Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level
Paper 1

2 November 2023

Zone A morning | **Zone B** morning | **Zone C** 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]**.

8823 – 6201

23 pages

1. Which of the following anthropometric considerations apply to the sandal shown in **Figure 1**?

Figure 1: Sandal

I. Reach
II. Range of sizes
III. Adjustability

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

2. What is the percentile used to determine distance D (floor to handle) in supermarket shopping carts, such as the one shown in **Figure 2**?

Figure 2: A supermarket shopping cart

[Source: 3DMAVR / Shutterstock.com]

A. 5th

B. 50th

C. 95th

D. 5th–95th

3. What is the most suitable data scale for measuring comfort?

A. Ratio

B. Interval

C. Ordinal

D. Nominal

4. Collecting primary anthropometric data is most relevant when designing…

A. custom-made desks.

B. school desks.

C. office desks.

D. computer desks.

5. What is a major challenge for resource management in the 21st century?

A. Development of renewable and sustainable resources

B. Installation of end-of-pipe technologies

C. Dematerialization of complex designs

D. Increased reconditioning

6. Toilet paper is usually made using fibre from softwood trees. Using 100 % bamboo fibre is a more environmentally friendly alternative because bamboo has a…

A. higher resource extraction rate.

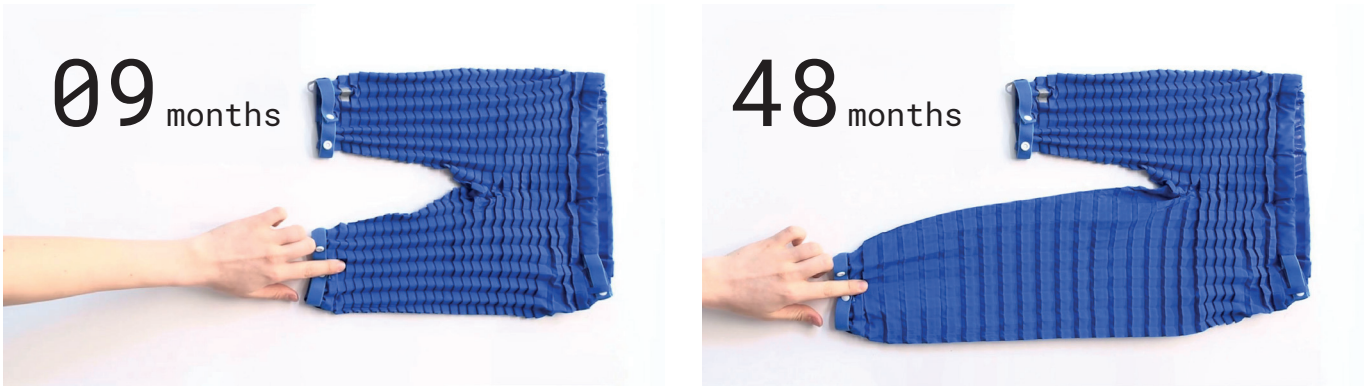
B. lower resource extraction rate.

C. higher renewability rate.

D. lower renewability rate.

7. Petit Pli® is a company that designs clothes for children as they grow. This means the child can wear the same pair of trousers (pants) from 9 months up to 4 years (48 months), see **Figure 3**.

Figure 3: Petit Pli® trousers



This is an example of…

A. reduce.

B. re-engineering.

C. repairing.

D. recycling.

8. Green legislation is most likely to encourage the following types of solution:

I. Incremental solutions
II. System level solutions
III. End-of-pipe solutions

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. 31 % of plastic waste ends up in landfills, 39 % is incinerated (burned) and only 30 % is recycled. The ideal waste mitigation strategy to combat this problem is:

A. Dematerialization

B. Circular economy

C. Re-engineering

D. Reconditioning

10. **Figure 4** shows a 3D printed guitar body that was manufactured as a single part.

Figure 4: A 3D printed guitar body

Which of the following would be the best method to 3D print the guitar body?

A. Stereolithography (SLA)

B. Selective laser sintering (SLS)

C. Laminated object manufacturing (LOM)

D. Fused deposition modelling (FDM)

11. Digital humans are made possible using…

A. bottom-up modelling.

B. finite element analysis (FEA).

C. haptic technology.

D. motion capture technology.

12. **Figure 5** shows an innovative footwear solution using smart material technology. The sole of the shoe charges mobile devices when in use.

Figure 5: Smart footwear

Which smart material property releases an electrical discharge when deformed by the walking action of the user?

A. Shape memory alloy

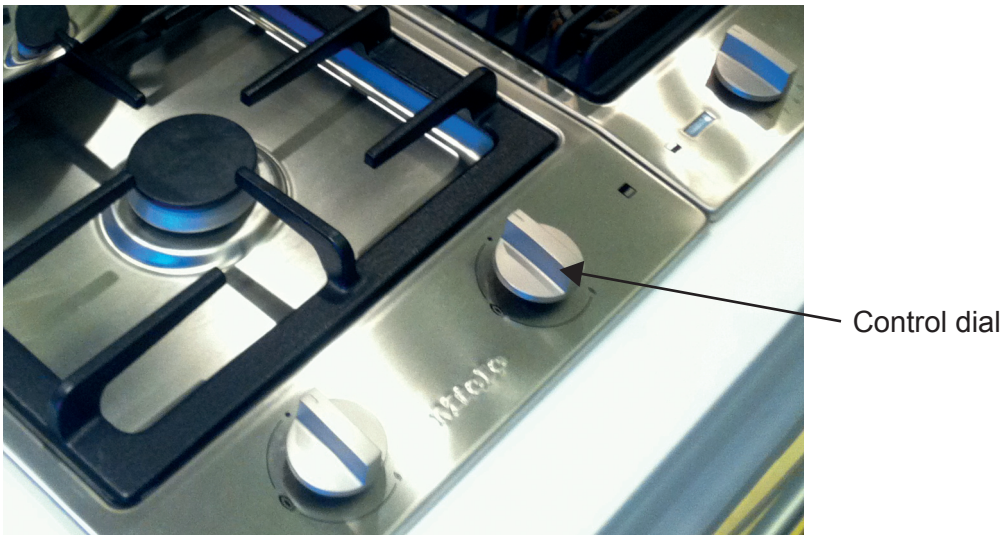
B. Piezoelectricity

C. Thermoelectricity

D. Electro-rheostatic

13. **Figure 6** shows control dials for hobs produced from urea-formaldehyde plastic.

Figure 6: Control dials for hobs



Urea-formaldehyde plastic is used because it is…

A. injection mouldable.

B. recyclable.

C. heat resistant.

D. low in hardness.

14. Teams of robots are used in car manufacturing to achieve…

A. faster production.

B. a larger working envelope.

C. machine to machine (M2M) communication.

D. a higher load capacity.

15.

Figure 7: A goldfish bowl

[Source: FreeImages.com/lute1]

Glass is used for goldfish bowls, see **Figure 7**, because it…

A. is unreactive.

B. has a high melting point.

C. is brittle.

D. can be coloured.

16. Why are some moulds for metals made out of super alloys?

A. To decrease the cost of moulds

B. To speed the cooling process

C. To increase the metal flow inside the moulds

D. To resist high temperatures

17. Touch screens became popular after Apple introduced the iPhone. This is an example of…

A. process innovation.

B. product versioning.

C. disruptive innovation.

D. shelved technology.

18. Sir James Dyson was dissatisfied with existing vacuum cleaners that lost suction when dust was trapped in their bags. At a factory he saw how sawdust was removed from the air by industrial extraction systems (cyclones). He was inspired to engineer the cyclone technology and produce the world's first bagless vacuum cleaner, see **Figure 8**.

Figure 8: Dyson's cyclone technology

[Source: ©Dyson Technology Limited 1992 – 2023]

Which strategy for innovation applies to Dyson's cyclone technology?

A. Constructive discontent

B. Chance

C. Technical curiosity

D. Adaptation

19. KitKat® manufactures chocolate bars and has introduced new flavours such as Tiramisu and Strawberry Cheesecake, see **Figure 9**.

Figure 9: Examples of KitKat® chocolate bars

[Source: KitKat® is a registered trademark of Société des Produits Nestlé S.A.]

This is an example of…

A. sustaining innovation.

B. disruptive innovation.

C. process innovation.

D. configurational innovation.

20. In 1913, Henry Ford introduced the assembly line for the production of the Model T Ford car.

Figure 10: The Model T Ford

Which characteristic has contributed the **most** to the Model T Ford, see **Figure 10**, reaching classic design status?

A. Defies obsolescence

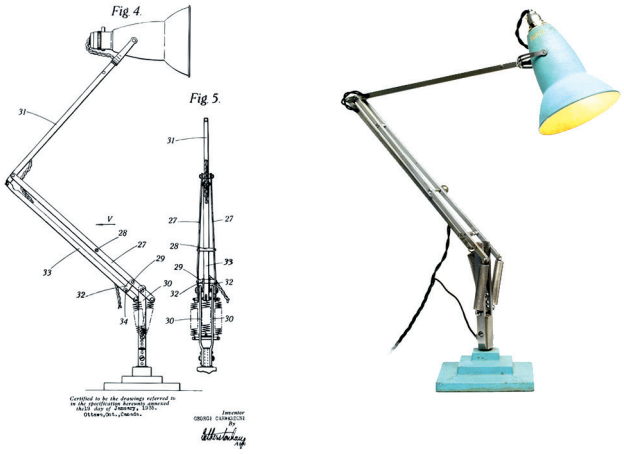
B. Mass production

C. Ubiquitous

D. Dominant design

21. When working on the design of a suspension system for cars, George Carwardine invented a mechanism that could be easily set in a number of positions. This led him to design the Anglepoise Lamp, see **Figure 11**.

Figure 11: The Anglepoise Lamp



Which of the following best applies to the design of this lamp?

A. Form follows function

B. Function follows form

C. Psychological function

D. Retro-styling

22. Inclusive design targets the following:

I. Users who are able bodied

II. Users with sensory impairments

III. Users with perceptual impairments

A. I and II only

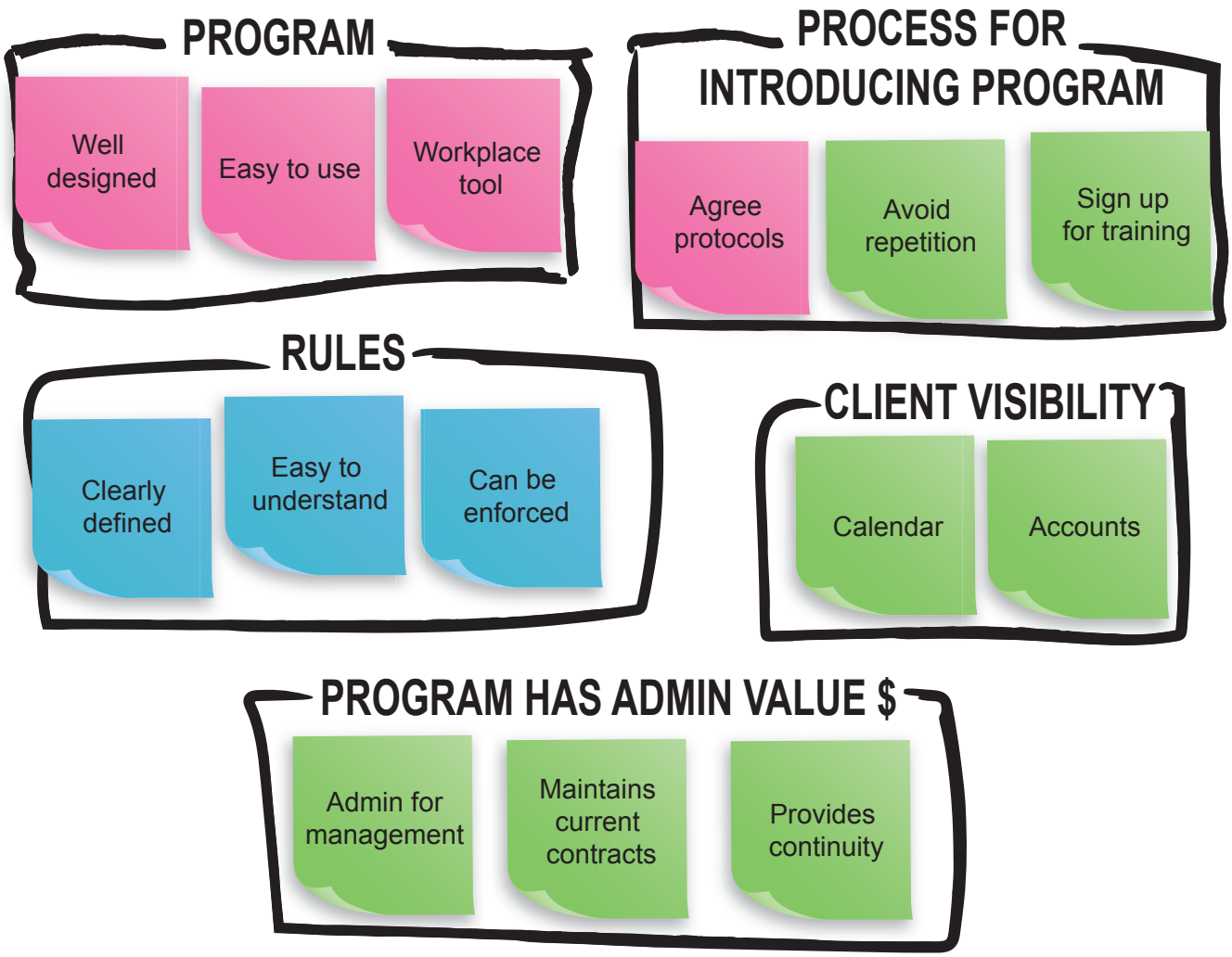
B. I and III only

C. II and III only

D. I, II and III

23. **Figure 12** shows the results of a problem-solving session where similar items have been grouped together.

Figure 12: The results of a problem-solving session



Which strategy for user-centred design (UCD) does this describe?

A. Perceptual mapping

B. Affinity diagramming

C. Environmental scanning

D. Participatory design

24. **Figure 13** shows Mushroom® Packaging which was designed and manufactured by a New York-based company called Mycelpack.

Using the same amount of energy to manufacture as conventional expanded polystyrene, Mushroom® Packaging is made using agricultural waste, is completely biodegradable and uses energy from renewable sources.

Figure 13: Mushroom® Packaging

Which combination of Datschefski's five principles of sustainable design apply to this product?

A. Solar, Safe, Cyclic

B. Safe, Cyclic, Efficient

C. Cyclic, Solar, Efficient

D. Efficient, Social, Cyclic

25. Which of the following concepts focuses on the values and criteria for measuring organizational success rather than solely focusing on profit?

A. Sustainability reporting

B. Product stewardship

C. Triple bottom line sustainability

D. Decoupling

26. Take-back legislation has implications for which of the following groups of people?

I. Manufacturers
II. Designers
III. Consumers

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

27. Taxes and subsidies are examples of…

A. bottom-up strategies.

B. micro energy sustainability.

C. government intervention.

D. energy security.

28. **Figure 14** shows a range of available PlayStation 5™ products.

Figure 14: A range of PlayStation 5™ products

PlayStation 5™ Game Console

PlayStation 5™ VR Headset

[Source: Miguel Lagoa / Shutterstock.com]

Generic Car controller

[Source: VikiVector / Shutterstock.com]

PlayStation 5™ Stand

Which of the products in **Figure 14** is considered to be a trigger product?

A. PlayStation 5™ Game Console

B. PlayStation 5™ VR Headset

C. Generic Car controller

D. PlayStation 5™ Stand

29. Which of the following corporate strategies could involve lowering the price of an existing product?

A. Product development

B. Market penetration

C. Market development

D. Product diversification

30. **Figure 15** shows a battery system designed by Tesla, which has a capacity of 100 megawatts and can store 129 megawatt-hours of energy from wind turbines nearby; enough to supply 30 000 homes for eight hours. It is hoped the huge lithium battery will increase the stability of the electricity grid and reduce power bills.

Figure 15: A battery system

Which of the following applies in **Figure 15**?

A. Micro energy

B. Bottom-up

C. Eco-design

D. Energy security

31. Which of the following market research strategies is likely to be the least costly to carry out?

A. Literature search

B. User trial

C. Expert appraisal

D. Perceptual mapping

32. **Figure 16** shows how the manufacturing process of different products on an assembly line are grouped together in order to maximize production efficiency and reduce machine downtime.

Figure 16: An assembly production chart

		Assembly Steps and Equipment							
		1	2	3	4	5	6	7	8
PRODUCTS	A	X	X	X		X	X		
	B	X	X	X	X	X	X		
	C	X	X	X		X	X	X	
	D		X	X	X			X	X
	E		X	X	X			X	X
	F	X		X		X	X	X	
	G	X		X		X	X	X	

This is an example of…

A. quality management.

B. product family.

C. statistical process control (SPC).

D. value stream mapping.

33. A designer specifies a component must be painted with high-quality gloss paint on every surface, even though 50 % of it will not be visible after it is assembled with the other components.

This is an example of which of the 7 wastes?

A. Overprocessing

B. Transportation

C. Motion

D. Overproduction

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34. Which of the following elements of computer integrated manufacturing (CIM) focuses most on lead times?

A. Design

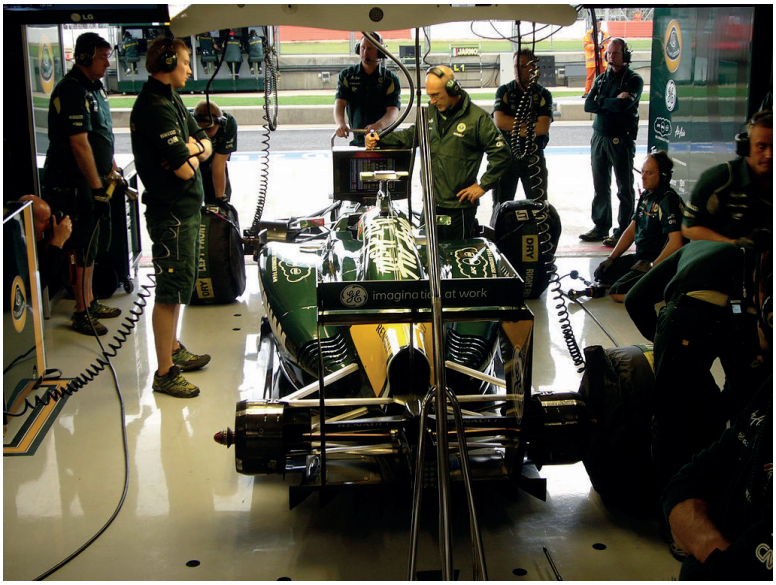
B. Planning

C. Inventory control

D. Cost accounting

35. **Figure 17** shows mechanics working in a garage at a Formula 1 racetrack. The floors are kept very clean so the mechanics can see any problems with the racing car, such as oil leaks.

Figure 17: The garage of a Formula 1 racetrack



This is an example of…

A. sorting.

B. sustaining.

C. stabilizing.

D. shining.

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

Figure 18 and **Figure 19** show the N30 wireless mouse, inspired by the Nintendo® games controller shown in **Figure 20**, which was popular in the 1980s.

Figure 18: N30 wireless mouse

Removed for copyright reasons

Figure 19: How the N30 wireless mouse works

Removed for copyright reasons

Figure 20: Nintendo® games controller

Daniel Jansson, who designed the mouse, describes it as functional, nostalgic and joyful. The mouse offers a better website navigation experience with page up, page down, upward and forward buttons on the side.

36. Which type of plastic was most likely used for the casing of the N30 wireless mouse?

A. Polyethylene terephthalate (PET)

B. Low-density polyethylene (LDPE)

C. Acrylonitrile butadiene styrene (ABS)

D. Polyvinyl chloride (PVC)

37. Which of the following design for manufacture (DfM) strategies has the greatest impact on how well the mouse can be recycled at the end of its life?

A. Design for materials

B. Design for process

C. Design for assembly

D. Design for disassembly

38. Which manufacturing technique was most likely used in the commercial production of the navigation buttons on the mouse?

A. Vacuum forming

B. Rotational forming

C. Injection moulding

D. Blow moulding

39. Which modelling technique would have enabled the designer to understand how accurately the buttons responded to being pressed?

A. Aesthetic model

B. Orthographic projection

C. Finite element analysis (FEA)

D. Instrumented modelling

40. Which of the following characteristics of a good user-product interface would have been most important for ensuring the controls on the mouse corresponded with the action they performed?

A. Affordances

B. Constraints

C. Mapping

D. Feedback

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References:

Figure 1 Muralinath, n.d. *Indian Made Men's sandals – stock photo*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/indian-made-mens-sandals-royalty-free-image/1161700112?adppopup=true [Accessed 22 July 2022].

Figure 2 3DMAVR / Shutterstock.com.

Figure 3 Images with permission from Petit Pli.

Figure 4 Image with permission from ODD Guitars.

Figure 5 Image with permission from Compound Footwear.

Figure 6 GardenKings. https://commons.wikimedia.org/wiki/File:HK_Ka_Wah_Centre_showflat_%E6%B7%B1%E7%81%A39_Marinella_T6-A_Meile_Gas_Cooking_Hob_Oct-2011.jpg. Licensed under CC BY-SA 3.0 DEED https://creativecommons.org/licenses/by-sa/3.0/deed.en. Image adapted.

Figure 7 Lute1, 2005. *Free Gold Fish close-ups Stock Photo*. [image online] Available at: https://www.freeimages.com/photo/gold-fish-close-ups-1362575 [Accessed 10 September 2020].

Figure 8 ©Dyson Technology Limited 1992 – 2023.

Figure 9 KitKat® is a registered trademark of Société des Produits Nestlé S.A.

Figure 10 ModelTMitch. https://commons.wikimedia.org/wiki/File:1925_Ford_Model_T_touring.jpg. Licensed under CC BY-SA 4.0 DEED https://creativecommons.org/licenses/by-sa/4.0/deed.en.

Figure 11 Image with permission from Anglepoise.

Figure 13 Wine Shipper. www.flickr.com/photos/75778657@N06/6806715347/. Licensed under CC BY-SA 2.0 https://creativecommons.org/licenses/by-sa/2.0/.

Figure 14 [PlayStation 5 Game Console] Howardcorn33. https://en.wikipedia.org/wiki/File:Black_and_white_Playstation_5_base_edition_with_controller.png. Public domain.

[PlayStation 5 VR Headset] Miguel Lagoa / Shutterstock.com.

[PlayStation 5 Car Controller] VikiVector / Shutterstock.com.

[PlayStation 5 Stand] Image provided by Venom UK.

Figure 15 denisbin. https://www.flickr.com/photos/82134796@N03/38783766915/in/photolist-226bWdn-226bWGt-23pNawh-JvGwEr-JvGwga-JvGx8a-u92sry-utsNEF-uqcF29-ttAh39-ttAtjs-u92saG-2nRTNy2/. Licensed under CC BY-ND 2.0 https://creativecommons.org/licenses/by-nd/2.0/.

Figure 17 Dell Inc. https://commons.wikimedia.org/wiki/File:2011_British_GP_-_Lotus_garage.jpg. Licensed under CC BY 2.0. https://creativecommons.org/licenses/by/2.0/deed.en.

Figure 20 [*Nintendo Entertainment System NES Controller*] 2016. [image online] Available at: https://commons.wikimedia.org/wiki/File:Nintendo-Entertainment-System-NES-Controller-FL.jpg [Accessed 10 September 2020].