Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Science B
Unit Physics P1

PHY1H

H

Physics
Unit Physics P1

Monday 30 January 2012 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- 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.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

There are no questions printed on this page

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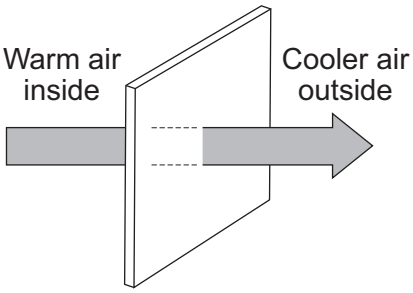
ANSWER IN THE SPACES PROVIDED

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

1 The diagram shows the direction of heat transfer through a single-glazed window.



1 (a) (i) Name the process by which heat is transferred **through** the glass.

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(1 mark)

1 (a) (ii) Explain how heat is transferred **through** the glass.

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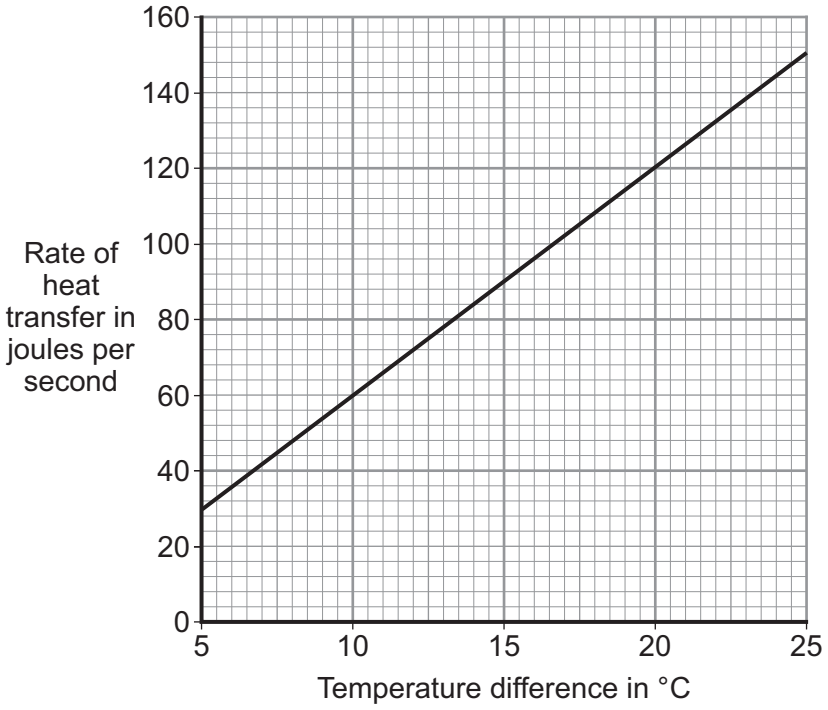
(2 marks)

Question 1 continues on the next page

1 (b) The rate of heat transfer through a window depends on the difference between the inside and outside temperatures.

The graph shows the rate of heat transfer through a $1m^2$ single-glazed window for a range of temperature differences.



1 (b) (i) What is the range of temperature differences shown in the graph?

From ..... to .....

(1 mark)

1 (b) (ii) A student looks at the graph and concludes:

'Doubling the temperature difference doubles the rate of heat transfer.'

Use data from the graph to justify the student's conclusion.

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(2 marks)

1 (b) (iii) A house has single-glazed windows. The total area of the windows in the house is 15 m^2.

On one particular day, the difference between the inside and outside temperatures is 20 °C.

Use the graph to calculate the total rate of heat transfer through all of the windows on this particular day.

Show clearly how you work out your answer.

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Rate of heat transfer = ... J/s

(2 marks)

1 (c) A homeowner plans to replace the single-glazed windows in his home with double-glazed windows. He knows that double-glazed windows will reduce his annual energy bills.

The table gives information about the double glazing to be installed by the homeowner.

Cost to buy and install	Estimated yearly savings on energy bills	Estimated lifetime of the double-glazed windows
£5280	£160	30 years

Explain, in terms of energy savings, why replacing the single-glazed windows with these double-glazed windows is not cost effective.

To gain full marks you must complete a calculation.

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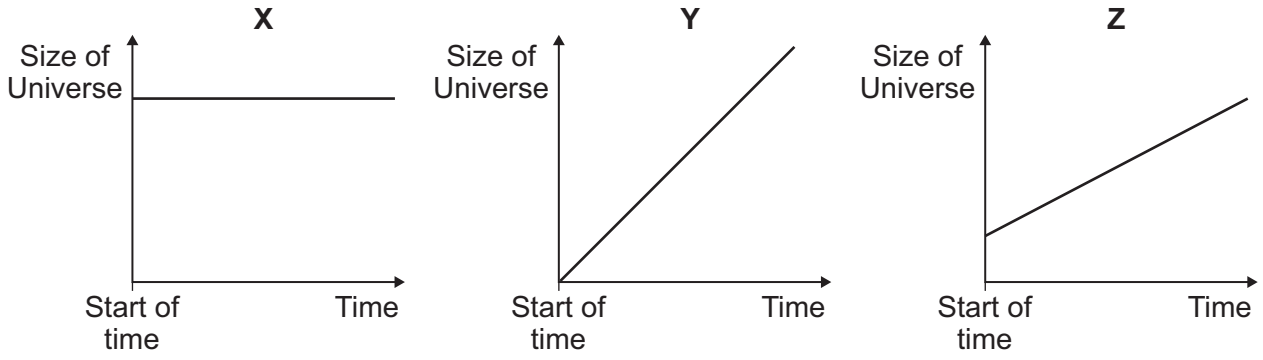
(2 marks)

10

2 The 'big bang' theory is one theory explaining the origin of the Universe.

2 (a) The graphs **X**, **Y** and **Z**, show how the size of the Universe may have changed with time.



Which graph would the 'big bang' theory suggest is correct?

Write your answer, **X**, **Y** or **Z**, in the box. ☐

Explain the reason for your answer.

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(3 marks)

2 (b) In 1948, an alternative to the 'big bang' theory, called the 'steady state' theory, was developed.
The 'steady state' theory suggested that the Universe, although expanding, has always existed without a beginning in time.

2 (b) (i) Complete the following sentence by drawing a ring around the correct line in the box.

The measurement of red-shift in the light from distant galaxies provides evidence

to support

only the 'big bang' theory.
only the 'steady state' theory.
both the 'big bang' and 'steady state' theories.

(1 mark)

2 (b) (ii) In 1965, scientists rejected the 'steady state' theory in favour of the 'big bang' theory.

Suggest what might cause scientists to stop supporting one theory and to start supporting an alternative theory.

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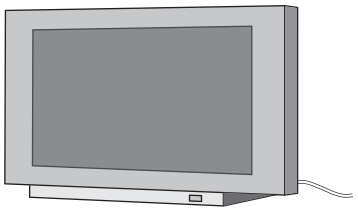
(1 mark)

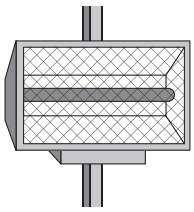
5

Turn over for the next question

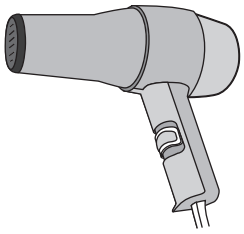
3 The data included in the diagrams gives the power of the electrical appliances.



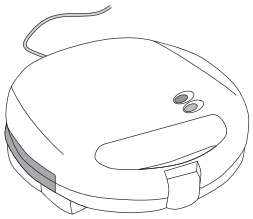
TV
160 W



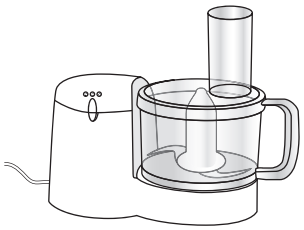
Radiant heater
1.0 kW



Hairdryer
1100 W



Sandwich toaster
1.1 kW



Food processor
0.4 kW

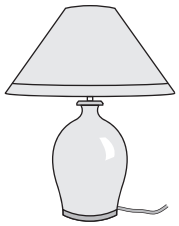


Table lamp
40 W

3 (a) (i) Which of the appliances are designed to transform electrical energy to kinetic energy?

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.....

(1 mark)

3 (a) (ii) Which of the appliances waste energy as heat?

.....

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(1 mark)

3 (b) Leaving the radiant heater switched on is likely to lead to more carbon dioxide being emitted into the atmosphere than leaving the table lamp on for the same length of time.

Explain why.

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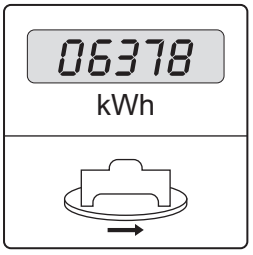
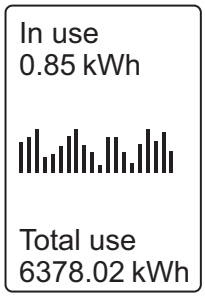
(2 marks)

3 (c) A homeowner decides to monitor the amount of electrical energy used in his home. He can do this by using the home's electricity meter or by using a separate electronic device.

The table gives some information about each method.

Electricity meter	Electronic device
Records to the nearest kilowatt-hour	Records to the nearest 1/100th kilowatt-hour
Homeowner takes readings at regular intervals	Energy use recorded continuously and stored for one year
	Displays a graph showing energy use over a period of time
	

3 (c) (i) Complete the following sentence.

The reading given by the electronic device is more ..... than the reading given by the electricity meter.

(1 mark)

3 (c) (ii) Suggest how data collected and displayed by the electronic device could be useful to the homeowner.

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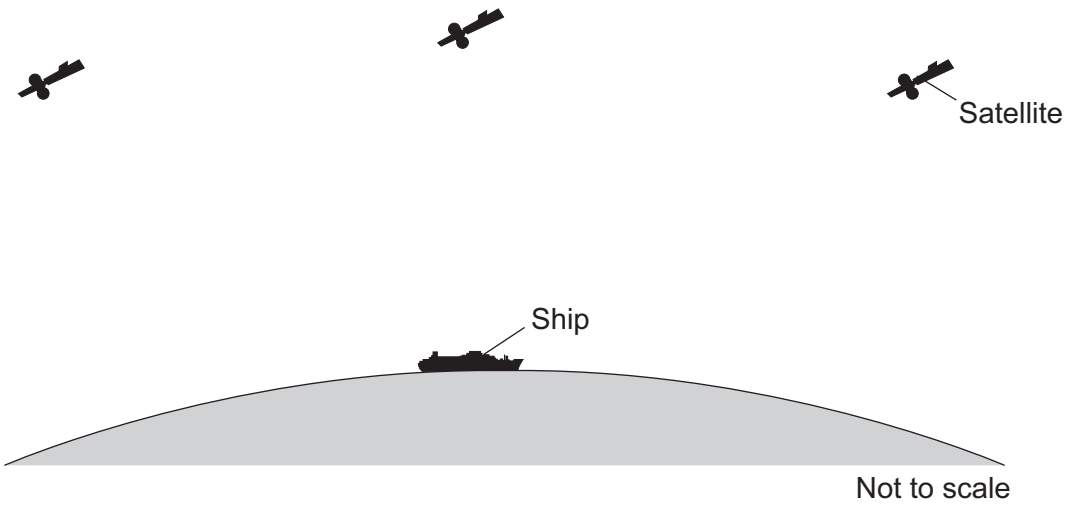
(3 marks)

8

Turn over ▶

4 The ship in the diagram is fitted with a navigation system. The navigation system works out the location of the ship by timing the microwave signals transmitted from at least three satellites.



4 (a) Microwaves are one type of electromagnetic wave.

Give **two** properties that all electromagnetic waves have.

1 .....

.....

2 .....

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(2 marks)

4 (b) The microwaves used in the navigation system are transmitted at a frequency of 1575 MHz.

Use the equation and information in the box to calculate the wavelength of the microwaves used in the navigation system.

wave speed = frequency × wavelength
microwaves travel at 300 000 000 m/s
1 MHz = 1 000 000 Hz

Show clearly how you work out your answer.

.....

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Wavelength = ... m

(3 marks)

4 (c) The ship is fitted with a metal aerial that receives the microwave signals from the satellites.

For the navigation system to work, what effect must the microwave signals have on the aerial?

.....

.....

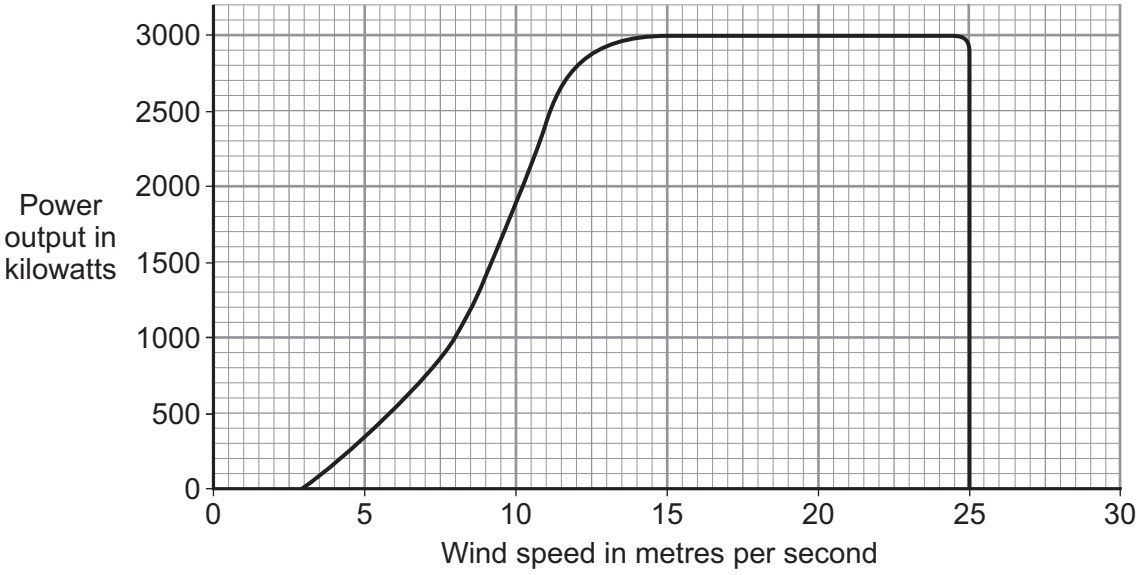
(1 mark)

6

Turn over for the next question

5 The world's biggest offshore wind farm, built off the Kent coast, started generating electricity in September 2010.

5 (a) The graph shows how wind speed affects the power output from one of the wind turbines.



In one 4-hour period, the wind turbine transfers 5600 kilowatt-hours of electrical energy.

Use the equation in the box and the data in the graph to calculate the average wind speed during this 4-hour period.

energy transferred = power × time

Show clearly how you work out your answer.

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Average wind speed = ... m/s

(3 marks)

5 (b) The wind turbines are linked to the National Grid by underwater cables.

5 (b) (i) What is the National Grid?

.....

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(1 mark)

5 (b) (ii) How is the National Grid designed to reduce energy losses during transmission?

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(1 mark)

5 (c) Read this extract from a newspaper.

> **Power crisis as island basks in sunshine**
>
> The population of a small island off the coast of Scotland decided to generate all their electricity from water and wind. However, they did not predict having a long period of warm, dry weather. A combination of low water levels and hardly any wind has drastically reduced the output from the hydroelectric power station and wind turbines.

Explain **one** way in which the islanders could try to ensure that a similar power crisis does **not** happen in the future.

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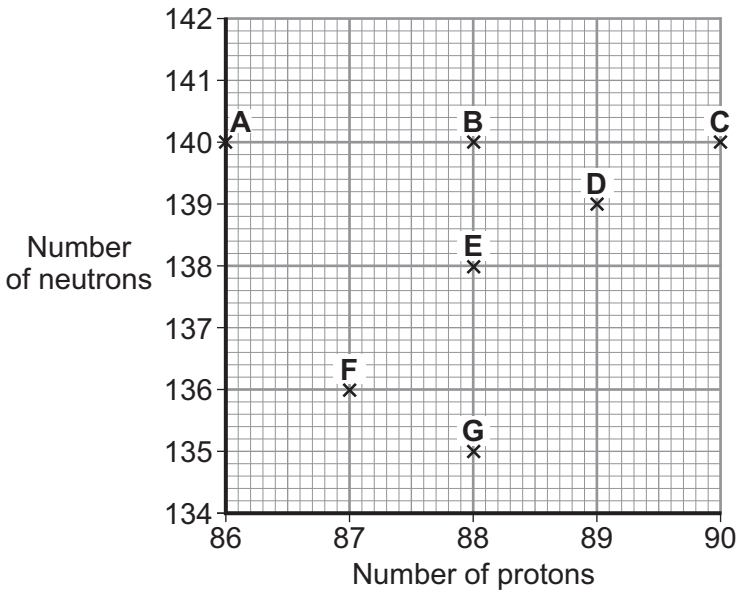
(2 marks)

7

6 (a) The chart gives the number of protons and neutrons within the nuclei of 7 different atoms, **A** – **G**.



Which of these atoms are isotopes of the same element?

.....

Give a reason for your answer.

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(2 marks)

6 (b) Radium-226 is a radioactive isotope that decays into radon gas by emitting alpha particles.

The decay can be represented by the equation below.

$$^{226}_{88}\text{Ra} \longrightarrow \square \atop \square \text{Rn} + \text{alpha particle}$$

6 (b) (i) Complete the equation by writing the correct number in each of the boxes.

(2 marks)

6 (b) (ii) A sample of radium-226 has a count rate of 400 counts per second.
The half-life of radium-226 is 1600 years.

How long will it be before the count rate has fallen to 50 counts per second?

Show clearly how you work out your answer.

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Length of time = ... years
(2 marks)

6 (c) In 1927, a group of women who had been employed to paint watch faces with a luminous paint sued their former employer over the illnesses caused by the paint. The women had been told that the paint, which contained radium, was harmless.

The company owners and the scientists working for the company knew that radium was harmful and took precautions to protect themselves from the radiation. The women were given no protection.

What important issue did the treatment of the women by the company owners and scientists raise?

Draw a ring around your answer.

economic **environmental** **ethical** **social**

Give a reason for your answer.

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(2 marks)

6 (d) In the 1920s, many people, including doctors, thought that radium could be used as a treatment for a wide range of illnesses. Medical records that suggested radium could be harmful were generally ignored. When some of the women who had used the luminous paint died, their deaths were not blamed on radium.

Suggest a reason why the evidence suggesting that radium was harmful was generally ignored.

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(1 mark)

9

END OF QUESTIONS

There are no questions printed on this page

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