Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Standard level
Paper 1

8 May 2024

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

45 minutes

Instructions to candidates

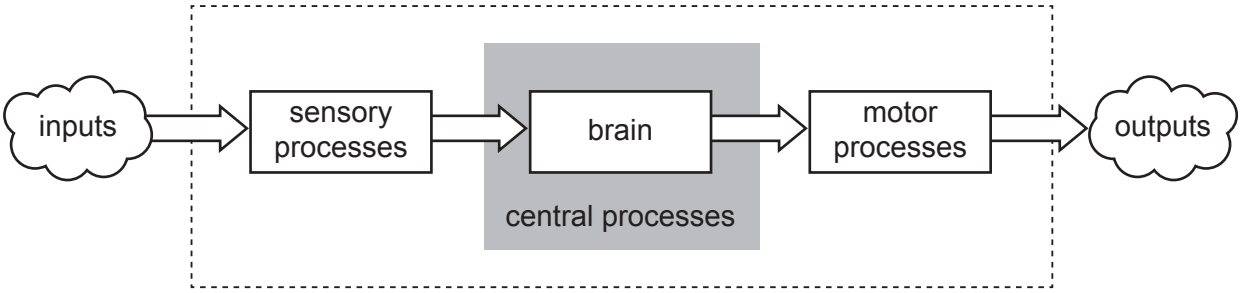
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[30 marks]**.

2224 – 6406

21 pages

1. **Figure 1** shows a flow diagram representing a human information processing system.

Figure 1: Human information processing system diagram



Which part of the human information processing system is related to physiological factors?

A. Sensory processes

B. Central processes

C. Motor processes

D. Inputs

2. Which of the following percentile data is most likely to be used for the adjustable seats in an automobile?

A. 50th

B. 75th

C. 5th–95th

D. 1st–99th

3. The design of an aircraft cockpit should help pilots stay alert. Which combination of environmental factors would be considered by the designer?

I. Light

II. Sound

III. Temperature

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

4. What natural resources can be identified in terms of quantity and quality?

A. Renewable

B. Non-renewable

C. Reserve

D. Renewability

5. **Figure 2** shows LG's newest front-loading washing machine that uses 25 litres less water than previous models.

Figure 2: LG's newest front-loading washing machine

[Source: Image with permission from LG Electronics.]

Which process requires the least energy?

A. Recycling

B. Repairing

C. Reconditioning

D. Re-engineering

Series 5

6. **Figure 3** shows a hiker using portable solar panels to charge and power their devices.

Figure 3: Solar charger for remote hikers

The solar charger allows for small amounts of energy to run low-energy products using what type of energy system?

A. National grid

B. Combined heat and power

C. Individual energy generation

D. Embodied

7. The aim of end-of-pipe technology is to reduce which aspect of the production process?

A. Energy

B. Labour

C. Pollution

D. Lead time

8. **Figure 4** shows *Pritt Stick* adhesive used for gluing paper and card. It was originally invented in 1969; more recently the company has improved the formulation so it is now made from 97 % natural ingredients.

Figure 4: *Pritt Stick* adhesive

What is this change to the increased use of natural materials an example of?

A. Clean technology

B. Life cycle analysis (LCA)

C. Reconditioning

D. Green design

9. Life cycle analysis (LCA) balances which of the following considerations?

I. Environmental

II. Product life cycle

III. Social

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

10. Which of the technologies listed can also be referred to as a converging technology?

I. Nanotechnology
II. Haptic technology
III. Biotechnology

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

11. What type of drawing is usually presented in 2D?

A. Isometric

B. Projection

C. Perspective

D. Exploded

12. The Stanford Solar Car Project (SSCP) is a team of students who design, build, and test a solar-powered electric vehicle. **Figure 5** shows a student testing the inside of the driver's cockpit.

Figure 5: Testing the Stanford Solar Car cockpit

[Source: Jim Merithew, Wired, © Condé Nast.]

Which of the following best describes the type of model shown in **Figure 5**?

A. Mock-up

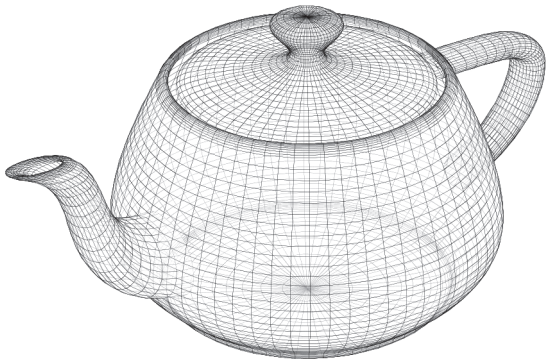
B. Aesthetic

C. Finite element analysis (FEA)

D. Scale

13. **Figure 6** shows a wire frame model of a teapot.

Figure 6: Wire frame model of a teapot



What is an advantage of this type of model?

A. Can be used for user research

B. Shows what the finished product will look like

C. Easy to construct

D. Communicates the physical characteristics of the product

14. Danish designer Matthias Bengtsson designed the Slice chair in 1998, see **Figure 7**. The data from the computer-aided design (CAD) program was exported to a laser-cutter to cut the hundreds of 3 mm-thick plywood slices which were then assembled by gluing each slice to form the layers of the chair.

Figure 7: The Slice chair

[Source: © Cooper Hewitt, Smithsonian Design Museum / Art Resource, NY.]

What example of rapid prototyping method has been used to produce the Slice chair?

A. Stereolithography (SLA)

B. Fused deposition modelling (FDM)

C. Laminated object manufacture (LOM)

D. Selective laser sintering (SLS)

15. **Figure 8** shows the UFO Sinker, a lead-free fishing weight made of a unique high density concrete composite as an environmentally friendly alternative for traditional sinkers made of lead.

Figure 8: UFO Sinker lead-free fishing weights

What property of the material is essential for the UFO Sinker to work effectively?

A. Mass

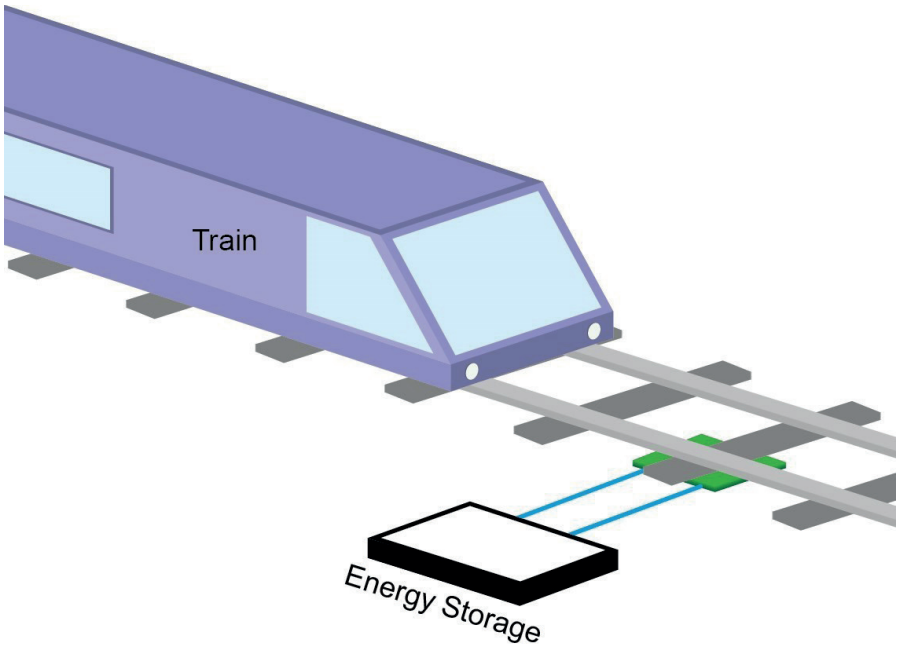
B. Hardness

C. Weight

D. Toughness

16. **Figure 9** shows an example of a smart technology developed by international company Innitrax. This smart material generates energy from pressure and stress on the railway track of passing trains to generate electricity.

Figure 9: Smart material used to generate electricity



Which property applies to this smart material?

A. Thermoelectric

B. Piezoelectric

C. Shape memory alloy

D. Electro-rheostatic

17. Modifying the physical properties of a material by decreasing the hardness and brittleness but increasing the ductility is known as:

A. Alloying

B. Tempering

C. Work hardening

D. Grain size

18. Camping tents, as shown in **Figure 10**, are made from high-performance synthetic textiles as they require a high strength-to-weight ratio.

Figure 10: Camping tent

Which synthetic textile material is best suited as the fabric of choice for tents?

A. Polyester

B. Nylon

C. Lycra®

D. Polystyrene

19. Plywood is created by gluing layers of wood (plys) together. Why are the layers glued together with the grain of each layer in an opposite direction?

A. Increase aesthetics

B. Increase hardness

C. Increase density

D. Increase strength

20. Which production method best describes the method used to manufacture, produce or process materials without interruption?

A. One-off

B. Batch

C. Continuous

D. Mass customization

21. Which process is used to convert yarn into fabric by matting the fibres together?

A. Turning

B. Spinning

C. Felting

D. Weaving

22. Robotic manufacturing systems that have their own central control unit containing machine vision sub-systems acting as their “eyes” are known as:

A. Mechanized robots

B. Multi-task robots

C. Machine to machine (M2M) robots

D. Wired robots

23. **Figure 11** shows the *chapeau claque* collapsible top hat which folds flat for easy storage. *Chapeau* is the French word for “hat” and the word *claque* refers to the sound the hat makes as it opens with the help of a spring.

Figure 11: *Chapeau claque* collapsible top hat

Which strategy was used to decide the name for the hat?

A. Analogy

B. Adaptation

C. Chance

D. Insight

24. What is an advantage of obsolescence to the consumer?

A. Cheaper products

B. Safer products

C. More innovative products

D. More durable products

25. **Figure 12** shows a BIC ballpoint pen first manufactured in the 1950s when it was seen as a radical new product. It has undergone only minor design changes since and still sells well.

Figure 12: BIC ballpoint pen

What is the most likely reason for the continued success of the pen?

A. Very little competition in the marketplace

B. Ballpoint pens will never become obsolete

C. It is still viewed as a pioneering design

D. It has a good balance of form and function.

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26. Dutch industrial designer Jan Gunneweg experiments with ways to bring wood to the forefront of design. **Figure 13** shows a wooden bicycle made from walnut. It is fully functioning and weighs similar to conventional bicycles.

Figure 13: Jan Gunneweg's wooden bicycle

What design principles best describe Gunneweg's approach to the design of the wooden bicycle?

I. Retro-styling
II. Practical function
III. Psychological function

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

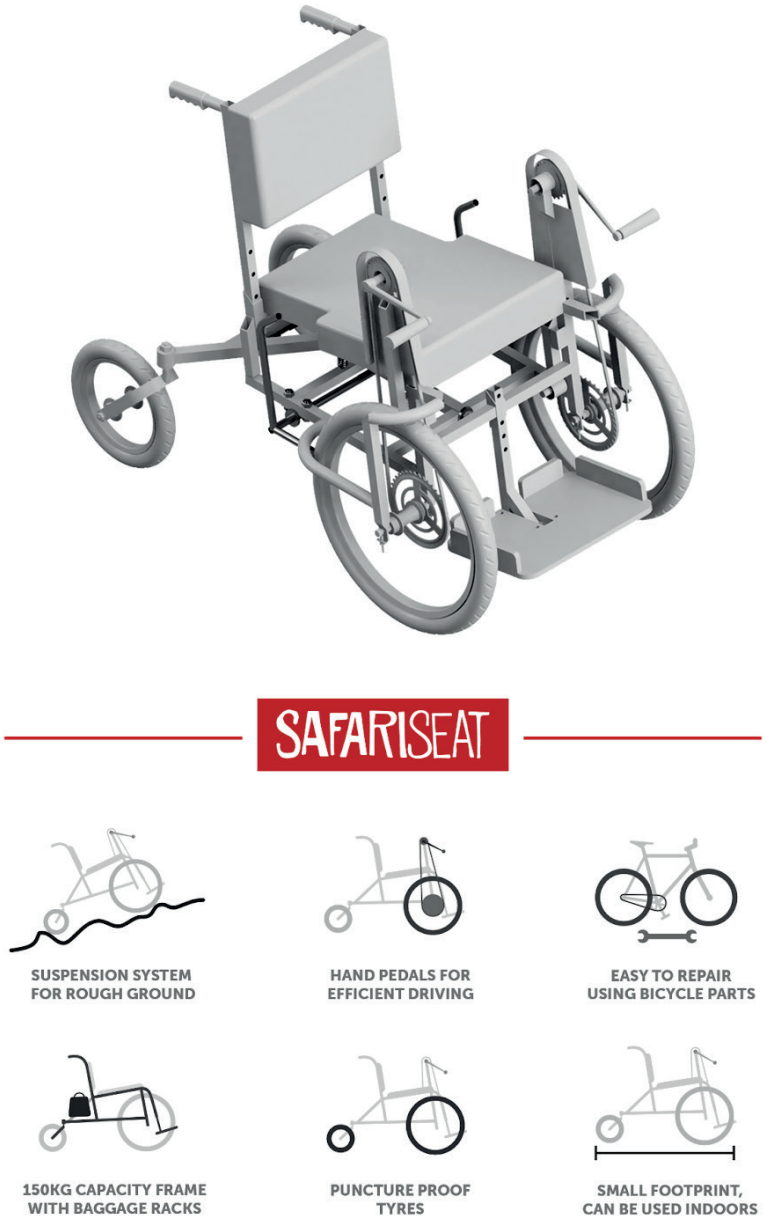
Questions 27–30 relate to the following case study. Please read the case study carefully and answer the questions.

The SafariSeat is an all-terrain wheelchair design that can be manufactured using standard bicycle parts that are easily locally sourced in low-resource regions of the world, see **Figure 14**.

Figure 14: The SafariSeat first prototype (with lever propulsion)

Designer and co-founder, Janna Deeble grew up in Kenya and recognized the need for affordable, repairable wheelchairs. The design team employed a user-centred design (UCD) process and local, community-based manufacturers to make prototypes during the SafariSeat's development process, see **Figure 15**. Creating employment in the local community is also one of SafariSeat's aims.

Figure 15: The SafariSeat design features



Using standard bicycle parts, the SafariSeat adapts hand pedals and sprockets for efficient driving, suspension for stability on uneven terrain, and the wheel and frame configuration can be customized dependent on the users' needs and the bicycle parts available, see **Figure 16**.

Figure 16: The SafariSeat in action

Over 90 % of people living in low-resource regions of the world who need a wheelchair cannot access one, and the SafariSeat aims to fill this gap.

27. To design the SafariSeat, which of the following would have been considered?

I. Anthropometric data

II. Psychological factor data

III. Physiological factor data

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

28. Which waste mitigation strategy is the SafariSeat utilizing?

A. Dematerialization

B. Recycle

C. Recondition

D. Re-engineering

29. Which production system is the SafariSeat employing?

A. Batch production

B. Mass customization

C. Design for assembly

D. Assembly line production

30. Which of the following was Deeble's driver for inventing the SafariSeat?

A. Constructive discontent

B. Desire to make money

C. Desire to help others

D. The need to express creativity

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References:

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Figure 3 Image with permission from BigBlue Energy Inc.

Figure 4 Image with permission from Henkel.

Figure 5 Jim Merithew, Wired, © Condé Nast.

Figure 6 https://github.com/rm-hull/wireframes/blob/master/GALLERY.md. Copyright © 2013 Richard Hull.

Figure 7 © Cooper Hewitt, Smithsonian Design Museum / Art Resource, NY.

Figure 8 UFO Sinker, n.d. *UFO Sinker* [image online] Available at: http://ufosinker.com/img/produkty/hruska.png [Accessed 22 February 2023].

Figure 9 ksrujana96. https://openclipart.org/detail/297458/train. Creative Commons Zero 1.0 Public Domain License https://creativecommons.org/publicdomain/zero/1.0/.

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