



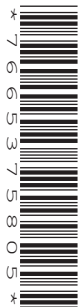
Oxford Cambridge and RSA

Friday 7 June 2019 – Morning

A Level in Design and Technology: Product Design

H406/01 Principles of Product Design

Time allowed: 1 hour 30 minutes



You may use:

- a scientific calculator
- a ruler
- pencils/pens
- geometrical instruments



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.

INFORMATION

- The total mark for this paper is **80**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in the question marked with an asterisk (*).
- This document consists of **20** pages.

Answer **all** the questions.

- 1 **Fig. 1** shows three images of a selfie stick. A selfie stick is a hand held product used to take photographs or video by holding a smartphone, beyond the normal range of the arm.

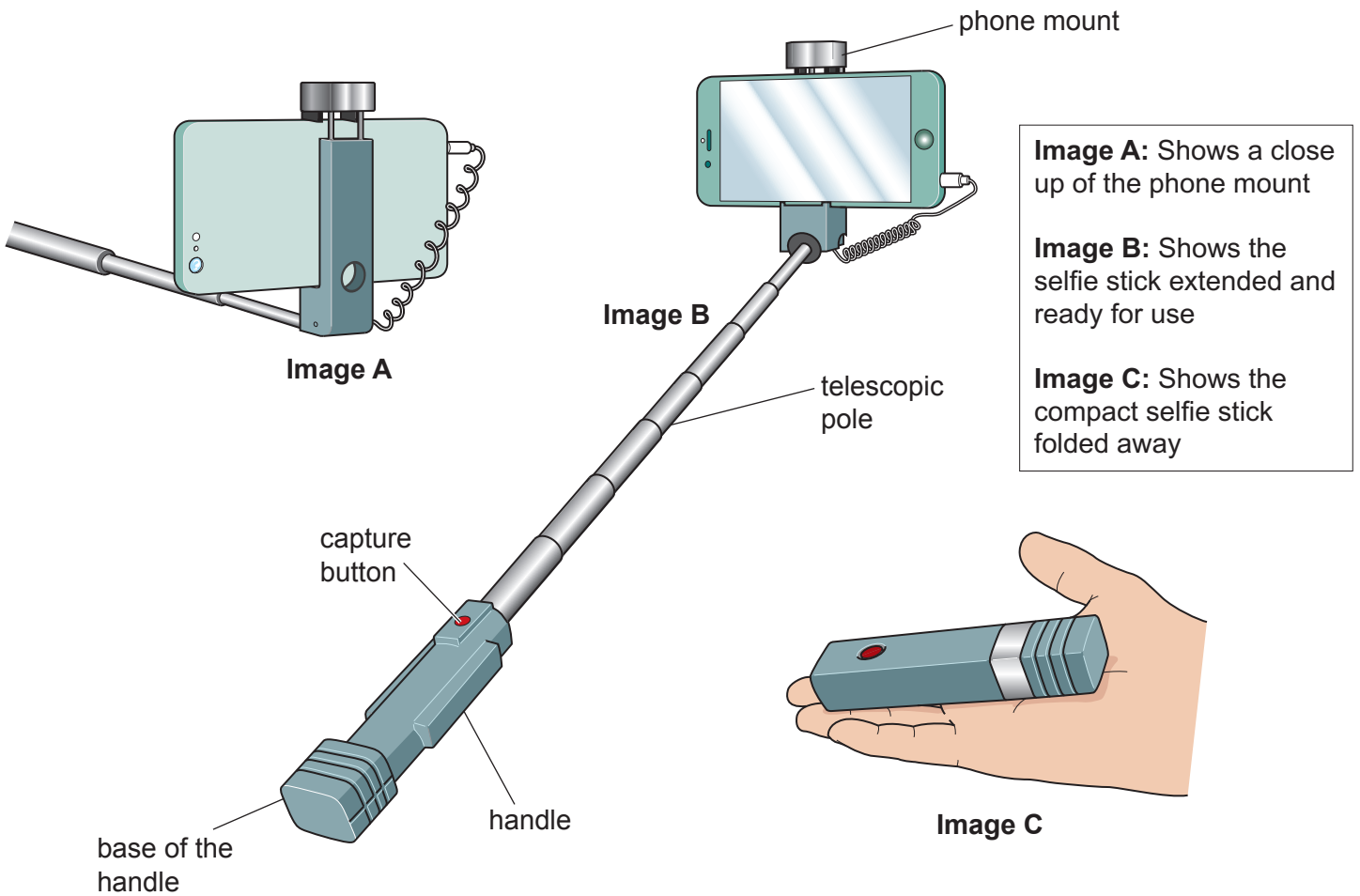


Fig. 1

- (a) Analyse **Fig. 1** to identify **two** design features of the selfie stick that ensure it functions as intended. Justify **each** of your responses.

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[4]

- (b) Name **one** metal that is suitable for the telescopic pole of the selfie stick and explain why this would be used.

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..... [2]

- (c) The maximum length of the selfie stick is 585mm from the base of the handle to the phone mount. The handle is 116mm long and the rest of the extension comes from the telescopic pole.

The telescopic pole is made up of 7 sections.
Each section is cut to the same length.
3mm of each section is covered by the larger section next to it including the section attached to the handle.

Calculate the length of one section of the telescopic pole in mm. Show your working.

Length of one section mm

[2]

(d) Explain **three** advantages to the designer of the selfie stick of using modelling during the iterative design process.

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[6]

- (f) Past and present technologies and design thinking have influenced the development of products in many different ways.

Describe **three** ways that past and present technologies and design thinking have influenced products such as the selfie stick.

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[6]

2 Fig. 2.1 shows two views of a remote control for an electronic device.



Fig. 2.1

- (a) The top surface of the battery hatch, shown in Fig. 2.1, is a rectangle measuring 30 mm wide and 60 mm long correct to the nearest mm. Calculate the upper bound of the area of this rectangle in mm². Show your working.

Upper bound mm²

[2]

- (b) The remote control batteries have a life span of approximately 75 hours. The remote control is used, on average, approximately 3 minutes every day. Estimate the number of years before the user will have to replace the batteries. Show your working.

Approximately years

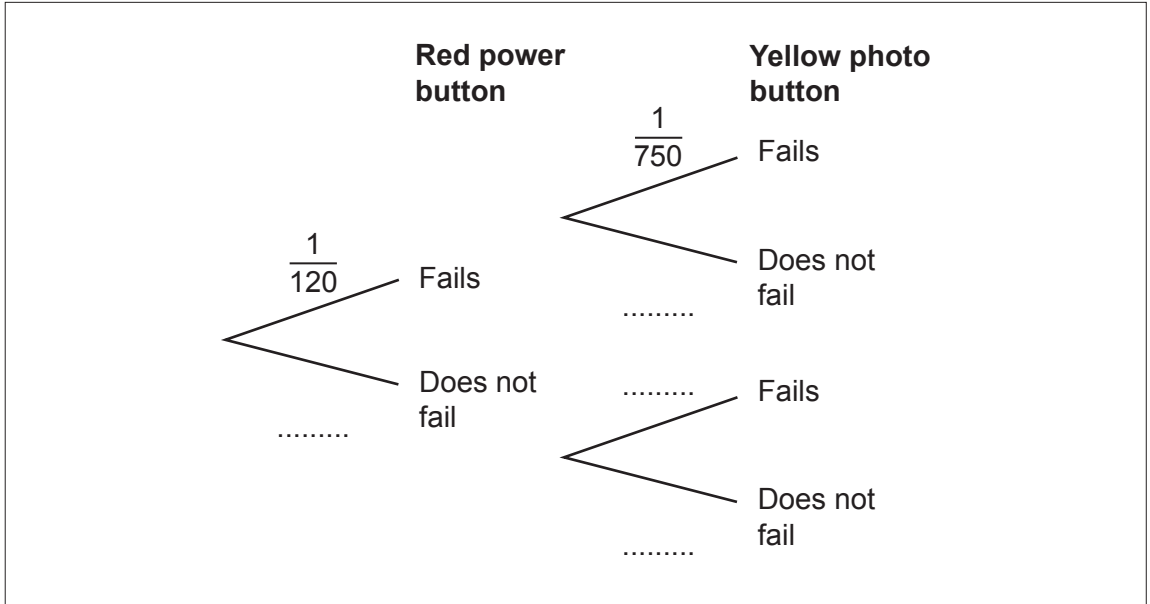
[2]

(c) During quality control testing the red power and yellow photo buttons sometimes failed.

The probability that the red power button fails is $\frac{1}{120}$

The probability that the yellow photo button fails is $\frac{1}{750}$

(i) Complete the probability tree diagram below.



[2]

(ii) Calculate the probability that both buttons fail. Show your working.

Probability

[2]

(d) Describe **two** ways in which ergonomic factors would be considered when designing the buttons on the remote control.

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[4]

Fig. 2.2 shows a CAD diagram of the central buttons in the lower part of the remote control. Arc X is part of the outer circumference of a circular array of four identical buttons.

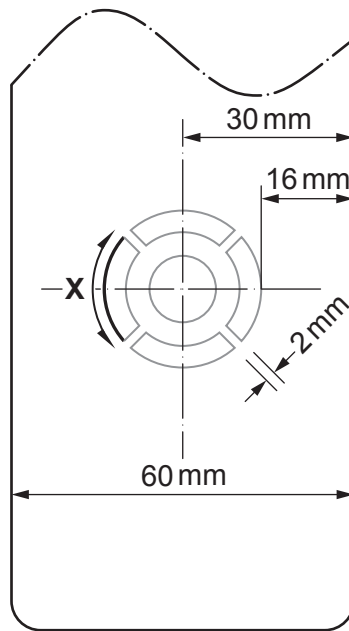


Fig. 2.2
(not to scale)

- (e) Using the diagram in Fig. 2.2, calculate the length of arc X in mm to 2 decimal places. Show your working.

The formula used to calculate the arc length of a circle is

$$\frac{\theta}{360^\circ} \times 2\pi r$$

Length of arc X mm

- 4 **Fig. 4.1** shows a hover board. A hover board is a personal transporter which is self-balancing and allows the user to travel short distances by tilting their body in the direction of travel.

Fig. 4.2 shows the outer shell of the hover board.

Fig. 4.3 shows the four component parts of the outer shell of the hover board.



Fig. 4.1



Fig. 4.2

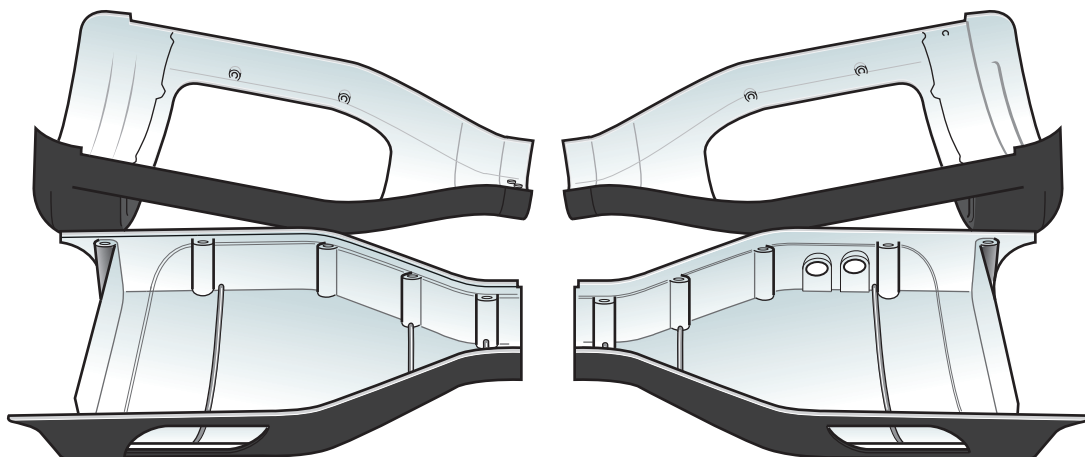


Fig. 4.3

(a) The outer shell of the hover board shown in **Fig. 4.2** is manufactured as a batch of 10 000.

(i) Name **one** suitable thermopolymer for use in the manufacture of the component parts of the outer shell of the hover board shown in **Fig. 4.3** and explain why it would be used.

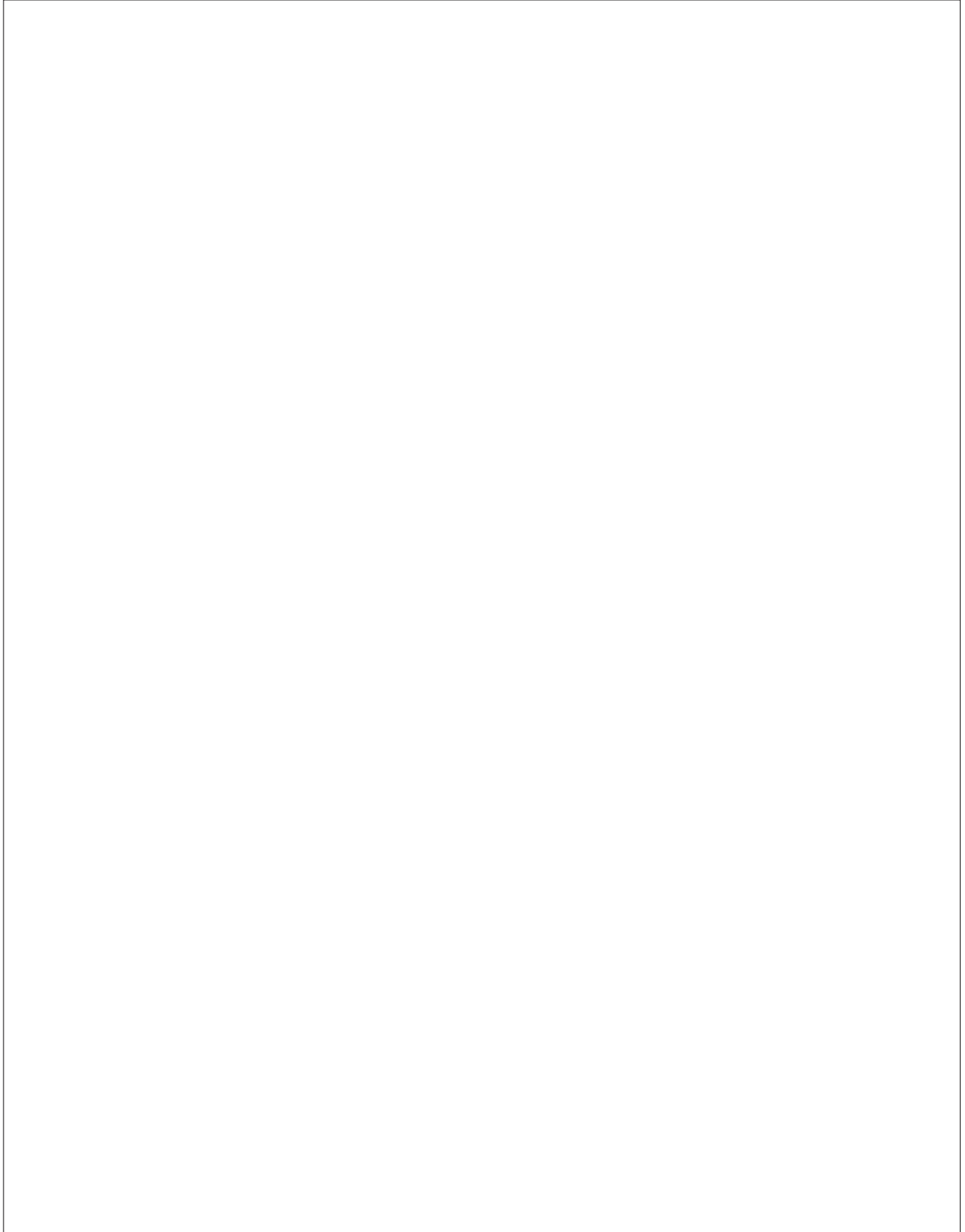
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..... [2]

(ii) Identify a suitable manufacturing process for the component parts of the outer shell of the hover board shown in **Fig. 4.3**.

..... [1]

- (iii) Use annotated sketches and/or notes to show how the process you have identified in **part (a) (ii)** would be used to manufacture the component parts of the outer shell of the hover board as a batch of 10 000.

Identify any relevant specialist tooling and quality control checks.



[8]

(iv) Describe **two** ways that the principles of designing for manufacture (DFM) have been incorporated in the design of the outer shell of the hover board.

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[4]

(b) The hover board covers a distance of 2.4 km in 20 minutes.

Calculate the average speed of the hover board in metres per second (m/s). Show your working.

Average speed m/s

[3]

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing. It consists of horizontal dotted lines spaced evenly down the page. A vertical solid line runs down the left side of the page, creating a margin. The entire area is intended for providing additional answer space.

A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.



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