

Design & Technology

AQA A-Level

Virtual modelling

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. What is the primary purpose of virtual modelling in product development?

- A** To reduce the need for physical prototypes
- B** To reduce marketing costs
- C** To replace human engineers

Q2. Which process uses virtual testing to analyse airflow around a car design?

- A** Finite Element Analysis (FEA)
- B** Computational Fluid Dynamics (CFD)
- C** Rapid prototyping

Q3. Finite Element Analysis (FEA) is mainly used to assess:

- A** Aerodynamic efficiency
- B** Stress distribution in mechanical components
- C** Material cost reduction

Q4. How does CFD help in testing liquid flow within a product?

- A** Simulates fluid behaviour using mathematical models
- B** Measures electrical conductivity
- C** Tests colour durability

Answers

Q1. A

Q2. B

Q3. B

Q4. A

Q5.

- 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

Q6.

Physical prototypes

- Physical prototypes can be quickly realised through styrofoam modelling or rapid prototyping without huge expense to the designer.
- Ergonomic features can be modelled and tested with target user groups, gaining direct feedback which can then help further development and refinement of the design.
- The function of mechanisms and dynamic features such as hinges or buttons can be tested.
- Observations of how potential user groups interact with the product can be made.
- Designers can use the physical model to test the aesthetic form and appearance of the product, developing and adjusting the design where necessary.

- Physical prototypes can be finished to represent the aesthetics of the final product allowing users or clients to provide detailed feedback that can be used by the designer.

Virtual prototypes

- Manufacturing methods can be explored and tool paths simulated identifying issues before manufacture or financial investment in tooling or machining
- Virtual prototypes can be used by CFD programs to test and simulate fluid and air flow. Data can be used by designers to improve aerodynamics.
- Financial savings will be made by negating the need for specialist testing of the physical model.
- Assembly of components can be tested to ensure compatibility with larger systems.
- FEA modelling can take place to simulate stresses of the physical product in use, saving time and money on physical modelling.
- Virtual prototypes can be quickly edited and materials and textures easily applied to represent a physical product.
- Virtual prototypes can be quickly shared with clients and manufacturers around the world.