

Design and Technology
(Product Design)
Advanced
COMPONENT 1

Total Marks

Wednesday 5 June 2024 – Afternoon

Time: 2 hours 30 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

INFORMATION

The total mark for this paper is 120.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

For questions requiring mathematics, you must show all your working out with your answer clearly identified at the end of your solution.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

1 Look at Figure 1 for Question 1 in the Diagram Booklet. It shows a chisel. The chisel blade is manufactured from carbon steel.

(a) During manufacture the chisel blade becomes work hardened.

Name TWO heat treatment processes that are used to restore the metal's mechanical properties making it tougher and less brittle.

(2 marks)

1 _____

2 _____

(continued on the next page)

1 continued.

- (b) Explain TWO reasons why carbon steel is used for the blade of the chisel.
(4 marks)**

1 _____

2 _____

(continued on the next page)

Turn over

1 continued.

(c) The chisel has a polypropylene handle.

Explain ONE benefit of using polypropylene for the chisel handle.

(3 marks)

(Total for Question 1 = 9 marks)

- 2 Look at Figure 2 for Question 2 in the Diagram Booklet. It shows a hot melt glue gun.**

Hot melt glue is widely used in furniture manufacturing and packaging.

- (a) Give TWO benefits of using hot melt glue.
(2 marks)**

1 _____

2 _____

(continued on the next page)

2 continued.

- (b) A manufacturer currently uses 500 glue sticks per week but is planning to increase production by 30%**

Cost of glue sticks: £9.44 per pack of 16

Percentage of waste glue: 12%

Calculate the annual cost of waste glue over a 52 week period at the increased level of production.

Give your answer in pounds to 2 decimal places.

**Show all of your workings.
(5 marks)**

Answer space continues on the next page.

2(b) continued.

Answer £ _____

(Total for Question 2 = 7 marks)

Turn over

3 Look at Figure 3 for Question 3 in the Diagram Booklet. It shows a table leg that has been turned from a square section of mahogany on a wood lathe.

**(a) Explain ONE property of mahogany that makes it a suitable material for turning on a wood lathe.
(2 marks)**

(continued on the next page)

3 continued.

- (b) Describe, using labelled sketches, how a square section of mahogany would be prepared and then turned into a cylinder, using a wood lathe.
(4 marks)**

Answer space continues on the next page.

3(b) continued.

(continued on the next page)

3 continued.

- (c) Explain TWO reasons why mahogany might NOT be considered a sustainable material.
(6 marks)**

Answer space continues on the next page.

1 _____

2 _____

Turn over

3(c) continued.

(Total for Question 3 = 12 marks)

4 Manufacturers use many methods to facilitate production efficiency, sustainability and quality.

(a) Manufacturers often utilise standardised parts and bought-in components when designing and manufacturing consumer products.

Give THREE benefits of using standardised parts and bought-in components.

(3 marks)

1 _____

2 _____

3 _____

(continued on the next page)

4 continued.

(b) Lean manufacturing utilises just-in-time (JIT) systems.

**Outline the benefits of a just-in-time (JIT) system.
(6 marks)**

Answer space continues on the next page.

Turn over

4(b) continued.

(continued on the next page)

4 continued.

- (c) Six Sigma is used in manufacturing to identify and remove the causes of defects.**

Reducing costs is one of the five value targets used in Six Sigma.

**Give TWO other value targets used in Six Sigma.
(2 marks)**

1 _____

2 _____

(continued on the next page)

4 continued.

- (d) Discuss how a circular economy will reduce the impact of manufacturing activity on the environment and promote sustainability.
(9 marks)**

Answer space continues on the next 3 pages.

4(d) continued.

[illegible]

Turn over

4(d) continued.

[illegible]

Turn over

4(d) continued.

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(Total for Question 4 = 20 marks)

- 5 A contractor has been asked to paint the floor of a design and technology workshop.**

Look at Figure 4 for Question 5 in the Diagram Booklet. It shows the floor plan of the design and technology workshop.

All dimensions are in metres (m)

- (a) Calculate the area of the design and technology workshop floor.**

**Give your answer to ONE DECIMAL PLACE.
(5 marks)**

Answer space continues on the next page.

5(a) continued.

Answer _____m²

(continued on the next page)

5 continued.

(b) The floor paint is only supplied in 5 litre cans.

A 5 litre can costs £48.00

One litre of paint will cover 12m^2 for each coat.

Two coats are required.

**Calculate the overall cost of the cans of paint
required to complete the painting of the floor.
(3 marks)**

Answer space continues on the next page.

5(b) continued.

Answer £ _____

(Total for Question 5 = 8 marks)

6 Look at Figure 5 for Question 6 in the Diagram Booklet. It shows a bandsaw used by a manufacturer of consumer products.

(a) One safe working practice when operating a bandsaw would be to wear personal protective equipment (PPE).

**Give TWO other safe working practices when operating a bandsaw.
(2 marks)**

1 _____

2 _____

(continued on the next page)

6 continued.

- (b) The manufacturer embraces user centred design when developing new products.**

User centred design considers user needs, wants and values.

Explain TWO other considerations of user centred design that help to ensure that products are fit for purpose.

(6 marks)

Answer space continues on the next page.

1 _____

6(b) continued.

2 _____

(continued on the next page)

6 continued.

- (c) Manufacturing companies comply with a wide range of health and safety legislation and regulations to protect workers.**

Discuss the consequences for a company of non-compliance with health and safety legislation and regulations.

(6 marks)

Answer space continues on the next 2 pages.

6(c) continued.

[illegible]

Turn over

6(c) continued.

(continued on the next page)

6 continued.

- (d) The level of risk, including severity and likelihood, is one part of a risk assessment.**

**Give TWO other parts of a risk assessment.
(2 marks)**

1 _____

2 _____

(continued on the next page)

6 continued.

- (e) Look at the table for Question 6(e) in the Diagram Booklet. It shows the total budget spent on various aspects of Health and Safety by a manufacturing company.**

The cost of PPE is increasing by 12%

Calculate what percentage of the Health & Safety budget is spent on PPE after the increase is applied.

(3 marks)

Answer space continues on the next page.

6(e) continued.

Answer _____%

(Total for Question 6 = 19 marks)

- 7** Look at Figure 6 for Question 7 in the Diagram Booklet. It shows the net (development) for a chocolate box.

Look at the isometric grid for Question 7 in the Diagram Booklet. Draw an accurate isometric projection of the chocolate box.

Use the isometric grid provided starting with lines **A–B** and **B–C** as your baselines.

Each segment of the grid equals **1 cm**

The height of the assembled box is **10 cm**

Dimensioning of the isometric projection is not required.

(6 marks)

(Total for Question 7 = 6 marks)

- 8 Look at Figure 7 for Question 8 in the Diagram Booklet. It shows a hotel elevator lobby in a building designed and constructed during the Art Deco period.

Discuss how the interior design of the hotel elevator lobby was influenced by Art Deco philosophies.
(9 marks)

Answer space continues on the next 3 pages.

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8 continued.

(Total for Question 8 = 9 marks)

- 9 Discuss how innovation management is used when developing and introducing new consumer products. (9 marks)**

Answer space continues on the next 4 pages.

[illegible]

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9 continued.

[illegible]

Turn over

9 continued.

(Total for Question 9 = 9 marks)

10 Photo-chromic glass is one type of smart material that reacts to ultraviolet (UV) light.

Reactive glass is another form of modern smart material.

**Explain TWO benefits and ONE drawback of reactive glass.
(9 marks)**

Answer space continues on the next 2 pages.

Benefit 1

10 continued.

Benefit 2

Drawback 1

Turn over

10 continued.

(Total for Question 10 = 9 marks)

11 Look at Figure 8 for Question 11 in the Diagram Booklet. It shows a ‘spinning’ bike used for indoor group exercise classes.

- **Main frame in welded mild steel with a powder coated finish**
- **Four height adjustable feet at ground contact points**
- **Seat adjustable vertically and horizontally**
- **Handlebars adjustable for height**
- **Digital liquid crystal display showing revolutions per minute (**RPM**), power output in Watts, distance travelled, heart rate and effort level**
- **Tension/effort level adjustment**
- **Stainless steel flywheel – weight **22 kg****
- **Overall weight – **64 kg****
- **User height range **1.50 m to 1.95 m****
- **Maximum user weight – **135 kg****
- **Cost **£1,150.00****

(continued on the next page)

11 continued.

**Evaluate how the designer of the 'spinning' bike has addressed ergonomics and user requirements for group exercise activities.
(12 marks)**

Answer space continues on the next 4 pages.

11 continued.

[illegible]

Turn over

11 continued.

[illegible]

Turn over

11 continued.

[illegible]

Turn over

11 continued.

(Total for Question 11 = 12 marks)

TOTAL FOR PAPER = 120 MARKS
END OF PAPER