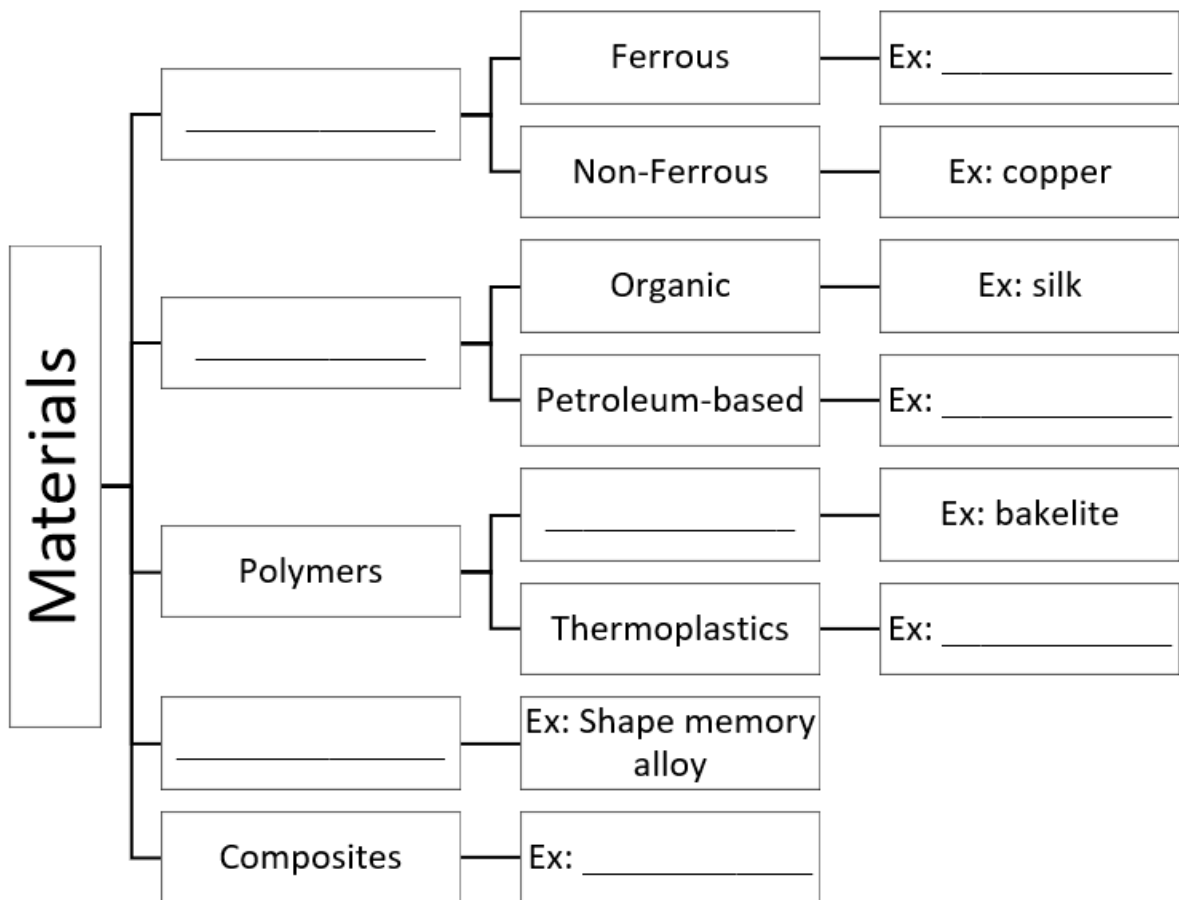


Chart 1

(Total: 4 marks)

5. Table 2 shows the main steps involved when making a plain seam on a sewing machine. Write numbers in the empty column to put the steps in the correct sequence.

Table 2

STEPS	SEQUENCE
Put material under the foot press and set machine to straight stitching.	
Put material right side facing each other.	
Make a straight stitch leaving enough seam allowance.	
Press open the seam by ironing.	

(Total: 2 marks)

6. Complete Table 3 by drawing a sketch of the mentioned items.

Table 3

bar chart	block diagram
multimeter	set square

(Total: 4 marks)

SECTION B: Design Aspect

Refer back to the situation on Page 2 and read the following problem carefully.

Clothes shops need to make products available for viewing to all customers and maximise their use of space. To do so, shelves and rails are placed on top of each other using the full possible height. However, not all customers may be able to reach the top shelves/rails of certain display units.

7. Consider the above problem to answer the following question.

- a. Describe **TWO** different ways by which the designer can explore the problem further to achieve a relevant design brief.

(4)

- b. Write down an initial design brief.

(1)

- c. Extract **TWO** keywords from your design brief.

(1)

(Total: 6 marks)

8. Define the term data analysis.

(Total: 2 marks)

9. Mechanical systems may be included in display units in order to increase accessibility.

In the spaces provided below sketch **TWO** different ideas for solutions to the problem above. The sketches must indicate how users interact with the solution, including any input and output movements. Add annotations to your sketches.

This question continues on the next page.

Idea 1

(5)

Idea 2

(5)

(Total: 10 marks)

10. Write an evaluation for each of the ideas sketched in question 9.

Evaluation idea 1:	<hr/> <hr/> (1)
Evaluation idea 2:	<hr/> <hr/> (1)

(Total: 2 marks)

11. This question is about Design Communication and Data Sharing.

a. Describe **TWO** ways how a designer can facilitate communication with the clothes shop owner.

_____ (2)

b. Name **ONE** tool that can be used to communicate and share data.

_____ (1)

(Total: 3 marks)

12. Explain what is meant by Iteration in an Iterative Design Process.

(Total: 2 marks)

SECTION C: Technology Aspect

13. Figure 1 shows a 3D design of a shop display for a new line of eyeglasses from a famous designer brand.

a. Name the 3D pictorial projection technique that was used to draw Figure 1.

_____ (1)

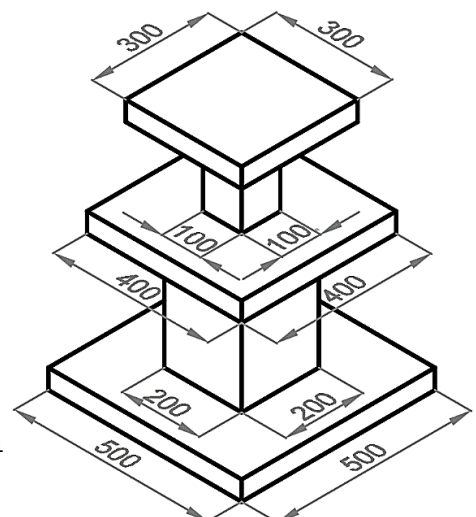


Figure 1

- b. Underline **ONE** of the following statements which best describes the 3D pictorial projection technique used in Figure 1:
- i. Front elevation, End elevation and a Plan.
 - ii. A 3D drawing showing faces at 30°/30°.
 - iii. A 3D drawing showing faces going towards the vanishing points. (1)
- c. Figure 2 shows an incomplete orthographic projection of the shop display in Figure 1. On Figure 2, complete the orthographic projection by drawing the Plan. The plan should be proportional and include overall dimensions and hidden detail.

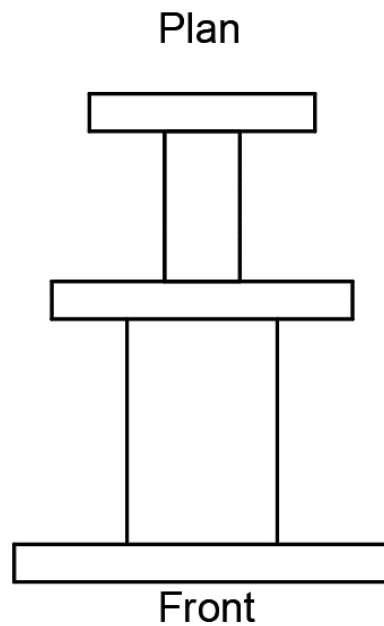


Figure 2

(3)

- d. To help the showcase stand out, the display is going to be painted in a monochromatic colour scheme. Explain what a monochromatic colour scheme is.

(1)

(Total: 6 marks)

14. The shop display shown in Figure 1 is made of manufactured wood.

a. Mention **ONE** example of a manufactured wood that could be used for the shop display.

_____ (1)

b. Fill in Chart 2 by completing the following instructions to show the aesthetic properties of the material mentioned in Question 14a.

- i. Draw a corner sample showing how the material looks including colour and pattern.
- ii. Describe how it looks.

(3)

CORNER SAMPLE	DESCRIPTION
	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Chart 2

c. Consider the material chosen in question 14a to answer the following questions.

i. Underline **ONE** suitable joining method from the list below which can be used to assemble the display's columns to the shelves as explained in Figure 3.

- dowel joint pop riveting welding dovetail joint screws (1)

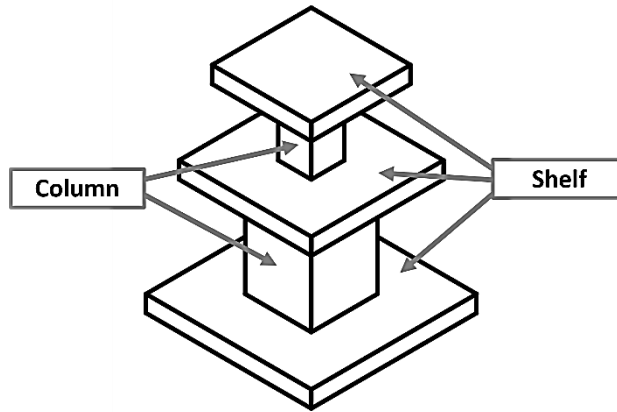


Figure 3


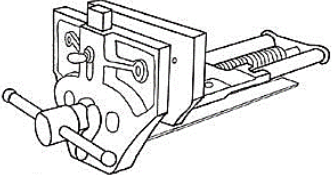
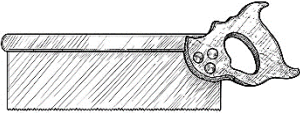
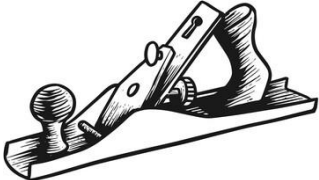
ii. In the space provided below sketch how the shelves are assembled to the columns using the joining method you chose in question 14ci.

(3)

(Total: 8 marks)

15. Table 4 shows some of the tools which can be used to manufacture the display in Figure 3. Fill in the tool list by writing the names and use of each tool.

Table 4

TOOL / EQUIPMENT	NAME	USE
		
		
		
		

(Total: 6 marks)

16. Figure 4 shows a polymer stand which is used to hold eyeglasses on display. Such stand was made using the 3D printing fabrication process.

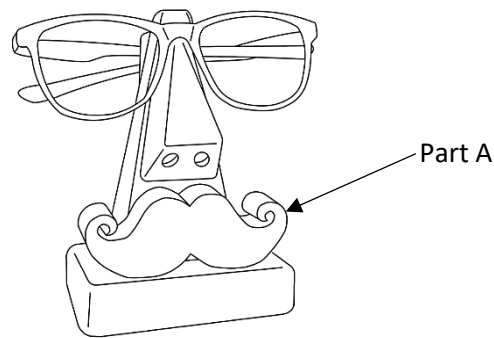


Figure 4

a. State the standard form in which 3D printing material is supplied.

_____ (1)

b. Suggest a suitable polymer which can be used to 3D print these eyeglasses stands.

_____ (1)

c. The profile of Part A on Figure 4 was created by tracing the outline of a bitmap image and transform it into a vector image. Describe why a bitmap image does **not** work well to convert into 3D.

 _____ (2)

d. Briefly explain how to digitally create the form marked as Part A on Figure 4 on a 3D drawing software.

 _____ (2)

(Total: 6 marks)

17. A rotating display was constructed for a jewellery shop window. The system of the rotating display consists of an input motor which drives a gearing system to slow down the output rotating speed. Figure 5 shows part of this gearing system.

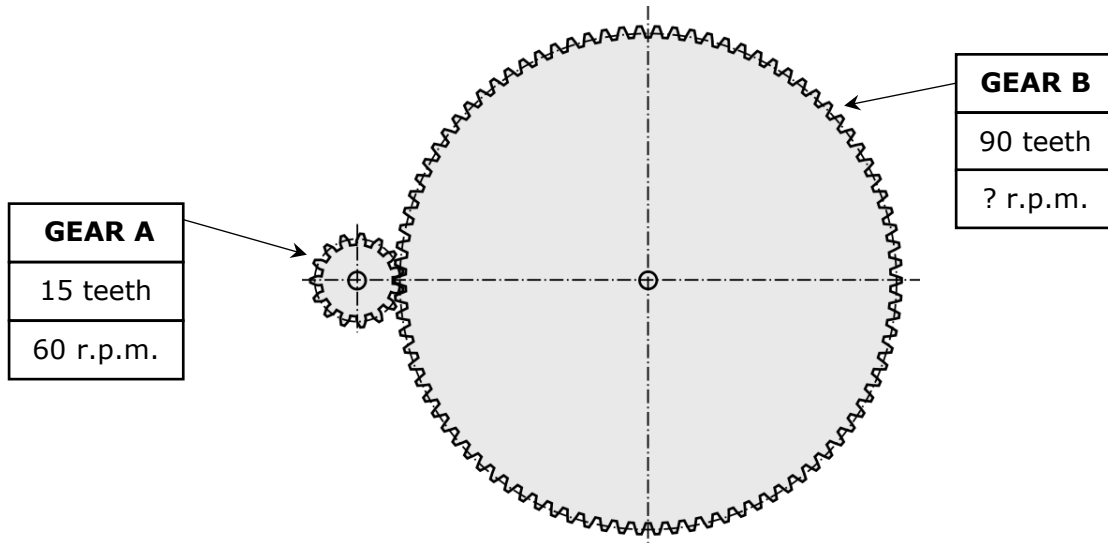


Figure 5

a. Name the type of gear train shown in Figure 5.

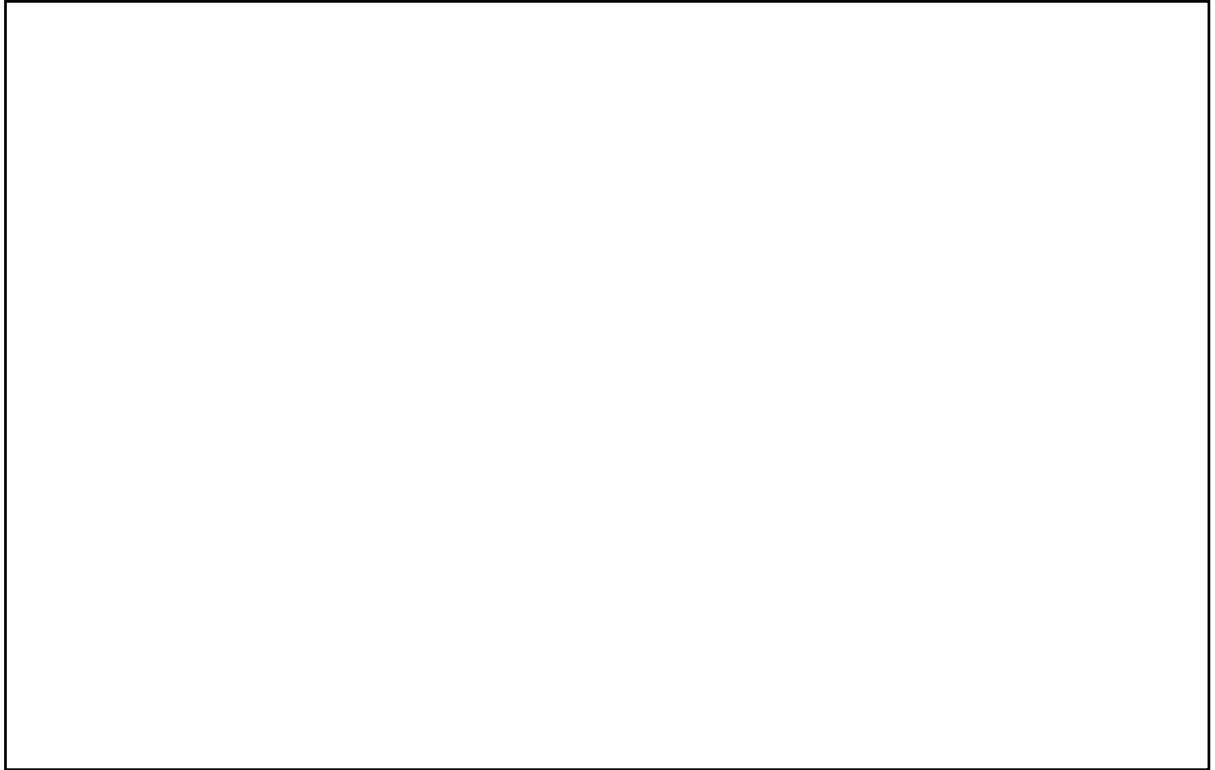
_____ (1)

b. On Figure 5, identify and label the driver gear which should be connected to the motor to make the output gear go slower. (1)

c. Using the information provided in Figure 5, calculate the rotating speed of Gear B.

(3)

- d. The mechanical system in Figure 5 needs to be modified so that Gear B rotates in the same direction of Gear A with the output speed remaining unchanged.
In the space provided below draw the modified gearing system. Label each gear in your drawing and show centre lines. The gears can be represented as circles.



(3)

- e. Suggest a suitable material to manufacture the gears.

_____ (1)

(Total: 9 marks)

18. A set of different LEDs were fitted to a display to attract more customers. Figure 6 shows a circuit to operate the LEDs when customers pass in front of the display.

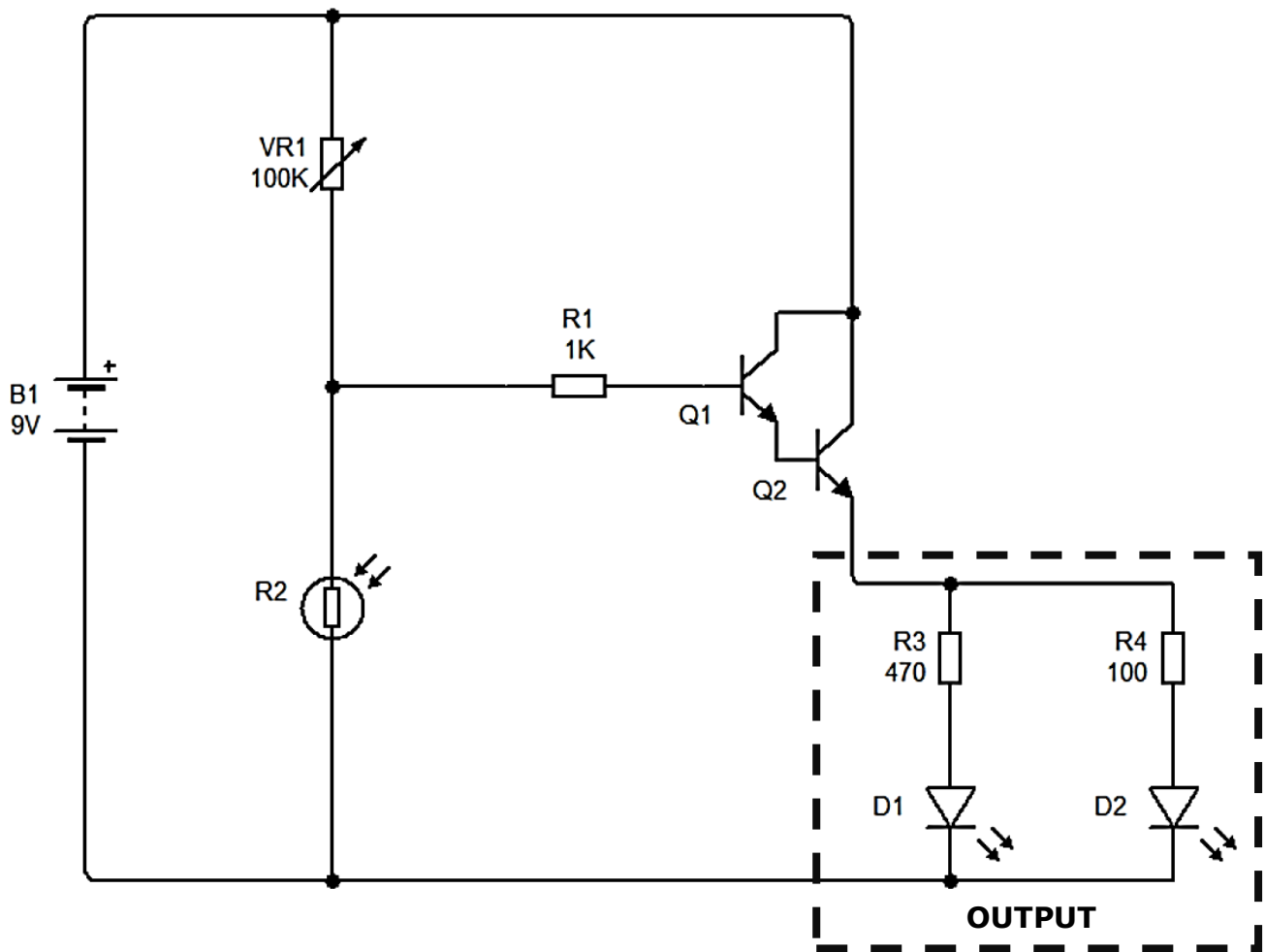


Figure 6

- a. The output subsystem is marked on the circuit diagram with a dashed square. On Figure 6 highlight and label the following:
- i. the input subsystem;
 - ii. the process subsystem.
- (2)

- b. Give the name of the configuration of components Q1 and Q2 on Figure 6 and suggest a reason why this configuration was used in the system.

Name:	
Reason:	

(2)

- c. This question is about latching and momentary switches.

- i. State the difference between latching and momentary switches.

(2)

- ii. Suggest which type of switch would be more suitable to be added as a power switch for the circuit shown in Figure 6 and give a reason for your answer.

Type of switch:	
Reason:	

(2)

- d. The circuit shown in Figure 6 makes use of different types of LEDs.

- i. Label and name the leads of the LED shown in Figure 7.

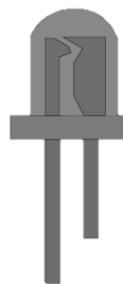


Figure 7

(1)

This question continues on next page.

ii. Using calculations, find out which LED in Figure 6 consumes more power.

(3)

e. A solar power supply is used to power the circuit. State an advantage and disadvantage of using such a power supply.

Advantage:	
Disadvantage:	

(2)

(Total: 14 marks)

19. The system shown in Figure 6 was redesigned to be controlled by microcontrollers.

Figure 8 shows the components which are connected to certain pinouts of the microcontroller. The microcontroller will be programmed to perform the following operations:

- When the LDR conditions are met, both LEDs light up for 5 seconds.
- Then the LEDs go OFF and a tune is played to promote the items being displayed.
- Both operations repeat for 3 times.
- All sequence restarts when the LDR conditions are met again.

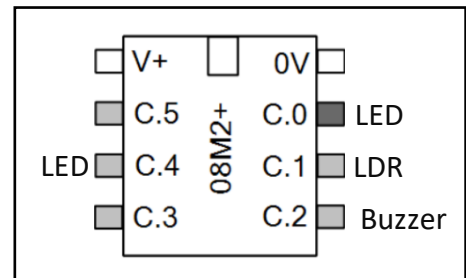
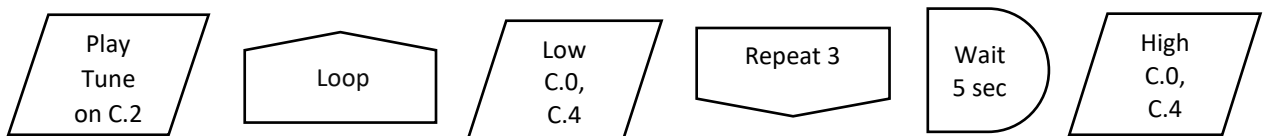


Figure 8

Use the below commands to complete the flowchart in Figure 9 to operate the program according to the description above.



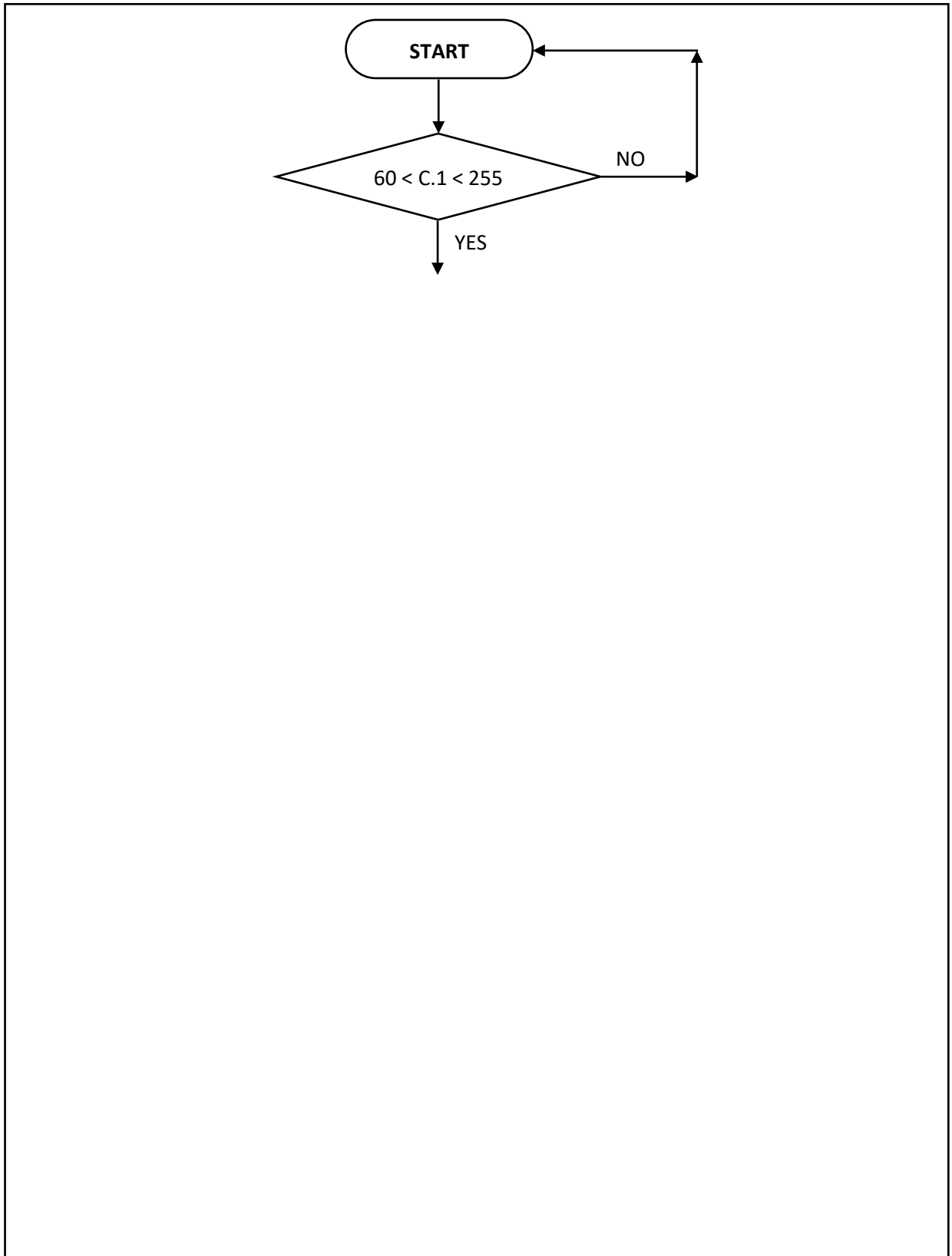


Figure 9

(Total: 6 marks)

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EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2022 MAIN SESSION**

SUBJECT: **Design and Technology**
PAPER NUMBER: IIB
DATE: 10th May 2022
TIME: 9:00 a.m. to 11:05 a.m.

Instructions

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

Non-programmable calculators and drawing instruments are allowed.

Show **ALL** the working for mathematical calculations.

Coloured pencils and/or markers may be used for sketches.

Useful Information

Formulae:

$$P = V \times I$$

$$V = I \times R$$

$$\text{Velocity Ratio} = \frac{\text{No. of teeth of Driver}}{\text{No. of teeth of Driven}} = \frac{\text{Speed of Driven}}{\text{Speed of Driver}}$$

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

Theme: Enjoying an Accessible Lifestyle

Situation: Accessibility in buildings such as shopping centres is controlled by regulations in order to achieve equality for everyone. Therefore, shop owners must consider the needs of all customers when planning the layout and display of their shops.

SECTION A: Core Design & Technology Principles

1. Underline the correct answer for each question:

- a. Which of the following can be **both** considered as stakeholders for the above situation?
 - i. Interior designers and customers using wheelchairs
 - ii. Policemen and firefighters
 - iii. Clothes manufacturers and computer manufacturers
 - iv. Tile layers and curtain makers

- b. Which of the following statements is a design specification?
 - i. Do not obstruct the passageway.
 - ii. Some customers commented that the entrance of the shopping centre is too narrow.
 - iii. The shopkeeper paid €1000 for a marketing campaign.
 - iv. The door of the shop should have a minimum width of 1m.

- c. Which of the following are parts of a belt-sanding machine?
 - i. Foot pedal and hand wheel
 - ii. Motor and guard
 - iii. Chuck and jaws
 - iv. Blade and handle

- d. Which of the following is **not** a renewable energy source?
 - i. Hydroelectric energy
 - ii. Biofuels
 - iii. Petroleum
 - iv. Solar energy

(Total: 4 marks)



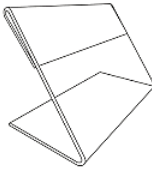
2. Write what the following acronyms stand for:

- a. CAM: C _____ A _____ M _____
- b. PPE: P _____ P _____ E _____
- c. PCB: P _____ C _____ B _____

(Total: 3 marks)

3. Name the manufacturing/fabrication process used to make the products shown in Table 1.

Table 1

<p>Product</p>	<p>Aluminium pipes</p> 	<p>Yoghurt tubs</p> 	<p>Plastic desktop display</p> 
<p>Manufacturing/ fabrication process</p>			

(Total: 3 marks)

4. Fill in the missing information in Chart 1 below.

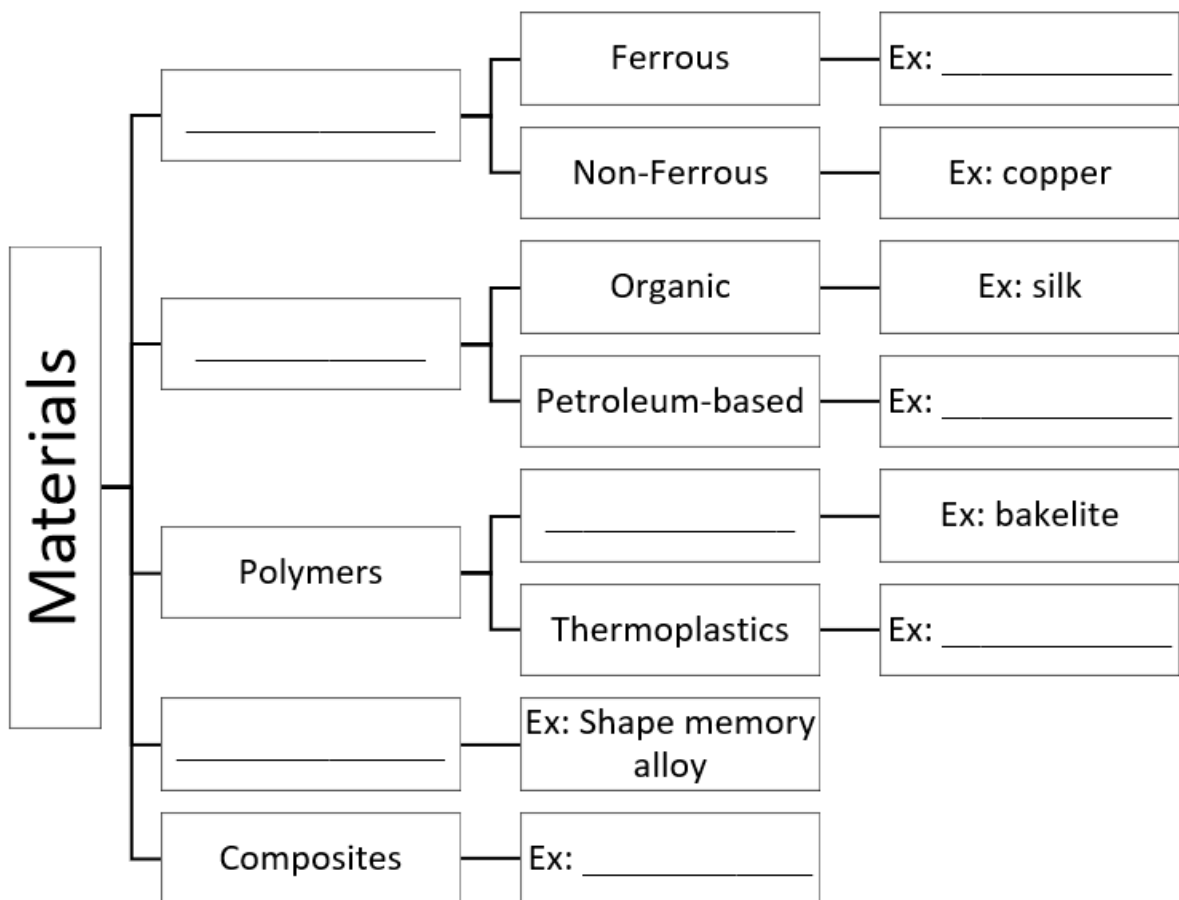


Chart 1

(Total: 4 marks)

5. Table 2 shows the main steps involved when making a plain seam on a sewing machine. Write numbers in the empty column to put the steps in the correct sequence.

Table 2

STEPS	SEQUENCE
Put material under the foot press and set machine to straight stitching.	
Put material right side facing each other.	
Make a straight stitch leaving enough seam allowance.	
Press open the seam by ironing.	

(Total: 2 marks)

6. Complete Table 3 by drawing a sketch of the mentioned items.

Table 3

bar chart	block diagram
multimeter	set square

(Total: 4 marks)

SECTION B: Design Aspect

Refer back to the situation on Page 2 and read the following problem carefully.

Clothes shops need to make products available for viewing to all customers and maximise their use of space. To do so, shelves and rails are placed on top of each other using the full possible height. However, not all customers may be able to reach the top shelves/rails of certain display units.

- 7. Consider the above problem to answer the following question.
 - a. Mention **FOUR** different criteria that the designer needs to consider when exploring the problem.

_____ (4)

- b. Write down an initial design brief.
- _____ (1)

- c. Extract **TWO** keywords from your design brief.
- _____ (1)

(Total: 6 marks)

- 8. Fill in the blank by using the words from the following word bank.

decisions information interpreting develop

Data analysis is the process of making sense of data by _____ relevant _____ and results in order to make design _____ and _____ specifications and project design.

(Total: 2 marks)

- 9. Mechanical systems may be included in display units in order to increase accessibility.

In the spaces provided below sketch **TWO** different ideas for solutions to the problem above. The sketches must indicate how customers would be helped with the solution proposed, including any input and output movements. Marks will be awarded for dimensions, annotations (including materials), clarity, presentation and good use of colour.

This question continues on next page.

Idea 1

(5)

Idea 2

(5)

(Total: 10 marks)

10. Mention **TWO** evaluation methods which can be used on any final product.

Evaluation method 1:	<hr/> <hr/> (1)
Evaluation method 2:	<hr/> <hr/> (1)

(Total: 2 marks)

11. This question is about Design Communication and Data Sharing.

a. Describe how a designer can facilitate two-way communication with the clothes shop owner.

_____ (1)

b. Name **TWO** tools that can be used to communicate and share data.

_____ (2)

(Total: 3 marks)

12. Fill in the blanks with **FOUR** correct words from the following word bank.

revisited product regularly freely improve user

An iterative design process allows the designer to go from one stage to another _____ to better explore and _____ design ideas. Each section of the iterative design process can be _____ and reflected upon _____.

(Total: 2 marks)

SECTION C: Technology Aspect

13. Figure 1 shows a 3D design of a shop display for a new line of eyeglasses from a famous designer brand.

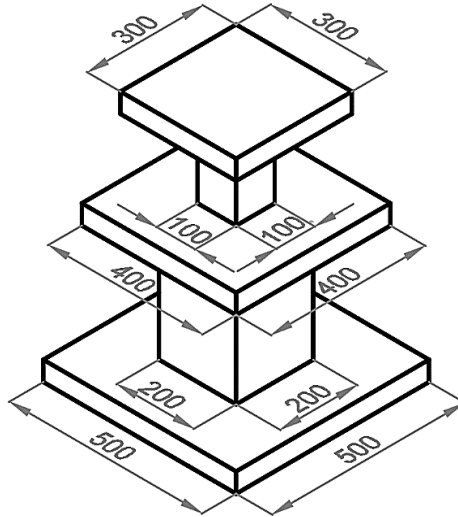


Figure 1

a. Underline the 3D pictorial projection technique that was used to draw Figure 1.

Oblique projection two-point perspective isometric projection (1)

b. Underline **ONE** of the following statements which best describes the 3D pictorial projection technique used in Figure 1:

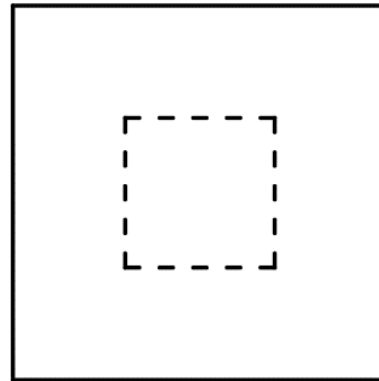
- i. Front elevation, End elevation and a Plan.
- ii. A 3D drawing showing faces at 30°/30°.
- iii. A 3D drawing showing faces going towards the vanishing points. (1)

c. To help the showcase stand out, the display is going to be painted in a monochromatic colour scheme. Explain what a monochromatic colour scheme is.

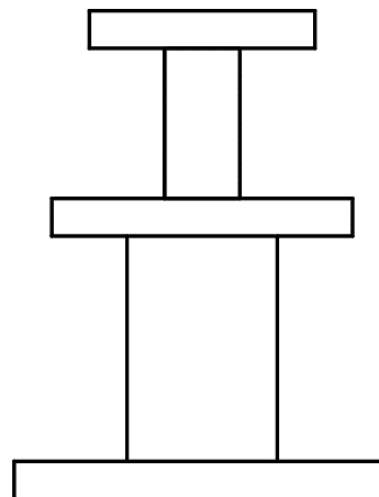
_____ (1)

This question continues on the next page.

- d. Figure 2 shows an incomplete orthographic projection of the shop display in Figure 1. On Figure 2, complete the Plan and add overall dimensions.



Plan



Front

Figure 2

(2)

- e. Give the name of **ONE** type of line which is used in Figure 2.

_____ (1)

(Total: 6 marks)

14. The shop display shown in Figure 1 is made of manufactured wood.

- a. Mention **TWO** examples of manufactured wood that could be used for the shop display.

Example 1: _____ (1)

Example 2: _____ (1)

- b. Choose **ONE** of the manufactured wood types mentioned in question 14a and fill in Chart 2 by completing the following instructions to show the aesthetic properties of the material.
- i. Write the name of the chosen wood.
 - ii. Draw the colour and pattern of the material on the given corner sample.
 - iii. Describe how it looks.

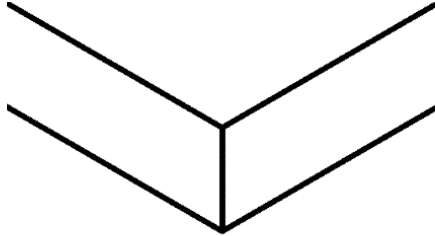
NAME OF WOOD: _____	
<p style="text-align: center;">CORNER SAMPLE</p> <div style="text-align: center; margin-top: 50px;"></div>	<p style="text-align: center;">DESCRIPTION</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Chart 2

(2)

This question continues on the next page.

- c. Particular screws were used to assemble the display's columns to the shelves as explained in Figure 3.

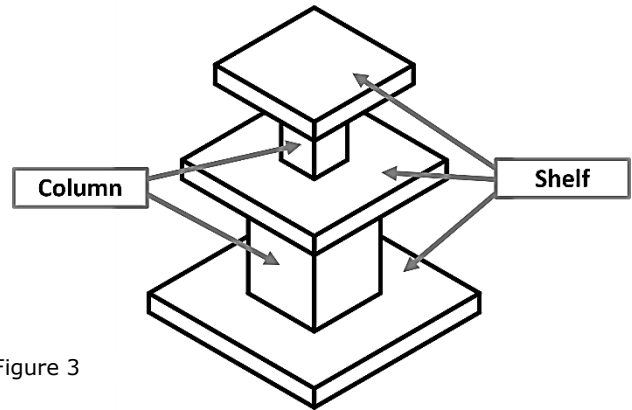


Figure 3

- i. In the space provided below, draw a suitable screw which can be used in this assembly and does **not** protrude above the surface.

(1)


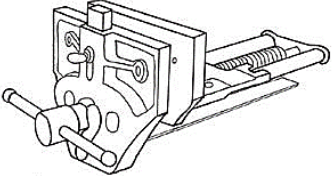
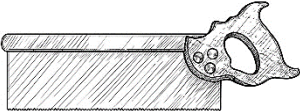
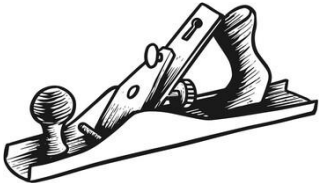
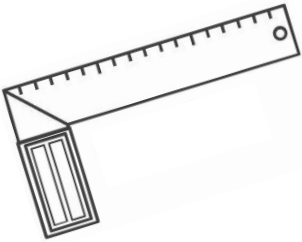
- ii. Considering the material chosen in question 14b, in the space provided below, sketch how the top shelf is screwed in a fixed position to the top column.

(3)

(Total: 8 marks)

15. Table 4 shows some of the tools which can be used to manufacture the display in Figure 3. Fill in the tool list by writing the names and use of each tool.

Table 4

TOOL / EQUIPMENT	NAME	USE
		
	woodworkers' vice	
		cutting straight edges
		
		

(Total: 6 marks)

Please turn the page.

16. Figure 4 shows a polymer stand which is used to hold eyeglasses on display. Such stands were made using the 3D printing fabrication process.

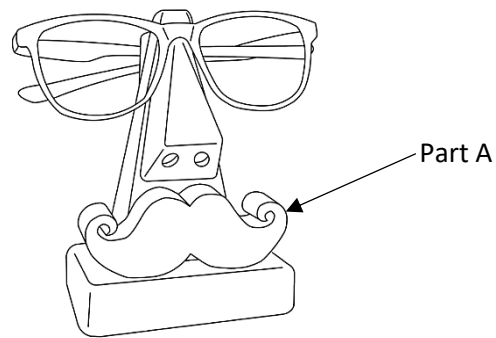


Figure 4

a. State the standard form in which 3D printing material is supplied.

_____ (1)

b. Suggest a suitable polymer which can be used to 3D print these eyeglasses stands.

_____ (1)

c. The profile of Part A on Figure 4 was created by tracing the outline of a bitmap image and transform it into a vector image. Define what a bitmap image is.

_____ (2)

d. Briefly explain how to digitally create the form marked as Part A on Figure 4 on a 3D drawing software.

_____ (2)

(Total: 6 marks)

17. A rotating display was constructed for a jewellery shop window. The system of the rotating display consists of an input motor which drives a gearing system to slow down the output rotating speed. Figure 5 shows part of this gearing system.

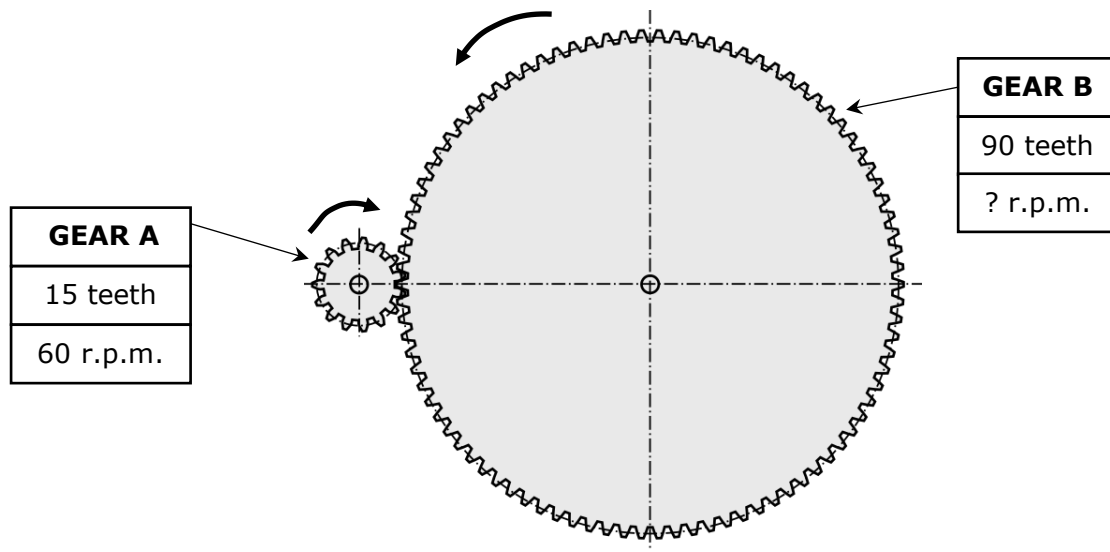


Figure 5

a. Underline the type of gearing system shown in Figure 5.

- simple gear train
 compound gear train
 rack and pinion
 cage gears
- (1)

b. On Figure 5, identify and label the driver gear which should be connected to the motor to make the output gear go slower. (1)

c. Using the information provided in Figure 5:
 i. Find the velocity ratio of the two gears.

(1)

This question continues on next page.

ii. Calculate the rotating speed of Gear B. Write your answer in r.p.m.

(2)

d. Figure 6 shows the same input and output gears separately. On Figure 6 draw the missing part so that Gear B rotates in the same direction of Gear A with the output speed remaining unchanged.
Label **all** parts in the drawing.

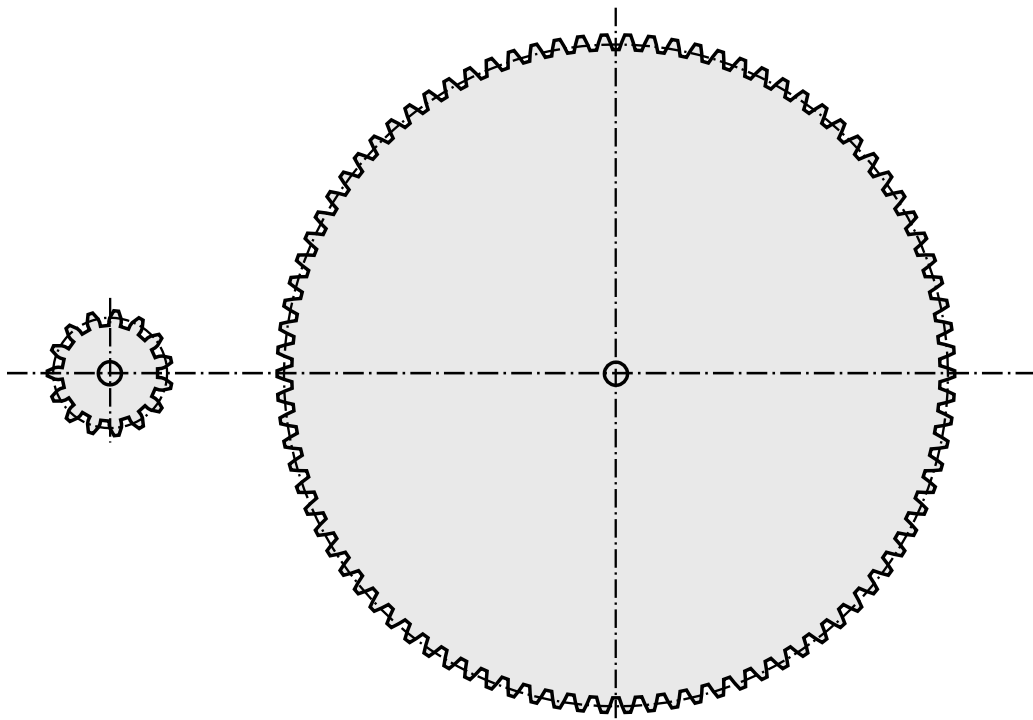


Figure 6

(3)

e. Suggest a suitable material to manufacture the gears.

(1)

(Total: 9 marks)

18. A set of different LEDs were fitted to a display to attract more customers. Figure 7 shows a circuit to operate the LEDs when customers pass in front of the display.

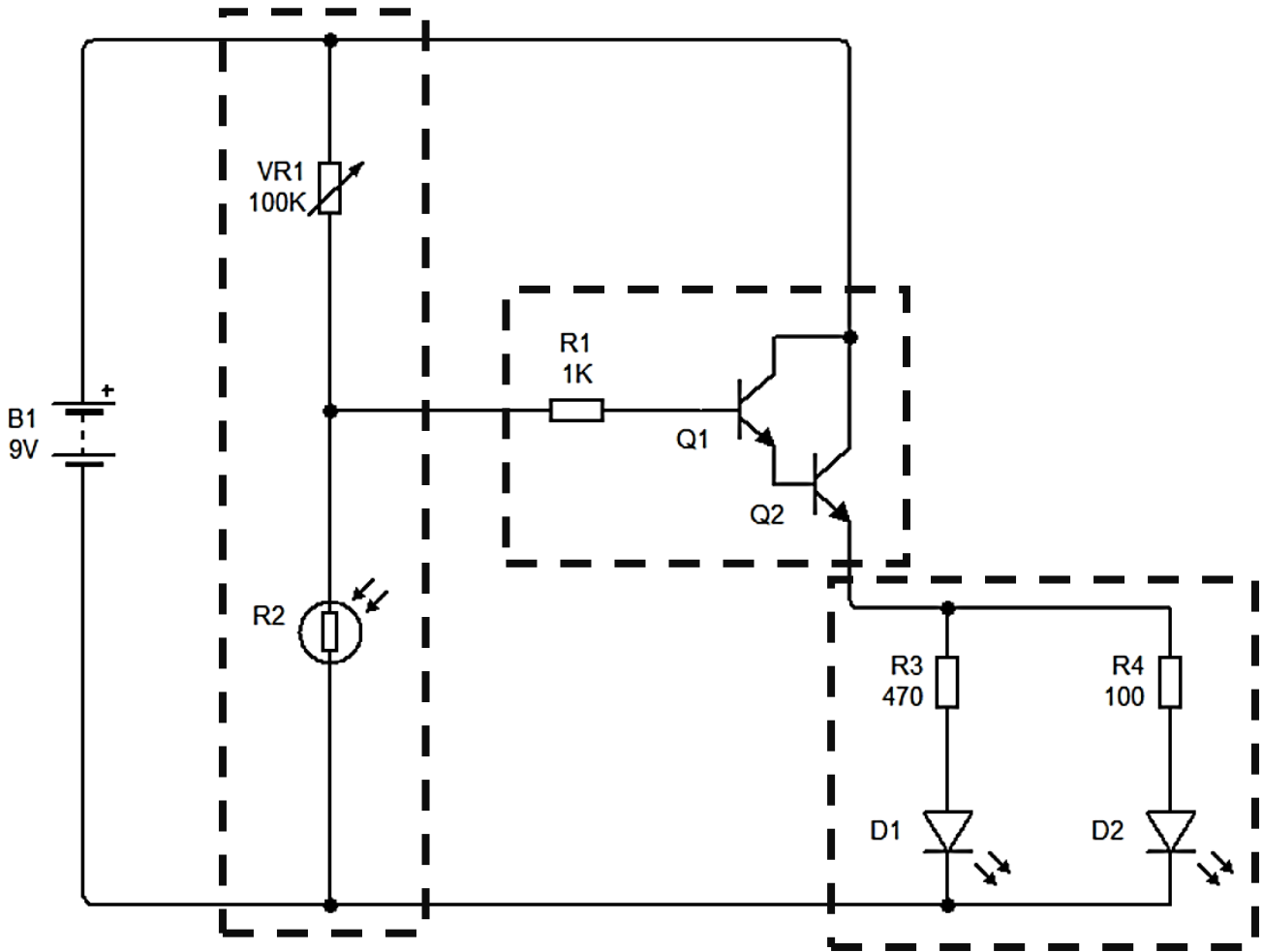


Figure 7

- a. Different subsystems are marked on the circuit diagram with a dashed square. On Figure 7, label the input, process and output subsystems. (2)
- b. Give the name of the configuration of components Q1 and Q2 on Figure 7 and suggest a reason why this configuration was used in the system.

Name:	
Reason:	

(2)

This question continues on next page.

c. This question is about switches.

i. Describe what a latching switch is.

_____ (1)

ii. Describe what a momentary switch is.

_____ (1)

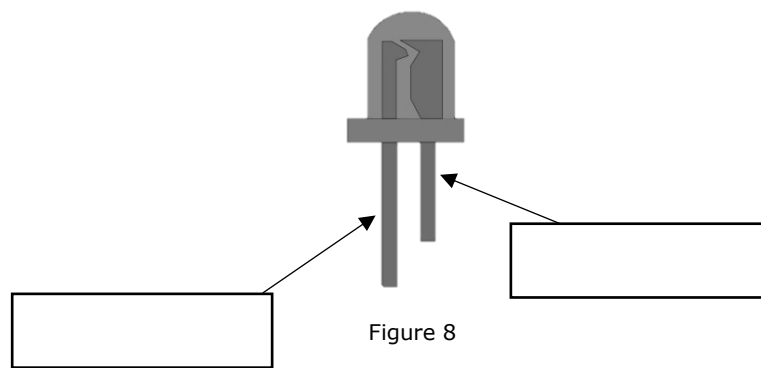
iii. Decide whether a latching or a momentary switch would be more suitable to be added as a power switch for the circuit shown in Figure 7. Give a reason for your answer.

Type of switch:	
Reason:	

(2)

d. The circuit shown in Figure 7 makes use of different types of LEDs.

i. Label and name the leads of the LED shown in Figure 8.



(1)

ii. Describe another way how the leads can be identified if both have the same length.

_____ (1)

iii. Using calculations, find out which LED in Figure 7 consumes more power.

Power consumed by LED D1	Power consumed by LED D2
LED ____ consumes more power.	

(3)

e. A solar power supply is used to power the circuit. State **TWO** advantages of using such a power supply.

(2)

(Total: 15 marks)

19. The system shown in Figure 7 was redesigned to be controlled by microcontrollers.

Figure 9 shows the components which are connected to certain pinouts of the microcontroller. The microcontroller will be programmed to perform the following operations:

- When the LDR conditions are met, both LEDs light up for 5 seconds.
- Then the LEDs go OFF and a tune is played to promote the items being displayed.
- Both operations repeat for 3 times.
- All sequence restarts when the LDR conditions are met again.

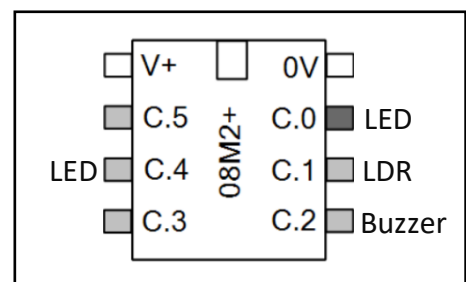
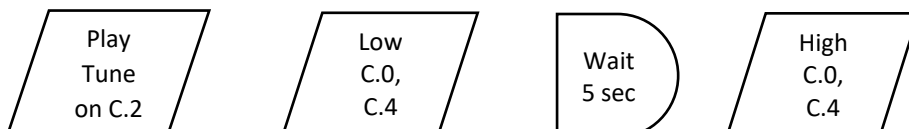


Figure 9

Use the below commands to complete the flowchart in Figure 10 to operate the program according to the description above.



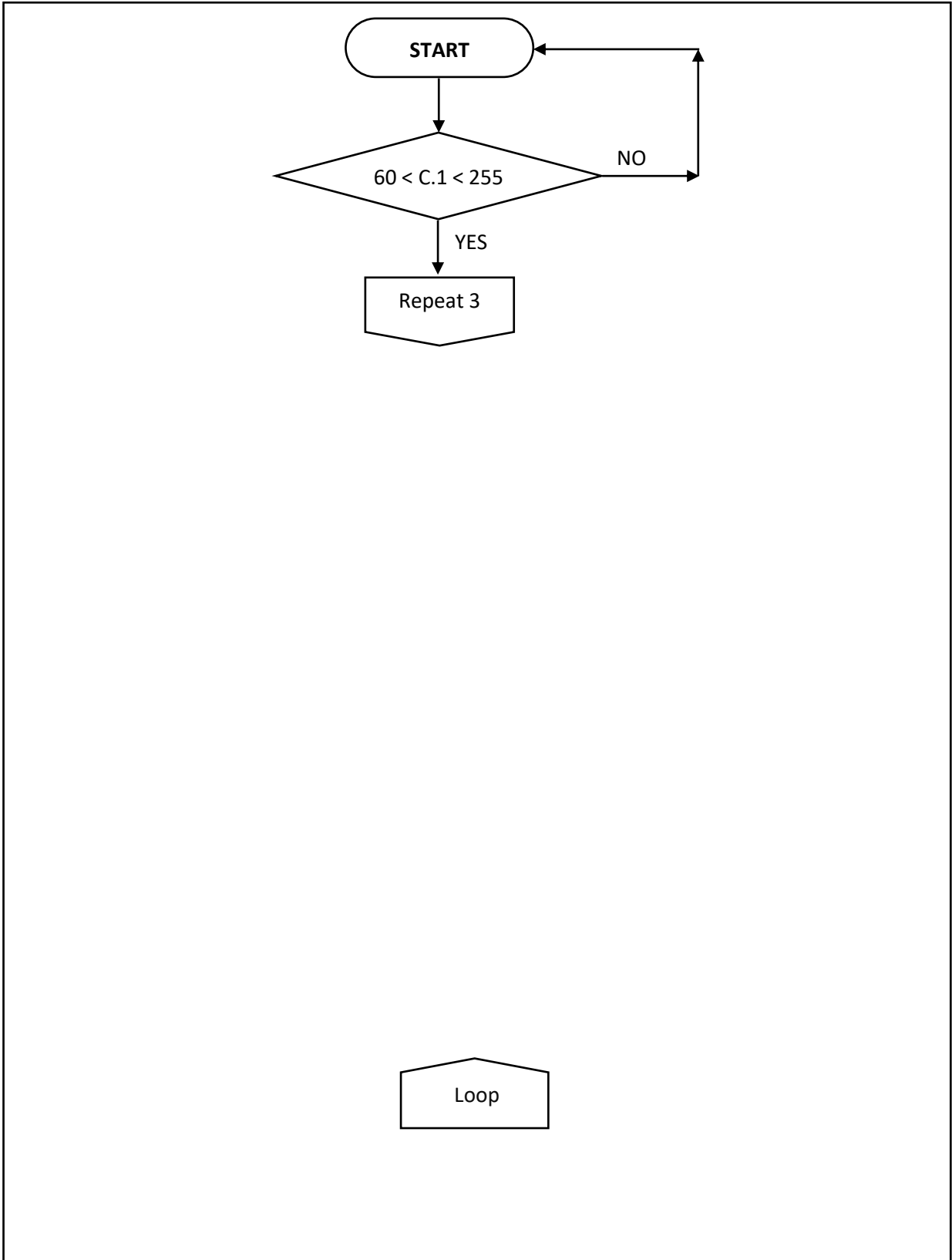


Figure 10

(Total: 5 marks)