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DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

Tuesday 11 November 2008 (afternoon)

1 hour 45 minutes

Candidate session number

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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 of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

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SECTION A

*Answer **all** the questions in the spaces provided.*

1. An architect is designing a small low-cost house for occupancy by two adults. The architect needs to evaluate the annual heating bill for the house. **Table 1** shows the percentage of solar heat gain from the windows.

Table 1: Percentage of solar heat gain

Windows	Number	Size	% Solar Gain
South facing	2	1 m^2	100
East facing	2	1 m^2	75
West facing	1	1 m^2	75
North facing	1	0.5 m^2	50

The house will be heated for 7 months of the year, October to April. **Table 2** shows a prediction of values for the average amount of solar energy collected through one south facing window for different months of the heating season.

Table 2: Prediction of solar heat gain for one south facing window

Month	Solar heat gain MJ/m^2
October	160
November	90
December	70
January	75
February	90
March	80
April	180

(a) (i) Calculate the total window area for the house. *[1]*

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(ii) Using the data in Table 1 calculate the average percentage of solar gain for all the windows. *[2]*

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(Question 1 continued)

(iii) Using the data in Table 2 calculate the total solar heat gain for east facing windows for the heating season. *[3]*

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(b) (i) Outline **one** reason why the figures in Table 1 and Table 2 may vary for different houses even though they are the same design. *[2]*

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(ii) Outline **one** reason why the north facing window in Table 1 is likely to be used for the bathroom. *[2]*

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(Question 1 continued)

In addition to solar energy, heat will also be gained from people and activities inside the house (incidental heat gains). **Table 3** shows the predicted annual incidental heat gains.

Table 3: Predicted annual incidental heat gains

Cooking	6000 MJ
Water heating	3200 MJ
Electrical appliances	900 MJ
Metabolic heat from people	1900 MJ

(c) (i) Calculate the total predicted annual incidental heat gains. *[1]*

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(ii) Outline **one** reason why the incidental heat gain for electrical appliances may vary from the figure stated in Table 3. *[2]*

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(iii) Explain why the heat gain for cooking is much higher than the other heat gains in Table 3. *[3]*

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(Question 1 continued)

The house is to have four separate rooms: living room; bedroom; bathroom; kitchen. Each room must have at least one wall on the exterior of the building. The rooms will be connected by a hall or corridor.

(d) (i) Outline **one** reason why each room must have at least one wall on the exterior of the building. *[2]*

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(ii) Outline **one** purpose of including a hall or corridor in the design of the house. *[2]*

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2. Outline **one** reason why polyurethane is used in surface finishes for wood. *[2]*

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3. (a) State a suitable strategy for gathering existing anthropometric data. *[1]*

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(b) Explain **one** limitation of collecting dynamic ergonomic data. *[3]*

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4. (a) Outline **one** strategy for sustainable development related to the workforce. *[2]*

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(b) Explain how consumer attitudes towards sustainable development have created a market pull situation. *[3]*

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5. (a) Describe the structure of laminated glass. *[2]*

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(b) Explain **one** reason why lamination is a popular technique for manufacturing wooden chairs. *[3]*

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6. (a) Outline **one** nutritional advantage of mycoprotein. *[2]*

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(b) Describe **one** aesthetic characteristic important to the commercial success of new foods. *[2]*

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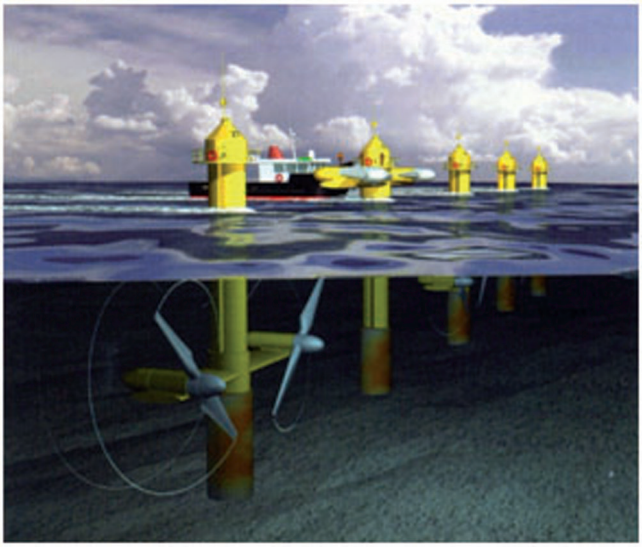
SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

7. **Figure 1** shows a CAD image of a proposed tidal power scheme which uses the power of tidal currents in much the same way that wind turbines use air currents. The rotors, which are long and thin are turned by the outgoing and incoming tides.

Figure 1: CAD image of a tidal power scheme



[Source: www.marineturbines.com, used with permission.]

(a) (i) Outline **one** advantage of tidal power compared to wind power in relation to energy conversion. *[2]*

(ii) Compare tidal power with wind power in relation to aesthetic considerations. *[2]*

(b) Explain how knowledge of Young's modulus has affected the designer's choice of materials for the rotor blades in Figure 1. *[3]*

(c) (i) Outline **one** limitation for the adoption of tidal power schemes worldwide. *[2]*

(ii) Outline **one** reason for designing the rotor blades to be long and thin. *[2]*

(d) Discuss **three** considerations that will determine the economic viability of the tidal power scheme. *[9]*

8. **Figure 2** shows a book shelf called "Legend" manufactured from oak, a hardwood. A limited edition of 250 were manufactured.

Figure 2: "The Legend" shelf unit

[Source: www.roche-bobois.com]

(a) (i) State **two** characteristics of hardwood trees. *[2]*

(ii) Outline **one** advantage of using hardwood for the unit. *[2]*

(b) (i) Outline **one** reason why the oak timber would be seasoned. *[2]*

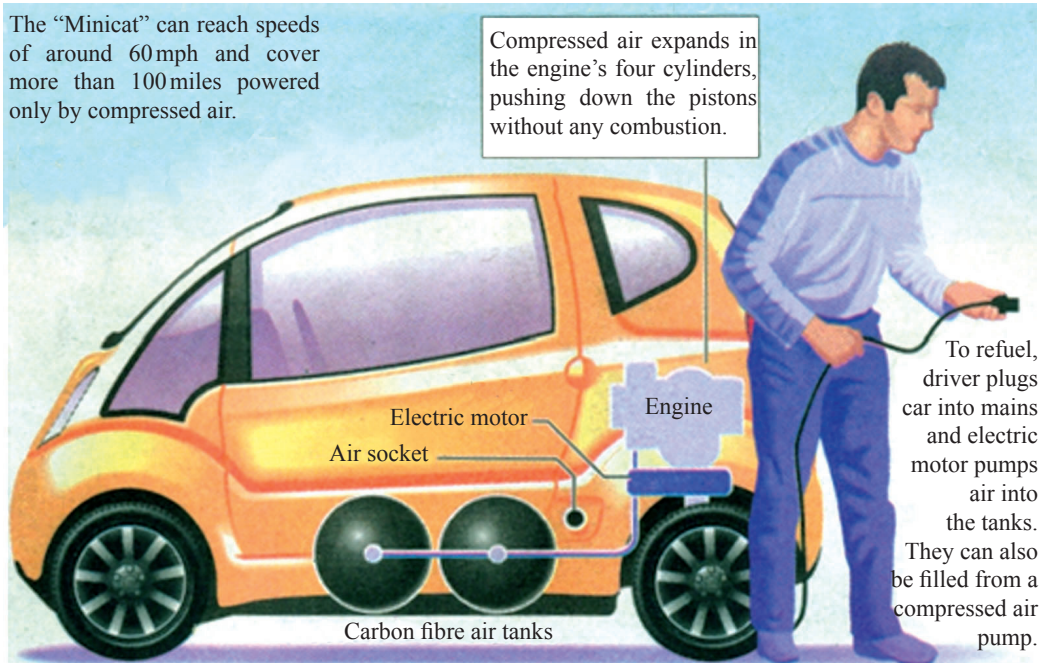
(ii) Explain the need for a factor of safety in the design of the shelf. *[3]*

(c) Describe **one** way in which the process of wasting contributes to the manufacture of the shelf unit. *[2]*

(d) Explain **three** ways in which fashion and planned obsolescence influence the product life cycle of the shelf unit. *[9]*

9. **Figure 3** shows a prototype car planned to go into production by the French company Moteur Développement International. Instead of a petrol engine there are two tanks containing air compressed to 300 bar, that is, 300 times the pressure of the air around us. When released from the tanks, the air expands, driving pistons in the four-cylinder engine. It can be plugged into the main power supply, allowing its electric motor to compress air into the tanks, but this takes four hours. A faster option is to fill the tanks from a compressed air pump, which takes only a couple of minutes.

Figure 3: The "Minicat" prototype electric car



[Source: MDI. Reprinted with permission.]

(a) (i) Outline why the "Minicat" car is a combination of incremental and radical design. *[2]*

(ii) Outline **one** advantage to the manufacturer of producing a prototype vehicle. *[2]*

(b) Outline **one** advantage of using carbon fibre for the air tanks. *[2]*

(c) Explain **one** reason why the "Minicat" car designer cannot claim zero carbon emissions. *[3]*

(d) Describe the contribution of R&D costs to the final cost of the car at this stage in its life cycle. *[2]*

(e) Explain how science, technology and philosophy have contributed to the design of the "Minicat" car. *[9]*