1.8 Design, testing and production: 30-minute Pack

AQA 8552 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions.

1 A plywood toy car has a wheel axle hole specified as 6.0 mm ± 0.2 mm. Five measured holes are 5.8, 5.9, 6.0, 6.2 and 6.3 mm. Calculate how many are within tolerance and state the acceptable range.

(Total for Question 1 is 3 marks)

2 A client orders 350 flat-pack book stands. Specification: assembled width 240 mm ± 2 mm; each stand must hold 4 kg for 1 minute; packaging must be recyclable and the stand must be repairable with a replaceable crossbar. Prototype width is 243 mm and it holds 4.5 kg for 1 minute. Evaluate compliance and propose a production and lifecycle improvement.

(Total for Question 2 is 4 marks)

3 A school lunch tray has a 12 mm rim. Three prototypes were tested by pouring 250 ml water into each tray and tilting it to 10 degrees for 5 seconds. Prototype A leaked at 8 degrees, B at 12 degrees, C at 11 degrees. Requirement: no leak at 10 degrees. Identify the successful prototypes and propose one improvement to make the test more reliable.

(Total for Question 3 is 3 marks)

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4 A bicycle-light bracket must clamp to a 31.8 mm handlebar, resist a 120 N pull for 10 seconds and be removable without tools. Prototype clamp internal diameter is 32.4 mm and slips at 95 N. Recommend one change and describe a measurable retest.

(Total for Question 4 is 3 marks)

5 A small batch of 40 personalised wooden desk organisers is required, each with three 6 mm slots and a different name. Compare a CNC router with hand sawing and filing, then choose a method. Include batch size, repeatability and personalisation.

(Total for Question 5 is 4 marks)

6 A reusable plant label needs 600 units for a garden centre, each 150 mm long, with rounded corners and a raised logo. Compare vacuum forming and injection moulding for this production quantity, then recommend a process.

(Total for Question 6 is 4 marks)

7 A batch of 24 foam camera cases must fit a supplied camera measuring 118 x 72 x 46 mm. A prototype cavity measures 116 x 70 x 44 mm. State whether it meets the fit requirement and give the three cavity dimensions needed for a 2 mm clearance on every side of the camera.

(Total for Question 7 is 3 marks)

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Mark scheme · 1.8 Design, testing and production: 30-minute Pack

Question 1

Calculates the acceptable range as 5.8 mm to 6.2 mm inclusive (6.0 ± 0.2 mm). **B1**

Counts the readings from 5.8 mm through 6.2 mm as within tolerance, including both limits. **B1**

States that 4 holes are within tolerance, excluding the 6.3 mm reading. **B1**

Answer: Range 5.8 mm to 6.2 mm inclusive. Four holes are in range; 6.3 mm is outside.

Question 2

States the acceptable width range is 238 mm to 242 mm and identifies the 243 mm prototype as outside tolerance. **B1**

Identifies that the stand passes the load test because 4.5 kg exceeds 4 kg for the required 1 minute. **B1**

Proposes a suitable production method for 350 stands, such as CNC routing with repeatable cutting dimensions adjusted to give widths within 238 mm to 242 mm. **B1**

Proposes a lifecycle improvement such as removable crossbar fasteners to allow repair, or recyclable card packaging to support end-of-life recycling. **B1**

Answer: Width range 238 to 242 mm, so 243 mm fails; load test passes. Adjust cutting jig/CNC dimensions to reduce width to range. For 350, CNC routing sheet material offers repeatability and nesting; design crossbar with removable fasteners and use recyclable card packaging to support repair and end-of-life sorting.

Question 3

Identifies prototype B as successful because it did not leak at 10 degrees. **B1**

Identifies prototype C as successful because it did not leak at 10 degrees. **B1**

Improves reliability by repeating trials under controlled conditions, such as the same measured volume, angle and timing, and recording results. **B1**

Answer: B and C; repeat each trial several times using same measured volume, angle gauge and timing, then record results.

Question 4

Recommends a change that improves grip, such as reducing the internal diameter or adding a compliant textured liner. **B1**

Specifies a measurable retest on a 31.8 mm handlebar using a force gauge up to 120 N. **B1**

States the 120 N pull should be held for 10 seconds with no slip, while checking the bracket remains removable without tools. **B1**

Answer: Reduce internal diameter/add compliant textured liner to improve grip; retest on a 31.8 mm bar with force gauge, increasing pull to 120 N and holding 10 seconds; confirm no slip and hand removal.

Question 5

Chooses CNC routing as suitable for making the three 6 mm slots. **B1**

Links CNC routing to repeatable, consistent slots across the batch of 40. **B1**

Explains that names can be changed digitally to personalise each organiser. **B1**

Compares hand sawing and filing as lower setup but slower or less consistent for repeated narrow slots, and relates CNC setup to the batch. **B1**

Answer: CNC router is suitable: programmed slots are consistent and names can vary digitally; setup is justified across 40 units. Hand work has lower setup but slower and less consistent for repeated narrow slots.

Question 6

Compares injection moulding as repeatable and capable of detailed features, including a raised logo. **B1**

Notes the high mould tooling cost for injection moulding. **B1**

Compares vacuum forming as lower cost or quicker to set up, but requiring trimming and potentially giving a less crisp raised logo. **B1**

Makes a recommendation for 600 units and justifies it against tooling cost and the required logo detail, allowing either process when the trade-off is explained. **B1**

Answer: Injection moulding gives repeatable detailed features at high volume but mould tooling is costly; vacuum forming has lower tooling cost and quicker setup but may not form a crisp raised logo and needs trimming. At 600, recommend vacuum forming if logo can be simplified, or injection moulding if detail/repeatability justifies tooling.

Question 7

Identifies the prototype cavity as too small to fit the camera. **B1**

Calculates the required cavity dimensions as 122 x 76 x 50 mm by adding 2 mm clearance on each opposing side. **B1**

States that each prototype cavity dimension must increase by 6 mm. **B1**

Answer: No, it is undersized. Required cavity dimensions are 122 x 76 x 50 mm: add 4 mm to each overall dimension for 2 mm on both opposing sides.

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