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Design technology

Standard level

Paper 1

8 May 2024

Zone A afternoon | Zone B afternoon | Zone C afternoon

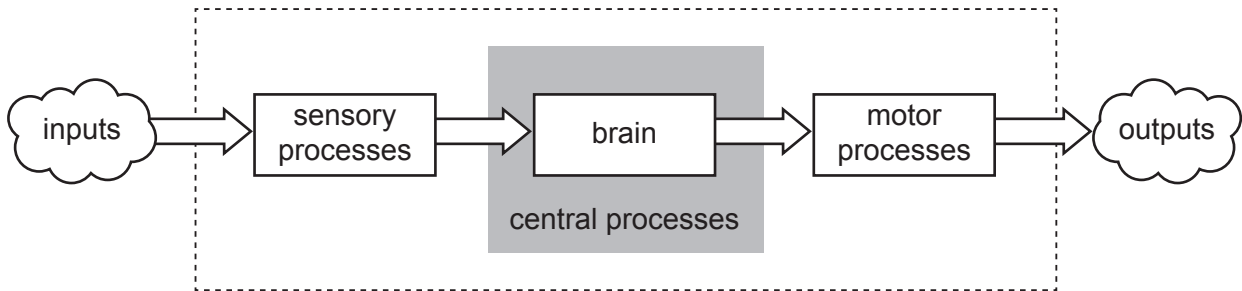
45 minutes

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]**.

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. Motor processes
 - B. Central processes
 - C. Sensory processes
 - D. Inputs
2. When considering the furniture for an open-plan office, which aspect of ergonomics would be most important?
- A. Adjustability
 - B. Range of sizes
 - C. Biomechanics
 - D. Clearance
3. Anthropometric data collection involves the summary, collation and synthesis of what type of data?
- A. Demographics for a population
 - B. Dimensions of body parts
 - C. Dimension between two physical objects
 - D. Intensity of light source in a room

4. 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
5. What natural resources can be identified in terms of quantity and quality?
- A. Renewable
 - B. Non-renewable
 - C. Reserve
 - D. Renewability

6. **Figure 2** shows the BMW Group Recycling and Dismantling Centre (RDC) in Germany. Parts of cars are separated by material for future use.

Figure 2: BMW Group Recycling and Dismantling Centre (RDC)



Which product recovery strategy is BMW using?

- A. Raw material
- B. Waste Electrical and Electronic Equipment (WEEE) recovery
- C. Recycling
- D. Waste to Energy

7. **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
8. Which incremental approach can be used by industries to reduce pollution and waste?
- A. Installing end-of-pipe technologies
 - B. Overhauling of one system level solution
 - C. Reducing manufacturing hours
 - D. Switching to non-renewable energy sources

9. Which of the following objectives are essential for the implementation of green products?
- I. Pollution
 - II. Energy
 - III. Manufacture
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
10. Which principle is used to warn consumers about any possible hazards based on potential problems in relation to the environmental impact of the production, use and disposal of a product?
- A. Protection
 - B. Prevention
 - C. Precaution
 - D. Planned obsolescence
11. Software that allows designers to perform a life cycle analysis (LCA) on a product and assess its environmental impact is known as:
- A. environmental assessment matrix
 - B. design for the environment software
 - C. United Nations Environmental Programme manual on Eco-design (UNEP)
 - D. circular economy

12. The Stanford Solar Car Project (SSCP) is a team of students who design, build, and test a solar-powered electric vehicle. **Figure 4** shows a student testing the inside of the driver's cockpit.

Figure 4: Testing the Stanford Solar Car cockpit



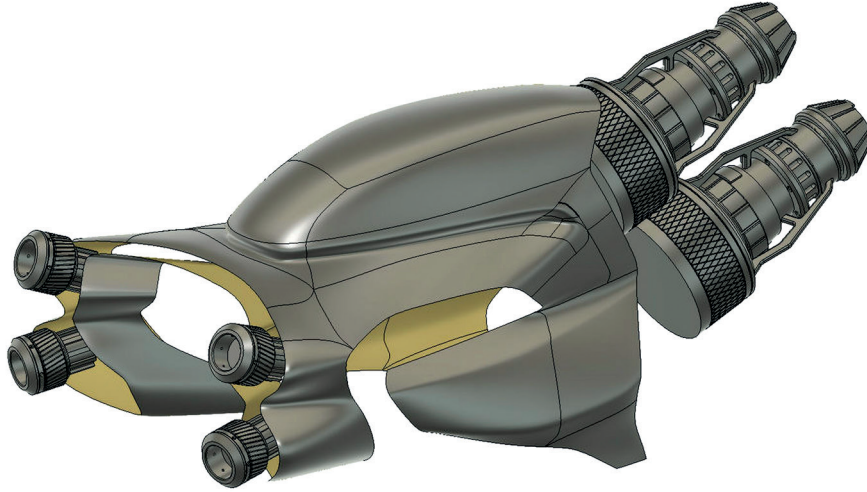
[Source: Jim Merithew, Wired, © Condé Nast.]

Which of the following best describes the type of model shown in **Figure 4**?

- A. Mock-up
- B. Aesthetic
- C. Finite element analysis (FEA)
- D. Scale

13. **Figure 5** shows a computer-aided-design (CAD) concept model part of a Space Drone project that focuses on the style of the design rather than the technical internal data.

Figure 5: Concept Space Drone



What type of model is shown in **Figure 5**?

- A. Surface
- B. Solid
- C. Virtual
- D. Animation

14. Danish designer Matthias Bengtsson designed the Slice chair in 1998, see **Figure 6**. 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 6: 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 7** 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 7: UFO Sinker lead-free fishing weights

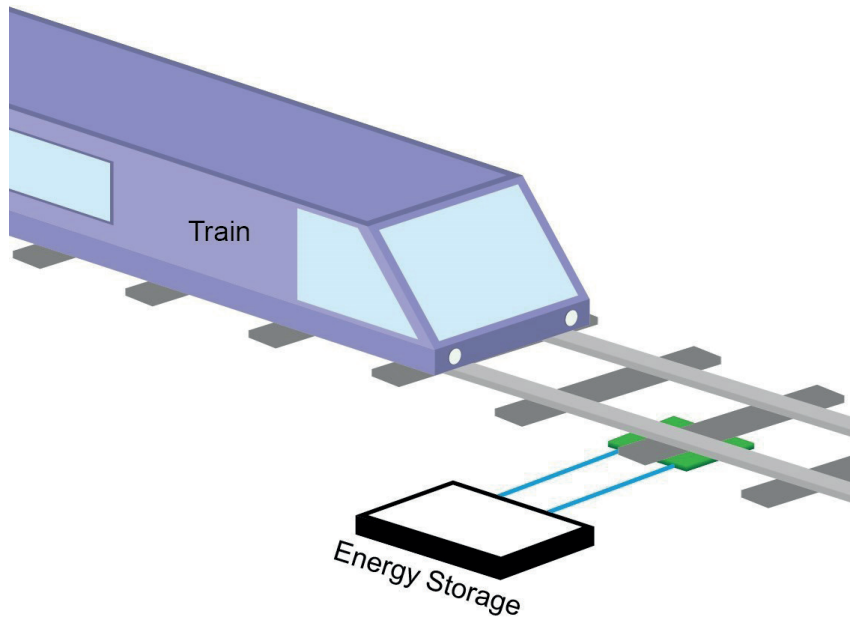


What property of the material is essential for the UFO Sinker to work effectively?

- A. Mass
- B. Hardness
- C. Weight
- D. Toughness

16. **Figure 8** shows an example of a smart technology developed by international company Innitrix. This smart material generates energy from pressure and stress on the railway track of passing trains to generate electricity.

Figure 8: 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.** A natural way to remove moisture content from timbers is known as:
- A. Kiln seasoning
 - B. Air seasoning
 - C. Stack seasoning
 - D. Closed seasoning
- 19.** Which production method best describes the scale used to manufacture, produce or process materials without interruption?
- A. One-off
 - B. Batch
 - C. Continuous
 - D. Mass customization

20. Which shaping technique has been used in the manufacture of the metal hair pins shown in **Figure 9**?

Figure 9: Metal hair pins



- A. Moulding
 - B. Casting
 - C. Thermoforming
 - D. Laminating
21. Which one of the following statements relates to one-off production?
- A. High-quality, high-volume production
 - B. Low-cost, high-volume production
 - C. High-cost, low-volume production
 - D. Low-quality, low-volume production

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. USB ports and cables as shown in **Figure 10**, allow the transfer of data and power between devices with relative ease. USB-C (shown on the right) is slowly becoming the standard port for consumer electronic devices.

USB-C ports:

- are smaller and thinner than USB-A (shown on the left)
- can be inserted either way whereas USB-A can only be inserted one way
- allow for faster data transfer speeds compared to USB-A.

Figure 10: USB-A (shown left) and USB-C (shown right)



Which of the following types of obsolescence will occur with the USB-A?

- I. Functional obsolescence
 - II. Planned obsolescence
 - III. Technological obsolescence
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

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 11** 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 11: 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 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 12** shows a wooden bicycle made from walnut. It is fully functioning and weighs similar to conventional bicycles.

Figure 12: Jan Gunneweg’s wooden bicycle



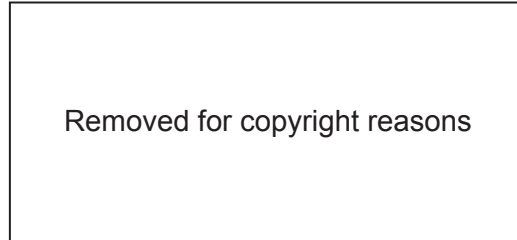
What design principles best describe Gunneweg’s approach to the design of the wooden bicycle?

- 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 Life Saving Dot is similar to a bindi. It is a self-adhesive dot containing iodine, see **Figure 13**. The Life Saving Dot is a patch used to transfer iodine through the skin.

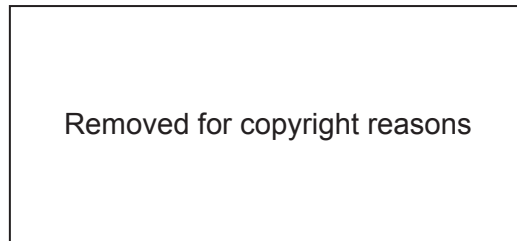
Figure 13: The Life Saving Dot



Iodine Deficiency Disorder (IDD) is the leading cause of preventable brain damage worldwide. In rural India, IDD is caused by a lack of iodine in the soil which prevents it from entering people’s diets. IDD particularly impacts women and can cause headaches, pregnancy complications, and breast cancer. The Life Saving Dot is a solution to this need.

Developed by the charitable foundation of advertising firm Grey Group Singapore, the Life Saving Dot provides the wearer with 150 to 200 micrograms of iodine when worn for at least four hours, see **Figure 14**.

Figure 14: The Life Saving Dot



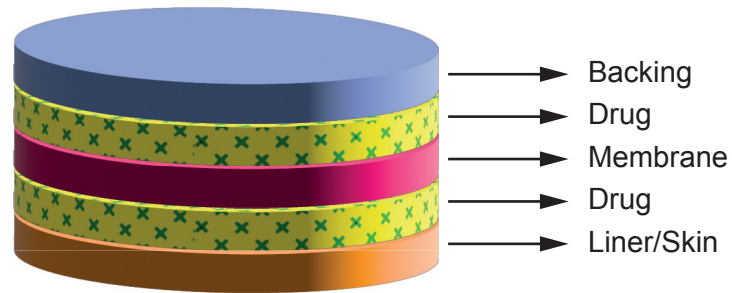
The Life Saving Dot was developed to be a low-tech solution that can be distributed efficiently to rural and disadvantaged Indian communities. By using the bindi, Grey Group hopes it is easier for users to adapt to this product, as the user does not need to change their normal behaviour. The Life Saving Dot comes in a variety of colours. The packaging and subsequent advertising campaign are designed to educate people about the issue and impacts of IDD, see **Figure 15**.

Figure 15: Advertising campaign for the Life Saving Dot



The skin patch consists of a layer of polymer, a matrix holding the drug, and a skin-safe adhesive, see **Figure 16**.

Figure 16: The composition of the Life Saving Dot



Patches like The Life Saving Dot need to be made from a material that is water resistant and durable enough to be easily applied and removed from the skin.

27. The graphical model in **Figure 16** is an example of...
- A. A 3D graphical model
 - B. A perspective drawing
 - C. An assembly drawing
 - D. A conceptual model
28. What is true of the composite materials of patches like The Life Saving Dot?
- A. They are easy to recycle
 - B. They have a reduced environmental impact
 - C. They are modified to have specific properties
 - D. They are designed to be mass customized

- 29.** Which innovation strategy did the Grey Group use?
- A. Architectural innovation
 - B. Modular innovation
 - C. Configurational innovation
 - D. Process innovation
- 30.** Which of Rogers' characteristics of innovation has Grey Group used in its marketing?
- I. Trialability
 - II. Observability
 - III. Compatibility
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
-

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- Figure 11** Trounce. <https://commons.wikimedia.org/wiki/File:03-BICcristal2008-03-26.jpg>. Licensed under CC BY 3.0 <https://creativecommons.org/licenses/by/3.0/deed.en>.
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