

Design technology
Higher level
Paper 1

Monday 14 November 2016 (morning)

1 hour

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 **[40 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 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
5. At which stage of its life cycle does a commercial aircraft have the highest output in terms of resources used and by-products generated?
- A. Pre-production
 - B. Production
 - C. Utilization
 - D. Disposal
6. What are key considerations in the design of green products?
- I. Materials
 - II. Waste
 - III. Energy
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

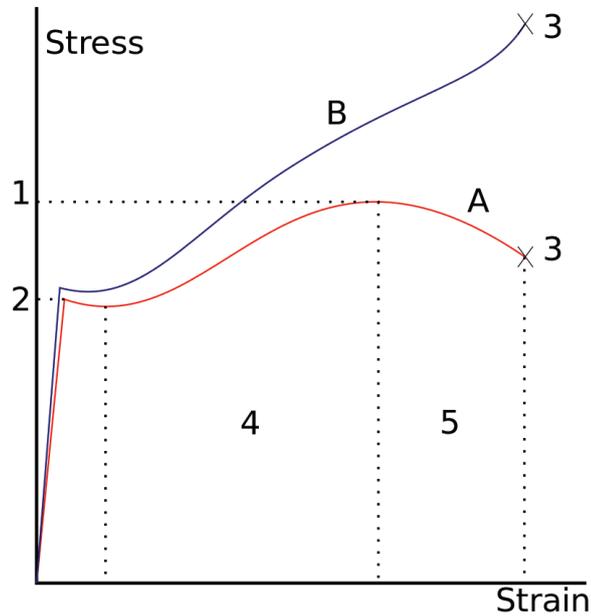
7. A non-renewable power station that treats its emissions to decrease polluting emissions is using:
 - A. Design for manufacture (DfM)
 - B. End-of-pipe technologies
 - C. System level solution
 - D. Clean technology

8. Which rapid prototyping technique takes sliced CAD data from a 3D model and cuts out each layer from a roll of material, using a laser or plotter cutter?
 - A. Stereolithography (SLA)
 - B. Fused deposition modelling (FDM)
 - C. Selective laser sintering (SLS)
 - D. Laminated object manufacturing (LOM)

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. Figure 2 shows a stress–strain curve for a material.

Figure 2: Stress–strain curve



[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
11. Which type of glass would be used for a car windscreen?
- A. Laminated
 - B. Pyrex[®]
 - C. Toughened
 - D. Soda-lime

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

Figure 3: 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
13. What is a disadvantage of composite materials?
- A. Low stiffness
 - B. Low density
 - C. Difficult to recycle
 - D. Difficult to mould

14. What is true of automation?
- A. Set up costs are low
 - B. Working conditions are dangerous
 - C. More social interaction for workforce
 - D. Work force is reduced
15. Which textile production process uses a loom to produce interlaced yarns?
- A. Knitting
 - B. Weaving
 - C. Lacemaking
 - D. Felting
16. 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
17. 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

- 18.** Which innovation strategy best describes the development of easy-to-use products intended for a mass market at a much lower cost?
- A. Radical
 - B. Process
 - C. Sustaining
 - D. Disruptive
- 19.** Which research method would be the most appropriate to discover if there was a market for a new product?
- A. User trial
 - B. Expert appraisal
 - C. User research
 - D. Performance test

20. 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
21. 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

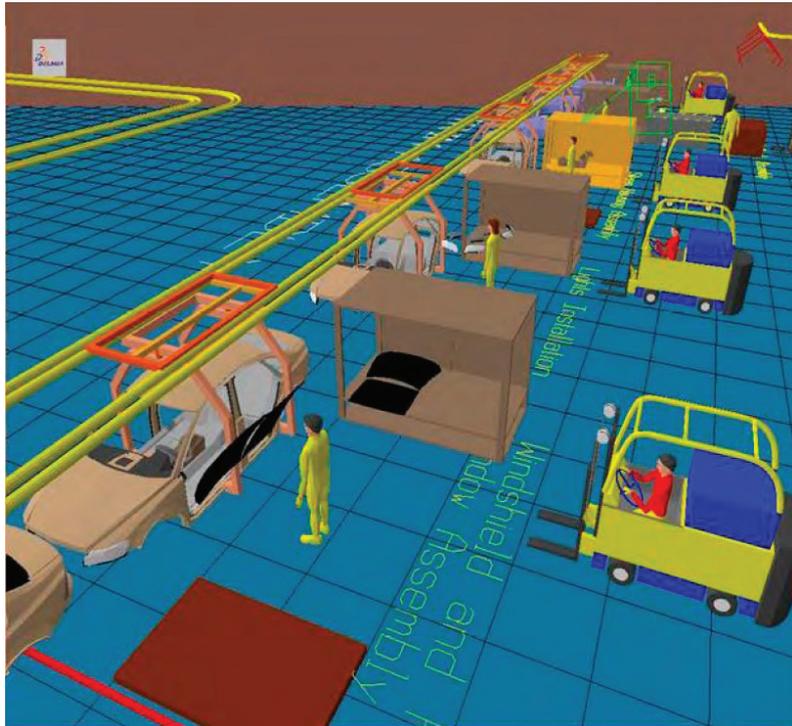
22. What are fictional characters used in user research to represent typical stakeholders and people whose needs must be satisfied?
- A. Personae
 - B. Secondary personae
 - C. Anti-personae
 - D. Scenario
23. Which aspect of the four pleasure framework reflects the sensual pleasure from the sound of a well-engineered car door closing?
- A. Socio-pleasure
 - B. Physio-pleasure
 - C. Psycho-pleasure
 - D. Ideo-pleasure
24. Which of the following is **not** a principle of user-centred design?
- A. The designer needs to have a deep understanding of the user, task and the environment
 - B. The design team works within one skill-set
 - C. The process is iterative, led by the user and developed through user-centred evaluation
 - D. The product must address the whole user experience
25. What is considered in a sustainability report?
- A. Profit, performance, product and governance
 - B. Governance, politics, output and profit
 - C. Environment, profit, product and politics
 - D. Economic, environmental, social and governance

26. Which eco group enthusiastically adopt environmentally friendly practices as consumers?
- A. Eco warriors
 - B. Eco-champions
 - C. Eco-supporters
 - D. Eco fans
27. What are the benefits for a utility company adopting a smart grid system?
- A. It relies on energy from one source only
 - B. It will provide a consistent energy output
 - C. It uses less wires, substation and switches
 - D. It has a low cost of implementation
28. Which of the following is **not** part of Datschefski's five principles of sustainable design?
- A. Solar
 - B. Cyclic
 - C. Efficient
 - D. Tidal
29. Which of the following is one of the 4Ps in the marketing mix?
- A. Process
 - B. People
 - C. Physical environment
 - D. Place

- 30.** To which corporate strategy does incremental design contribute?
- A. Product development
 - B. Market penetration
 - C. Market development
 - D. Product diversification
- 31.** Which strategy is most likely to generate quantitative data?
- A. Performance test
 - B. User trial
 - C. User research
 - D. Expert appraisal

32. **Figure 5** below shows an example of computer-integrated manufacturing (CIM).

Figure 5: An example of CIM



[Source: http://upload.wikimedia.org/wikipedia/commons/a/ac/NIST_Manufacturing_Systems_Integration_Program.jpg]

What is an advantage of CIM?

- A. Low set-up costs
- B. No stoppages in production when carrying out maintenance tasks
- C. No cost for retraining the work force to update skills
- D. Cost of maintenance is low

33. A business manufactures lamps which has the following costs and revenues:

Fixed costs = €100 000

Sales price per item = €5

Variable costs per item = €3

What would be the number of lamps needed to be sold for the manufacturer to break even?

- A. 5000
- B. 33 334
- C. 50 000
- D. 100 000

34. Which quality management system regulates the quality of raw materials?

- A. Statistical process control (SPC)
- B. Quality control (QC)
- C. Quality assurance (QA)
- D. Just-in-time (JIT)

35. Which waste would not be reduced by a company switching from just-in-case (JIC) to just-in-time (JIT)?

- A. Overproduction
- B. Unnecessary inventory
- C. Transporting of raw material
- D. Defects

Questions 36–40 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 7**) as part of their environmental responsibility towards the reduction of climate change.

36. **Figure 7** shows solar panels.

Figure 7: 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

- 37. 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

- 38. 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

- 39. 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

- 40. Which growth strategy has Apple used with the introduction of the smaller second generation MacPro?
 - A. Product development
 - B. Pioneering
 - C. Hybrid
 - D. Market development
-