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Design technology

Higher level

Paper 1

16 May 2025

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

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. **Figure 1** shows computer workstations that allow doctors to move easily from room to room when consulting with patients.

Figure 1: Computer workstations in a hospital



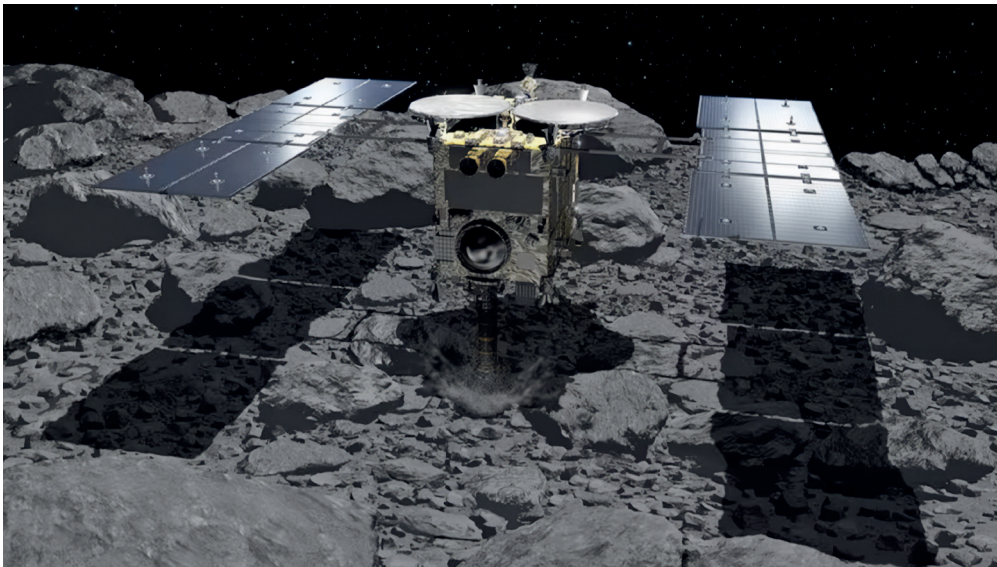
[Source: With permission from Altus, Inc.]

To protect doctors from developing repetitive strain injury which ergonomic design feature is essential?

- A. Fixed monitor height
 - B. Non-adjustable chair
 - C. Fixed keyboard tilt
 - D. Height-adjustable desk
-
2. Which design characteristic can positively impact the user's perception of a space or product?
 - A. High noise levels
 - B. Poor lighting
 - C. Clean and organized layout
 - D. Limited user control

3. What percentile range would most likely be used for the design of train seats?
- A. 5th–95th
 - B. 10th–90th
 - C. 15th–85th
 - D. 20th–80th
4. Water has been found in an asteroid sample collected by Japan's Hayabusa2 space probe, marking the first discovery of its kind. **Figure 2** shows an artist's rendering of the Hayabusa2 space probe hovering over an asteroid.

Figure 2: An artist's rendering of the Hayabusa2 space probe



Water found on an asteroid can be used for fuel and life support.

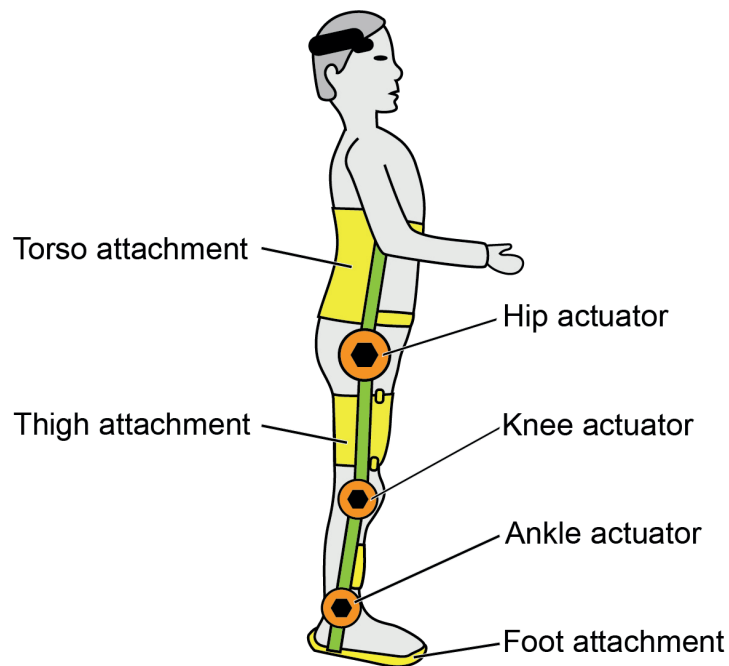
Which of the following terms best describe an asteroid with a confirmed presence of water in the context of a future mining mission?

- A. Resource
- B. Reserve
- C. Prospect
- D. Unexplored

5. To minimize the environmental impact of water extraction from asteroids for future mining missions, which of the following waste mitigation strategies should be employed?
- A. Recycling
 - B. Landfill disposal
 - C. Emission control
 - D. Disposal in space
6. Which of the following energy sources would be the most sustainable and efficient option for powering mining operations on asteroids?
- I. Solar
 - II. Battery
 - III. Nuclear
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
7. Which of the following is a disadvantage of an incremental solution when considering waste/pollution mitigation for a company?
- A. Limited impact on the overall level of waste/pollution
 - B. The company can react quicker to changing legislation
 - C. Less risk of failure as they are using familiar and already successful technologies
 - D. There is a risk that more waste/pollution will be generated
8. Which stakeholder has the most impact on the life cycle analysis (LCA) of a product during the “distribution including packaging” stage?
- A. Designer
 - B. Manufacturer
 - C. Retailer
 - D. User

9. **Figure 3** shows the conceptual model of a wearable exoskeleton for the physical treatment of children with motor impairment.

Figure 3: Conceptual model of a wearable exoskeleton



What is the primary role of conceptual modelling in the design process of a wearable exoskeleton (see **Figure 3**)?

- A. To create physical prototypes of the product
 - B. To conduct rigorous testing and analysis of the design
 - C. To visualize and communicate design ideas
 - D. To finalize the detailed design specifications
10. What is the primary function of aesthetic models in the product development process?
- A. To create aesthetically pleasing prototypes
 - B. To look and feel like the final product
 - C. To serve as functional prototypes
 - D. To conduct market research

11. The Kevlar car tyre in **Figure 4** can last for years and roll for thousands of miles without getting punctured.

Figure 4: Section of a Kevlar tyre



Which mechanical properties of Kevlar primarily enhance the durability and puncture resistance of tyres?

- A. Ductility
 - B. Hardness
 - C. Tensile strength
 - D. Stiffness
12. Which components manufactured from superalloys benefit from the high-temperature strength and resistance to creep?
- I. Jet engine turbine blades
 - II. High-performance racing cars
 - III. Nuclear power plant components
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

- 13.** What is the primary method used to manufacture polyethylene terephthalate (PET) bottles?
- A. Compression moulding
 - B. Injection moulding
 - C. Thermoforming
 - D. Blow moulding
- 14.** Which of the following negative impacts on the environment are associated with mass production systems?
- I. Increased resource consumption and depletion
 - II. Increased air and water pollution due to industrial activities
 - III. Increased soil erosion due to intensive farming
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
- 15.** Which combination of properties make acrylonitrile butadiene styrene (ABS) plastic a suitable material for injection moulding?
- I. High melting point
 - II. High tensile strength
 - III. Widely available
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

16. What is the primary advantage of using a first generation assembly line robot to weld two metal components together?
- A. The robot can check the quality of the weld.
 - B. The robot can detect when a worker is in their work envelope and stop working.
 - C. They are relatively low cost compared to 2nd generation robots.
 - D. They can perform multiple tasks on an assembly line.
17. The ForeverPen is designed to be a long-lasting writing utensil, see **Figure 5**. Its nib (tip) is made from a silver composite that can write smoothly like a pencil but doesn't require any lead or ink. This technology is inspired by a historical drawing technique called silverpoint.

Figure 5: The ForeverPen on a notebook



Which intellectual property (IP) protection offers exclusive rights to the unique features and functionalities of the ForeverPen, preventing others from making, using, or selling a similar invention?

- A. Copyright ©
- B. Patent
- C. Trademark TM
- D. None of the above

- 18.** How does sustaining innovation contribute to the long-term success of a company?
- A. By creating entirely new markets and transforming industries
 - B. By making minor adjustments to current business practices
 - C. By periodically introducing disruptive products to replace existing ones
 - D. By maintaining product relevance and meeting evolving customer needs
- 19.** Designed products that replicate nature use which strategy for innovation?
- A. Technology push
 - B. Act of insight
 - C. Analogy
 - D. Adaptation

In 2023 Levi Strauss & Co celebrated the 150-year anniversary of their most iconic product the 501® Original jean, see **Figure 6**. Manufactured using denim fabric, the garment has stood the test of time to become a classic design owing to its durability, practicality and use of the cotton fibre.

Originally designed as work clothes for gold miners' Levi's® jeans have been worn through the ages and across cultures.

Figure 6: Iconic Levi's® 501® Original jean classic design



20. What makes the Levi's® 501® Original jean a classic design that has stood the test of time?
- A. The use of organic cotton in the manufacturing process
 - B. The incorporation of features for better fit and comfort
 - C. The iconic straight leg and button-fly design that remains unchanged over the years
 - D. The introduction of trendy and fashionable washes
21. How does the balance between form and function benefit the popularity of Levi's® jeans (Figure 6)?
- A. The jeans focus solely on aesthetics, leading to a decline in their practicality.
 - B. The jeans are fashionable yet durable and comfortable to wear.
 - C. The jeans prioritize utility, making them unappealing to fashion-conscious consumers.
 - D. The focus on aesthetics makes the jeans suitable for occasional wear but not for everyday use.

22. A typical modern aircraft flight deck is equipped with a wide range of advanced electronic instruments. A guiding aviation design principle compartmentalizes main systems on the overhead panel, pedestal, and mode control panel so that hydraulic, electrical and fuel systems have dedicated locations.

Figure 7: An aircraft flight deck



[Source: © Airbus SAS 2014. All rights reserved.]

What characteristic indicates how the knobs and buttons in the flight deck can be used?

- A. Texture
- B. Affordance
- C. Physio-pleasure
- D. Visibility

23. Health and safety considerations feature highly within the visual communication and physical design used in the aerospace industry. Typical aircraft landing gear levers have a wheel shape to grasp, and flap levers represent the shape of a wing.

Figure 8: Aircraft landing gear lever



Figure 9: Aircraft flap lever



[Source: Anaspides Photography.]

What consideration has been used in the design of these control levers?

- A. Natural environment
- B. Adjustability
- C. Adaptation
- D. Visibility

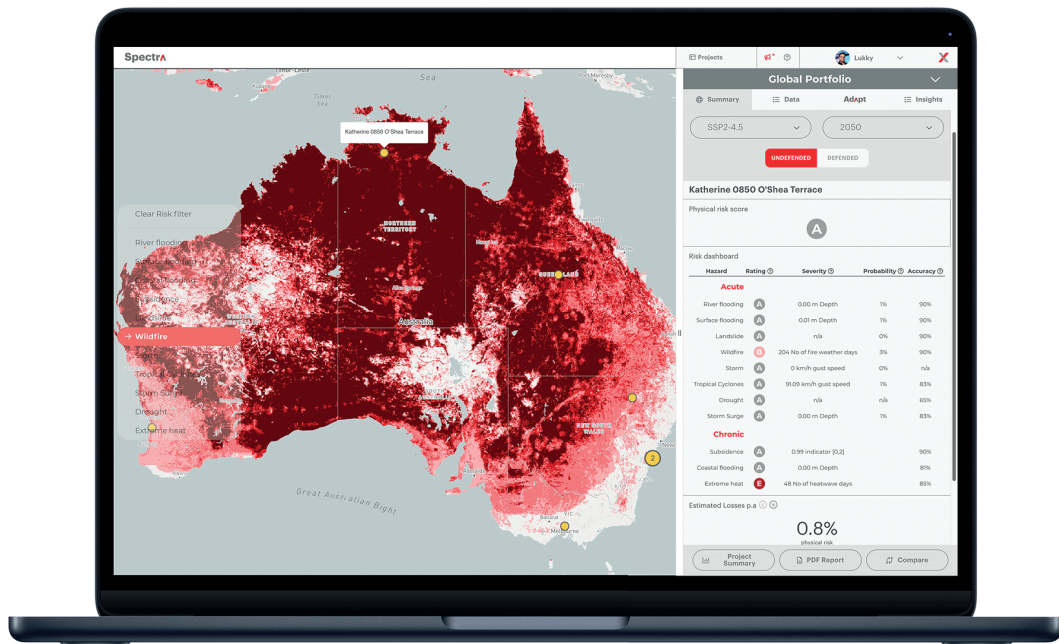
- 24.** During the user-centred design (UCD) process which strategy provides user feedback to inform development of the product?
- A. Prototype testing session
 - B. Field research
 - C. Usability laboratory
 - D. Method of extremes
- 25.** If a material can be placed in landfill or composted at the end of its life to decompose harmlessly, which approach does this satisfy?
- A. Solar
 - B. Safe
 - C. Efficient
 - D. Cyclic
- 26.** Which is a clear example of sustainable consumption?
- A. Not driving to work, buying only the groceries you need, having a dual flush toilet
 - B. Owning an electric car, working from home, cooking with gas
 - C. Taking backroads to avoid paying tolls, recycling, solar charging your phone
 - D. Using LED globes, avoiding single-use plastics, owning a mobile phone (cell phone)

- 27.** Who holds similar viewpoints on a particular topic and takes action to promote positive change to meet their goals?
- A. Product champions
 - B. Product stewards
 - C. Eco-champions
 - D. Pressure groups
- 28.** What is one of the primary goals of energy security?
- A. Increasing energy efficiency in industries
 - B. Developing clean energy technologies for environmental sustainability
 - C. Ensuring a steady supply of energy resources at affordable prices
 - D. Ensuring environmental sustainability in energy production

29. Climate-X claims to use artificial intelligence (AI) to perform climate risk modelling that provides short and long-term insights into weather and climate impacts (**Figure 10**). This is designed to help businesses identify what actions they need to take in advance.

This type of information may support roofing companies to order increased volumes of roofing materials in anticipation of extreme weather events such as hurricanes (cyclones).

Figure 10: Illustration of the Climate-X dashboard



Which corporate strategy is most likely to find new applications for existing products and open up new markets?

- A. Imitative
 - B. Market development
 - C. Product development
 - D. Market penetration
30. What is the transport industry an example of?
- A. Target audience
 - B. Market segment
 - C. Market sector
 - D. Target market

31. Michelin, a map and tyre manufacturer, is well known for its commitment to quality and innovation within the automotive industry. Michelin also promote excellence through their Michelin Star Award in the food and beverage sector of the hospitality industry.

The Michelin tyre brand was made popular through its well-known character, Bibendum, known as the 'Michelin Man', a humanoid consisting of tyres who features on Michelin's distinct logo and advertisements.

Figure 11: The Michelin logo



[Source: With permission from Michelin.]

What term is commonly used to describe consumers who consistently choose Michelin tyres over other brands?

- A. Product acceptance
- B. Late majority
- C. Brand loyalty
- D. Product champion

32. When devising a price for a product, which of the following strategies are used?

- I. Personal selling
- II. Psychological pricing
- III. Cost-plus pricing

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

33. Which is a goal of lean production?

- A. Continual feedback and incremental improvement
- B. The supply of raw material and electrical equipment
- C. Shareholders' maximizing profitability
- D. Minimizing waste within production services

34. What is a principle of lean production?

- A. Developing an effective quality control (QC) system
- B. Having zero inventory
- C. Having a multi-skilled workforce
- D. Doing it right the first time

35. **Figure 12** shows an example of computer integrated manufacturing (CIM).

Figure 12: A CIM system on a car production line



What is an advantage of computer integrated manufacturing (CIM)?

- A. Reduced workforce
- B. The rate of production can be increased
- C. No wear and tear
- D. No maintenance costs

Questions 36–40 relate to the following case study. Please read the case study carefully and answer the questions.

A living wall is a vertical wall of live plants. LiveWall® brings nature into urban spaces improving aesthetics and the physical and mental wellbeing of users, see **Figure 13**.

A LiveWall® also reduces heating and ventilation costs by releasing moisture that cools the air during summer and restores moisture to heated spaces in the winter.

LiveWall® manufacture the planter boxes which are mass produced from acrylonitrile butadiene styrene (ABS) plastic and hang on aluminium extruded support rails.

The plants in the LiveWall® need regular irrigation and maintenance to avoid neglected plants becoming overwhelmed by weeds or perishing from a lack of nutrition which would be unappealing.

Figure 13: A LiveWall® in California, USA



Figure 14: A LiveWall® ABS plastic planter box.

Full width (16 inches / 406.4mm)

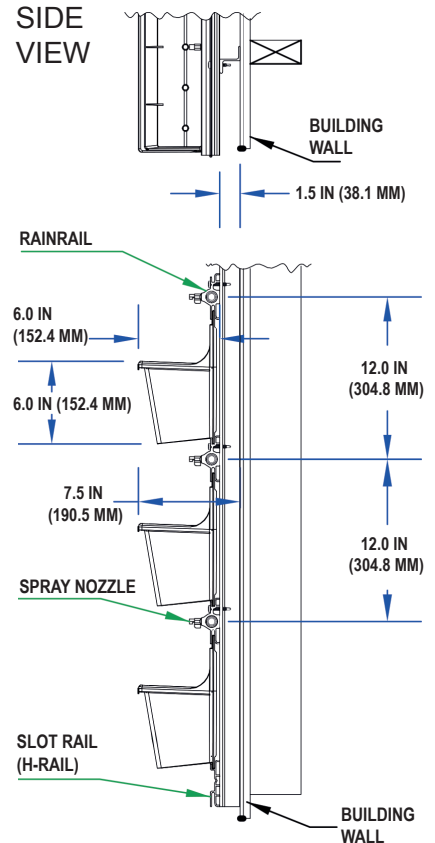
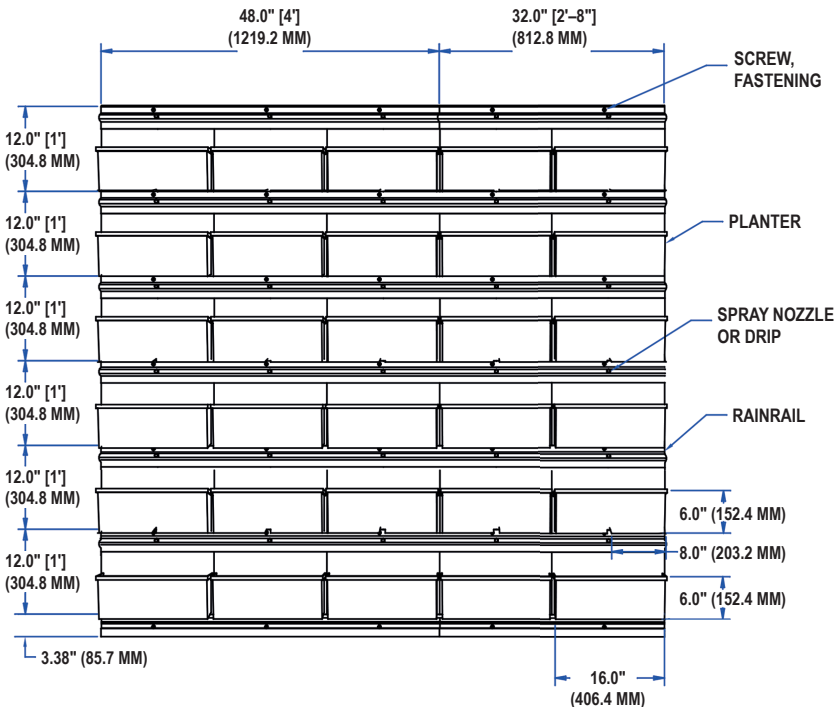


Figure 15: A formal drawing of a LiveWall® plan

LiveWall (Green Wall) Elevation
FRONT VIEW – STANDARD SIZE PLANTERS

S1

SIDE VIEW



IRRIGATION FEED:

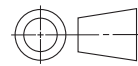
- REAR (SEE S2R)
- SIDE (SEE S2S)

PLANTER COLOUR:

- COOL GREY
- FOREST GREEN
- SAGE

WATERING METHOD:

- SPRAY NOZZLES
- DRIP EMITTERS



LiveWall®

36. Which green design objective could have been considered when designing the LiveWall®?

- A. Minimizing the aesthetic appeal
- B. Minimizing the number of different materials used
- C. Minimizing the ergonomic design
- D. Minimizing recycling opportunities

37. The LiveWall® plan in **Figure 15** is an example of what type of drawing?

- A. Perspective drawing
- B. Sketching
- C. 3D graphical model
- D. Orthographic drawing

38. What technique is used for manufacturing the LiveWall® planter boxes shown in **Figure 14**?
- A. Injection moulding
 - B. Vacuum forming
 - C. Casting
 - D. Laminating
39. While the public will benefit from the LiveWall®, it will be architects who specify the LiveWall® for use in building projects. What category does the architect fit into?
- A. Target audience
 - B. Target market
 - C. Target sector
 - D. Target segment
40. Before being delivered to clients, all LiveWall® planter boxes are visually checked for defects. What is this an example of?
- A. Quality control (QC)
 - B. Quality assurance (QA)
 - C. Statistical process control (SPC)
 - D. Waste reduction
-

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References:

- Figure 1:** Altus, 2024. *2024 Trends in Height Adjustable Workstations for the Healthcare Industry*. [image online] Available at: <https://www.altus-inc.com/insight?categories=workstations> [Accessed 5 November 2024].
- Figure 2:** Illustration by Akihiro Ikeshita.
- Figure 4:** With permission from ZC Rubber Group.
- Figure 5:** ForeverPen. With permission from World's Tiniest. www.worldstiniest.com.
- Figure 7:** © Airbus SAS 2014. All rights reserved.
- Figure 8:** Ollie Desforges, 2021. *Airliner Landing Gear Lever – stock photo*. [image online] Available at: <https://www.gettyimages.co.uk/detail/photo/airliner-landing-gear-lever-royalty-free-image/1301602744?phrase=aircraft+landing+gear+lever&searchscope=image%2Cfilm&adppopup=true> [Accessed 5 November 2024]. Source adapted.
- Figure 9:** Anaspides Photography.
- Figure 10:** Climate X, n.d. *Climate X Spectra Wildfire, SSP2-4.5 2050*. [image supplied by Climate X].
- Figure 11:** With permission from Michelin.
- Figure 12:** RicAguiar, 2008. *Car factory building new vehicles with robotic arms – stock photo*. [image online] Available at: <https://www.gettyimages.co.uk/detail/photo/car-factory-building-new-vehicles-with-robotic-arms-royalty-free-image/172957534?adppopup=true> [Accessed 5 November 2024].
- Figure 13:** With permission from LiveWall, LLC.
- Figure 14:** With permission from LiveWall, LLC.
- Figure 15:** With permission from LiveWall, LLC.