

OCR A-Level

Physical Testing in Manufacturing: Ensuring Functional Feasibility (8.2b)

Materials required for questions

- Pencil
- Rubber
- Calculator

Instructions

- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

Advice

- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don't spend too much time on one question

Good luck!

Q1. Which of the following is a primary reason for conducting durability testing on materials during manufacturing?

- A** To determine the colour accuracy of the material
- B** To ensure the material can withstand wear, stress, and environmental conditions over time
- C** To assess the material's cost-effectiveness

Q2. Testing models and prototypes for performance is carried out to:

- A** Confirm that the product looks attractive in marketing photos
- B** Verify that the product functions as intended before full-scale production
- C** Select the retail price of the final product

Q3. Consumer testing involves:

- A** Having potential users interact with the product to gather feedback on usability and satisfaction
- B** Testing the product in extreme laboratory conditions only
- C** Checking the quality of raw materials before manufacturing

Q4. Virtual testing allows designers to:

- A** Simulate product performance and identify issues using software before physical prototypes are made
- B** Replace all physical testing indefinitely
- C** Market the product online before it is manufactured

Q5a. The image below shows a stainless steel frying pan.



Describe one physical test that the frying pan would undergo to test performance. **(2 marks)**

Q5b. The designer of the frying pan used digital design software in the development of the design. Discuss the role of digital design software during design development. Refer to specific examples in your answer. **(6 marks)**

Answers

Q1. B

Q2. B

Q3. A

Q4. A

Q5a.

Possible physical testing methods may include:

- The materials could be tested to determine the rate of corrosion when exposed to sun and rain (1). Materials could be exposed to different weather conditions/tested for a change in toughness (1).
- Durability analysis of the racket (1) to test the wear rate of the strings/handle.
- Function testing through destructive testing (1) to assess how the tennis racket will perform in normal use. (1)
- User trials (1) could be used to evaluate the performance/feel of the racket, when in use (1)
- Any other valid suggestion.

Q5b.

Indicative content:

- Mathematical modelling is used to optimise the design The results can also be presented as graphs and charts.
- Generative design tools produce optimum forms e.g. Adidas 3D printing customised midsoles for their runners or airbus to achieve lightest, strongest design that uses the minimal amount of material.
- Communication of ideas through visual presentation, rendering and photo quality rendering.
- Online collaboration to discuss and exchange ideas with experts and/or other designers. This could also include discussing ideas/ designs with stakeholders.
- Product simulation and testing, and test weak areas that may fail, (Finite Element Analysis (FEA)).
- Scientific analysis of real-world physical factors to determine whether a product will work in the way it's intended. This can also be used to optimise the design.
- Rapid prototyping such as 3D printing can be used to test ideas.
- Any other valid suggestion.

Q6.

Indicative content:

- CFD: Computational Fluid Dynamics used to simulate pressures and the flow of liquids around the submarine to prevent the need to test in deep water.
- FEA: Finite Element Analysis used to simulate force loadings on individual components and assess the risk of collapse/failure without risking human life.
- By inputting material properties weight distribution and overall mass calculations can be observed.
- Assembly models can be used to ensure components fit accurately.
- Visibility from port holes can be simulated using VR models
- Virtual testing can be used to test electronic control systems prior to production.
- Hydraulic and pneumatic systems can be simulated with mechanisms prior to operation.
- Internal control panels and access can be modelled in VR.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.

Q7.

Indicative content

- FEA can help a designer identify a weakness in the structure of a design before time has been taken to produce a physical prototype.
- FEA allows designers to test how different materials could be used without the expense of producing various iterations of a prototype.
- Inappropriate designs can be discounted at an early stage of development saving time and resources and allowing designers to work more efficiently.
- A degree of stress testing can take place with instant feedback without the cost and time that would be needed if third party companies were used.
- FEA can be undertaken throughout the development process allowing manufacturers to refine individual components before manufacture.
- Testing can take place and maximum working loads calculated.
- There is no need for destructive testing to take place and therefore reducing the material used to make numerous physical prototypes.

- Simulations in different environmental conditions can take place such as extremes of temperature, reducing the need for costly testing facilities.

This list is not exhaustive. Accept any other valid responses.