M13/4/DESTE/HPM/ENG/TZ0/XX

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DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 1

Thursday 16 May 2013 (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.
- The maximum mark for this examination paper is *[40 marks]*.

1. What is **not** identified in the design brief?

A. The target market

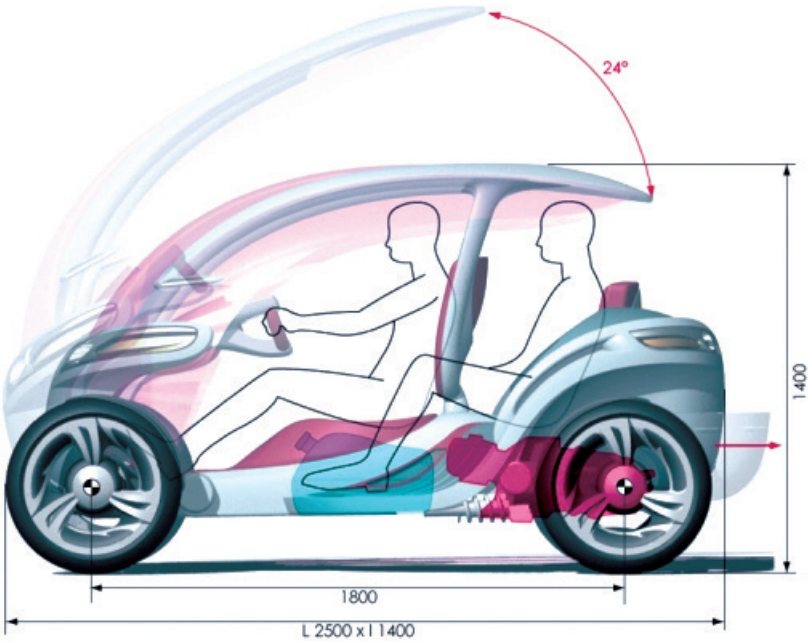
B. The design goal

C. The major constraints on the design

D. The detailed requirements for the design

2. **Figure 1** shows a concept vehicle – the Scooto – a cross between a scooter and a car designed to carry three people. It was designed by the French design and engineering studio ETUD Intégral. A prototype of the concept car was exhibited at the Paris Motor Show.

Figure 1: Concept car designed by ETUD



[Source: Designed by ETUD integral"]

What is **not** likely to be true of a prototype of the concept vehicle?

A. It communicates the concept to potential customers better than a drawing

B. It will work like the final product

C. It may never go into commercial production

D. It models radical features of the design

3. **Figure 2** shows a pair of safety scissors produced by Elephant Products company. They were produced to overcome injuries sustained by children in using scissors for art and craft activities.

Figure 2: Safety scissors produced by Elephant Products

[Source: http://www.elephantproducts.com/pakidermscissors.html?pab=1_6]

Which ideas-generating technique would have been used to identify the problems associated with earlier designs for children's scissors?

A. Brainstorming

B. Adaptation

C. Constructive discontent

D. Analogy

4. What is true of convergent thinking?

I. It is analytical

II. It is conceptual

III. It is solution-focused

A. I and II

B. I and III

C. II and III

D. I, II and III

5. Which cycles focus on producing a suitable solution to a problem?

	Design cycle	Product cycle
A.	No	No
B.	No	Yes
C.	Yes	No
D.	Yes	Yes

6. What is more likely to be true of a lone inventor than a product champion?

A. S/he is an entrepreneur

B. S/he has influence in a company

C. S/he is objective over the merits of an invention

D. S/he has in-depth understanding of the scientific aspects of a design

7. What is **not** the result of recycling?

A. A supply of virgin raw material

B. Salvaging high-value materials

C. Reducing the hazards associated with disposal

D. Reducing landfill

8. What benefits are achieved by addressing issues identified in the life cycle analysis of a product?

I. Saving natural resources
II. Reducing energy consumption
III. Minimizing waste

A. I and II

B. I and III

C. II and III

D. I, II and III

9. Which design strategy is most likely to promote recycling?

A. Using permanently joined sub-assemblies

B. Minimizing the number of components

C. Using standard components

D. Labelling components with the material from which they are made

10. Which strategy is **not** facilitated by manufacturing washing machines from standard components?

A. Repair

B. Reconditioning

C. Reuse

D. Recycling

11. What is the ability of a material to withstand pulling forces?

A. Ductility

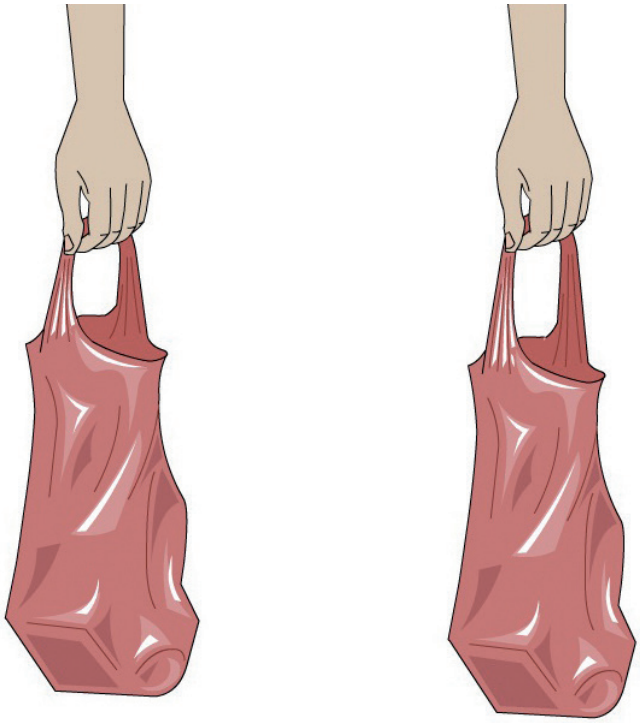
B. Hardness

C. Tensile strength

D. Toughness

12. **Figure 3** shows what happens when a plastic bag is overloaded.

Figure 3: The effect of a heavy load on a plastic bag



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

What explains the effect of a heavy load on a plastic bag as shown in Figure 3?

A. Plastic deformation

B. Stiffness

C. Ductility

D. Tensile strength

13. Why are thermosets unsuitable for use as adhesives in products designed for disassembly by application of heat?

A. Thermosets have extensive bonding between the linear chains

B. The effect of temperature on a thermoset is irreversible

C. Thermosets have a rigid 3D structure

D. Thermosets are made of linear chain molecules

14. Which characteristic would make a material suitable for use in the development of a robotic limb?

A. Change in viscosity when exposed to electric field

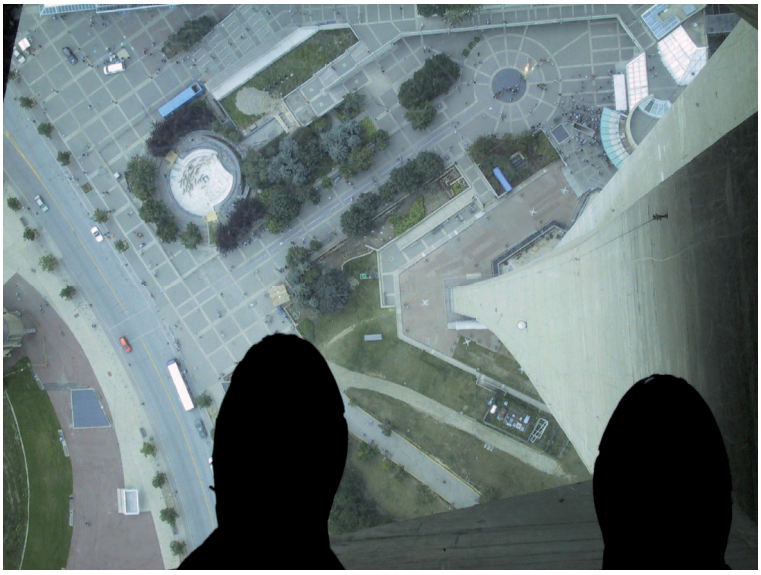
B. Change in viscosity when exposed to magnetic field

C. Change in shape when exposed to electric field

D. Change in shape when exposed to magnetic field

15. **Figure 4** shows the view through the glass floor in the viewing platform of the CN Tower in Toronto (**Figure 5**).

Figure 4: The glass floor in the CN Tower



[Source: http://upload.wikimedia.org/wikipedia/commons/e/e9/Glass_Floor_of_the_CN_Tower.JPG]

Figure 5: The CN Tower

[Source: http://en.wikipedia.org/wiki/File:Toronto_-_ON_-_Toronto_Harbourfront7.jpg]

Which combination of properties makes glass a suitable material for the floor of the viewing platform in the CN Tower?

I. It is strong in compression

II. It is strong in tension

III. It is transparent

A. I and II

B. I and III

C. II and III

D. I, II and III

16. Which manufacturing technique would have been used to produce the basket shown in **Figure 6**?

Figure 6: A basket

[Source: http://commons.wikimedia.org/wiki/File:Cistell_002.jpg]

A. Moulding

B. Casting

C. Weaving

D. Stitching

17. What is **not** true of the breakeven point for a product?

A. Fixed costs are covered

B. Variable costs decrease with increased production

C. Total costs equal sales revenue

D. It impacts on the unit cost of a product

18. Which costs will be higher for automated production than for craft production?

A. Capital costs

B. Labour costs

C. Raw material costs

D. Marketing costs

19. In which design context would the 5th–95th percentile be used?

A. The length of a bed

B. The range of adjustment for the driver's seat in a car

C. The reach envelope for a workstation

D. The height of a wash hand basin

20. What is a major advantage of user research?

A. It is cost-effective

B. It provides mainly quantitative data

C. It is time-consuming

D. It does not require a prototype

21. Which process is focussed on identifying defects in a product after it is developed but before it is released?

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

22. Which type of power does **not** result in the production of carbon dioxide?

A. Muscle power

B. Water mill

C. Steam engine

D. Diesel engine

23. Which atmospheric pollutant causes acid rain?

A. Nitrogen oxide

B. Carbon monoxide

C. Sulphur dioxide

D. Lead

24. What characterizes the use of panels of photovoltaic cells?

A. Low set up costs

B. High running costs

C. Good continuity of supply

D. Low maintenance costs

25. What is **not** true of using an untreated laminated veneer lumber (LVL) beam instead of a solid timber beam for structural applications?

A. It can be used for exterior applications

B. It has better load-bearing characteristics for the same cross-sectional area

C. It has uniform characteristics along its length

D. Large pieces can be produced easily

26. A designer must select a factor of safety so that a product is strong enough but not too strong. Some factors of safety used in different design contexts are shown in **Table 1**.

Table 1: Factors of safety used for different design contexts

Design context	Factor of safety
Lift	11.0
Commercial aircraft	1.5
Human space vehicle	1.4
Cargo-carrying space vehicle	1.25

What enables a designer to select a low factor of safety?

A. More developmental testing

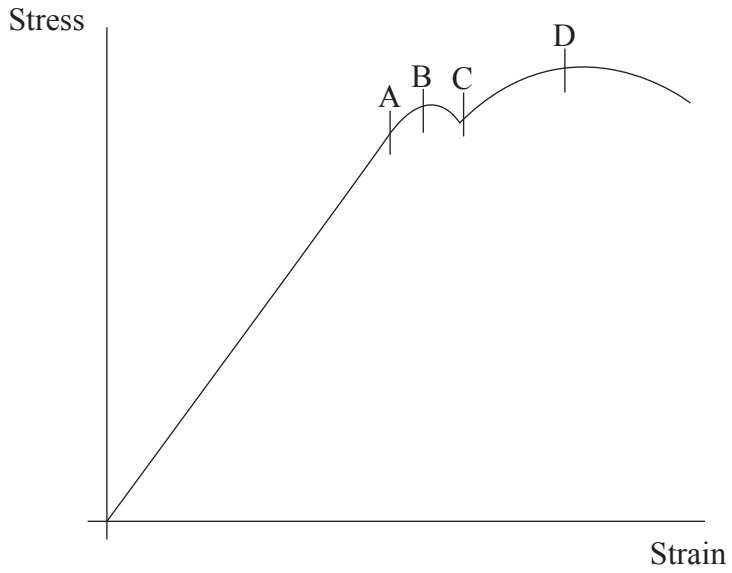
B. Sufficient data to undertake precise calculations

C. Only a small number of parts are being manufactured

D. Close control of the way the product is used

27. **Figure 7** shows a stress-strain graph for a material.

Figure 7: A stress-strain graph for a material



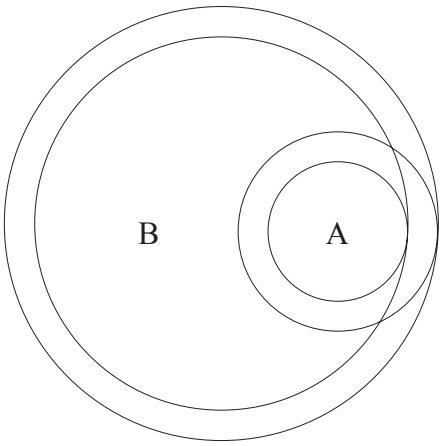
Which point indicates the yield point?

28. A salad spinner (**Figure 8**) can be used to dry salad leaves after washing. It comprises a bowl, a basket with lots of holes and a lid with a handle. The handle is linked to a small gear (A) with 12 teeth which meshes with a large gear (B) with 48 teeth (**Figure 9**). The large gear is part of the lid and fits into the basket so that when the handle is turned the basket spins inside the bowl and water is separated from the salad leaves and collects in the bowl.

Figure 8: A salad spinner

[Source: http://en.wikipedia.org/wiki/File:Slacentrifuge.jpg]

Figure 9: Interlocking gear arrangement in lid of salad spinner



[Source: ©International Baccalaureate Organization 2013]

How many times will the inner bowl turn for every turn of the handle?

A. 0.25

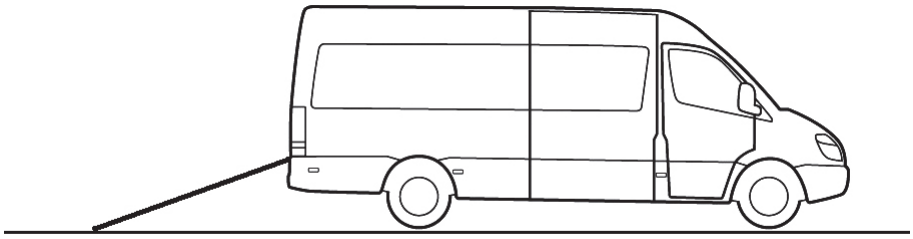
B. 1

C. 4

D. 192

29. **Figure 10** shows a ramp used to load a small van. The height of the ramp is one metre, the length of the ramp is three metres.

Figure 10: A ramp for loading a furniture removal van



What is determined by dividing the length of the ramp by the height of the ramp?

A. Effort

B. Velocity ratio

C. Efficiency

D. Moment arm

30. What is **not** an advantage of the friction welding process for metals?

A. Little preparation of the material being welded is required

B. The size of parts which can be joined

C. Different materials can be joined

D. It results in a strong joint

31. Which manufacturing process would be used to produce hollow parts with a high strength-to-weight ratio?

A. Spray-up

B. Vacuum bagging

C. Filament winding

D. Lamination

32. What is an aspect of environmental sustainability?

A. Carrying capacity

B. Productivity

C. Cultural identity

D. Empowerment

33. Which attributes characterize living buildings?

I. They can produce renewable energy on-site to meet all energy needs

II. They use rainwater collected on site for all plumbing features

III. They do not output waste water into the sewerage system

A. I and II

B. I and III

C. II and III

D. I, II and III

34. Which factor relating to heat loss or gain from a building is determined by climatic considerations?

A. Temperature difference

B. Area

C. Thickness

D. Thermal conductivity

35. What differentiates an active solar energy system from a passive solar energy system?

A. It absorbs heat from the sun

B. It is an energy-saving system

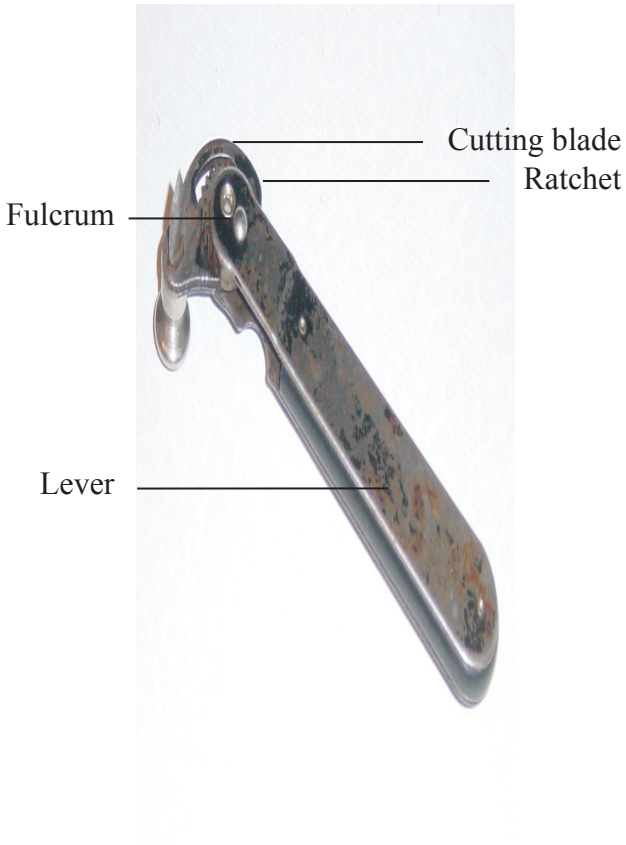
C. It pumps a heat-absorbing fluid through a collector

D. It uses a solar collector to store energy

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

The Sieger can opener (**Figure 11**) was invented and patented in 1913. It made can opening easy for the first time and is recognised as a design classic. The Sieger Eminent can opener was first produced in 1949 to expand the product range and is still in commercial production. It consists of a metal (steel) cutting blade attached to a ratchet and a handle which acts as a lever. Its design has changed little since it was first invented. The Sieger company now produces a range of can openers for commercial and household use so it is an example of a robust design which evolved into a product family.

Figure 11: The Sieger Eminent can opener



[Source: http://commons.wikimedia.org/wiki/File:Dosenoeffner-Sieger.jpg]

36. Which property of metals makes metal suitable for the cutting blade of the Sieger Eminent can opener?

A. Hardness

B. Stiffness

C. Tensile strength

D. Toughness

37. What feature of a ratchet is important in the design of the Sieger Eminent can opener?

A. It increases the speed

B. It decreases the force

C. It exerts a force when turned in one direction only

D. It alters the axis of rotation

38. What defines a robust design?

A. A flexible design that can be adapted to changing market requirements

B. A design which takes account of its environmental impact

C. A design developed by thinking about a problem in a different way

D. A design in which trivial changes over time cumulate into significant change

39. What is true of the handle of the Sieger Eminent can opener?

I. It increases the mechanical advantage of the can opener

II. It is a second-class lever

III. It increases the force on the cutting blade

A. I and II

B. I and III

C. II and III

D. I, II and III

40. What advantage does developing a product family of can openers give the Sieger company?

I. Faster time to market

II. Cost-effectiveness

III. Increased productivity

A. I and II

B. I and III

C. II and III

D. I, II and III