

Design technology
Standard level
Paper 1

Monday 14 November 2016 (morning)

45 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[30 marks]**.

1. Data for which percentile would normally be applied in the height of a kitchen counter?

Figure 1: Kitchen counter



[Source: https://de.wikipedia.org/wiki/Datei:L_K%C3%BCche_2015.jpg by Friedrich Böhringer, own work]

- A. 5th percentile
- B. 50th percentile
- C. 95th percentile
- D. 99th percentile
2. What factors need to be considered when designing a can opener for an elderly person with arthritis?
- I. Physiological
- II. Biomechanics
- III. Anthropometric
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

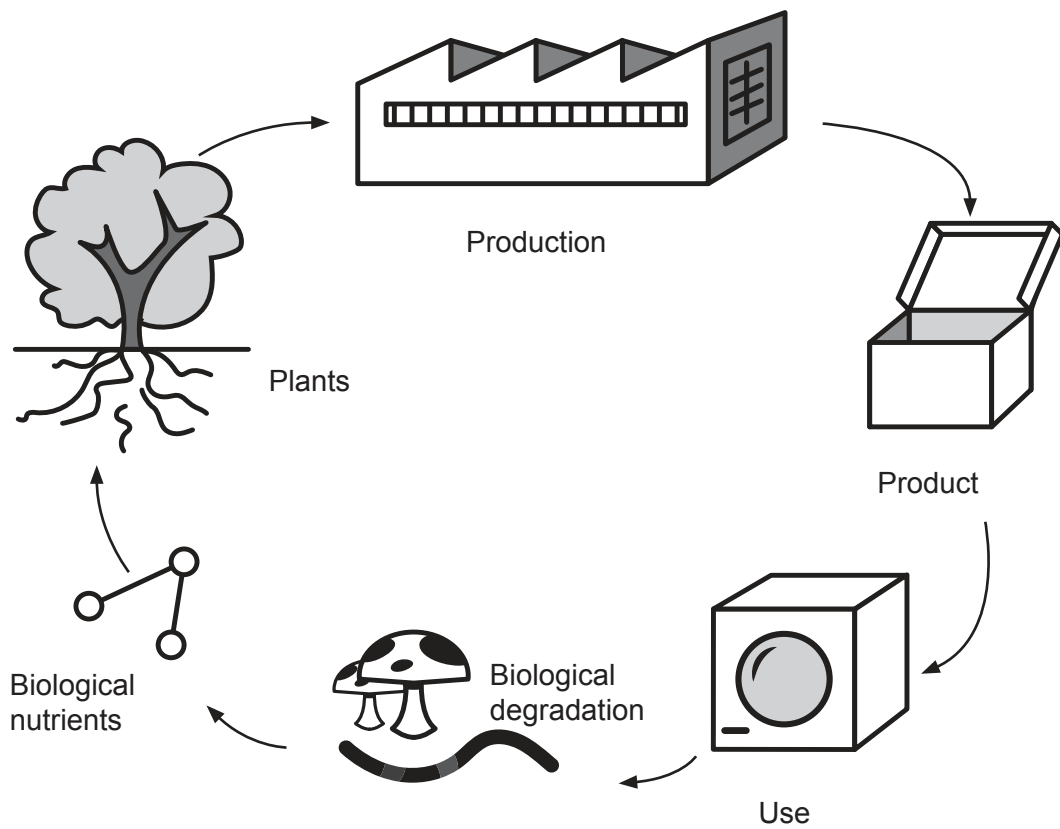
3. What is **not** an ergonomic consideration in the design of an airline seat?
- A. The force needed to adjust the seat
 - B. The texture of the fabric
 - C. The dimensions of the seat
 - D. The colour of the seat
4. Which design consideration does **not** apply to motorcycle helmets?
- A. Range of sizes
 - B. Adjustability
 - C. Suitable for 50th percentile
 - D. Safety
5. Which of the following terms does this definition apply to? “The total amount of energy consumed by all the processes associated with the production of materials.”
- A. Embodied energy
 - B. Operational energy
 - C. Production energy
 - D. Latent energy
6. Which of the following best describes a resource that is inexhaustible?
- A. Renewable
 - B. Recovery
 - C. Reserves
 - D. Non-renewable

Turn over

- 7. What could be used to power a combined heat and power system (CHP)?
 - A. Wind
 - B. Batteries
 - C. Solar energy
 - D. Biomass

- 8. Which eco design principle is illustrated in **Figure 2**?

Figure 2: The principles of eco design



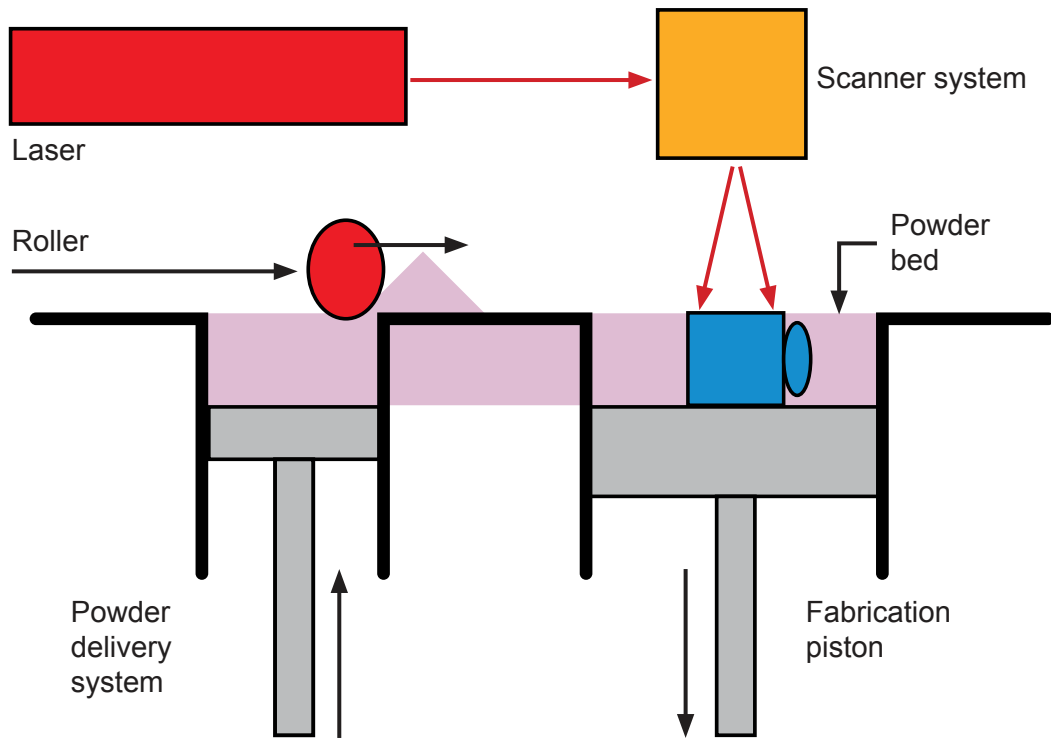
[Source: adapted from www.sustainablebrands.com]

- A. Cradle to gate
- B. Cradle to cradle
- C. Cradle to grave
- D. Life cycle analysis

- 9. Which type of CAD has the ability to link graphic screens together in such a way as to simulate motion or a process?
 - A. Haptic technology
 - B. Animation
 - C. Motion capture
 - D. Virtual reality (VR)

- 10. What example of rapid prototyping is shown here?

Figure 3: A rapid prototyping system



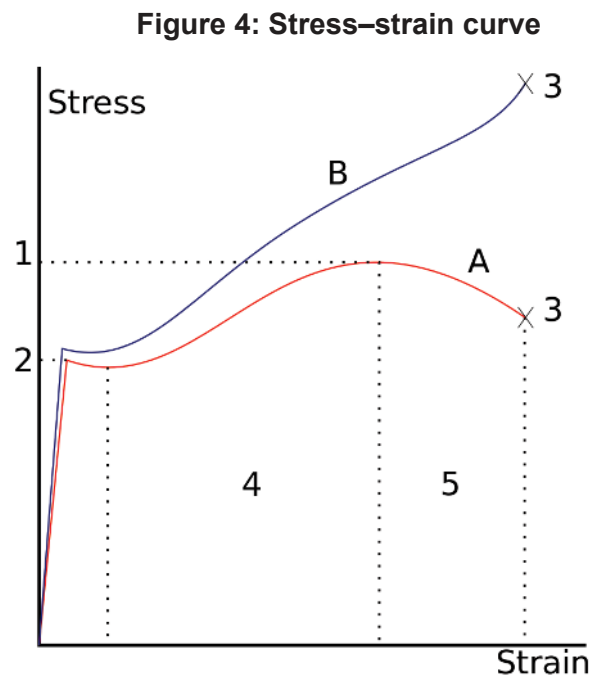
[Source: adapted from www.martello.co.uk]

- A. Stereolithography (SLA)
- B. Fused deposition modelling (FDM)
- C. Selective laser sintering (SLS)
- D. Laminated object manufacturing (LOM)

Turn over

- 11. Which models can take measurements to provide accurate quantitative feedback for analysis?
 - A. Instrumented
 - B. Aesthetic
 - C. Mock-up
 - D. Surface

12. **Figure 4** shows a stress–strain curve for a material.



[Source: adapted from https://upload.wikimedia.org/wikipedia/commons/f/f1/Stress_v_strain_A36_2.svg]

Which part of the curve shows when the material will return to its original shape?

- A. A–B
- B. B–D
- C. D–C
- D. A–D

13. How could small grain size be achieved in a piece of metal?
- A. Heating followed by rapid cooling
 - B. Heating followed by slow cooling
 - C. Selectively cooling one area of the metal
 - D. Selectively heating one area of the metal
14. Which type of glass would be used for a car windscreen?
- A. Laminated
 - B. Pyrex[®]
 - C. Toughened
 - D. Soda-lime

Turn over

15. Braking systems require the fluid within the system to increase in viscosity when the brakes are applied.

Figure 5: Large truck braking system



[Source: https://commons.wikimedia.org/wiki/File:International_Durastar_4400_crop.jpg by Jason Lawrence]

What smart material would be the most useful when designing a braking system for large trucks?

- A. Piezoelectric
- B. Magneto-rheostatic
- C. Electro-rheostatic
- D. Photochromic

16. **Figure 6** shows an Enhanced Combat Helmet (ECH) as used by the US Military. The main materials used in its construction are ballistic fibres such as Kevlar[®] which makes the helmet bullet proof. What does the success of this product rely on?

Figure 6: Enhanced Combat Helmet



[Source: [https://en.wikipedia.org/wiki/Enhanced_Combat_Helmet_\(United_States\)](https://en.wikipedia.org/wiki/Enhanced_Combat_Helmet_(United_States))]

- A. The high compressive strength of the fibres
- B. The fibres are orientated in the same direction
- C. The high tensile strength of the Kevlar fibres
- D. The high density of the fibres

Turn over

17. Which plastic would be the most appropriate for manufacturing the body of a mobile phone?
- A. Polyurethane
 - B. Acrylonitrile butadiene styrene
 - C. High impact polystyrene
 - D. Polyethene
18. What is a disadvantage of composite materials?
- A. Low stiffness
 - B. Low density
 - C. Difficult to recycle
 - D. Difficult to mould
19. What is a wasting technique?
- A. Laminating
 - B. Casting
 - C. Turning
 - D. Weaving
20. Which textile production process uses a loom to produce interlaced yarns?
- A. Knitting
 - B. Weaving
 - C. Lacemaking
 - D. Felting

21. What would **not** be a reason for treating timber?
- A. To make it stronger
 - B. To increase its resistance to fungal attack
 - C. To enhance its aesthetics
 - D. To increase its resistance to damp environments
22. **Figure 7** shows a Makerbot Replicator 2–3D printer. At what stage of their product life cycle are 3D printers?

Figure 7: Makerbot Replicator 2–3D printer



[Source: https://en.wikipedia.org/wiki/MakerBot#/media/File:MakerBot_Replicator_2_Desktop_3D_Printer.jpg by OhanaUnited]

- A. Launch
- B. Growth
- C. Maturity
- D. Decline

Turn over

- 23.** What is likely to best describe a lone inventor?
- A. Someone working outside or inside an organization who is committed to the invention
 - B. Someone who has no expertise to develop a complex modern product combining different technologies
 - C. Someone who takes an invention to market
 - D. Someone who champions products within an organization
- 24.** Which term best describes consumers who take more time to consider adopting a new innovation based on feedback from users before taking the risk of purchasing a product?
- A. Early majority
 - B. Laggards
 - C. Late majority
 - D. Innovators

25. The Coca-Cola Company bottle (see <http://www.clipartkid.com/images/291/coca-cola-bottle-clip-art-pic-18-uW3RoE-clipart.jpg>) recently celebrated its 100th anniversary.

What best describes why the Coca-Cola bottle has achieved classic design status?

- A. Mass production
 - B. Retro-styling
 - C. Ubiquity/omnipresence
 - D. Dominant design
26. What attribute makes an object into a design classic?
- A. It defies obsolescence and transcends its original function
 - B. Its constant presence
 - C. Being instantly recognisable and provoking emotional reaction
 - D. Its form follows its function

Turn over

Questions 27–30 relate to the following case study. Please read the case study carefully and answer the questions.

Apple as a global company is showing an increased awareness of its impact on the environment during the use of energy and materials in the manufacture of its products.

The second generation MacPro was announced in 2013 and achieves twice the overall performance of the first generation MacPro but is only one-eighth of its size. The second generation MacPro has a different configuration in the layout of the internal components which centres around a unified thermal core. This innovative design maximizes the airflow as well as thermal conductivity to operate the system at maximum efficiency.

Apple has started using solar energy to 100% power their data centre in North Carolina, USA (as shown in **Figure 10**) as part of their environmental responsibility towards the reduction of climate change.

27. **Figure 10** shows solar panels.

Figure 10: Solar panels



[Source: https://upload.wikimedia.org/wikipedia/commons/thumb/b/b8/Photovoltaik_Dachanlage_Hannover_-_Schwarze_Heide_-_1_MW.jpg/420px-Photovoltaik_Dachanlage_Hannover_-_Schwarze_Heide_-_1_MW.jpg]

Which innovation has been used in the development of the solar panels?

- A. Architectural innovation
- B. Modular innovation
- C. Configurational innovation
- D. Organizational innovation

Turn over

28. Which CAD process would have been used during the virtual prototyping stages to test the cooling efficiency of the MacPro system?
- A. Motion capture
 - B. Surface modelling
 - C. Finite element analysis
 - D. Solid modelling
29. What waste mitigation strategy has Apple used in the design of the second generation 2013 version of the MacPro compared to the first generation?
- A. Recycling
 - B. Reconditioning
 - C. Dematerialization
 - D. Reusing
30. Which pair of statements is true for Apple when using solar panel technology to power its data centre in North Carolina, USA?

	Fixed costs	Variable costs
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High