

Total Marks
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Design and Technology  
(Product Design)  
Advanced  
Component 1

Friday 12 June 2020 – Morning

Time: 2 hours 30 minutes plus your additional  
time allowance

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  
– there may be more space than you need.**

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

**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.**

**Turn over**

**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 In the Diagram Booklet Figure 1 shows a fabric canopy for use in a garden. It is supported on aluminium legs and anchored with nylon cords.**

**(a) The fabric canopy is made from polyester because it is lightweight, waterproof and durable.**

**Give TWO further characteristics of polyester fabric that make it a suitable material for the canopy.  
(2 marks)**

**1** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**2** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**(continued on the next page)**

**Turn over**

**1 continued.**

**(b) The cords are made from nylon.**

**Explain TWO working properties of nylon that make it a suitable material for the cords. (4 marks)**

**1** \_\_\_\_\_

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**1 continued.**

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**1 continued.**

**(c) The support legs are made from aluminium tube.**

**Explain ONE advantage of using aluminium tube rather than solid oak poles for the support legs. (3 marks)**

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**(TOTAL FOR QUESTION 1 = 9 MARKS)**

**Turn over**



**2 In the Diagram Booklet Figure 2 shows a drinks carton made from foil-lined board.**

**(a) One of the reasons foil-lined board has been selected for the drinks carton is because it has appropriate strength.**

**State TWO further working properties of foil-lined board that make it a suitable material for the drinks carton. (2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

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**(continued on the next page)**

**Turn over**

**2 continued.**

**(b) In the Diagram Booklet Figure 3 shows a different type of drink carton.**

**The base is 5 cm diameter ( $r = 2.5$  cm).**

**The top is 8 cm diameter ( $R = 4$  cm).**

**The capacity of the carton is  $500 \text{ cm}^3$  ( $V = 500 \text{ cm}^3$ ).**

**Calculate the height ( $h$ ) of the carton, in cm using the formula:**

$$V = \frac{1}{3} \pi h (R^2 + Rr + r^2)$$

$$\pi = 3.142$$

**(continued on the next page)**

**Turn over**

**2 continued.**

**Give your answer to 3 significant figures.**

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

**Answer \_\_\_\_\_cm**

**(TOTAL FOR QUESTION 2 = 7 MARKS)**

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**Turn over**

**3 Smart and modern materials are often used in consumer products.**

**(a) Explain ONE way that thermo-chromic materials could improve the safety of consumer products. (2 marks)**

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**(continued on the next page)**

**3 continued.**

**(b) In the Diagram Booklet Figure 4 shows a pair of spectacles with a shape memory alloy (SMA) frame.**

**Explain TWO benefits of using shape memory alloy (SMA) for spectacle frames. (6 marks)**

**1** \_\_\_\_\_

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**Turn over**

3 continued.

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**(TOTAL FOR QUESTION 3 = 8 MARKS)**

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- 4 In the Diagram Booklet Figure 5 shows a front wing panel for a mass produced car.**

**The wing is manufactured from sheet steel and attached to the steel supporting structure of the car.**

**(continued on the next page)**

**4 continued.**

**(a) Name THREE joining methods that could be used to attach the steel front wing panel to the steel supporting structure of the car during assembly. (3 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

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**3** \_\_\_\_\_

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**Turn over**



**4 continued.**

**(b) The mass produced steel front wing panel is produced using an automated machine process.**

**In the Diagram Booklet Figure 6 shows the steel supplied in roll form.**

**Outline the process used to form the front wing panel from the steel roll.  
(6 marks)**

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**4 continued.**

**(c) Steel is sometimes treated in order to improve its working properties.**

**Using the space below and page 20, describe using annotated sketches, the process of case hardening a one-off product in a school workshop. (6 marks)**

**4 continued.**

**4 continued.**

**(d) In the Diagram Booklet Figure 7 shows a table of tensile failure load results for a batch of steel.**

**Calculate each of the following, using the data shown in Figure 7.**

**Show all of your workings.**

**(i) The modal failure load of the steel. (1 mark)**

**Answer \_\_\_\_\_**

**(continued on the next page)**

**Turn over**

**4 continued.**

**(ii) The median failure load of the steel. (2 marks)**

**Answer \_\_\_\_\_**

**(continued on the next page)**

**Turn over**

**4 continued.**

**(iii) The mean failure load of the steel.  
(4 marks)**

**Answer \_\_\_\_\_**

**(TOTAL FOR QUESTION 4 = 22 MARKS)**

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**Turn over**

**5 Quality is an important issue in the manufacturing of consumer products.**

**One disadvantage of quality control systems is the high set-up cost.**

**(a) Give TWO further disadvantages of quality control systems. (2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

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**5 continued.**

**(b) Built-in obsolescence affects both consumers and manufacturers.**

**Evaluate the effects that built-in obsolescence has on manufacturers.  
(9 marks)**

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## 5 continued.

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**(TOTAL FOR QUESTION 5 = 11 MARKS)**

# Turn over

- 6 (a) Protecting the intellectual property rights of designers, inventors and companies has both advantages and disadvantages.

**Give TWO disadvantages of patenting designs. (2 marks)**

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**6 continued.**

**(b) When manufacturing consumer products, companies can use various project management strategies.**

**Explain TWO ways Six Sigma can improve manufacturing processes.  
(6 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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6 continued.

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**6 continued.**

**(c) Despite the use of quality assurance systems consumers still occasionally receive faulty goods.**

**Discuss how consumer rights legislation provides protection to the consumers who receive faulty goods.  
(6 marks)**

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**6 continued.**

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**6 continued.**

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**(d) Give TWO ways that a product can be sustainably disposed of at the end of its useful life. (2 marks)**

**1** 

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**2** 

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**Turn over**

**6 continued.**

**(e) Figure 8 shows a table of temperatures at different times of the day.**

**FIGURE 8**

<b>12 noon</b>	<b>1 pm</b>	<b>2 pm</b>	<b>3 pm</b>	<b>4 pm</b>	<b>5 pm</b>
<b>17 °C</b>	<b>18 °C</b>	<b>18 °C</b>	<b>17 °C</b>	<b>16 °C</b>	<b>15 °C</b>

**A paint manufacturer will only guarantee their product if it is applied at a temperature above 12 °C.**

**On page 11 of the Diagram Booklet produce and extrapolate a line graph to represent the table and estimate the time when painting will have to stop.  
(3 marks)**

**Answer \_\_\_\_\_**

**(TOTAL FOR QUESTION 6 = 19 MARKS)**

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**Turn over**

- 7 Health and safety regulations limit the weight of components that may be lifted without mechanical assistance.**

**In the Diagram Booklet Figure 9 shows a drawing of a component made from 6 mm thick mild steel plate.**

**6mm thick mild steel plate weighs  $47.1 \text{ kg/m}^2$**

**Using the space below and page 38, calculate the weight of the component shown in Figure 9.**

**Show all of your workings.**

**Give your answer in kg. (5 marks)**

**7 continued.**

**Answer \_\_\_\_\_ kg**

**(TOTAL FOR QUESTION 7 = 5 MARKS)**

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**Turn over**

**8 In the Diagram Booklet Figure 10 shows an office building designed and constructed during the Art Deco period.**

**Discuss how the design of the office building was influenced by Art Deco philosophies. (9 marks)**

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**(TOTAL FOR QUESTION 8 = 9 MARKS)**

**Turn over**

- 9 (a) Quality control and efficiency are key issues in modern manufacturing.

**Discuss the use of computer-aided testing within quality control systems for a high volume manufacturer.**

**(9 marks)**

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**9 continued.**

**(b) Value and value stream are the first two stages of lean manufacturing.**

**Explain the THREE further stages of lean manufacturing. (9 marks)**

**1** \_\_\_\_\_

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\_\_\_\_\_

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(TOTAL FOR QUESTION 9 = 18 MARKS)

**10 In the Diagram Booklet Figure 11 shows a modern lightweight travel suitcase.**

**Evaluate the functionality of the suitcase for use by holidaymakers, with reference to the specification. (12 marks)**

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Turn over



10 continued.

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**(TOTAL FOR QUESTION 10 = 12 MARKS)**

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**TOTAL FOR PAPER = 120 MARKS**  
**END**