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Design technology
Standard level
Paper 1

Thursday 5 November 2020 (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. Which part of the human information processing system would most likely be affected by mental stress?
 - A. Motor processes
 - B. Output
 - C. Sensory processes
 - D. Central processes

2. Which of the following usually relies on collecting anthropometric data relevant to the 5th percentile only?
 - A. Reach
 - B. Clearance
 - C. Adjustability
 - D. Range of sizes

3. Which of the following is influenced by perception?
 - A. Biomechanics
 - B. Strength
 - C. Thermal comfort
 - D. Reach

4. **Figure 1** is an example of a tool used by designers.

Figure 1: A tool used to demonstrate the stages and impacts of a project

| | | Environmental considerations | | | | | | | | |
|----------------|------------|------------------------------|------------|---------|---------|-------|---------|---------|------------|-------|
| | | Water | | | Air | | Soil | | Biological | |
| | | Surface | Subsurface | Coastal | Quality | Noise | Quality | Erosion | Flora | Fauna |
| Project stages | Production | 4 | | 4 | 3 | 3 | | | | |
| | Logistics | | | | 4 | 4 | | | | |
| | Fitting | | | | | 3 | 3 | 2 | 4 | 4 |
| | Operation | | | | 4 | 4 | | | | |

What is **Figure 1** an example of?

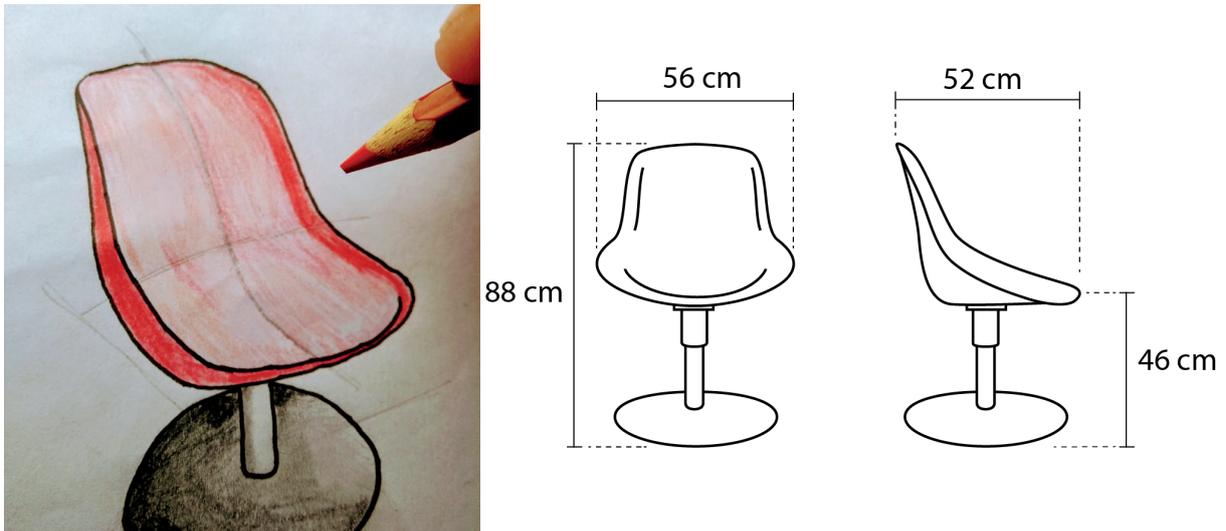
- A. Life cycle analysis (LCA) matrix
- B. Design for the environment software
- C. Affinity diagramming
- D. Environmental impact assessment matrix

5. Which of the following renewable energy resources could be considered as having the least environmental and social impact?
- A. Geothermal energy
 - B. Solar
 - C. Wind
 - D. Hydropower
6. Which of the following best describes a circular economy?
- A. Maximizing the amount of material that can be recycled
 - B. Designing products so they produce the minimal amount of pollution
 - C. Designing products so their waste can be used as a resource
 - D. Designing products so they can be disposed of as easily as possible
7. Which of the following is considered most reliable in terms of constant supply?
- I. Solar
 - II. Nuclear
 - III. Tidal
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
8. Which of the following waste mitigation strategies involves the use of small amounts of energy?
- I. Re-use
 - II. Recycle
 - III. Repair
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

9. Which of the following strategies would be the easiest way to ensure energy was being used most efficiently?
- A. Constructing power plants closer to cities
 - B. Combining renewable and non-renewable energy sources
 - C. Implementing combined heat and power (CHP)
 - D. Reducing reliance on international grid systems
10. Which of the following best describes a system level solution?
- A. Reducing pollutants and waste at the end of the production processes
 - B. Removing harmful gases from the exhaust stream before they are released into the atmosphere
 - C. Using waste as a resource in a closed loop system
 - D. Considers the impact of production at every stage and seeks to minimize the negative consequences

11. **Figure 2** shows a freehand drawing and an orthographic projection of a chair.

Figure 2: Different representations of a chair

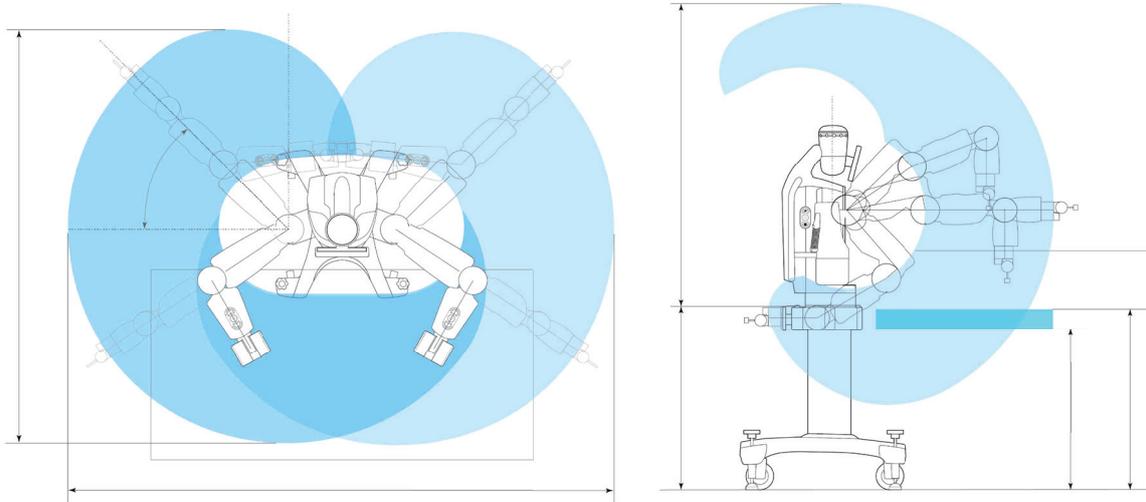


What is an advantage of using a freehand drawing rather than an orthographic drawing?

- A. More accurate
 - B. Allows quick exploration of ideas
 - C. Can be given to a manufacturer to make it
 - D. All parts drawn in proportion
12. In computer-aided design (CAD), when a model is created that has no interior material and is just a visual representation of the final product, this is considered as a...
- A. Bottom up model
 - B. Surface model
 - C. Solid model
 - D. Top down model
13. What best describes a physical model that can be used to test ergonomic features but does not function?
- A. Scale model
 - B. Prototype
 - C. Mock-up
 - D. Instrumented model

14. Figure 3 shows an industrial robotic arm.

Figure 3: An industrial robotic arm



The blue shaded area shows how far the robotic arm can reach. What is this area called?

- A. Task area
 - B. Work envelope
 - C. Load capacity
 - D. Load area
15. Which of the following would affect the choice of a production system?
- I. Labour
 - II. Skills and training
 - III. Impact on the environment
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

16. Which of the following is a permanent joining method?
- A. Nuts and bolts
 - B. Screws
 - C. Fusing
 - D. Velcro
17. Composite fibres can be soaked with a liquid polymer resin and then pulled through a heated die to form parts such as tubes. What is this process called?
- A. Pultrusion
 - B. Laminating
 - C. Moulding
 - D. Extrusion
18. Which fibre has the following properties?
- Absorbent
 - Slow to dry
 - Cool to wear on the skin
 - Can be machine washed and ironed
 - Creases easily
- A. Wool
 - B. Cotton
 - C. Silk
 - D. Polyester
19. Plastic products often have a symbol moulded onto them. What is the reason for this?
- A. To make them easier to manufacture
 - B. So consumers can make choices on what to buy
 - C. To show that they are non toxic
 - D. To make them easier to identify, separate and recycle

20. Coffee tables with glass tops are often made from an impact resistant type of glass that is made by cooling the outside of the glass rapidly. What is this type of glass called?
- A. Soda glass
 - B. Laminated glass
 - C. Toughened glass
 - D. Pyrex
21. Nike is a global running shoe brand well recognized by the Nike Swoosh (tick) design.

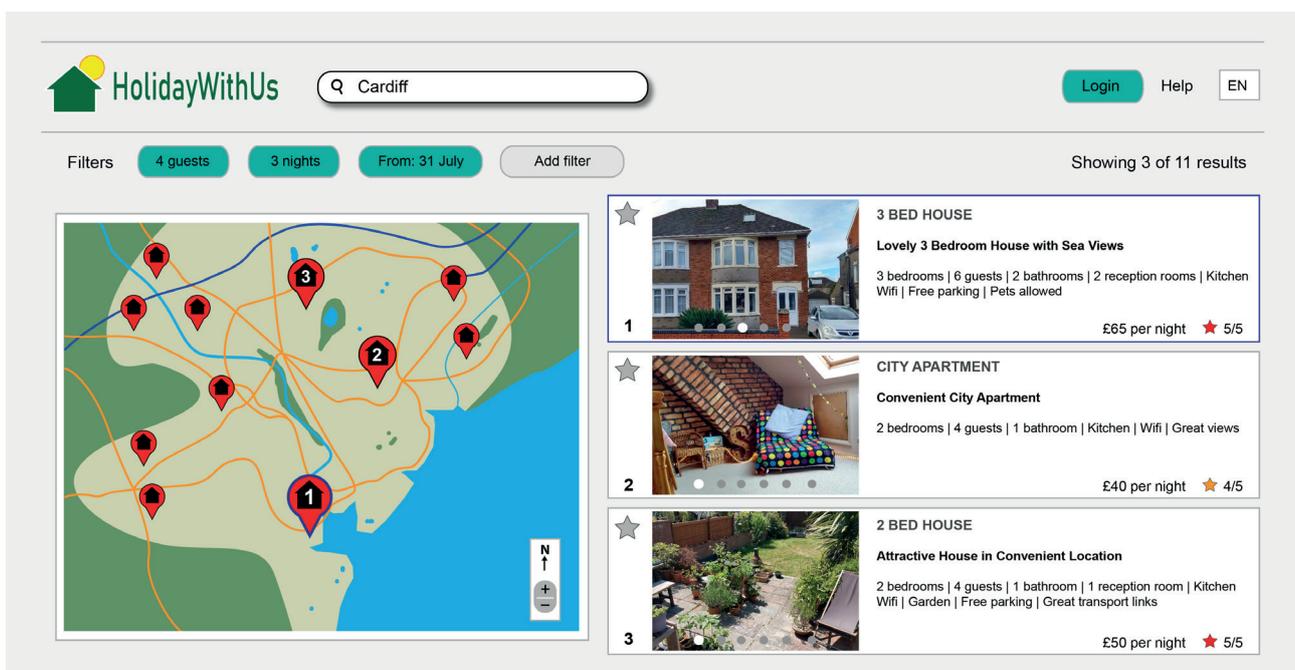
Figure 4 removed for copyright reasons

Which of the following intellectual property (IP) strategies would be used to prevent any other company from copying the Nike Swoosh design?

- A. Copyright ©
- B. Patent
- C. Trademark ®
- D. Service mark (SM)

22. Which of the following are true about a first to market strategy?
- I. It may involve significant risks
 - II. It guarantees success in new markets
 - III. It can involve costly research & development
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III
23. HolidayWithUs enables people to rent out their properties using the company website, see **Figure 5**. Instead of staying in hotels or guesthouses, people can now stay in private homes. This has completely changed how people travel.

Figure 5: A screenshot of the HolidayWithUs website



What is this type of innovation known as?

- A. Sustaining innovation
- B. Disruptive innovation
- C. Modular innovation
- D. Architectural innovation

24. Which of the following statements are true of classic designs?
- I. The function of the product is better than its competitors
 - II. The form of the product provokes emotional reactions
 - III. Obsolescence does not impact the product's popularity
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
25. The ballpoint pen, see **Figure 6**, was invented by László Bíró in 1938. The first ballpoint pen to go on sale in the UK in 1946 cost 55 shillings (UK£2.75), which was more than half the average weekly wage at the time. In 1953, Marcel Bich developed a process for the manufacture and assembly of ballpoint pens that dramatically increased the volume of production and reduced the cost of each pen.

Figure 6: The Bic ballpoint pen



Which of the following principles was most likely the reason for the Bic ballpoint pen becoming a classic design?

- A. Defying obsolescence
- B. Mass production techniques
- C. Status and culture
- D. Transcending its original function

26. Figure 7 shows four different products.

Figure 7: Four different products



Identify the product where the psychological function rather than practical function was the determining factor in the design.

- A. Lockheed lounge chair
- B. Oxo Grip vegetable peeler
- C. Sports glasses for children
- D. Exoskeleton

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

Figure 8 and **Figure 9** show the Werner ProForm™ F3 Construction Harness. In the event of a fall, a construction worker can pull a cord to release a built-in seat to reduce the likelihood of injury.

The product was developed by Priority Designs after workers were careless when putting on traditional harnesses. After a fall, workers would often be suspended for hours, awaiting rescue in an extremely uncomfortable and potentially dangerous situation with their harness often being the cause of extreme pain.

This harness is manufactured using lightweight materials to deliver maximum comfort and safety performance. The parts of the harness that connect with the body promote airflow and maximize comfort.

Figure 8: Quick Connect buckle system



Figure 9: Adjustable straps are used to maximize comfort



27. Which of the following is the most likely driver for invention for the Werner ProForm™ F3 Construction Harness?
- A. Desire to make money
 - B. Constructive discontent
 - C. Scientific curiosity
 - D. Technological breakthrough
28. Which of the following material properties would be most important for the part of this harness that connects the worker to the built-in seat?
- A. Ductility
 - B. Compressive strength
 - C. Stiffness
 - D. Tensile strength
29. The comfort of the workers using this harness is what type of human factor?
- A. Psychological
 - B. Physiological
 - C. Anthropometrics
 - D. Adjustability
30. The buckle closing system of this harness was virtually prototyped to identify areas of high stress on the material. What computer aided design (CAD) method would be used for this?
- A. Instrumented models
 - B. Surface modelling
 - C. Finite element analysis (FEA)
 - D. Virtual reality
-

References:

- Figure 1** © International Baccalaureate Organization 2020.
- Figure 2** [**freehand drawing of a chair**] © International Baccalaureate Organization 2020.
[**orthographic drawing of a chair**] © International Baccalaureate Organization 2020.
- Figure 3** Image with permission from Hunan Cothinkrobotics Technology Co. Ltd.
- Figure 5** © International Baccalaureate Organization 2020.
- Figure 6** Image of the Cristal[®] pen was provided with permission from BIC USA INC.
- Figure 7** [**Lockheed lounge chair**] Courtesy of Phillips, photograph by Clint Bowers, and Marc Newson Limited for providing the image.
[**OXO Grip vegetable peeler**] OXO Y Peeler.
[**exoskeleton**] https://commons.wikimedia.org/wiki/File:Honda_Walking_Assist_Device_with_Bodyweight_Support_System_front_2013_Tokyo_Motor_Show.jpg. Image by Morio under copyright CC 3.0 licence (<https://creativecommons.org/licenses/by-sa/3.0/deed.en>).
- Figure 8** [**Werner ProForm F3 Construction Harness Quick Connect buckle system**] Courtesy of Werner.
- Figure 9** [**Werner ProForm F3 Construction Harness**] Courtesy of Werner.