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DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 2

Candidate session number

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Monday 7 November 2011 (afternoon)

1 hour

Examination code

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Write your answers in the boxes provided.

SECTION A

*Answer **all** questions. Write your answers in the boxes provided.*

1. **Figure 1** shows a graph representing periods of innovation from 1785 to 2020 presented in the form of waves by the economist Joseph Schumpeter. **Table 1** lists some of the technological innovations associated with each wave of innovation.

Figure 1: Schumpeters waves of innovation

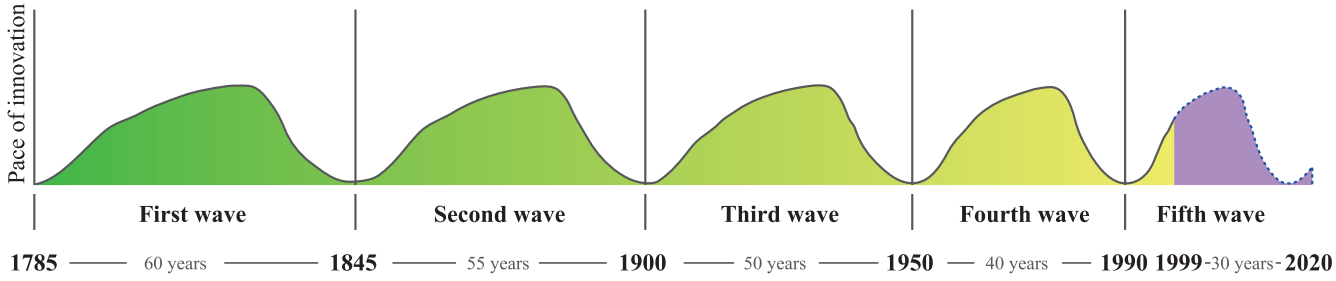

Table 1: Technological innovations associated with Schumpeter's waves of innovation

1785	1845	1900	1950	1990
Water power Textiles Iron	Steam Rail Steel	Electricity Chemicals Internal combustion engine	Petrochemicals Electronics Aviation	Digital networks Software New media

(a) (i) State which innovation wave represents the beginning of the Industrial Revolution. *[1]*

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(ii) State which innovation wave represents the use of automation in mass production systems. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(iii) Describe the pace of innovation represented by the five waves. *[2]*

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(b) (i) Outline the production method used before 1785. *[2]*

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(ii) Identify the technology from **Table 1** which was the basis for the development of plastic materials. *[2]*

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(c) (i) State the technology from **Table 1** which formed the basis for the development of the motor car. *[1]*

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(Question 1 continued)

(ii) Suggest why aviation is stated as an innovation beginning in the 1950s although the first aeroplane was invented in 1903. *[3]*

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2. (a) Define *percentile range*. *[1]*

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(b) Explain the limitations of using the 50th percentile as a means of designing for the "average" person. *[3]*

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3. (a) State the type of materials which can change from a fluid to a solid in a fraction of a second when exposed to an electric field. *[1]*

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(b) Explain what is meant by *smart materials*. *[3]*

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SECTION B

*Answer **one** question. Write your answers in the boxes provided.*

4. **Figure 2** shows the Envirofit stove manufactured by a company formed to commercialize $25 million of research by the University of Colorado. The company was sponsored by Royal Dutch Shell, an oil company.

Content removed for copyright reasons

The stoves are made from an alloy and are more efficient at conserving heat than traditional models. The stoves use biomass as a fuel. Half of the world's population cook on open-fire stoves. The Envirofit stove cuts smoke and toxic emissions by 80% and uses half of the amount of fuel compared to traditional methods. It costs approximately 20% of a typical family's monthly household budget in developing countries.

(a) (i) State **one** reason why Royal Dutch Shell supports the Envirofit stove. *[1]*

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(This question continues on the following page)

(Question 4 continued)

(ii) Outline **one** reason why the stove may reduce in cost if it succeeds as an innovation. *[2]*

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(iii) Outline **one** reason why the metal alloy for the frame of the stove is likely to be nickel based. *[2]*

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(b) (i) State **one** type of test that would be used in the design development stage of the stove to evaluate its reliability. *[1]*

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(Question 4 continued)

(ii) Suggest **one** reason why the research and development costs for the Envirofit stove were so high. *[3]*

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(c) (i) Outline **one** possible disadvantage of the Envirofit stove for its target market other than cost. *[2]*

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(Question 4 continued)

(ii) Discuss **three** advantages of the Envirofit stove compared to open-fire cooking. *[9]*

5. **Figure 3** shows the MK2 Trans Furniture table. It can be used as a coffee table or as a dining table to seat 6 people or as a large desk. It is transformed from a coffee table into a table or desk in two easy moves. The MK2 table is made from a steel alloy and is available with a variety of different coloured surface finishes. A similar version of the MK2 table is made from plywood, also with a variety of different surface finishes.

Figure 3: MK2 Trans furniture steel alloy table

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

(a) (i) Define *ductility*. *[1]*

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(ii) Outline **one** reason for the application of a surface finish to steel other than aesthetics. *[2]*

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(Question 5 continued)

(iii) Describe how the tensile strength of a metal is increased by alloying. *[2]*

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(b) (i) State the most likely scale of production for the MK2 table. *[1]*

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(ii) Explain why the MK2 steel table may contribute to a green design policy. *[3]*

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(Question 5 continued)

(c) (i) Outline **one** reason for including a factor of safety in the design of the MK2 table. *[2]*

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(ii) Discuss the use of plywood for the MK2 table in relation to its product life cycle. *[9]*

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6. **Figure 4** shows the Samsung Navibot robot vacuum cleaner which sells for approximately US$ 600. It contains a system which allows it to take photographs of a room and use them to create an electronic map to navigate the optimal cleaning path. A sensor can tell when it is about to topple over the edge of a step, at which point the cleaner goes into reverse. The cleaner has 5 cleaning programmes for different surfaces, can be operated by remote control and will run for 90 minutes on a single charge after which it returns to a docking station to recharge.

Content removed for copyright reasons

(a) (i) State which of the Navibot's fixed costs is most likely to be the highest. *[1]*

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(ii) Outline **one** physical property important for the material used to manufacture the casing of the Navibot. *[2]*

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(Question 6 continued)

(iii) Describe the idea generating technique used to decide the name of the Navibot. *[2]*

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(b) (i) State the product life cycle stage of the Navibot. *[1]*

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(ii) Discuss the potential length of the life cycle of the Navibot. *[3]*

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(Question 6 continued)

(c) (i) Describe the Navibot as an example of radical and incremental design. *[2]*

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(ii) Discuss **three** limitations of the Navibot as a potential successful innovation. *[9]*

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Answers written on this page
will not be marked.