

Design technology
Higher level
Paper 1

Thursday 12 May 2016 (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]**.

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1. A designer is developing the design for a new wheelchair. As part of her research she takes measurements of people attending a health clinic.

What type of data is the designer generating?

- A. Primary data
 - B. Secondary data
 - C. Psychological data
 - D. Marketing data
-
2. A designer was commissioned to develop a unisex bicycle (**Figure 1**). The designer created three different frame sizes and set limits for the minimum and maximum heights of the seat and handlebars.

Figure 1: A unisex bicycle



[Source: www.giant-bicycles.com]

Which strategy was the designer using?

- A. A range of sizes
- B. Adjustability
- C. A combination of a range of sizes and adjustability
- D. Mass customization

3. What is a physiological factor that should be considered when designing a car seat for a child?
- A. Alertness
 - B. Dematerialization
 - C. Convergence
 - D. Comfort
4. **Figure 2** shows a symbol widely used on plastic products made of polyethylene terephthalate (PETE).

Figure 2: A symbol used on plastic products made of polyethylene terephthalate (PETE)



[Source: www.dixiebits.com]

- Which waste mitigation strategy does the symbol shown in **Figure 2** promote?
- A. Repair
 - B. Reuse
 - C. Recycling
 - D. Reconditioning
5. What best describes the embodied energy within a product?
- A. The energy consumed throughout the entire product life
 - B. The energy within a product's batteries
 - C. The energy required to recycle a product
 - D. The reduction in the amount of wasted energy achieved through clean production

6. Although new environmental legislation can be highly disruptive, it can sometimes lead to benefits for manufacturers.

What are the potential benefits of environmental legislation for a manufacturer?

- I. Reduced energy costs
- II. Reduced material costs
- III. Reduced waste

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

7. What are disadvantages of using solar power?

- I. Lack of continuity of supply
- II. Low efficiency of energy conversion
- III. Carbon dioxide emissions

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

8. **Figure 3** shows a typical example of an office chair.

To design the chair the manufacturer decided to undertake life cycle analysis (LCA).

Figure 3: A typical office chair



[Source: https://en.wikipedia.org/wiki/Office_chair#/media/File:Desk_chair.jpg]

Which phases in the product lifecycle would the designer consider in undertaking LCA in relation to the design of the chair shown in **Figure 3**?

- A. Marketing material, promotion, sales
 - B. Pre-production, production, distribution and packaging, utilization, disposal
 - C. Concept design, detail development, prototyping, manufacture
 - D. Density, conductivity, expansion, hardness
9. What is both a driver and a barrier to clean technology adoption by manufacturers?
- A. Market expectations
 - B. Legislation
 - C. Cost
 - D. Research and development

10. What is a disadvantage of using an environmental impact matrix?
- A. It is time-consuming to implement
 - B. It is not a good way to display the results of an environmental impact analysis
 - C. It enables impacts to be categorized
 - D. It enables impacts to be prioritized
11. **Figure 4** shows a metal part created using a rapid prototyping technology.

Figure 4: A metal part created using a rapid prototyping technology



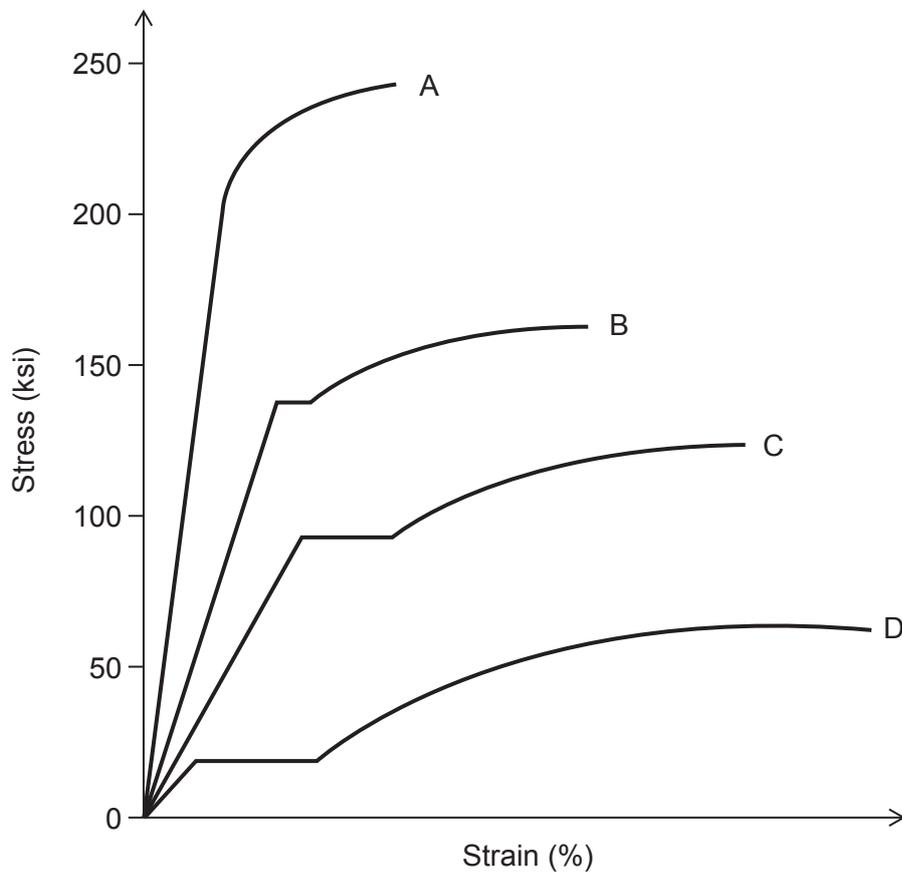
[Source: www.solidconcepts.com]

- Which rapid prototyping technology could be used to produce the part shown in **Figure 4**?
- A. Fused deposition modelling (FDM)
 - B. Stereolithography
 - C. Laminated object manufacture (LOM)
 - D. Selective laser sintering (SLS)

- 12. Validating a design in a usability laboratory is an example of a:
 - A. Restricted context
 - B. General context
 - C. Partial context
 - D. Total context

- 13. **Figure 5** shows a comparative stress-strain diagram for four materials: A, B, C and D.

Figure 5: A comparative stress-strain diagram for four materials: A, B, C and D



[Source: © International Baccalaureate Organization 2016]

Which of the materials shown in **Figure 5** is the most ductile?

14. What is **not** a method for modifying the physical properties of a metal?
- A. Tempering
 - B. Fabrication
 - C. Alloying
 - D. Work hardening

15. What is generally true of hardwoods compared to softwoods?

	Density	Resistance to damp environments
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High

16. A designer specifies that a component should be made from a solid block of metal using computer numerical control (CNC).

What term best describes this process?

- A. Additive manufacturing
 - B. Subtractive manufacturing
 - C. Casting
 - D. Thermoforming
17. Batch production involves:
- A. A large number of products
 - B. A small number of products
 - C. A set number of products
 - D. An indeterminate number of products

18. Which combination of absorbency and elasticity characterizes cotton fibres?

	Absorbency	Elasticity
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High

19. Coca-Cola® PET bottles are made in two phases: phase 1 produces PET bottle preforms (**Figure 6**); phase 2 moulds the preforms into the final bottle shape.

Figure 6: A PET soft drinks bottle preform



[Source: https://upload.wikimedia.org/wikipedia/commons/d/d4/Plastic_bottle.jpg]

Which combination of moulding techniques would be used in each phase of producing a PET soft drinks bottle?

	Phase 1	Phase 2
A.	Blow moulding	Blow moulding
B.	Injection moulding	Blow moulding
C.	Blow moulding	Injection moulding
D.	Injection moulding	Injection moulding

20. **Figure 7** shows the Alessi Juicy Salif lemon squeezer designed in 1988 by Philippe Starck. It is made of PTFE-treated pressure-cast aluminium and polyamide. The Juicy Salif has become recognized as a design classic. The aim of the design was to present the Juicy Salif as high-quality silverware. Starck is rumoured to have claimed that the Juicy Salif “is not meant to squeeze lemons, it is meant to start conversations.”

Figure 7: The Alessi Juicy Salif lemon squeezer designed by Philippe Starck



[Source: www.starck.com. Used with permission.]

What describes Philippe Starck’s approach to the design of the product shown in **Figure 7**?

- A. Retro-styling
- B. Practical function
- C. Compromise
- D. Psychological function

21. The Coca-Cola® bottle (**Figure 8**), designed by the Root Glass Company of Terre Haute, Indiana in 1915, is based on the shape of a cocoa bean. It has become widely recognized as a design classic.

Figure 8: A Coca-Cola® bottle

Image removed for copyright reasons

Which description best explains the Coca-Cola® bottle's recognition as a design classic?

- A. The design united technological advance with beautiful design.
- B. The design served as a standard of its time.
- C. The design has resisted changes in taste and fashion.
- D. The design was innovative in its use of materials.

22. **Figure 9** shows a designer working with a member of the target user group for a product.

Figure 9: A designer working with a member of the target user group for a product



[Source: Scott Bureau/RIT University News]

Why do designers test prototypes with potential users?

- A. To test if the product is safe
- B. To test the manufacturability of the product
- C. To understand typical user errors to inform design development
- D. To assess the final aesthetics

23. What characterizes participatory design?

- I. Designers work with users in sessions where users offer new solutions
 - II. Designers draw on their own experience to inform development
 - III. Designers use survey data to inform their concepts
- A. I only
 - B. I and II only
 - C. II and III only
 - D. I, II and III

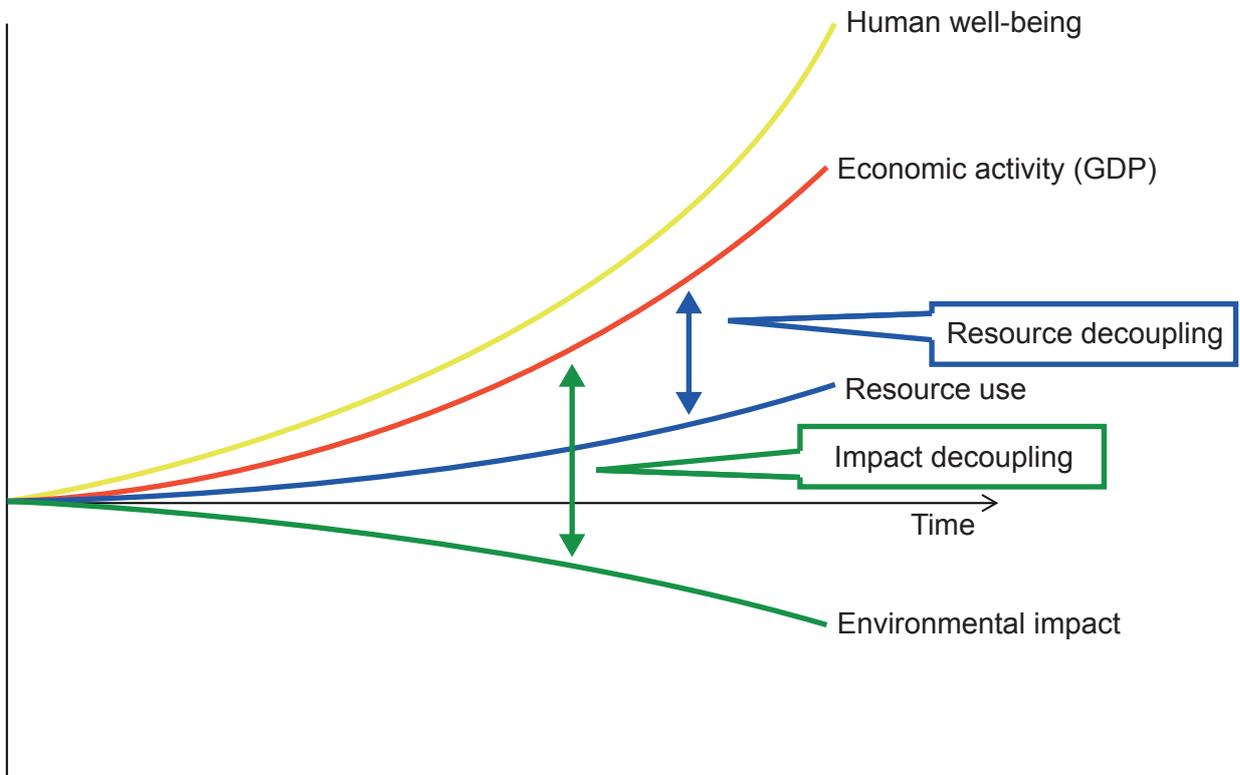
24. The managers of a city centre community theatre were concerned that older people were not visiting evening events because they were afraid to travel at night. A design consultancy was commissioned to see how designing new transport systems might help to overcome this problem. The designers talked to many older people about their experiences and how they liked to spend their free time. They used this information to create fictional profiles to represent the potential target market for testing their design ideas.

What strategies were the designers employing?

- A. Expert appraisal
- B. Personae and scenarios
- C. Usability testing
- D. Affinity diagramming

25. Figure 10 shows a graphical representation of decoupling.

Figure 10: Decoupling



[Source: UNEP International Resource Panel Report (2011)]

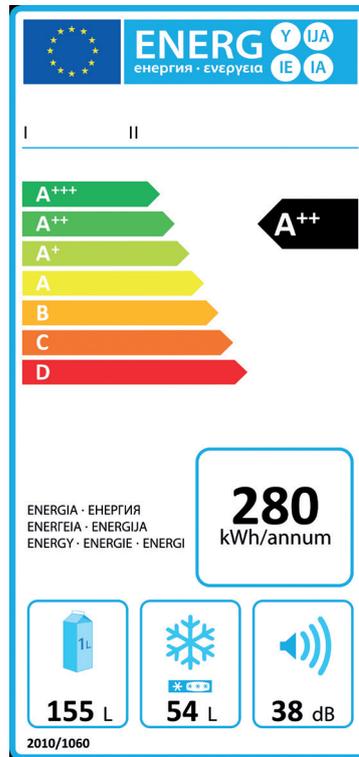
How would decoupling contribute to a strategy for sustainability?

- I. Increased efficiency in the use of resources
 - II. Reduced environmental impact from resource depletion
 - III. Increased human well-being
- A. I and II
 - B. I and III
 - C. II and III
 - D. I, II and III

26. Which government intervention could be used to encourage sustainable innovation in the longer term?
- A. Regulation
 - B. Education
 - C. Taxes
 - D. Subsidies
27. Which triple bottom line considerations relate to sustainable design rather than to green design?
- I. Social
 - II. Economic
 - III. Environmental
- A. I and II
 - B. I and III
 - C. II and III
 - D. I, II and III

28. **Figure 11** shows a European Union energy label for a refrigerator.

Figure 11: A European Union energy label for a refrigerator



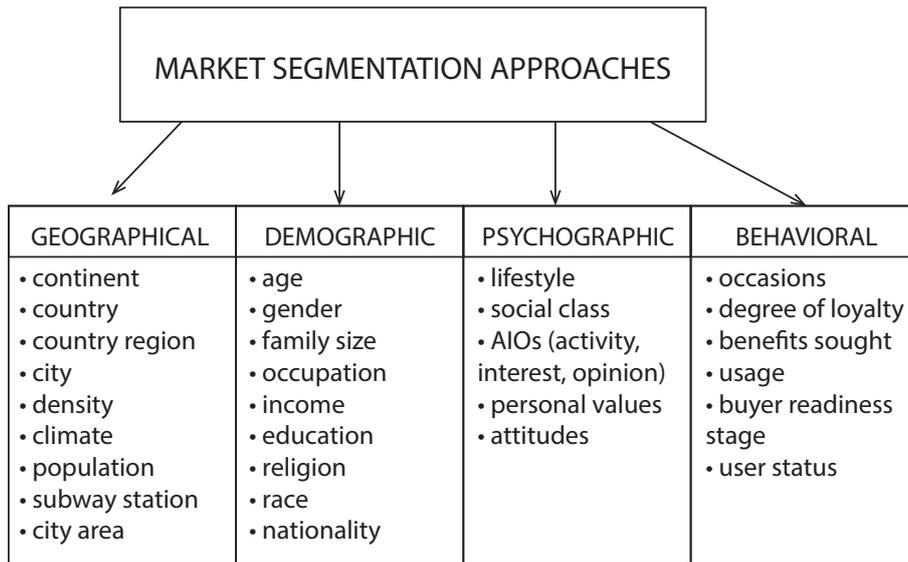
[Source: "The new EU energy label explained". www.direct.gov.uk/energylabel. This information has been produced by the Department for Environment, Food and Rural Affairs (Defra). Crown Copyright.]

What is a major advantage of using pictograms rather than words for the energy label shown in **Figure 11** for use in the European Union?

- A. It enables consumers to compare the energy efficiency in use of similar products.
- B. The same label can be used in different countries in the European Union.
- C. It is a widely recognized and respected guide for manufacturers and consumers.
- D. It indicates the quality of the product.

29. **Figure 12** shows four different approaches to market segmentation.

Figure 12: Four approaches to market segmentation



[Source: © International Baccalaureate Organization 2016]

Which category shown in **Figure 12** would be the most appropriate way to segment the market for a family car?

- A. Geographical
- B. Demographic
- C. Psychographic
- D. Behavioral

30. Which combination of product and market characterizes the corporate strategy of market penetration?

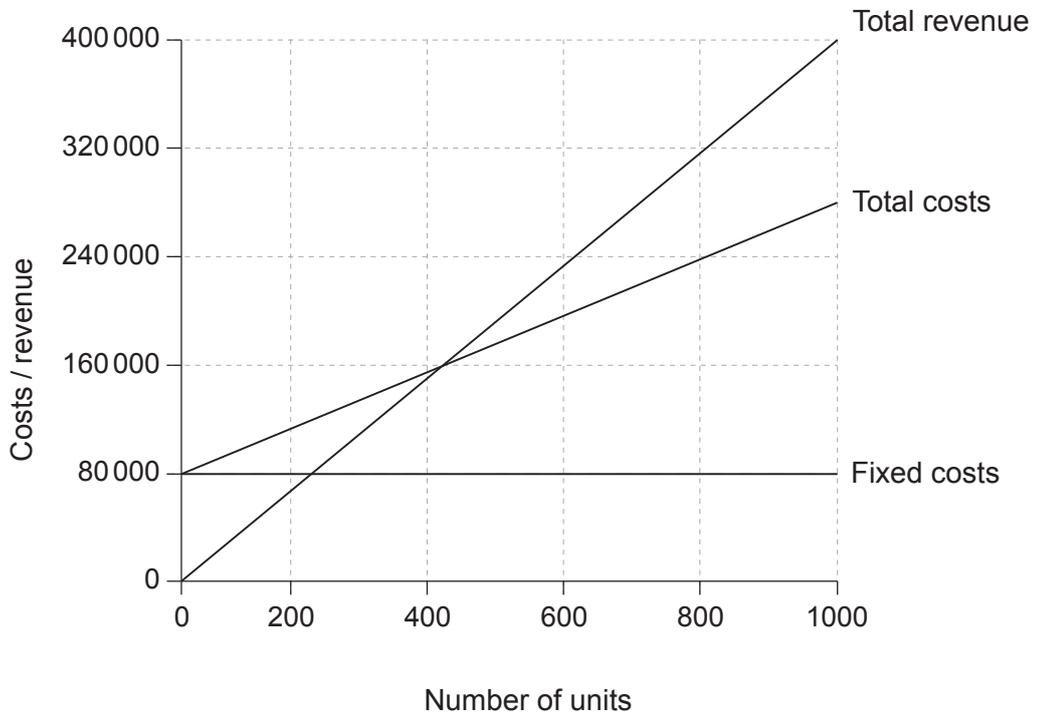
	Product	Market
A.	Existing	Existing
B.	Existing	New
C.	New	Existing
D.	New	New

31. Which price setting strategy would ensure that a manufacturer covers his/her costs of production?
- A. Product line pricing
 - B. Psychological pricing
 - C. Cost-plus pricing
 - D. Demand pricing
32. What can be determined through secondary market research?

	The price that was paid by consumers for similar products	The price that consumers would pay for a particular new product in the same product category
A.	No	No
B.	Yes	No
C.	No	Yes
D.	Yes	Yes

33. **Figure 13** shows a graph of costs/revenue against sales. The manufacturer has decided to set a break-even point at 400 units for a new product to be sold at a unit price of \$400.

Figure 13: Costs/revenue against sales



What would be the manufacturer's profit when 1000 units are sold?

- A. 40 000
 - B. 80 000
 - C. 120 000
 - D. 160 000
34. Which waste would be eliminated by moving from just in case (JIC) to just in time (JIT) production?
- A. Waiting
 - B. Defects
 - C. Overproduction
 - D. Transporting

35. What is a disadvantage of statistical process control over other methods of quality control, for example continuous monitoring?
- I. Early detection of problems
 - II. Cost
 - III. Time
- A. I and II
 - B. I and III
 - C. II and III
 - D. I, II and III

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

A design consultancy was commissioned by a major retail outlet to design an own brand baby's highchair. In order to understand what the customer wants in terms of product functions, the design team undertook research involving ten parents interacting with a range of existing highchairs in a laboratory setting (**Figure 14**). The designers created and watched videos of how the parents tested each of the chairs. The designers also asked the parents what were their favourite features and which was their favourite chair. They then revealed the prices and asked which chair the users would consider purchasing.

This allowed the designers to develop a design specification for the new highchair. This specification was then used to guide design and development which included further testing with the target market.

Figure 14: A range of existing highchairs



[Source: © International Baccalaureate Organization 2016]

36. What is the advantage of observing users interacting with existing products?
- A. It provides an understanding of what users consider when choosing a product
 - B. It provides an understanding of the best production strategy
 - C. It enables a designer to test the mechanical properties of the product
 - D. It enables an assessment of the economic viability of the product
37. Why would the design team have chosen to video record the parents testing the highchairs?
- A. For internal quality management
 - B. To show final designs to clients
 - C. To demonstrate their design capability
 - D. To evaluate how potential users interact with products

- 38.** Given the designers' aims, what other design research methods would have been suitable for collecting the requisite data?
- I. Observing users in store
 - II. A survey of existing product users
 - III. Participatory design with potential users
- A. I and II
 - B. I and III
 - C. II and III
 - D. I, II and III
- 39.** The designers created physical models to test their assumptions with users in the laboratory. Which type of model would be used for this purpose?
- A. Conceptual modelling
 - B. Mock-ups
 - C. Data modelling
 - D. Virtual reality
- 40.** The designers asked about the users' favourite chairs and after revealing the prices asked which they would consider buying. What aspect of the design were the designers exploring?
- A. Quality control
 - B. Market sectors
 - C. Cost effectiveness
 - D. Perceptions of value for money
-