Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
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10	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2012

Physics (B): Physics in Context PHYB2

Unit 2 Physics Keeps Us Going

Module 1 Moving People, People Moving
Module 2 Energy and the Environment

Friday 25 May 2012 1.30 pm to 2.45 pm

For this paper you must have:
- a pencil and a ruler
- a calculator
- a protractor
- a Data and Formulae Booklet, (enclosed).

Time allowed
- 1 hour 15 minutes

Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.
- You are expected to use a calculator where appropriate.
- A *Data and Formulae Booklet* is provided as a loose insert.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- You are advised to spend about 20 minutes on **Section A** and about 55 minutes on **Section B**.

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ANSWER IN THE SPACES PROVIDED

Section A

Answer **all** questions in this section.

There are 19 marks in this section.

1 (a) State what is meant by a superconducting material.

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(2 marks)

1 (b) State an application of a superconductor and explain why it is useful in this application.

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(2 marks)

2 Below is a list of some regions of the electromagnetic spectrum.

X-ray, radio, microwave, visible, infrared

2 (i) Select the region from the list that has the longest wavelength.

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(1 mark)

2 (ii) Select the region from the list that produces an ionising effect in human tissue.

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(1 mark)

2 (iii) Select the region from the list that contains radiation with a wavelength of 0.03 m.

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(1 mark)

3 Runners can experience injuries to their leg joints due to jarring when their feet strike the ground.
Explain how scientists have improved the soles of running shoes to reduce the risk of these injuries.

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(3 marks)

4 A battery in a laptop computer has an electromotive force (emf) of 14.8 V and can store a maximum charge of 15.5×10^3 C. The battery has negligible internal resistance.

4 (a) Calculate the maximum amount of energy this battery can deliver.

energy ..... J

(2 marks)

4 (b) The average power consumption of the laptop is 30 W.

Estimate how long the laptop can be operated from the fully charged battery.
Give your answer in hours.

time ..... hours

(2 marks)

5 (a) Define resistance.

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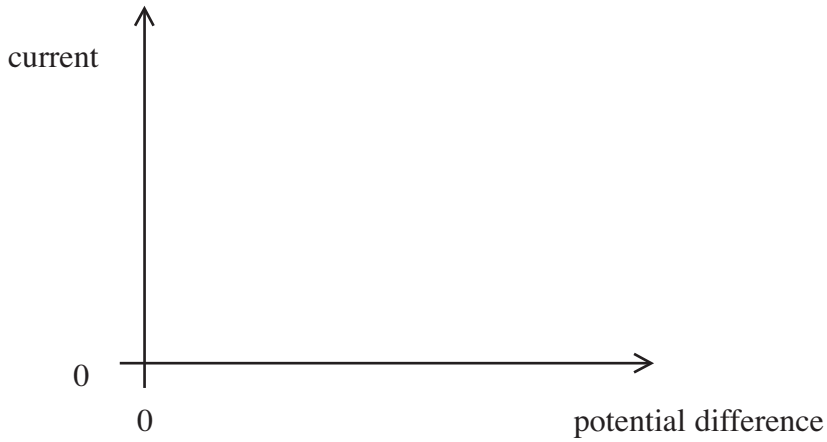
(1 mark)

5 (b) (i) Sketch onto the axes below a graph of the variation of current with potential difference for a filament lamp.



(1 mark)

5 (b) (ii) State and explain, in terms of electron flow, how the resistance of the filament lamp changes as the current in the lamp increases.

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(3 marks)

19

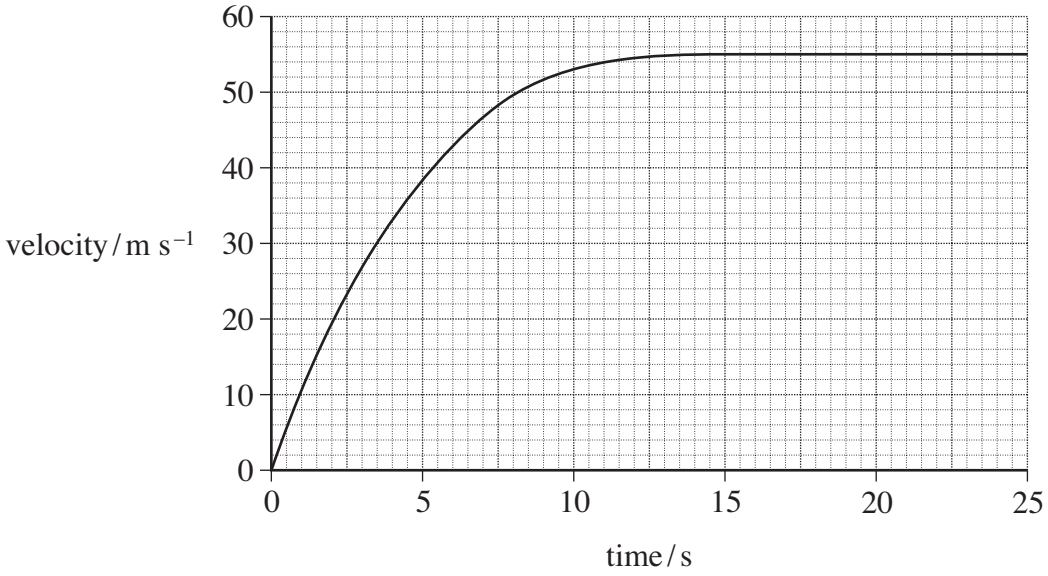
Section B

Answer **all** questions in this section.

There are 51 marks in this section.

6 A parachutist jumps from a hovering helicoptor. **Figure 1** shows the velocity-time graph for the parachutist before the parachute opens.

Figure 1



6 (a) Using **Figure 1**, estimate the distance the parachutist falls during the first 10 seconds of the parachute jump.

distance ..... m

(3 marks)

6 (b) After 25 s the parachute opens.
State and explain how the subsequent motion of the parachutist is affected by the opening of the parachute.
Your description should give details of the motion from the instant the parachute is opened until just before the parachutist reaches the ground.

The quality of your written communication will be assessed in your answer.

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(6 marks)

9

7 In a laboratory experiment that models the behaviour of icebergs in sea water, a block of ice floats in a beaker of salt water.

7 (a) State the principle of flotation.

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(1 mark)

7 (b) The block of ice has a volume of $3.40 \times 10^{-5}\,m^3$ and a density of $9.00 \times 10^{2}\,kg\,m^{-3}$.

7 (b) (i) Calculate the mass of the block of ice.

mass ..... kg

(2 marks)

7 (b) (ii) The density of the salt water, in which the block floats, is $1.30 \times 10^{3}\,kg\,m^{-3}$.

Calculate the volume of the block above the surface of the water.

volume ..... m^3

(3 marks)

7 (b) (iii) State and explain how the answer to part 7 (b)(ii) would be affected by increasing the density of the salt water in which the block is placed.

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(2 marks)

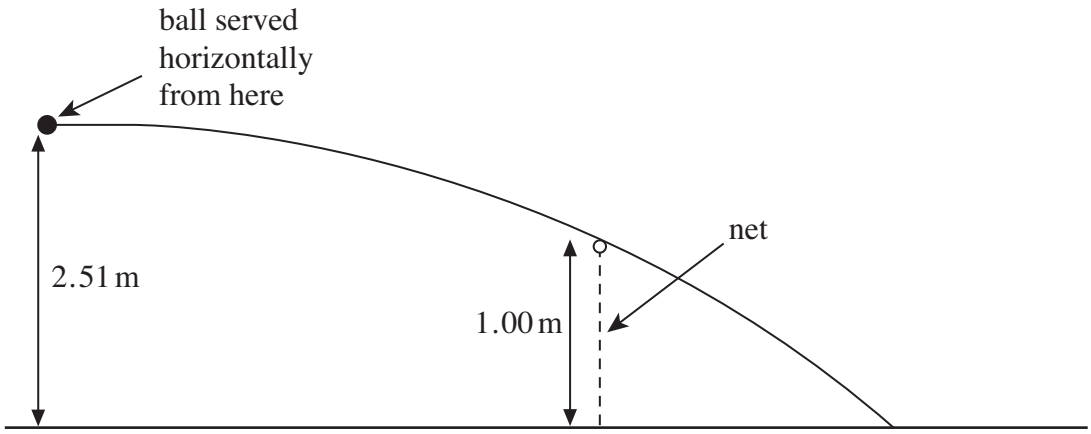
8

Turn over for the next question

8 A tennis player serves a ball from a height of 2.51 m at 18.0 m s^{-1} in a horizontal direction. The ball just clears the net which is 1.00 m high. In this question assume that air resistance is negligible.

Figure 2 shows the ball and its resulting trajectory across the court.

Figure 2



not to scale

8 (a) Show that the ball takes approximately 0.6 s to reach the net after being served.

(3 marks)

8 (b) (i) Calculate the vertical component of the velocity of the ball as it passes over the net.

vertical component of velocity ..... $m\,s^{-1}$

(2 marks)

8 (b) (ii) Calculate the overall velocity of the ball as it passes over the net.

magnitude of velocity ..... $m\,s^{-1}$

angle to horizontal ..... degree

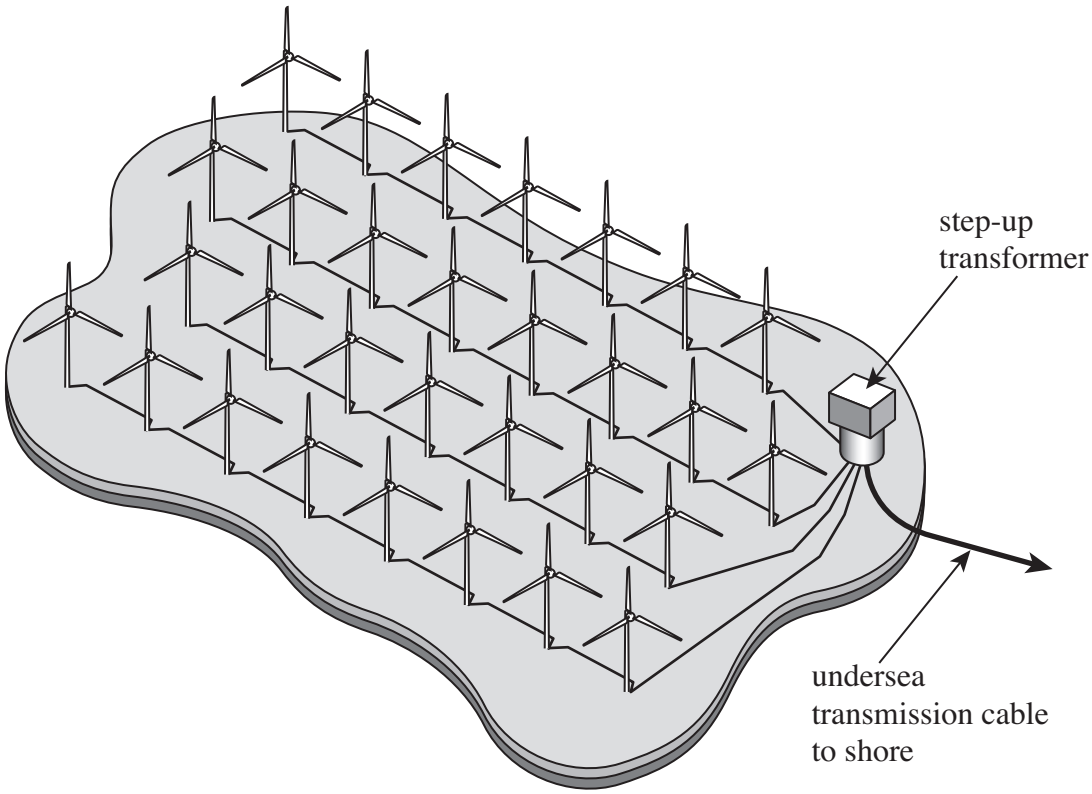
(3 marks)

8

9 An offshore wind farm located 28 km from the shore has 30 wind turbines. The wind farm delivers electrical power to the shore using an undersea transmission cable.

Figure 3 shows the 30 wind turbines, step-up transformer and undersea transmission cable.

Figure 3



9 (a) (i) State **one** advantage and **one** disadvantage of locating a wind farm offshore.

advantage .....

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disadvantage .....

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(2 marks)

9 (a) (ii) State and explain an advantage of using a step-up transformer for the transmission of electrical power from this wind farm.

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(3 marks)

9 (b) Each of the 30 wind turbines has a blade length of 45 m. On a particular day, the wind speed is $9.0\,m\,s^{-1}$.

9 (b) (i) Calculate the mass of air passing through one wind turbine in one second.
density of air = $1.3\,kg\,m^{-3}$

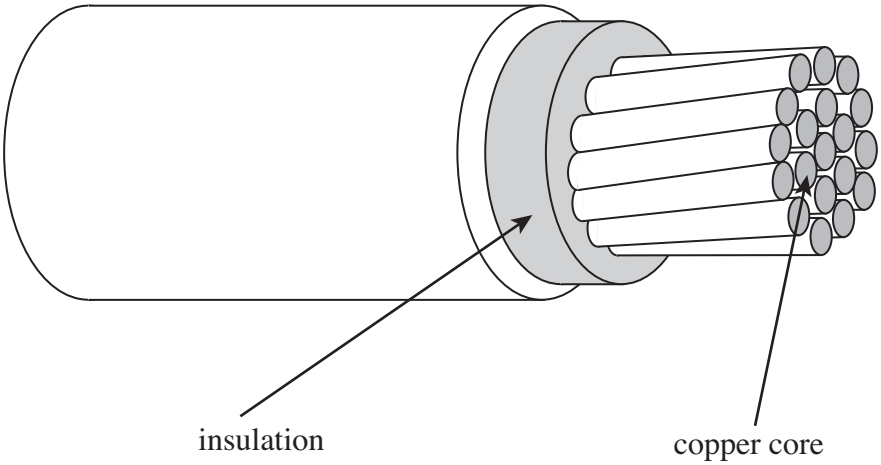
mass ..... kg
(2 marks)

9 (b) (ii) Calculate the total kinetic energy available each second to the wind farm from the wind.

total kinetic energy each second ..... J
(2 marks)

9 (c) A simplified diagram of a section of the undersea transmission cable is shown in **Figure 4**.

Figure 4



The undersea transmission cable is 28 km in length and has a conducting core consisting of 19 strands of copper wire each with a resistance of 17.3 Ω.

9 (c) (i) Calculate the cross-sectional area of one of these strands of copper wire.
resistivity of copper = 1.68×10^{-8} Ω m

cross-sectional area of a strand of wire ..... m^2

(3 marks)

9 (c) (ii) Show that the resistance of the undersea transmission cable is about 0.9 Ω.

(1 mark)

9 (d) On a different day, the wind speed is greater than $9.0\,m\,s^{-1}$ and the wind farm produces 110 MW of electrical power. The transformer steps up the voltage to 150 kV before the power is transmitted through the undersea transmission cable.

9 (d) (i) Calculate the current in the undersea transmission cable assuming that the transformer is 100% efficient.

current ..... A
(2 marks)

9 (d) (ii) Calculate the power loss in the undersea transmission cable due to the current.

power loss ..... W
(2 marks)

17

10 **Figure 5** shows car **A** being towed at a steady speed up a slope which is inclined at 5.0° to the horizontal. Assume that the resistive forces acting on car **A** are negligible.

Figure 5

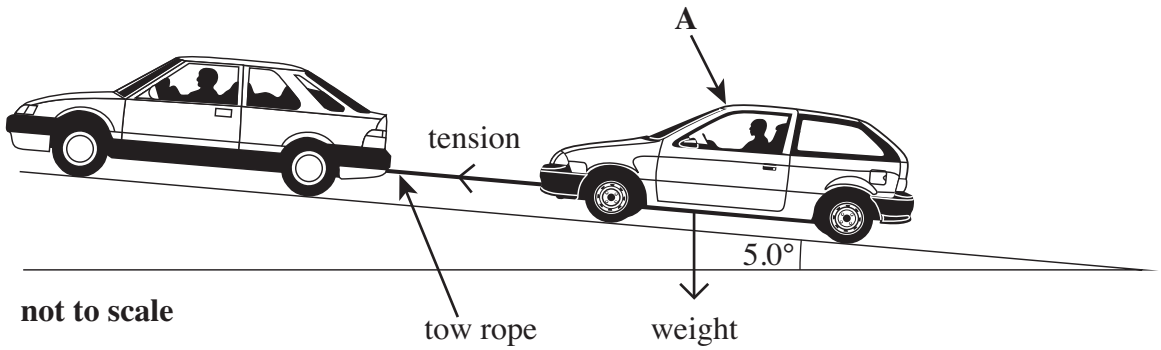
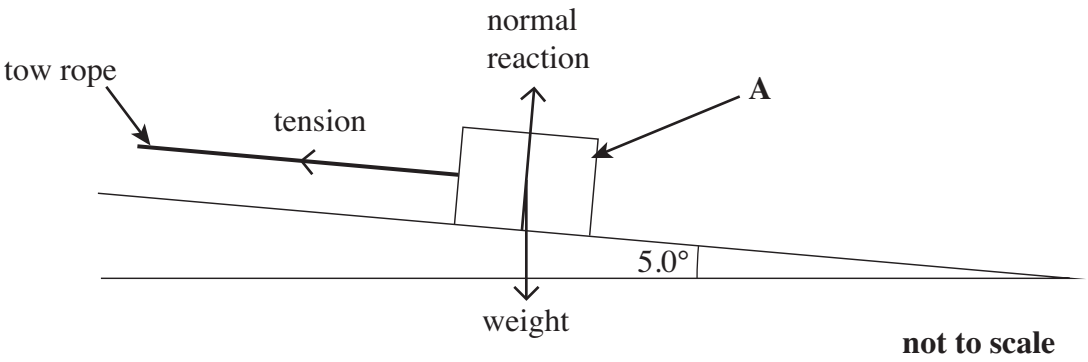


Figure 6 represents a simplified version of the forces acting on car **A** at the instant shown in **Figure 5**.

Figure 6



10 (a) (i) Car **A** has a mass of 970 kg.
Show that the component of its weight that acts parallel to the slope is approximately 830 N.

(2 marks)

10 (a) (ii) Calculate the energy stored in the tow rope as car **A** is towed up the slope at a steady speed. The tow rope obeys Hooke's law and has a stiffness of 2.5×10^4 N m^{-1}.

energy stored ..... J

(4 marks)

10 (b) The tow rope is attached to a fixing point on car **A** using a metal hook.
During the ascent of the slope the fixing point snaps and the metal hook becomes detached from car **A**. The metal hook gains speed due to the energy stored in the rope.
State and explain how the speed gained by the hook would have changed if the rope used had a stiffness greater than 2.5×10^4 N m^{-1}.

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(3 marks)

9

END OF QUESTIONS

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