IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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N04/4/DESTE/HP2/ENG/TZ0/XX

88046202

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

School code

Wednesday 17 November 2004 (afternoon)

Candidate code

1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

- Write your school code and candidate code 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 school code and candidate code 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. **Figure 1** shows the London Eye, which was designed as a landmark project for the millennium. It is like a giant bicycle wheel (circumference 424 m) with a central hub and spindle (330 tonnes) connected to outer and inner rims by a total of 64 cable spokes, each 75 m long. 32 passenger capsules are mounted around the rim with a maximum capacity of 25 people per capsule. The entire structure stands 135 m high and is supported by an "A" frame from one side only (see **Figure 2**). The wheel turns continuously anti-clockwise, during operating hours, at 0.26 m/s, even when people are getting on and off. As passengers travel from X to Y in fine weather they can see over 40 km in each direction (see **Figure 3**).

Figure 1: The London Eye

Figure 2: The structure is supported by an "A" frame from one side only

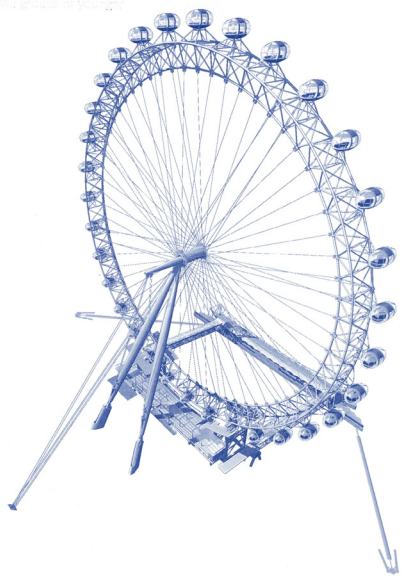
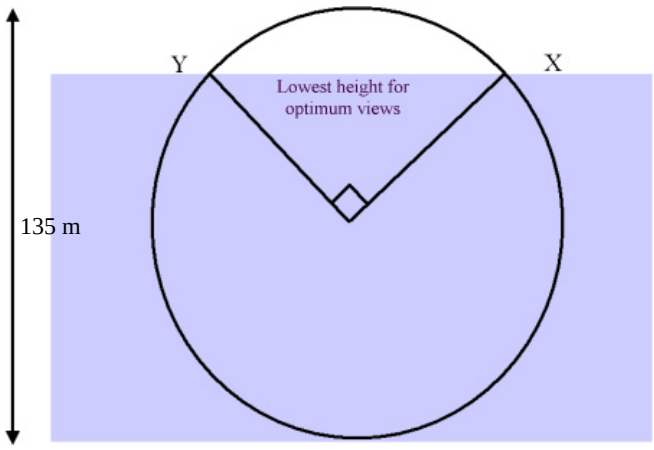


Figure 3: Passengers enjoy views of over 40 km as they travel from point X to point Y



(This question continues on the following page)

(Question 1 continued)

(a) (i) State the total length of cable required for the spokes in km. *[1]*

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(ii) Calculate how long to the nearest minute passengers enjoy the optimum views as the capsule they are inside is rotated from X to Y, as shown in **Figure 3**. *[3]*

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(b) (i) State the importance of tensile forces in relation to the design of the wheel. *[1]*

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(ii) Explain the relationship between strength and stiffness in the structure. *[3]*

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(c) (i) List **two** dominant considerations in the design of the London Eye. *[2]*

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(ii) Outline **one** way in which the designers could justify the London Eye as a landmark project for the millennium. *[2]*

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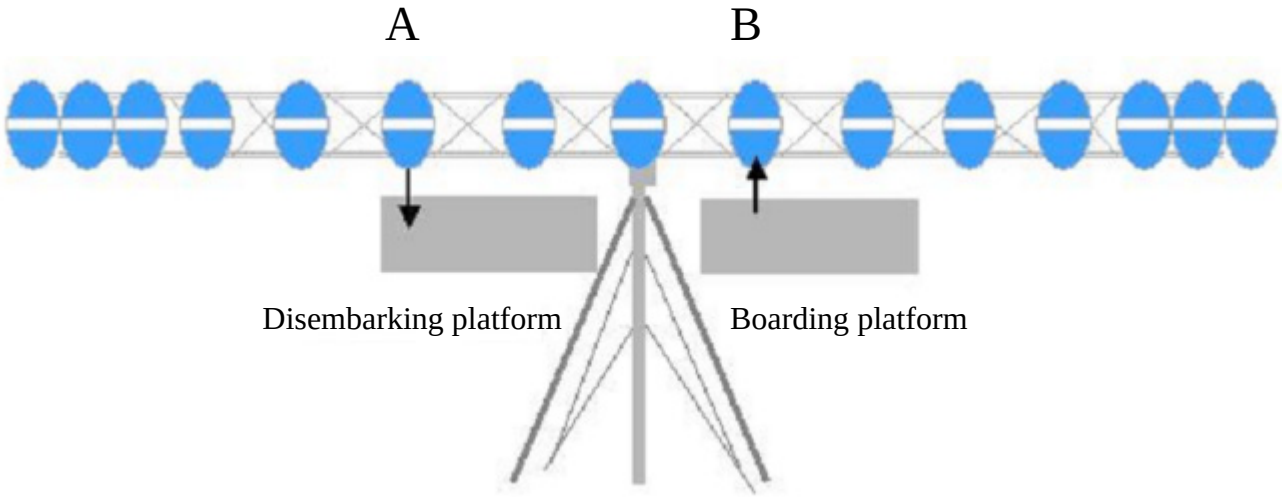
(Question 1 continued)

Figure 4 shows passengers disembarking after their "flight". The boarding and disembarking platforms are each 20 m long. Passengers begin disembarking (see **Figure 5)** from a capsule once it has reached the disembarking platform. The last passenger has to leave before the capsule moves past the end of the disembarking platform. Similarly passengers board the capsule as it moves along the boarding platform. The wheel turns at approximately quarter of normal walking speed and slow enough that people can get on and off without the wheel stopping. To load and unload the maximum number of 25 people takes approximately 25 seconds. No more than two wheelchair users are allowed in any one capsule or eight wheelchair users in total on the wheel.

Figure 4: Passengers disembarking from a capsule.

Figure 5: Boarding and disembarking platforms at the London Eye site.



(d) (i) State how many capsules are empty between the exit and entry points. *[1]*

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(ii) Outline **one** advantage of a capsule being empty between disembarking and boarding. *[2]*

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(Question 1(d) continued)

(iii) List **two** reasons, apart from the speed of the wheel, that the designer would take into account in determining the length of the platform. *[2]*

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(e) Explain **one** reason why the designers have specified the maximum number of wheelchair users to be on the London Eye at any one time. *[3]*

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2. (a) Define *convergent thinking.* *[1]*

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(b) Explain the importance of convergent thinking in the development of a product design specification (PDS) from a design brief. *[3]*

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3. (a) Define *clean technology*. *[1]*

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(b) Explain how scientific knowledge can help designers evaluate clean technologies. *[3]*

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4. (a) State **one** example of a composite timber. *[1]*

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(b) Explain how the use of composite timber joined with fasteners or dowel joints for making flat-pack self assembly furniture increases planned obsolescence. *[3]*

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5. (a) List **two** nutritional advantages of mycoprotein. *[2]*

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(b) Outline **one** way in which the manufacture of mycoprotein can be considered a form of alternative technology. *[2]*

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6. (a) List **two** strategies for collecting ergonomic data. *[2]*

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(b) Outline **one** limitation of collecting ergonomic data in a dynamic situation. *[2]*

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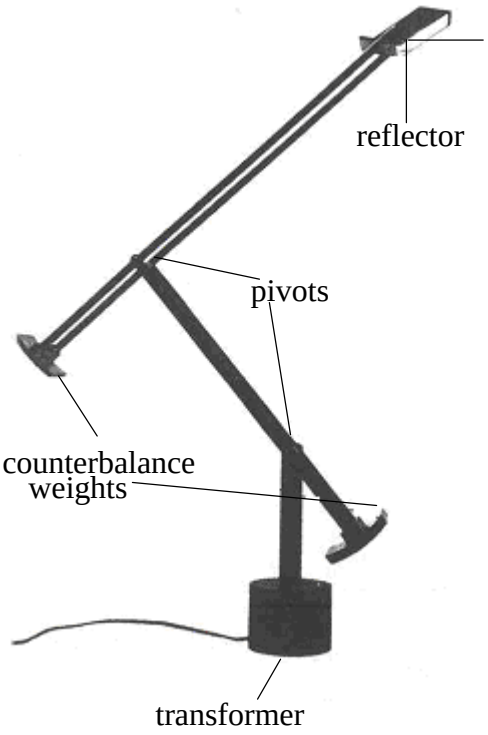
SECTION B

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

7. **Figure 6** shows the Tizio lamp, a steel desk lamp using a low voltage/low wattage light bulb designed by Richard Sapper in 1972. In this design there are two hollow beams containing the electric cables which can be moved to adjust the angle and height of a light source over a working surface. Each beam has a counterbalanced weight at the end to keep the whole lamp in equilibrium.

Figure 6: Tizio lamp designed by Richard Sapper in 1972



(a) (i) State **one** mechanical property of steel that makes it suitable for the lamp. *[1]*

(ii) Describe why steel must be treated or finished. *[2]*

(iii) Outline **one** suitable treatment or finish for the steel lamp. *[2]*

(b) (i) List **two** characteristics of glass that make it suitable for the reflector. *[2]*

(ii) Outline **one** feature of the design which helps conserve resources. *[2]*

(c) (i) Outline **one** stage in the design process for the lamp during which orthographic drawings would be relevant. *[2]*

(ii) Suggest **three** ways in which the designer has balanced form with function in the design of the lamp. *[9]*

8. The pencils shown in **Figure 7** are called Remarkable pencils. They are produced by a British company by recycling thermoplastic vending cups. **Figure 8** shows how traditional wooden pencils are manufactured from softwood slats in which eight grooves, each half as deep as the lead is thick, are made. Two slats are glued together, encasing the lead in a "sandwich". Individual pencils are cut from the sandwich, finished as in **Figure 9** and capped with an eraser.

Figure 7: The Remarkable pencil – each is made from a recycled plastic cup.

Figure 8: Traditional wooden pencil manufacture.

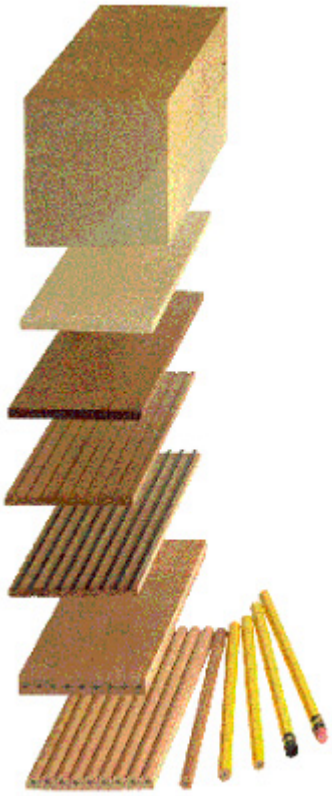
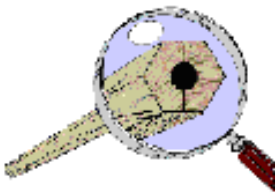


Figure 9: A finished pencil.



(a) (i) Describe the structure of wood. *[2]*

(ii) List **two** characteristics of softwood trees. *[2]*

(b) (i) State **one** advantage of producing the plastic pencil by extrusion. *[1]*

(ii) Describe the reversible effect of temperature on a thermoplastic with reference to the orientation of chains. *[2]*

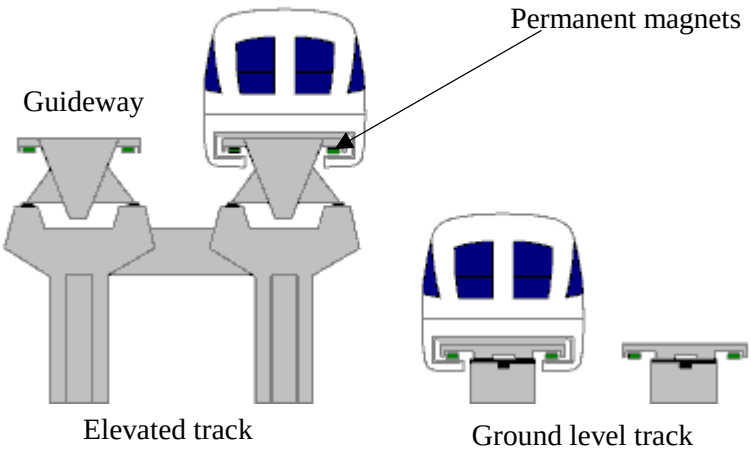
(iii) Describe the structure and bonding of a thermoplastic. *[2]*

(c) (i) Outline **one** way in which the plastic pencil can be regarded as an example of radical design. *[2]*

(ii) Explain **three** ways in which the plastic pencil meets the criteria for clean technology. *[9]*

9. **Figure 10** shows a levitating train, often referred to as a Maglev train. The train is driverless and glides along a track containing superconducting electromagnets. Electromagnets are also placed under the train carriages. In urban areas where space is at a premium the track can be built above street level.

Figure 10: The Maglev levitating train



(a) (i) State the manufacturing technique for producing superconductors. *[1]*

(ii) The resistivity of superconductors becomes nearly zero at temperatures below 140 K. Describe the bonding arrangement that allows for this. *[2]*

(iii) Outline one way in which the use of superconductors for the train helps conserve resources. *[2]*

(b) (i) List **two** issues that need to be considered by the designer to ensure the safety of using the leviating train system on an elevated track. *[2]*

(ii) Identify **one** way in which the levitating train is similar to an automated guided vehicle (AGV). *[2]*

(c) (i) Outline **one** way in which the levitating train can be regarded as an example of incremental design. *[2]*

(ii) Explain **three** ways in which the levitating train can contribute to a sustainable development policy. *[9]*