

**DESIGN TECHNOLOGY  
HIGHER LEVEL  
PAPER 2**

Wednesday 14 November 2007 (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.

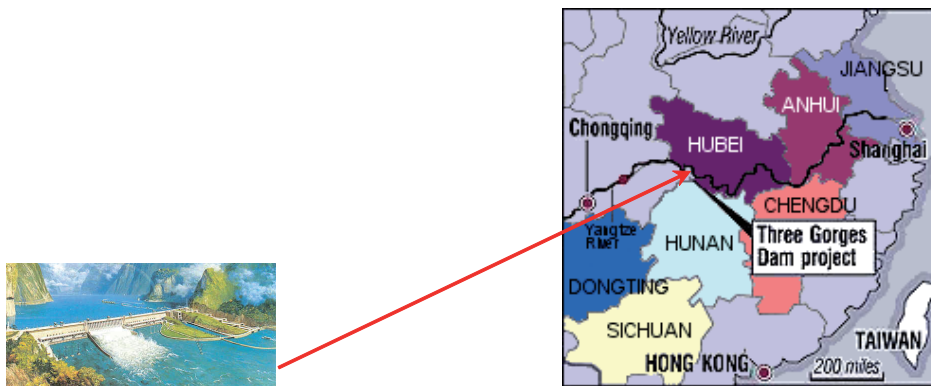


### SECTION A

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

1. China has undertaken a very large scale civil-engineering project – the Three Gorges Dam which contains the largest hydroelectric power station in the world. The principal purpose of the project is to generate power to keep pace with China’s economic growth and to relieve flooding in the area. The dam reservoir is 370 miles long and construction of the dam required extensive logging in the area. About one third of the total cost of the project is concerned with re-housing people who have to be moved because of the construction works. **Figure 1** indicates the location of the dam. **Figure 2** shows a cross section diagram of the reservoir. **Figure 3** is a table which states data about the dam.

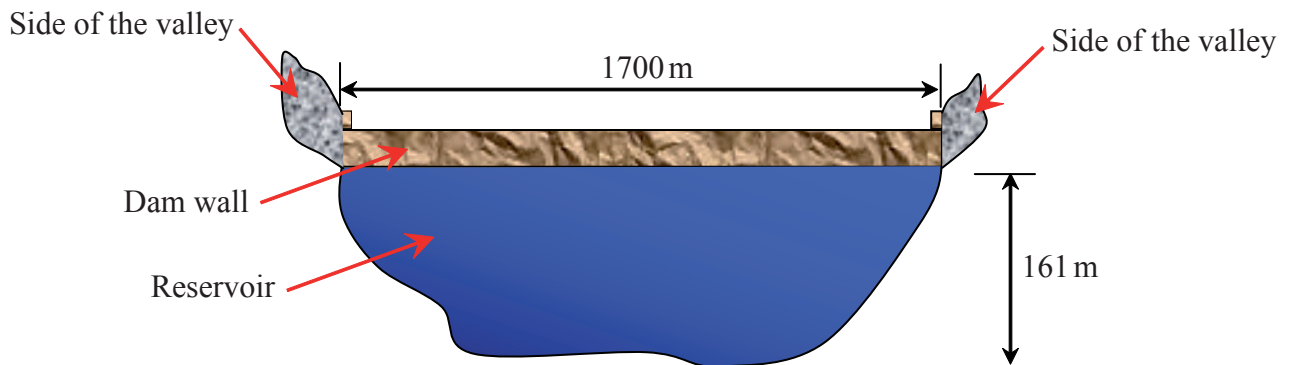
**Figure 1: The location of the Three Gorges Dam Project**



[Source: <http://www.yangtze.com/gallery/scenery/yichang/tgp-proj.html>]

[Source: adapted from <http://www.threegorgesprobe.org/tgp/index.cfm>]

**Figure 2: Cross section of the reservoir in front of the dam wall**



*(This question continues on the following page)*



*(Question 1 continued)*

**Figure 3: Data concerning the Three Gorges Dam**

Height of dam wall	185 m
Area of lake	1083 Sq Km
Volume of water	339.3 billion cubic metre
People needed re-housing	1.1 million
Projected power generation	84 billion kilowatt-hours
Amount of coal that would be used to generate the same electric energy as the Three Gorges project	32 million tonnes per year
Building cost of dam wall per 400 m	1.7 million US \$
Estimated cost of project	30 billion US \$
Relocations	2 cities 326 townships 1351 villages

- (a) (i) Calculate the approximate cost of re-housing the people who will have to move because of the Three Gorges Dam Project. [2]
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- .....
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- (ii) Calculate the cost of constructing the dam wall from the data in Figures 2 and 3. [3]
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*(This question continues on the following page)*



*(Question 1 continued)*

- (b) (i) Calculate how high the dam wall is above the level of the water from the data supplied. [2]

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- (ii) Explain **one** reason why there is a need for a factor of safety to be incorporated into the design of the Three Gorges dam wall. [3]

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- (c) (i) State **one** advantage and **one** disadvantage of the Three Gorges Dam Project in relation to sustainability. [2]

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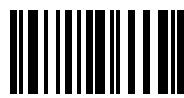
- (ii) State **two** probable economic reasons why the Chinese Government has chosen to generate electricity using hydroelectric power. [2]

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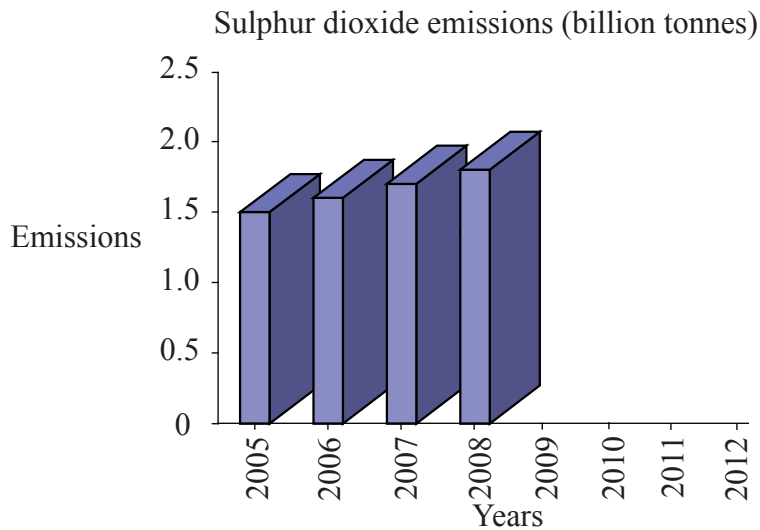


(Question 1 continued)

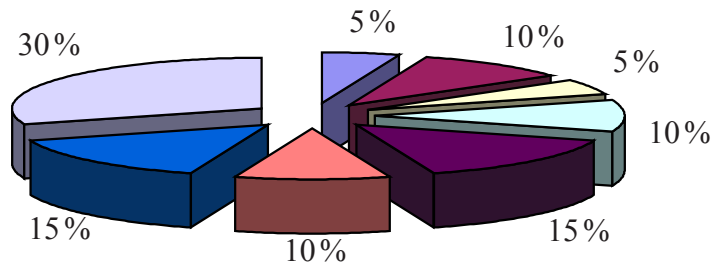
Three quarters of China’s current electrical energy production is produced from burning coal. In 2002, 150 million tonnes of coal was used to generate electricity to meet 75% of China’s requirement.

**Figure 4** shows how industry predicts the rise of sulphur dioxide emissions between the years of 2005 and 2008.

**Figure 4: Graph showing the projected rise in sulphur dioxide emissions**



**Figure 5: Chart showing percentage distribution of Three Gorges Dam hydro-electricity when the project is finished**



**Key to pie chart**



- (d) Estimate the annual volume of sulphur dioxide emissions by 2012 if the current rate of increase in coal burning in China continues as shown in Figure 4. [2]

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- (e) (i) Identify what percentage more hydroelectric energy Hubei Province will receive compared with Sichuan province when the Three Gorges Dam Project is complete. [1]

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- (ii) Calculate the number of dams (of the same size as the Three Gorges Dam) that would be required to be able to generate the same quantity of electrical energy as China's coal power stations produced in 2002. [3]

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- 2. (a) Define *thermal conductivity*. [1]

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- (b) Discuss **one** reason why thermal conductivity is an important consideration in the design of a metal kettle to be used on a fire, gas stove or electric hot plate. [3]

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3. (a) State the manufacturing technique used to produce nylon thread. [1]

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(b) Explain how the use of a nylon fabric is cost-effective in achieving the desired surface finish for ski jackets. [3]

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4. (a) List **two** materials from which glass is primarily made. [2]

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(b) Compare the effect of an impact on toughened **and** laminated glass. [2]

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5. (a) State **two** characteristics of the technique of *brainstorming*. [2]

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(b) Identify **two** differences between divergent and convergent thinking. [2]

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6. (a) Define *appropriate technology*. [1]

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(b) List **three** characteristics of appropriate technology. [3]

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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. Cutlery can be made in a range of different materials. **Figure 6** shows cutlery made from stainless-steel and **Figure 7** shows cutlery made from a thermoplastic.

**Figure 6: Stainless-steel cutlery**



[Source: <http://www.underview.com/2001/lifestyle/cutlery>]

**Figure 7: Plastic cutlery**



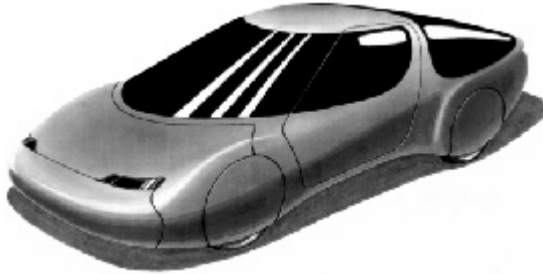
[Source: <http://www.chplastic.com>]

- (a) (i) List **two** materials added to mild steel in the manufacture of stainless steel. [2]
- (ii) Describe **one** characteristic of stainless steel that makes it suitable for use in the manufacture of cutlery. [2]
- (b) (i) Outline the relevance of a high Young’s Modulus in the selection of stainless steel to be used for the manufacture of cutlery. [2]
- (ii) Compare a stainless steel knife with a plastic knife of similar dimensions in terms of stiffness and deflection. [3]
- (c) (i) Outline the structure and bonding of a thermoplastic material. [2]
- (ii) Evaluate plastic cutlery in relation to aesthetics, ease-of-manufacture and the environment. [9]



8. **Figure 8** shows the CAD model of a concept car. If it were to go into production the car body would be made from a lightweight thermoplastic material and could be powered by a renewable energy source.

**Figure 8: CAD model of a concept car**



[Source: <http://maui.net/~jstark/hybrid.gif>]

- (a) (i) Outline **one** advantage of using injection moulding for producing the body panels for the car. [2]
- (ii) Outline **one** reason why density is an important environmental consideration in selecting plastic rather than steel for the car body. [2]
- (iii) Outline the relevance of plastic deformation in the manufacturing process if steel were used to make the car body panels. [2]
- (b) (i) Outline **one** advantage of automating the production line for the manufacture of this car. [2]
- (ii) List **two** ways in which robots could contribute to the cost-effectiveness of the production of the car on an assembly line. [2]
- (c) (i) Define *sustainable development*. [1]
- (ii) Discuss **three** ways in which the concept car is likely to meet the criteria for sustainable development if it was mass produced. [9]



9. A new type of school is shown in **Figure 9**. The school has been designed to provide plenty of interior open space.

An impression of the building that the designer used in an early phase of the project is shown in **Figure 10**.

**Figure 9: The new school**



[Source: <http://www.samappleby.demon.co.uk/freelance/local%20authority/selection/pages/BR037.htm>]

**Figure 10: Designer’s impression of the inside of the school at ground floor level**



[Source: <http://www.capitalcityacademy.org/> (then launch the gallery)]

- (a) (i) State the type of freehand drawing that is shown in Figure 10. [1]
- (ii) State **one** advantage and **one** disadvantage of using a physical model of the school during the consultation process. [2]
- (iii) Outline **one** factor that influences the spacing of the roof support pillars along the front of the building in Figure 9. [2]

*(This question continues on the following page)*



*(Question 9 continued)*

- (b) (i) State **one** strategy that the designer may have used to obtain information from prospective students. [1]
  - (ii) Explain how expert appraisal could have been used to gather information for the design of the school. [3]
  - (c) (i) Outline **one** way in which the use of movable classroom walls impacts on the ergonomics of the school design. [2]
  - (ii) Discuss **three** psychological factors relating to the ergonomics of the interior space in Figure 10. [9]
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