M12/4/DESTE/SPM/ENG/TZ0/XX

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DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 1

Tuesday 8 May 2012 (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 model would be most appropriate to evaluate the forces acting on a bridge structure?

A. Scale model

B. Prototype

C. Mathematical model

D. Clay model

2. Ron Hickman – a do-it-yourself enthusiast – damaged a chair he was using to support a piece of wood he was sawing. This gave him an idea for a work bench which became the Workmate (**Figure 1**).

Figure 1: Black and Decker Workmate

[Black & Decker Workmate 425 ®. Used with permission.]

What ideas generating technique is this an example of?

A. Analogy

B. Adaptation

C. Constructive discontent

D. Brainstorming

3. Which combination of "incremental design" and "radical design" characterizes many design problems?

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

4. What is characteristic of convergent thinking?

I. Conceptual

II. Analytical

III. Solution focused

A. I and II

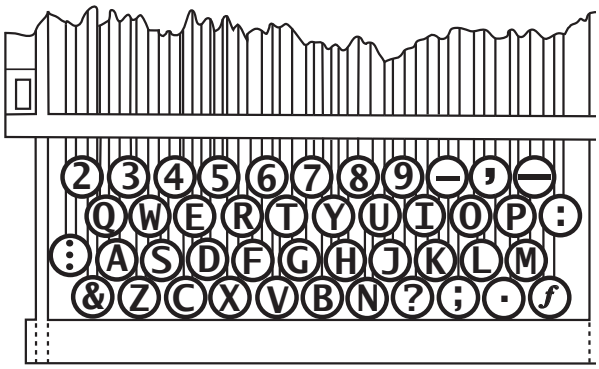
B. I and III

C. II and III

D. I, II and III

5. The QWERTY typewriter keyboard (**Figure 2**) was designed by Christopher Latham Sholes around 1870 to speed up typing and is now the most widely-used keyboard layout on most English-language computers (**Figure 3**).

Figure 2: Sholes' 1878 QWERTY keyboard design



[Adapted from: http://en.wikipedia.org wikiFile:QWERTY_1878.png Author: C.L. Sholes U.S. Patent No. 207,559 27 August 1878]

Figure 3: QWERTY design on computer keyboard

[From: http://en.wikipedia.org/wiki/File:QWERTY_keyboard.jpg; created by MichaelMaggs.]

Why did the QWERTY keyboard become the dominant design for English-language computer keyboards?

I. It reduced the cost of retraining.

II. The mechanical keys do not jam.

III. It helped the transition from typewriter to computer.

A. I and II

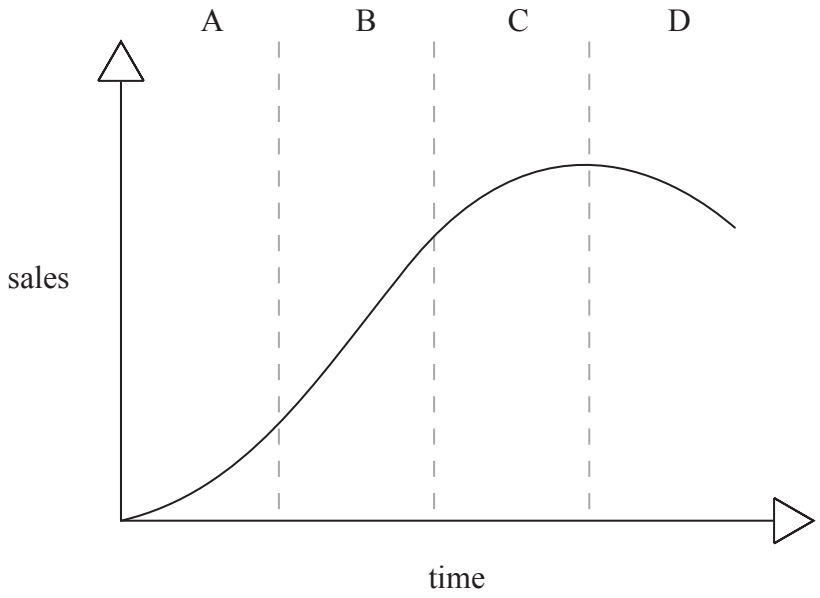
B. I and III

C. II and III

D. I, II and III

6. At which stage of the product cycle (**Figure 4**) do most changes to a product usually take place?

Figure 4: Sales of a product over time at different stages of the product cycle



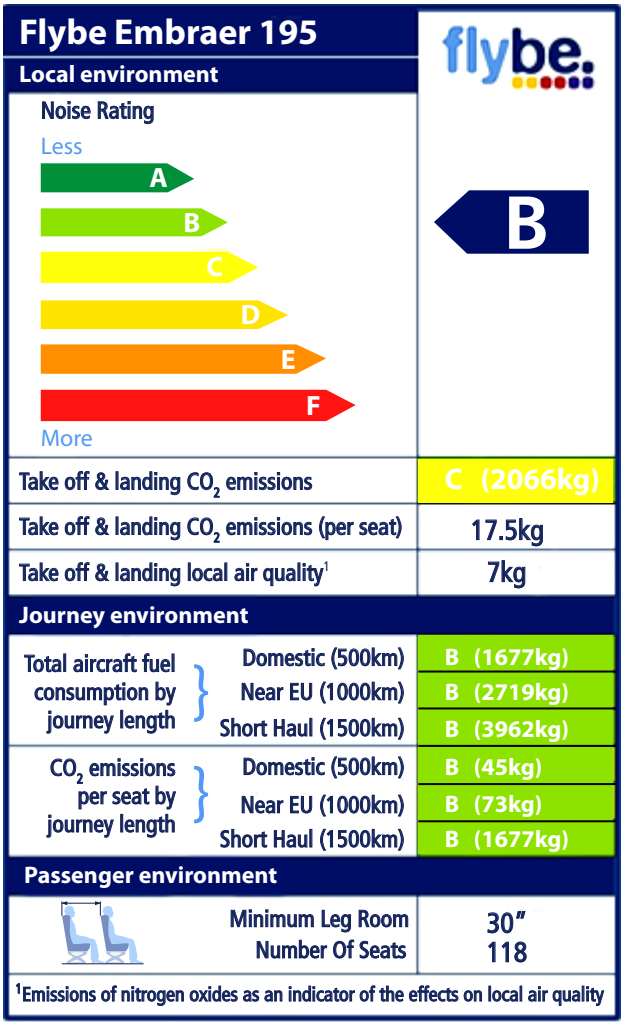
[Source: www.tomspencer.com.au/2009/01/25/product-life-cycle-model/]

7. Which combination of "risk" and "potential gain" characterizes a pioneering corporate strategy?

	Risk	Potential gain
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High

8. Flybe is one of Europe's biggest regional airlines. In June 2007 Flybe pioneered the development of an eco-labelling scheme for aircraft (**Figure 5**). The label was modelled on those used for the sale of household appliances and shows a range of environmental indicators for particular aircraft. Flybe has published its methodology so that it can be used by other airlines.

Figure 5: The Flybe eco-label



[Used with permission.]

Why should all airlines use the same methodology to calculate the environmental impact of their aircraft?

A. To improve the image of Flybe.

B. To enable consumers to compare between different airlines.

C. To assist the management of other airlines.

D. To anticipate legislation.

9. What is most likely to increase as a result of the implementation of "take back" legislation for cars?

A. Landfill costs

B. Product life cycle

C. Variety of materials used

D. Number of component parts

10. What makes a product more difficult to disassemble?

A. Toxic materials

B. Metallic coatings

C. Permanent fixings

D. Labelling material

11. An alloy is defined as:

A. the smallest part of an element that can exist chemically.

B. two or more atoms that are bonded together.

C. a mixture containing at least one metal.

D. a mixture of two or more substances with one acting as the matrix or glue.

12. **Figure 6** shows a cooking pot with a lid made of two dissimilar materials; glass and stainless steel.

Figure 6: Cooking pot

[Bueno cookware range from WMF. Used with permission.]

Which physical property is important when selecting materials for the lid of the cooking pot?

A. Low hardness

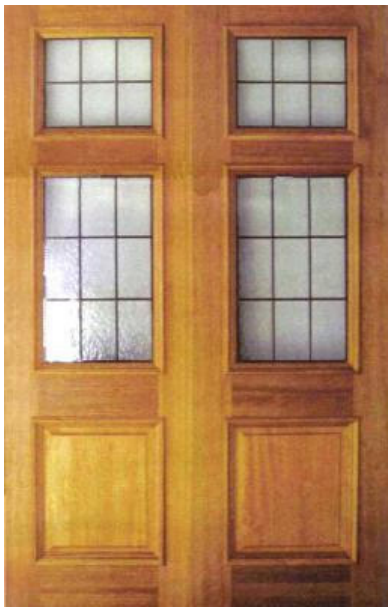
B. High thermal conductivity

C. Low thermal expansion

D. High density

13. **Figure 7** shows a hardwood (mahogany) external door.

Figure 7: Mahogany door



[www.bdjoineryltd.co.uk/external-hardwood-pairs/churchill-glazed-hardwood-pai; Best Door Joinery, Ltd.]

Why would the door be treated with a transparent (varnish) finish rather than an opaque (paint) finish?

A. Aesthetics

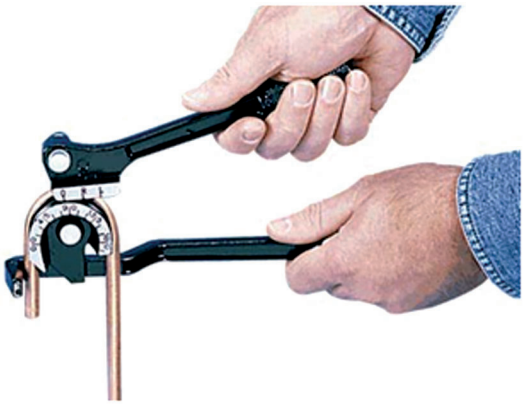
B. Hardness

C. Tensile strength

D. Resistance to damp environments

14. **Figure 8** shows a copper tube being shaped using a pipe bender.

Figure 8: Copper tube and pipe bender



[Please refer to this image http://www.northerntool.com/shop/tools/product_33396_33396]

Which characteristic is **not** demonstrated by the shaping of the copper tube?

A. Plasticity

B. Malleability

C. Ductility

D. Elasticity

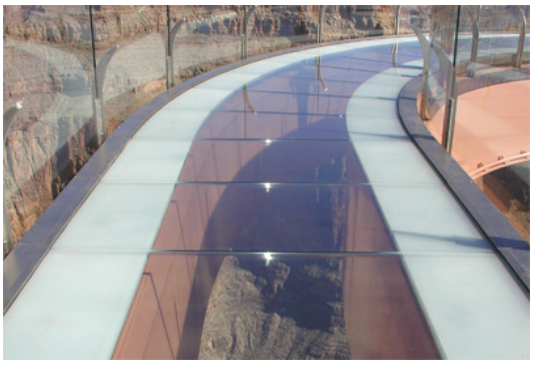
15. Which combination of "performance" and "temperature" makes nickel-based superalloys suitable for aircraft engines?

	Performance	Temperature
A.	Low	Low
B.	Low	High
C.	High	Low
D.	High	High

16. **Figure 9** and **Figure 10** show the Grand Canyon Skywalk, a glass walkway that spans 21 metres over the Grand Canyon's rim at a height of 1219 metres above the Colorado River.

Figure 9 and 10: The Grand Canyon Skywalk

[Source: http://en.wikipedia.org/wiki/File:SkywalkFromOutsideLedge.jpg, by Wikipedia user ComplexSimpleLLC]



[www.lochsa.com/Projects/Skywalk1.html; Lochsa Engineering]

Which combination of "resistance to compressive forces" and "resistance to tensile forces" characterizes glass and constrains the design of the Grand Canyon Skywalk?

	Resistance to compressive forces	Resistance to tensile forces
A.	No	No
B.	No	Yes
C.	Yes	No
D.	Yes	Yes

17. Nitinol is a smart material. It is a plastic material and can be stretched but does not return to its original shape when the stretching force is removed. However when it conducts an electric current it heats up and returns to its original shape.

Which class of materials is nitinol an example of?

A. Shape memory alloy

B. Electro-rheostatic

C. Magneto-rheostatic

D. Piezoelectric

18. What is a disadvantage of craft production?

A. Quality is perceived to be higher

B. The cost of the product is often higher

C. Products are unique

D. There is often a close relationship between the craftsman and the client

19. Which costs will be higher per unit of product for craft production than for automated production?

A. Capital costs

B. Labour costs

C. Raw material costs

D. Marketing costs

20. What will be of greater concern to a manufacturer using a Just-in-Time (JIT) approach rather than one using a Just-in-Case (JIC) approach?

A. Storage

B. Raw material supply

C. Waste

D. Workforce

21. Before Henry Ford applied assembly-line production to the development of a simple and reliable car only very rich people could afford them. Henry Ford's design for a Model T Ford (**Figure 11**) was based on assembly-line production, which meant that the mass produced car was affordable for a mass market and revolutionized American society.

Figure 11: Model T Ford

[http://en.wikipedia.org/wiki/File:1919_Ford_Model_T_Highboy_Coupe.jpg]

Which aspect of assembly-line production allowed the Model T Ford to become a mass market product?

I. Automation

II. Standardization

III. Labour skills

A. I and II

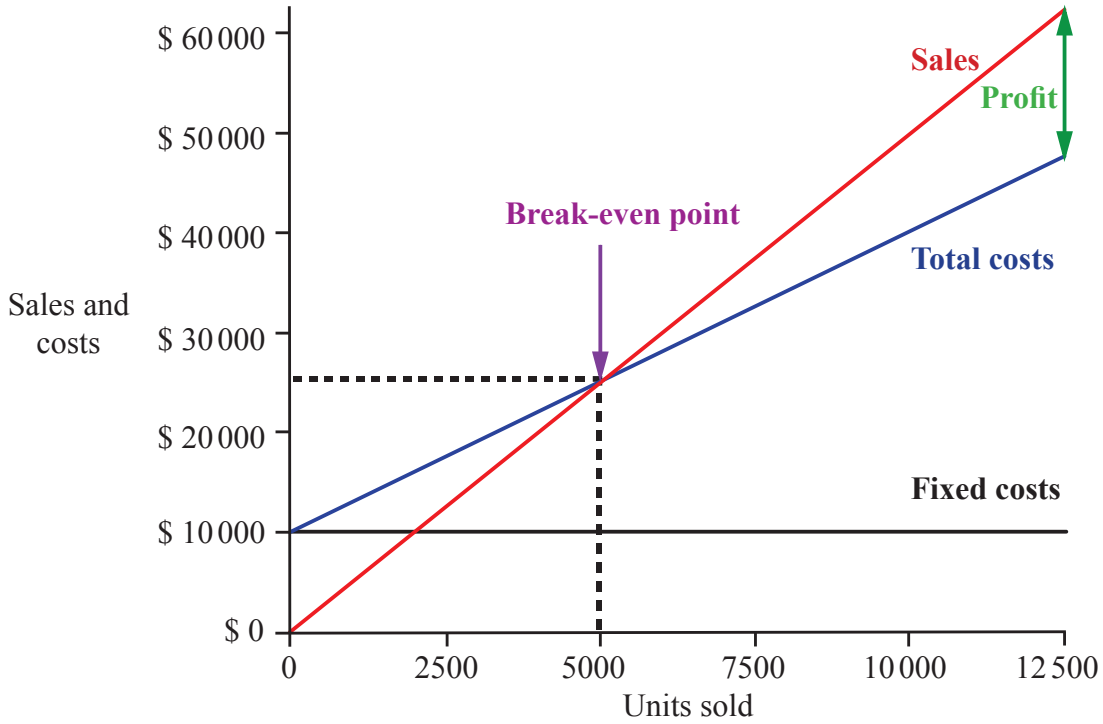
B. I and III

C. II and III

D. I, II and III

22. **Figure 12** shows a graph of costs against sales ($) and cost ($) against the number of units sold.

Figure 12: Sales ($) and Costs ($) against unit sold for a product



[http://simplestudies.com/repository/lectures/ch10_break-even_point_representation.gif. Used with permission.]

What does each unit contribute to the fixed costs at the break-even point?

A. $ 2

B. $ 5

C. $ 7

D. $ 10

23. Which percentile would be used to determine the height of a door handle?

A. 5^{th}

B. 95^{th}

C. $5^{th} – 95^{th}$

D. 50^{th}

24. **Figure 13** and **Figure 14** show a roadable aircraft called Transition®. It is classified by aviation authorities as a light sport aircraft. Its wings fold at the touch of a button to convert into a car. Roadable aircraft have to meet motor vehicle regulations and aviation regulations. This results in conflicts which the designer must resolve.

Figure 13 and Figure 14: Transition® Roadable Aircraft

Images removed for copyright reasons.

[Please refer to: http://www.terrafugia.com/images/LeavingGarageWM-Med.jpg and http://www.terrafugia.com/images TransitionFlyingLookingUpWM-Med.jpg]

Which of the following regulations for light sports aircraft would be a major constraint on the designer of the roadable aircraft?

A. A maximum take off weight of 1320 pounds

B. A maximum speed of more than 120 knots

C. No more than two seats

D. Fixed landing gear

25. Which is an advantage of using a field trial to evaluate the design of a solar panel?

A. Time

B. Cost

C. Sample size

D. Testing in-situ

26. Which evaluation technique is likely to provide largely quantitative data?

A. Literature search

B. Performance test

C. User trial

D. User research

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

Tupperware is a product family of food containers (**Figure 15**) with a unique seal modelled on a paint tin lid (**Figure 16**). Tupperware was developed by Earl Tupper who worked for the plastics division of chemical manufacturing giant DuPont. The first plastics were brittle with an unpleasant odour (smell). Tupper developed an odour-free flexible plastic. His polyethene food cartons were first sold in 1945. Tupperware was difficult to re-seal as air had to be released when putting the lid on. It was not successful until Brownie Wise sold Tupperware through a network of housewives who hosted parties and were able to demonstrate how to re-seal the containers to customers.

Figure 15: The Tupperware product family

[From: http://en.wikipedia.org/wiki/File:Tupperware_plastic_containers.jpeg]

Figure 16: A Tupperware container

[http://en.wikipedia.org/wiki/File:Small_authentic_tupperware.JPG by DonMike10]

27. Which ideas generating technique was used by Earl Tupper for his unique seal?

A. Adaptation

B. Constructive discontent

C. Brainstorming

D. Attribute listing

28. What is true of the thermoplastic polyethene used to produce Tupperware?

I. Linear chain molecules

II. Strong primary bonds between polymer chains

III. Strong primary bonds within polymer chains

A. I and II

B. I and III

C. II and III

D. I, II and III

29. Which evaluation criterion was **not** met by the early Tupperware products?

A. Ease of use

B. Ease of maintenance

C. Durability

D. Safety

30. What did Earl Tupper and Brownie Wise contribute to the success of Tupperware?

	Earl Tupper	**Brownie Wise**
A.	Inventor	Inventor
B.	Product champion	Inventor
C.	Inventor	Product champion
D.	Product champion	Product champion