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DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 1

Monday 7 November 2011 (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.

1. **Figure 1** shows designers working on a 1:4 scale clay model of a car.

Figure 1: Designers working on a clay model of a car

[Source: http://www.cardesignonline.com/design/modelling/clay-modelling.php]

What can be evaluated using a 1:4 scale clay model as part of the design development process?

A. Performance

B. Ergonomics

C. Safety

D. Aesthetics

2. Divergent thinking in the design process is

I. solution focused.
II. conceptual.
III. used to generate ideas.

A. I and II

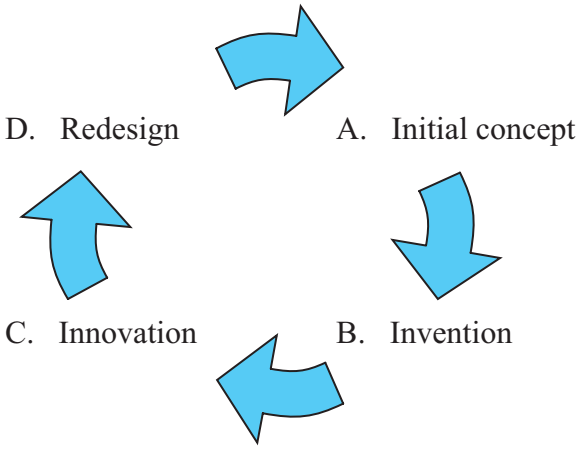
B. I and III

C. II and III

D. I, II and III

3. **Figure 2** shows four stages of innovation. At which stage of innovation would constructive discontent be an appropriate ideas generating strategy?

Figure 2: Stages of innovation



4. Which combination of product and market relates to the corporate strategy of market development?

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

5. Which descriptors apply to both the mature and the late stage of the product cycle?

I. Gained acceptance

II. Diffused into the marketplace

III. Selling well

A. I and II

B. I and III

C. II and III

D. I, II and III

6. The Global Eco-labelling Network (GEN) represents eco-labelling programmes from different countries. Which aspects of GEN's work are most useful in the short-term to companies who export products?

I. GEN promotes the standardization of eco-labelling programmes.

II. GEN provides information about eco-labelling standards from different countries.

III. GEN participates in international conferences promoting eco-labelling.

A. I and II

B. I and III

C. II and III

D. I, II and III

7. **Figure 3** shows a Kodak FunSaver disposable camera. Which aspect of the design of the FunSaver camera would promote reuse?

Figure 3: Kodak FunSaver single use camera

[Source: http://store.kodak.com/store/ekconsus/en_US/pd/FUN_SAVER_Camera/productID.164407600]
Used with permission.

A. Increasing the product life cycle of the FunSaver camera

B. Increasing the number of parts made from recycled material

C. The casing of the FunSaver camera can be opened using a special tool so that the removed parts are not damaged

D. Reducing the material content used in the manufacturing process

8. **Figure 4** shows the Grigoros Kayak shoe designed by Nike for the Beijing Olympics.

Content removed for copyright reasons

Which features of the design contribute most to ease of recycling?

I. No adhesives are used in the construction of the shoe

II. Minimal tooling required for production

III. Made of one material (rubber)

A. I and II

B. I and III

C. II and III

D. I, II and III

9. Which material group can be divided into “ferrous” and “non-ferrous”?

A. Metal

B. Ceramic

C. Timber

D. Textile

10. Which material would be most useful for spectacle (eye-glass) frames?

A. Magneto-rheostatic

B. Electro-rheostatic

C. Piezoelectric

D. Shape memory alloy

11. Which combination of bond strength relates to a thermoplastic material?

	Bonds within the linear chains	Bonds between the linear chains
A.	Weak	Weak
B.	Weak	Strong
C.	Strong	Weak
D.	Strong	Strong

12. Why is softwood timber usually cheaper than hardwood timber?

A. It only grows in temperate regions

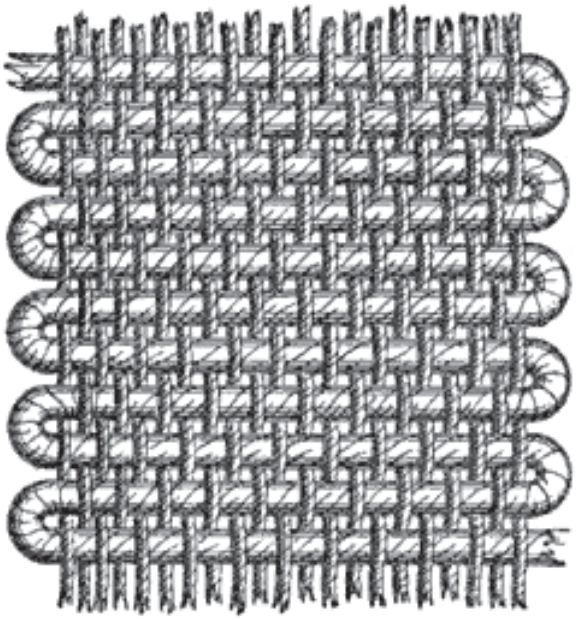
B. It grows quicker

C. It is more difficult to work with

D. There is less demand for it

13. Which manufacturing technique is shown in **Figure 5**?

Figure 5: Textile fabric



[Source: http://en.wikipedia.org/wiki/File:Kette_und_Schu%C3%9F.jpg
Created by Wikipedia user Ryj.]

A. Stitching

B. Weaving

C. Machining

D. Using fasteners

14. An "end-of-pipe" strategy for clean manufacturing is an example of

	Incremental	Radical
A.	No	No
B.	No	Yes
C.	Yes	No
D.	Yes	Yes

15. Which combination relates to mass customization?

	Price	Response to individual customer need
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High

16. What is true of batch production but not of mass production?

A. Economies of scale

B. Limited volume

C. Standardized products

D. Automation

17. Which form of obsolescence relates to the unpredictable timescales for the product lifecycle of fashion accessories?

A. Technological obsolescence

B. Material obsolescence

C. Planned obsolescence

D. Style obsolescence

18. Which product would be designed to ensure that it can be used by the 5th percentile of an adult population?

A. The width of a cinema seat

B. Position of a light switch on a wall

C. The height of a door

D. The length of a bed

19. **Figure 6** shows children's building bricks made of thermoplastic. The building bricks are low cost/high volume products. It is very important that each building brick is made to a precise specification so that they can fit together in a variety of ways. Which combination of evaluation strategies will result in a product which meets its specification?

Figure 6: Lego® bricks

[Source: http://en.wikipedia.org/wiki/File:Lego_Color_Bricks.jpg
Created by: Alan Chia]

	Quality control	Quality assurance
A.	No	No
B.	No	Yes
C.	Yes	No
D.	Yes	Yes

20. **Figure 7** shows a cycle helmet. Which strategy would be used to evaluate the cycle helmet for safety?

Figure 7: Cycle helmet

[From: http://en.wikipedia.org/wiki/File:Bicyclehelmet_da_060713.jpg
Created by: Jorgen Larsen]

A. User research

B. User trial

C. Performance test

D. Expert appraisal

21. What type of energy is used for a water-powered mechanical production system?

A. Kinetic energy

B. Potential energy

C. Chemical energy

D. Electrical energy

22. **Figure 8** and **Figure 9** show a solar cooker designed for use by people doing outdoor leisure activities.

Figure 8: Solar cooker

Figure 9: Solar cooker in use

[Source: http://en.wikipedia.org/wiki/File:Wanzijia.jpg
Created by Wikipedia user: Hawyih]

What is a disadvantage of the solar cooking system?

A. Portability

B. Reduced risk of forest fires

C. Free energy

D. Cannot be used at night

23. What defines Young's modulus?

A. Stress/strain

B. Load/deflection

C. Change of length/original length

D. Force/area

24. Designing for which range of "factor of safety" will require the use of strict quality control procedures in production and regular maintenance during use?

A. 1.25 – 1.5

B. 1.5 – 2

C. 2.0 – 2.5

D. 2.5 – 3.0

25. **Figure 10** shows some paper clips. A paper clip has to hold several sheets of paper tightly rather than remain open. Which characteristic is important in determining whether a paper clip performs its function appropriately?

Figure 10: Paper clips

[From: http://en.wikipedia.org/wiki/File:Wanzijia.jpg
Created by Wikipedia user: Hawyih]

A. Elastic region

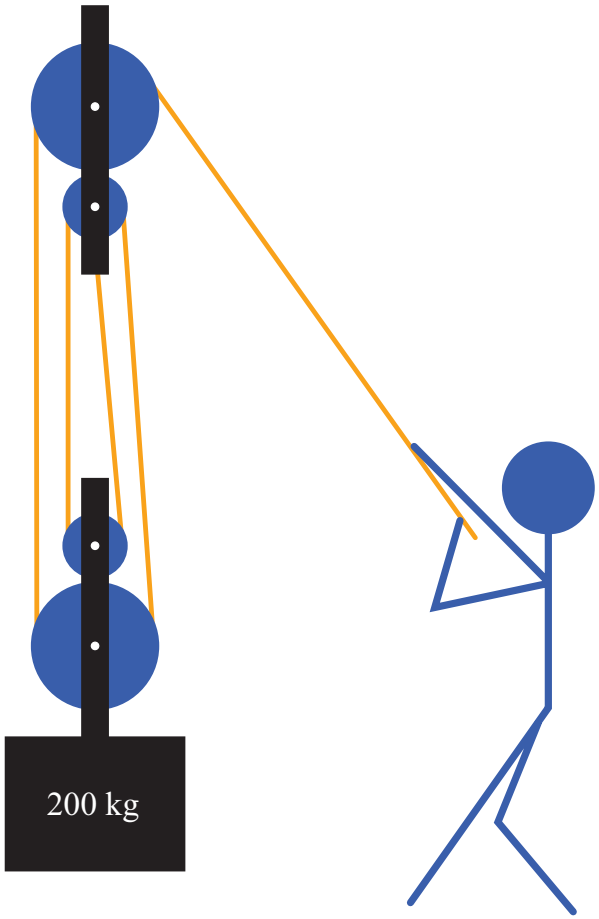
B. Plastic flow region

C. Yield stress

D. Ultimate tensile strength

26. What is the mechanical advantage for the pulley system in **Figure 11**?

Figure 11: A pulley system



[Source: http://www.dynamicscience.com.au/tester/solutions/hydraulicus/pulleys2.htm]
Used with permission.

A. 2

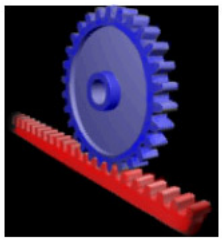
B. 3

C. 4

D. 5

27. **Figure 12** shows a rack and pinion mechanism (the rack is shown in red and the pinion in blue) which can be used in the steering system of a car. When the steering wheel is turned the pinion spins and moves the rack to which the wheels of the car are attached.

Figure 12: Rack and pinion mechanism



Adapted by the IB from a Wikipedia image.

What would be the effect of increasing the diameter of the pinion?

	Effort required to turn the steering wheel	Number of turns of the steering wheel to turn the wheels of the car
A.	Less	Fewer
B.	Less	More
C.	More	Fewer
D.	More	More

28. Which feature of a ratchet would be taken advantage of in the children's toy shown in **Figure 13**?

Figure 13: A children's toy featuring a ratchet mechanism

[Source: www.automata.co.uk. Used with permission.]

A. The teeth rotate in one direction only

B. It provides a jerky movement

C. The teeth rotate in two directions

D. It is used at high speeds

29. What is an advantage of manufacturing furniture using the technique of lamination?

A. Low cost

B. Suitable for mass production

C. No finishing required

D. High strength to weight ratio

30. What is an advantage of injection moulding?

A. Low capital costs

B. Low energy costs

C. Suitable for small scale production

D. Clean technology

31. What is defined as *"a short length of extruded pipe for use in blow moulding"*?

A. Sprue

B. Flash

C. Die

D. Parison

32. Why is Plaster of Paris used in lost wax casting?

A. To cover the wax

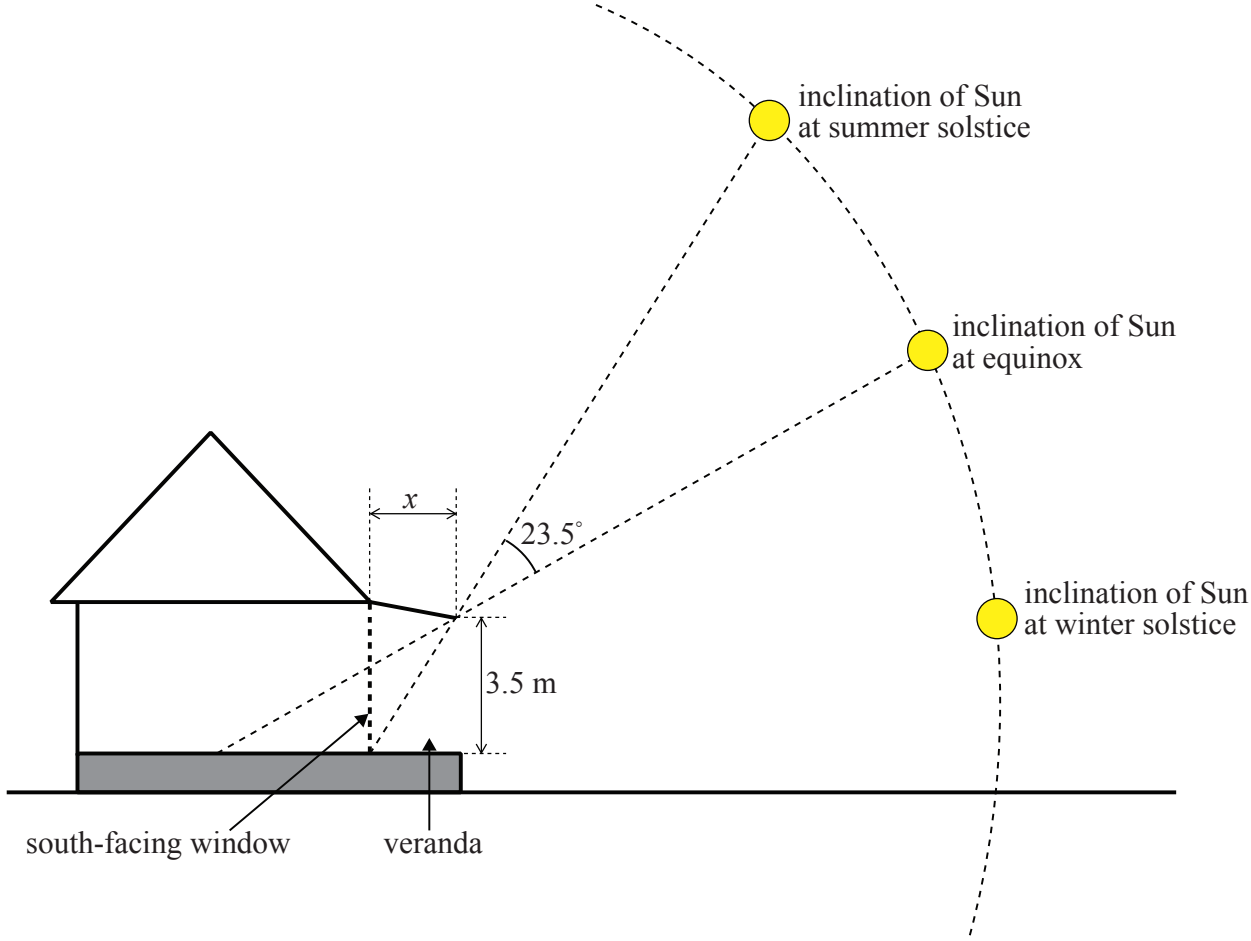
B. To create the initial mould

C. To reduce costs

D. To make the wax more porous

33. **Figure 14** shows a house located at 45° N. The house has a south-facing floor to ceiling window and a roof-covered veranda.

Figure 14: A house located at 45° N where the inclination of the sun at the equinox is 45°



What is the length of dimension x to ensure that the south-facing window of the house is shaded completely at the summer solstice?

A. $x = (3.5/\tan 23.5)$ metres

B. $x = (3.5/\tan 45)$ metres

C. $x = (3.5/\tan 47)$ metres

D. $x = (3.5/\tan 68.5)$ metres

34. What is an advantage of using deciduous trees rather than evergreen trees as part of the passive solar design of a sustainable building?

A. They provide shade in summer only

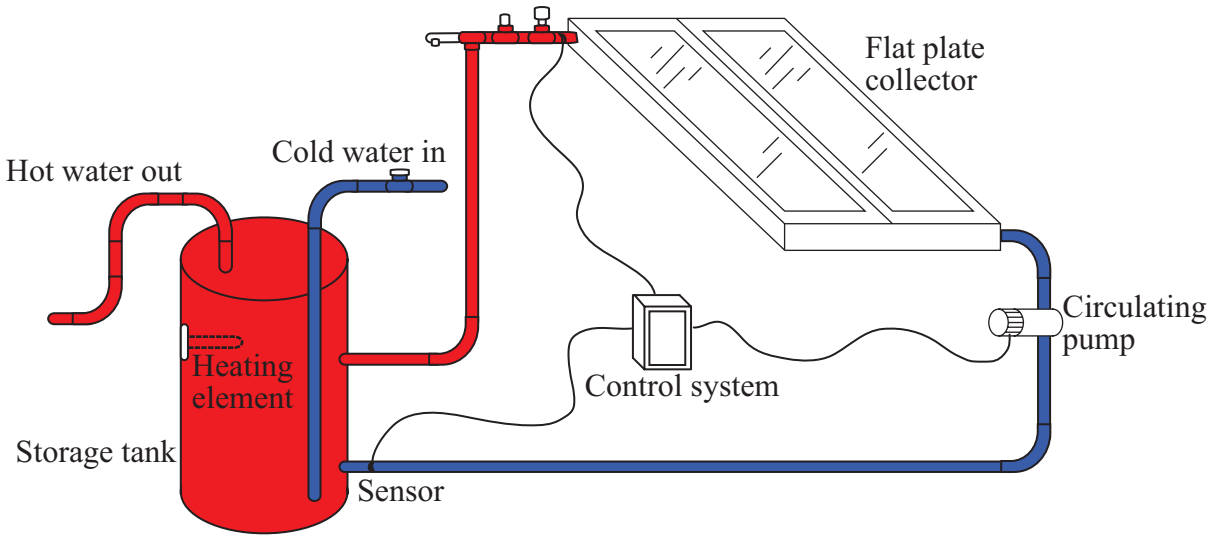
B. They provide shade all the year round

C. They act as a windbreak

D. They reduce the surface temperature of a building

35. **Figure 15** shows an active solar hot water system. Key elements in the system are a flat plate collector, a circulating pump, a storage tank, a control system and a back-up heating element.

Figure 15: Active solar hot water system



Which component of the active solar hot water system would benefit from being black?

A. Storage tank

B. Circulating pump

C. Control system

D. Flat plate collector

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

Solar panels are increasingly used to harness the energy of the sun and make buildings more sustainable. The solar panel shown in **Figure 16** is made up of 36 solar cells. The solar cells (see **Figure 17**) are permanently joined together by heat fusing. They are then covered with a sheet of laminated anti-reflective glass which is sealed to a support frame.

Figure 16: Solar panel

[Source: http://en.wikipedia.org/wiki/File:Solar_panels_in_Ogiinuur.jpg Created by: Chinneeb]

Figure 17: Solar Cell

[Source: http://en.wikipedia.org/wiki/File:Solar_cell.png Created by a US Department of Energy employee]

36. What are the advantages of using laminated glass for the solar panel?

I. High stiffness

II. High hardness

III. Resistance to damp environments

A. I and II

B. I and III

C. II and III

D. I, II and III

37. What is the benefit of integrating solar panel technology with other renewable technologies within one system?

A. Reduced maintenance

B. Continuity of supply

C. Increased set-up costs

D. Reduced running costs

38. Why is the laminated glass anti-reflective?

A. Reduces the cost of the solar panel

B. Optimises the efficiency of the solar panel

C. Increases the product life of the solar panel

D. Protects the solar panel from sun damage

39. What is a disadvantage of the permanent joining of the solar cells?

A. Planned obsolescence

B. Reduced maintenance

C. Increased durability

D. Extended product life cycle

40. Which strategy would limit the sustainability of solar panels to supply the total energy requirements of an office building?

A. The solar panel tracks the path of the sun

B. Increasing the size of the solar panel

C. Regular cleaning

D. Increasing the number of employees