Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
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9	
10	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2013

Physics (B): Physics in Context PHYB2

Unit 2 Physics Keeps Us Going

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

Wednesday 5 June 2013 9.00 am to 10.15 am

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 20 marks in this section.

1 Complete the following table.

energy source	Is the source renewable?	Is CO_2 emitted when the source is used to generate electricity?
Biomass	yes	yes
Fossil fuels		
Hydroelectric		
Nuclear		
Wind		

(4 marks)

2 The *U*-value of a solid brick wall is $2.0\,W\,m^{-2}\,K^{-1}$. Calculate the rate of heat transfer through a solid brick wall of area $15\,m^2$ when there is a temperature difference of 13 K between the two sides of the wall.

Give an appropriate SI unit for your answer.

rate of heat transfer ..... unit .....

(2 marks)

3 A girl throws a ball vertically upwards before catching it at the same height as it was released. The initial speed of the ball is $7.5\,m\,s^{-1}$. Ignore air resistance.

3 (a) Calculate the time for which the ball is in the air.

time ..... s

(2 marks)

3 (b) Calculate the maximum height above the point of release that the ball reaches.

maximum height ..... m

(2 marks)

Turn over ▶

4 Electricity is produced by a coal-fired power station. The transmission of the electricity using the National Grid is 90% efficient. A low energy compact fluorescent lamp (CFL) is 10% efficient.

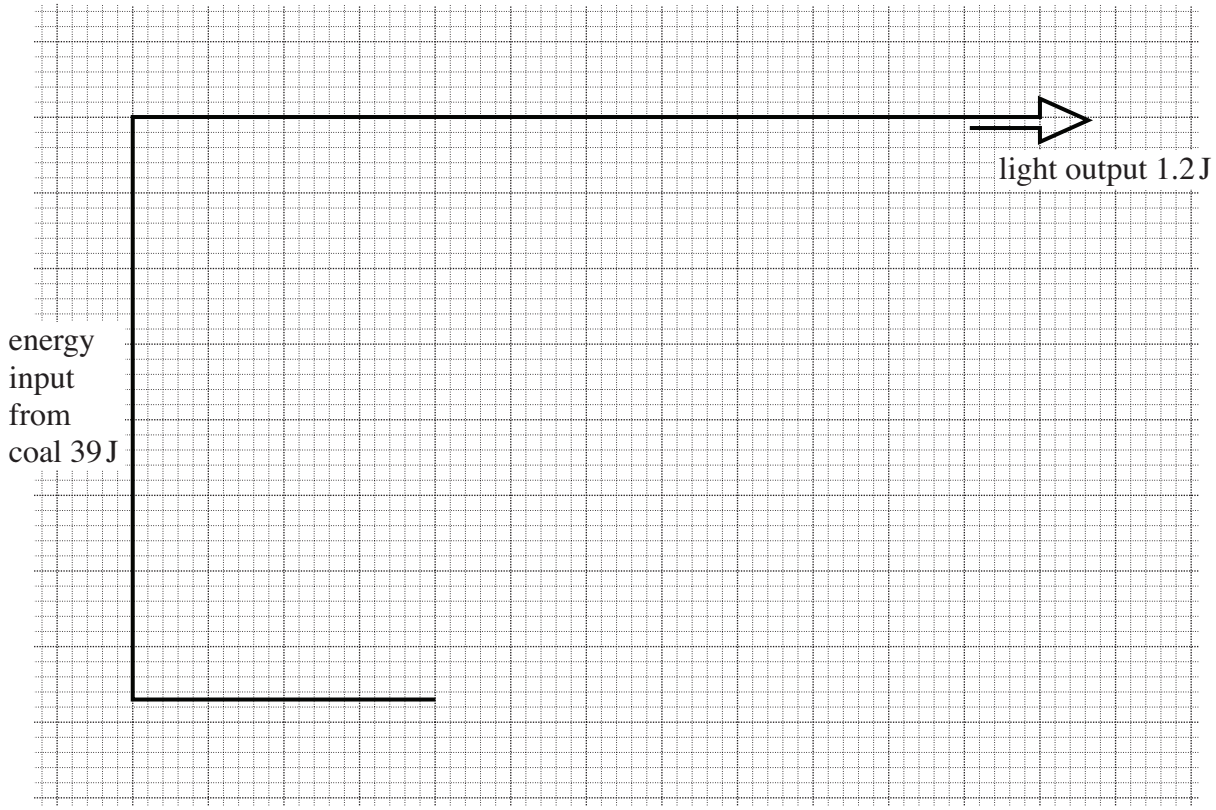
To produce 1.2 J of light from a CFL requires 39 J from the burning of coal.

4 (a) Show that the efficiency of the coal-fired power station is approximately 35%.

(2 marks)

4 (b) Complete the Sankey diagram in **Figure 1** to illustrate the overall energy conversions that occur after the coal has been burned.

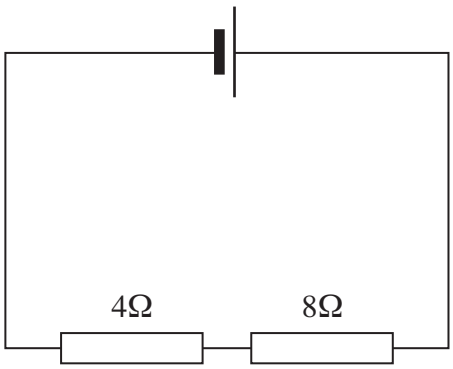
Figure 1



(3 marks)

5 (a) The cell in **Figure 2** has an emf of 3.0 V and negligible internal resistance.

Figure 2



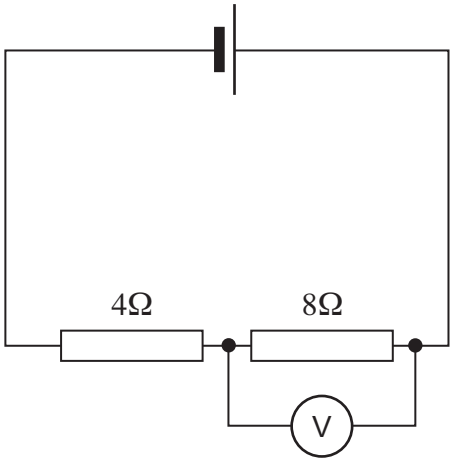
Calculate the potential difference across the 8 Ω resistor.

potential difference V

(2 marks)

5 (b) **Figure 3** shows the same circuit with a voltmeter connected across the 8 Ω resistor.

Figure 3



The voltmeter reads 1.8 V. Calculate the resistance of the voltmeter.

resistance ..... Ω

(3 marks)

20

Section B

Answer **all** questions in this section.

There are 50 marks in this section.

6 The driver of a car travelling with a velocity, v, along a level road, applies the brakes. The brakes lock and the car skids to a stop. The skidding distance, d, is given by

$$d = kv^2$$

where k is a constant.

6 (a) For a car travelling at a speed of $30\,m\,s^{-1}$, d is 45 m. Calculate the value of d when the car is travelling at $15\,m\,s^{-1}$.

d ..... m

(2 marks)

6 (b) The mass of the car and its passengers is 700 kg. Calculate the average skidding force that would bring the car to a stop from an initial speed of $30\,m\,s^{-1}$ in a skidding distance of 45 m.

average skidding force ..... N

(4 marks)

6 (c) By considering the equations for kinetic energy and the skidding distance, discuss how the heat generated when the car skids is related to d.

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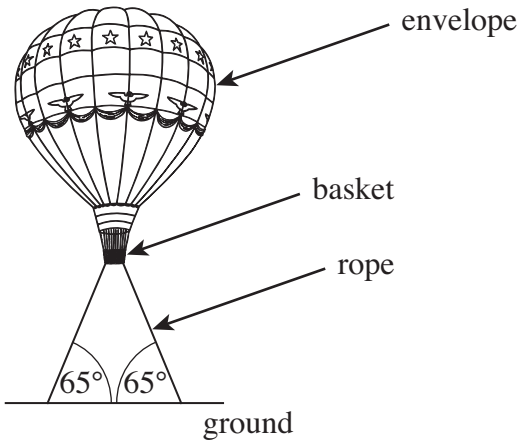
(3 marks)

9

7 **Figure 4** shows a hot-air balloon which is tethered to the ground by two ropes each making an angle of 65° with the level ground. The upward force on the basket is 7.8×10^2 N.

Figure 4



7 (a) (i) Show on **Figure 4** the direction of the force exerted by each rope on the basket.

(1 mark)

7 (a) (ii) Calculate the tension in one of the ropes.

tension ..... N

(3 marks)

7 (b) The balloon has buoyancy because hot air within the envelope displaces cold air. Archimedes' principle applies to the balloon.

volume of the envelope = 2.50×10^3 m^3
density of cold air = 1.20 kg m^{-3}
density of hot air = 0.92 kg m^{-3}

7 (b) (i) State Archimedes' principle.

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(1 mark)

7 (b) (ii) Show that the weight of the cold air displaced is about 3×10^4 N.

(2 marks)

7 (b) (iii) Calculate the weight of the balloon when the envelope is deflated and contains no air.

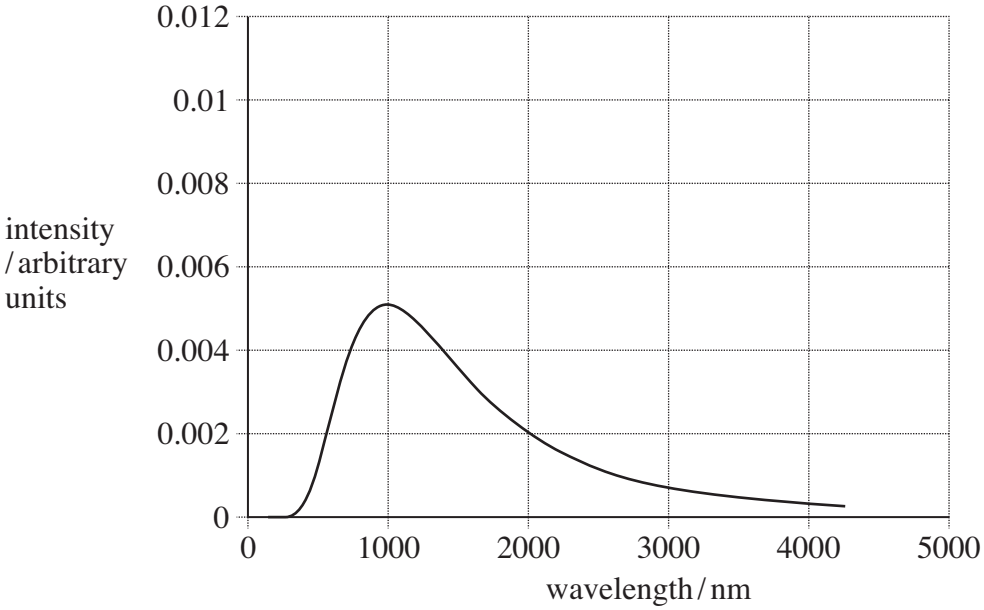
weight of deflated balloon ..... N

(3 marks)

10

8 **Figure 5** shows the variation with wavelength, λ, of the intensity of electromagnetic radiation emitted by a star at a surface temperature of 2900 K.

Figure 5



The surface of the Sun is at a temperature of 5800 K and that of the Earth is 290 K. They may both be considered to radiate energy as black bodies.

8 (a) (i) Show, with an arrow labelled **M** on **Figure 5**, the maximum wavelength of visible light from the star.

(1 mark)

8 (a) (ii) Calculate the wavelengths corresponding to the maximum intensity for the radiation emitted by the Sun and the Earth.

wavelength for the Sun ..... nm

wavelength for the Earth ..... nm

(3 marks)

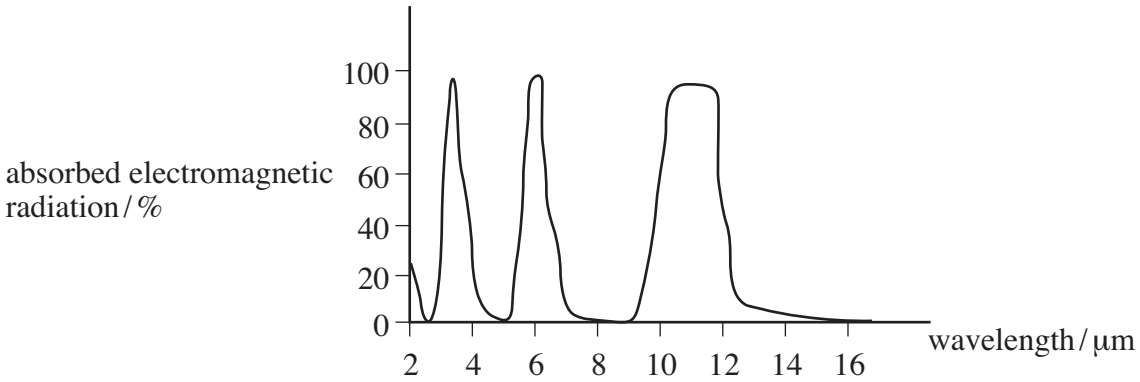
8 (a) (iii) Draw on **Figure 5** the emission curve for the Sun.

(1 mark)

Turn over ▶

8 (b) **Figure 6** shows how the percentage of electromagnetic radiation, absorbed by carbon dioxide, varies with the wavelength of the radiation.

Figure 6



8 (b) (i) The graph indicates that carbon dioxide has radiation windows.
Suggest what is meant by the term *radiation windows* in this context.

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(1 mark)

8 (b) (ii) State and explain whether carbon dioxide has a radiation window for radiation of wavelength 11 μm.

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(1 mark)

8 (c) Discuss the role of transmitted, absorbed and emitted radiation in global warming through the 'greenhouse' effect. Your answer should make reference to thermal emission from the Sun and from the Earth.

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

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(6 marks)

13

9 At room temperature a metal has a resistivity of $4.5 \times 10^{-7}\ \Omega\text{m}$. A wire made from this metal has a radius of 0.70 mm.

9 (a) (i) Calculate the resistance of a 2.5 m length of the wire at room temperature.

resistance ..... Ω

(3 marks)

9 (a) (ii) Calculate the power dissipated in this length of wire when it carries a current of 20 mA. Assume the resistance of the wire is constant.

power ..... W

(2 marks)

9 (b) The wire becomes superconducting as it is cooled. Draw a sketch graph on the axes below to show how the wire's resistivity would vary with temperature as it is cooled from room temperature θ_r.

(3 marks)

9 (c) Explain why the efficiency of electrical power transmission is improved when conventional wires are replaced with superconducting wires.

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(1 mark)

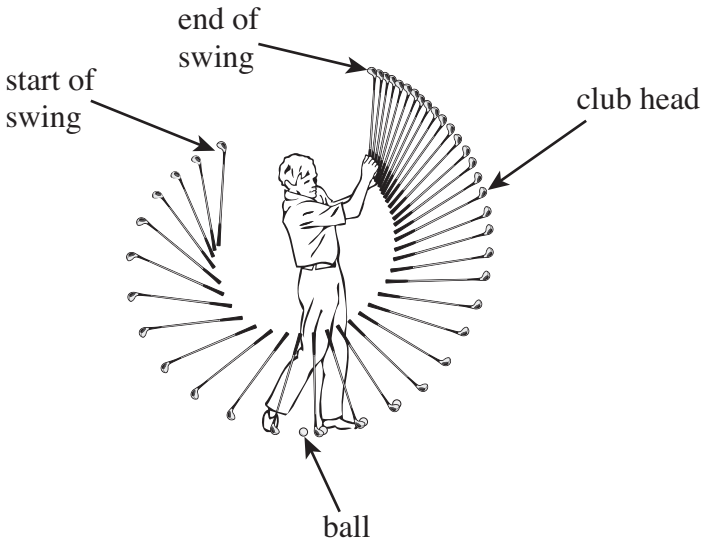
9

Turn over for the next question

10 When hitting golf balls long distances, golfers *follow through* with the swing. Doing this increases the time for which the club head is in contact with the ball.

Figure 7 is a stroboscopic photograph of a golf swing. The images were taken at equal time intervals.

Figure 7



10 (a) Sketch, on the axes below, how the speed of the club head varies with time over the whole swing.

(2 marks)

10 (b) Explain in terms of the impulse acting on the ball the advantage to the golfer of following through with the swing.

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(2 marks)

10 (c) The club head is in contact with the ball for a time of 180 μs. The mass of the club head is 0.17 kg and that of the ball is 0.045 kg. At the moment of contact the ball is at rest and the club head is moving with a speed of 35 m s^{-1}. The ball moves off with an initial speed of 58 m s^{-1}.

10 (c) (i) Calculate the average force acting on the ball while the club head is in contact with it.

average force on ball ..... N

(2 marks)

10 (c) (ii) Deduce the average force acting on the club head due to its collision with the ball.

average force on club head ..... N

(1 mark)

10 (c) (iii) Explain why it is not possible to transfer all the kinetic energy of the club head to the ball.

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(2 marks)

9

END OF QUESTIONS

There are no questions printed on this page

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