

**DESIGN TECHNOLOGY  
HIGHER LEVEL  
PAPER 1**

Thursday 10 May 2007 (afternoon)

1 hour

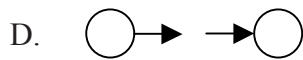
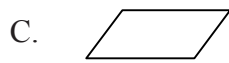
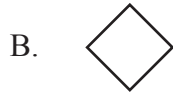
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**INSTRUCTIONS TO CANDIDATES**

- 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.

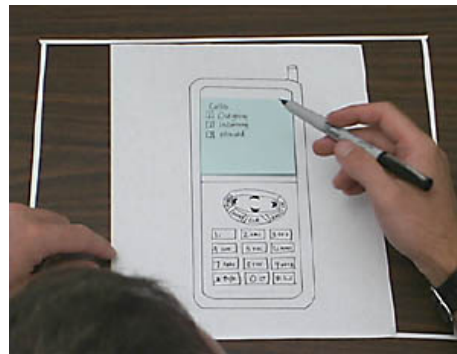
1. What is included in the product design specification (PDS) but not in the design brief?
  - A. Evaluation criteria for a good design proposal.
  - B. The major constraints which the design must achieve.
  - C. Identification of the target market.
  - D. Precise limits for all performance requirements.
  
2. Which is **most** likely to result in changes to the design of an existing product?
  - A. Adaptation
  - B. Brainstorming
  - C. Analogy
  - D. Constructive discontent
  
3. In which technique for solving problems are solutions to a problem in one field used to provide a new idea for a solution in another?
  - A. Adaptation
  - B. Animation
  - C. Analogy
  - D. Brainstorming

4. Which flow chart symbol is used to represent a decision?



5. Paper prototyping is widely used to collect data for developing computer interfaces, e.g. for mobile phone displays (see Figure 1). This approach has a number of advantages as it is an extremely fast and cheap way of collecting data. It can be used very early in the development of a design.

**Figure 1: Paper prototyping in the development of a mobile phone display**

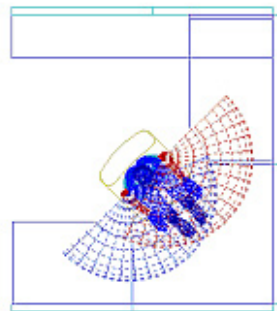


For which combination of user research and user trial is paper prototyping appropriate for data collection?

	User research	User trial
A.	Yes	No
B.	Yes	Yes
C.	No	No
D.	No	Yes

6. What distinguishes planned obsolescence from fashion?
- A. The need to meet health and safety standards.
  - B. The predictability of timescales for the product cycle.
  - C. The increased consumption of raw materials unless use of recycled materials is prioritised.
  - D. The environmental impact of the manufacturing processes unless clean technologies are adopted.
7. A “reach envelope” is the volume in 3-D space that a person can reach. Reach envelopes are used by designers, *e.g.* for the design of a cockpit-style workspace (see Figure 2a and 2b below). Data for which percentile range would ensure that the maximum numbers of users would be able to reach items within the workspace?

**Figure 2a: Reach envelope**



**Figure 2b: Cockpit style workspace**



- A. 99th
- B. 95th
- C. 50th
- D. 5th

8. Which property is **most** important in the selection of a material for the cable of a lift (elevator) which is designed to take people quickly up a high-rise building?
- A. Tensile strength
  - B. Stiffness
  - C. Toughness
  - D. Hardness
9. Which material group is subdivided into “natural” and “synthetic”?
- A. Timber
  - B. Plastics
  - C. Textile fibres
  - D. Metals
10. Of the following manufacturing processes used at different stages in the production of a cotton shirt, which is an example of a shaping process?
- A. Stitching
  - B. Using fasteners
  - C. Weaving
  - D. Cutting
11. What is a **disadvantage** of sintering?
- A. No surface machining is required.
  - B. High energy requirements.
  - C. Can be used with high melting-point materials.
  - D. Does not require the production of a mould.

12. What is a **disadvantage** of lamination?

- A. No finishing is required.
- B. Complex shapes can be produced.
- C. May need the production of a mould.
- D. Different materials can be combined.

13. What is **not** necessarily true of automating a mechanised production process?

- A. Product quality increases.
- B. Training requirements are different.
- C. Capital costs increase.
- D. Variable costs increase.

14. Which combination of “**affected by the volume of production**” and “**time at which costs are incurred**” characterises fixed costs?

	<b>Affected by the volume of production</b>	<b>Time at which costs are incurred</b>
A.	Yes	Before production commences
B.	No	Before production commences
C.	Yes	During production
D.	No	During production

15. Which combination of “changes to the product” and “diffusion into the marketplace” characterises the mature stage of the product life cycle?

	<b>Changes to the product</b>	<b>Diffusion into the marketplace</b>
A.	Many	High
B.	Many	Low
C.	Few	High
D.	Few	Low

Questions 16 to 20 relate to the following case study. Please read the case study and then answer the questions.

### CASE STUDY

Polyethylene terephthalate (PET), commonly known as polyester, is a clear plastic used for beverage containers. It is cheap, lightweight, shatter-resistant and recyclable. Recycled PET can be used for producing carpet yarns and polyester fibrefill for sleeping bags and winter coats. However, in 1999 in the United States of America (USA), data showed that only 41 % of beverage containers were recycled, and about 114.4 billion beverage containers (7.7 million tons of PET) were disposed of – many into landfill sites (see **Figure 3**).

Refundable bottle deposits have been found to be an extremely effective method for ensuring bottles are returned for recycling. In 2002 in the USA, legislation (called the National Beverage Producer Responsibility Act) was introduced to force the industry to design the most efficient deposit-return systems.

**Figure 3: Beverage containers in a landfill site**



16. Which design objective for green products is **not** achieved by the National Beverage Producer Responsibility Act?
- A. Increased efficiency in the use of materials, energy and other resources.
  - B. Taking full account of the end disposal of the product.
  - C. Analysing and minimizing potential safety hazards.
  - D. Reducing to a minimum any long-term harm caused by the use of the product.
17. Which characteristic of PET is **least** likely to ensure that it is recycled?
- A. It is cheap
  - B. It can easily be converted into a form for use in other products
  - C. It is shatter-resistant
  - D. It is a lightweight material



18. At which life cycle stage of a beverage container would the symbol shown in Figure 4 on the container help to reduce environmental impact?

Figure 4: Symbol marked on PET products



- A. Pre-production
- B. Distribution
- C. Utilization
- D. Disposal
19. Why can PET recycling be regarded as a clean technology?
- I. It reduces the exploitation of natural resources
- II. It does not produce toxic emissions
- III. It minimizes waste
- A. I, II and III
- B. I and II
- C. II and III
- D. I and III
20. Which category of consumers is **least** likely to behave responsibly in relation to the disposal of their beverage containers without the use of refundable deposits?
- A. Ecowarriors
- B. Ecochampions
- C. Ecofans
- D. Ecophobes

21. Why is wood treated?

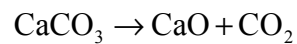
- I. To reduce attack by micro-organisms.
- II. To enhance its aesthetic properties.
- III. To reduce its moisture content.

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

22. Which is the primary component of glass?

- A.  $\text{Na}_2\text{O}$
- B.  $\text{CaO}$
- C.  $\text{Na}_2\text{CO}_3$
- D.  $\text{SiO}_2$

23. Which chemical change that takes place in a blast furnace does the following equation relate to?



- A. The reduction of iron oxide to iron metal.
- B. The removal of the impurity silicon dioxide to form slag.
- C. The reduction of the carbon content of iron by forming carbon dioxide.
- D. The formation of calcium oxide from limestone.

24. What is true of nylon?
- A. It comprises hydrocarbon chains.
  - B. It has a zig-zag molecular structure.
  - C. It is relatively inelastic.
  - D. It increases in strength when wet due to the increased alignment of polymers.
25. Why does the resistivity of a superconductor become nearly zero at low temperatures?
- A. The atoms are in a tetrahedral arrangement.
  - B. Ions can be separated easily.
  - C. Outer electrons overlap.
  - D. Weakly bonded electrons move freely at these temperatures.
26. What is a benefit of using mycoprotein to produce novel food products?
- A. Low protein content
  - B. High salt content
  - C. Low cholesterol content
  - D. Low fibre content
27. What is formed by the combination of elements in fixed proportions?
- A. Crystal
  - B. Compound
  - C. Atom
  - D. Molecule

28. In which bond do the outer electrons of atoms come close enough to overlap and be shared between nuclei?
- A. Ionic
  - B. Metallic
  - C. Covalent
  - D. Hydrogen
29. The property of a material to return to its original length after a tensile force is removed is known as
- A. elasticity.
  - B. plasticity.
  - C. fatigue.
  - D. failure.
30. What is a property of Kevlar?
- A. High absorbency
  - B. Lightweight
  - C. Low tensile strength
  - D. High elasticity
31. Which formula is used to calculate a compressive strain?
- A. Force/area
  - B. Change of length/original length
  - C. Stress/strain
  - D. Design load/normal maximum load

32. What describes the relationship between the applied load on a structure and the extent of deflection?
- A. Stiffness
  - B. Young's modulus
  - C. Stress
  - D. Strain
33. What is true of the factor of safety?
- A. The factor of safety will always be less than 1.
  - B. The factor of safety will always be greater than 1.
  - C. A lower factor of safety results in a safer design.
  - D. Regular inspection and maintenance is a feature of high factor of safety designs.
34. Which type of bonding contributes to the rigid three-dimensional structure of thermosets?
- A. Weak secondary bonding between chains
  - B. Weak secondary bonding within chains
  - C. Primary covalent bonding within chains
  - D. Primary covalent bonding between chains
35. Which combination of “**demand**” and “**availability in the market place**” favours the exploitation of a reserve?

	<b>Demand</b>	<b>Availability in the market place</b>
A.	High	Low
B.	Low	Low
C.	High	High
D.	Low	High

36. Figure 5a shows the principle of how solar radiation can be focused for cooking using a parabolic mirror. Figure 5b shows a parabolic solar cooker produced in China being demonstrated to local people in a village in Nepal. This model costs 100\$. Figure 5c shows a parabolic solar cooker made of a wooden base covered with a bamboo net on which is a multi-layered clay-cow dung surface covered with thin cotton cloth, paper and finally aluminium foil. It has been produced in Nepal by the local people at a cost of 3\$.

**Figure 5a: Focusing solar radiation with a parabolic mirror**



**Figure 5b: Demonstrating a parabolic solar cooker produced in China to people in Nepal**



**Figure 5c: A parabolic solar cooker produced in Nepal from local materials**



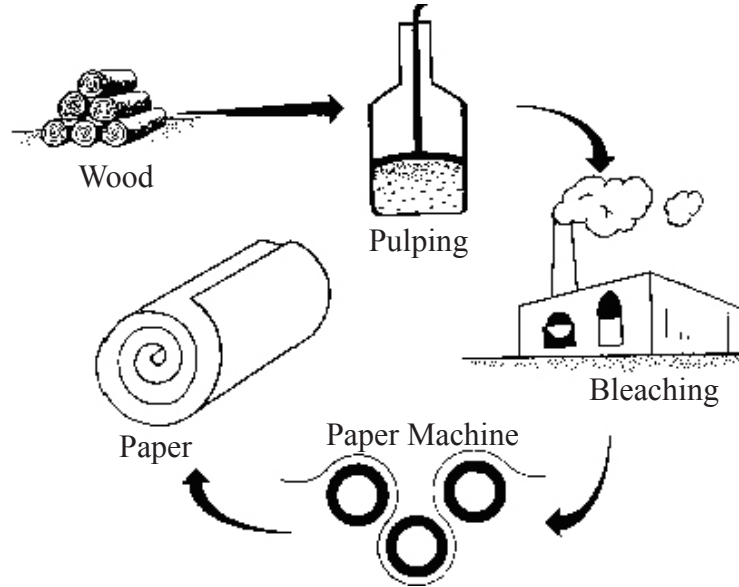
Which characteristic of appropriate technology is achieved when either of the solar cookers is used in Nepal?

- A. Uses local materials
  - B. Low in capital costs
  - C. Is not detrimental to the environment
  - D. Creates jobs employing local skills and labour
37. What is a disadvantage of using solar energy as a renewable energy source for cooking in northern Europe?
- A. Capital costs
  - B. Running costs
  - C. Continuity of supply
  - D. Maintenance costs

38. Which strategy would be likely to produce short-term profitability as well as long-term sustainability for a manufacturer that operates one large manufacturing plant?
- A. Introduce clean technology
  - B. Introduce technologies that match the capabilities of the local population
  - C. Open a distributed network of smaller manufacturing plants close to market
  - D. Reduce the use of resources
39. Which is **not** true of a product consistent with sustainable development?
- A. Its use value should be more important than its exchange value.
  - B. It should demand exceptional user skill.
  - C. It should be designed for high durability and repairability.
  - D. It should be consistent with the cultural values of its users.

40. To manufacture paper wood has to be pulped, bleached and rolled in a paper machine (see Figure 6). Recycled paper can be fed into the system at the pulping stage.

**Figure 6: Stages in paper manufacturing**



[Source: Johnston, P. et al., (1996), Towards Zero-Effluent Pulp and Paper Production, Greenpeace International (Accessed at <http://archive.greenpeace.org/toxics/reports/tcf/tcf.html>)]

What is true of increasing the amount of recycled paper added to the paper manufacturing stream?

- A. Profits would be decreased.
- B. The consumption of natural resources would be increased.
- C. Waste would be minimized.
- D. Less bleaching would be required.