Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2012

Science B
Unit Physics P1

Physics
Unit Physics P1

PHY1H

H

Wednesday 20 June 2012 9.00 am to 9.45 am

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.

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

1 A farmer has installed a biogas electricity generator on his farm. This device generates electricity by burning the methane gas produced from rotting animal waste. Methane is a greenhouse gas. When methane burns, carbon dioxide and water are produced.

The animal waste rots in an anaerobic digester. The digester and the generator are kept inside a farm building and cannot be seen from the outside.

1 (a) The animal waste used in the anaerobic digester is a *renewable* energy source.

What is meant by an energy source being *renewable*?

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(1 mark)

1 (b) Suggest **one** reason why farmers have been encouraged to install their own biogas generators.

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(1 mark)

1 (c) The farmer's monthly electricity bill using the mains electricity supply was £300. The biogas generator cost the farmer £18 000 to buy and install.

Assuming the biogas generator provides all of the farmer's electricity, what is the pay-back time for the generator?

.....

Pay-back time = ...

(1 mark)

1 (d) It would have been cheaper for the farmer to have bought and installed a small wind turbine.

Give **two** advantages of using the biogas generator rather than a wind turbine, to generate the electricity used on the farm.

1 .....

.....

2 .....

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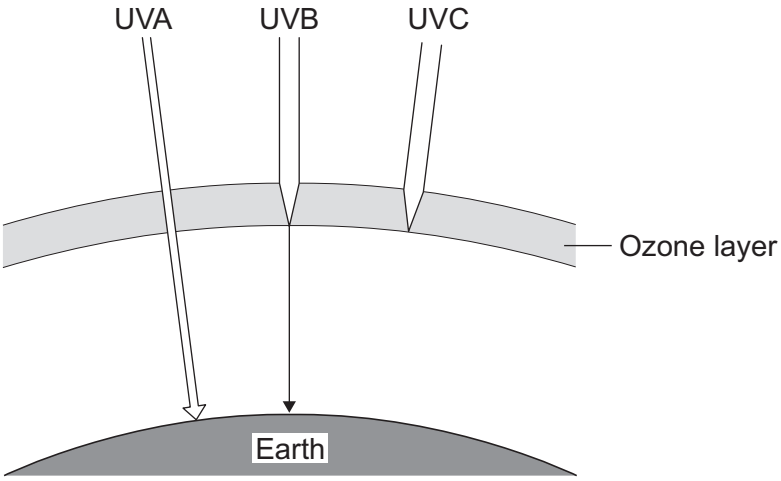
(2 marks)

5

2 When outside, we need to protect our skin and eyes from the harmful effects of ultraviolet (UV) radiation. There are three types of UV radiation.

2 (a) The diagram shows the effect of the ozone layer on each of the three types of UV radiation. The width of the arrow represents the amount of UV radiation.



2 (a) (i) Which type of UV radiation will **not** have a harmful effect on our skin or eyes?

Draw a ring around your answer.

UVA **UVB** **UVC**

Give a reason for your answer.

.....

.....

(2 marks)

2 (a) (ii) The ozone layer above some places on the Earth's surface is very thin.

Explain the effect of a decrease in the thickness of the ozone layer on the risk to health from UV radiation, for people living at these places.

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(2 marks)

Question 2 continues on the next page

Turn over ▶

2 (b) Scientists have investigated the effect that the type of ground surface has on the amount of UV radiation entering the eye.

Two dummies, each fitted with UV sensors in the eyes, were used to measure the intensity of the UV radiation over the same period of time. The measurements were taken with one dummy facing the Sun, and the other dummy facing away from the Sun.

Measurements were taken in two places, one on a snow-covered area, the other on a sandy beach.

The results of their investigation are given in the table.

Position of the dummy head	**Intensity of UV radiation in the snow-covered area in arbitrary units**	**Intensity of UV radiation in the sandy beach area in arbitrary units**
Facing the Sun	650	250
Facing away from the Sun	520	50

2 (b) (i) What was the independent variable in this investigation?

.....

(1 mark)

2 (b) (ii) How could the reliability of the data collected in this investigation have been improved?

.....

.....

(1 mark)

2 (b) (iii) Some of the UV radiation measured by the sensors has been reflected from the surface of the ground.

Which surface is the best reflector of UV radiation, sand or snow?

Draw a ring around your answer. **sand** **snow**

Give **one** reason for your answer.

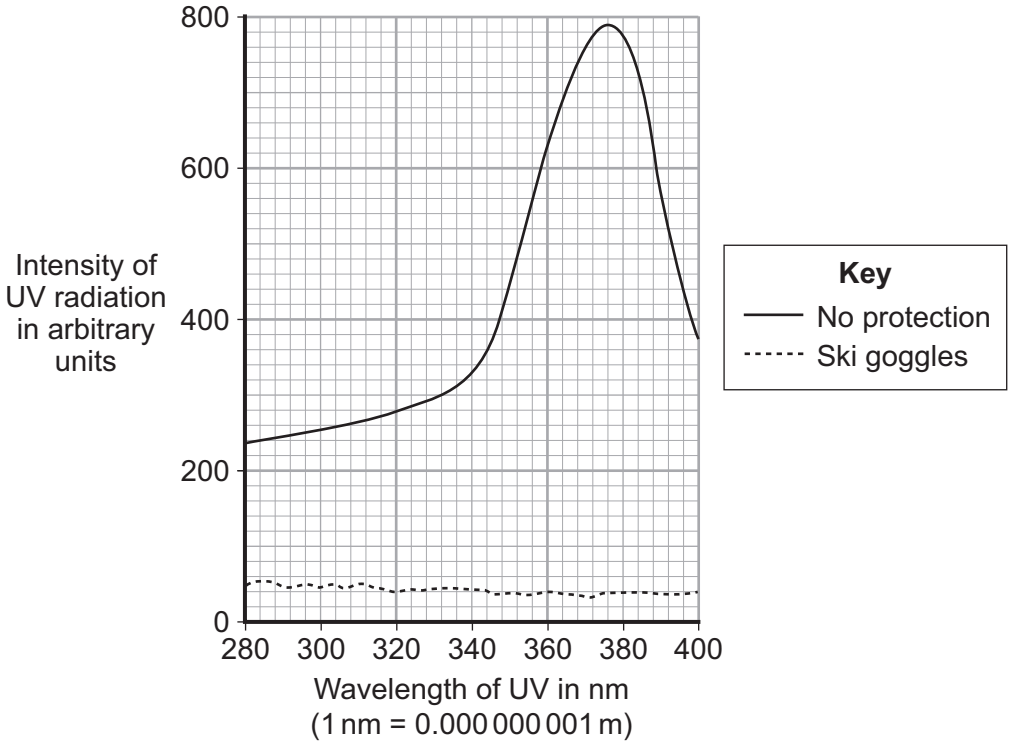
.....

.....

(1 mark)

2 (c) Ski goggles are designed to block UV radiation. The manufacturer of one brand of ski goggles claims that the goggles block 100 % of all UV radiation. These goggles were tested using UV radiation with a range of different wavelengths.

The results of the test are shown in the graph.



Do the results of the test support the claim made by the manufacturer?

Draw a ring around your answer. **Yes** **No**

Explain the reason for your answer.

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(2 marks)

9

3 Mobile phone networks send digital signals using microwaves.

3 (a) What type of radiation are microwaves?

.....

(1 mark)

3 (b) One part of a mobile phone is designed to convert an analogue signal into a digital signal.

Draw in the boxes below an example of an analogue signal and an example of a digital signal.

Analogue signal	**Digital signal**

(2 marks)

3 (c) Read the following extract taken from a newspaper.

Parents organise petition against plans to site phone mast near school

Parents continue to protest against the proposed mobile phone mast. This is despite learning that a recent national study has found no link between childhood cancer and mobile phone masts. Some scientists commenting on the study claim that the evidence is unreliable and that the long-term effect of microwave radiation has yet to be proved.

3 (c) (i) Using the information in the extract, suggest **one** reason why the parents continue to protest against the mobile phone mast.

.....

.....

(1 mark)

3 (c) (ii) Some schools have mobile phone masts in their school grounds. The schools are paid by a mobile phone company for allowing this.

Complete the following sentence by drawing a ring around the correct line in the box.

Accepting payment for allowing a mobile phone mast in school grounds raises

ethical and economic
economic and environmental
environmental and social

issues.

(1 mark)

5

Turn over for the next question

4 Optical telescopes may be used to observe galaxies. Some optical telescopes are on the Earth and some are on satellites in space.

4 (a) How is the image produced by an optical telescope on a satellite in space better than the image produced by an optical telescope on the Earth?

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Give a reason for your answer.

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(2 marks)

4 (b) Scientists have observed that the wavelengths of the light from galaxies moving away from the Earth are longer than expected. This observation is called red-shift.

4 (b) (i) What does the size of the red-shift tell the scientists about the distance a galaxy is from the Earth?

.....

.....

(1 mark)

4 (b) (ii) Complete the following passage.

Red-shift provides evidence to support the 'big bang' theory. The 'big bang' theory is

one of the ways of explaining the ..... of the Universe.

(1 mark)

4

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

5 A homeowner had a new gas boiler installed.

5 (a) The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)
Efficiency	0.95

5 (a) (i) Use the equation in the box to calculate the energy transferred each second by the gas boiler to the water inside the boiler.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Energy transferred by the gas boiler each second = ... kJ

(2 marks)

5 (a) (ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Use the equations in the box to calculate the total number of hours that the gas boiler would operate for £30.

energy transferred = power × time
total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

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Number of hours = ...

(2 marks)

5 (b) Although the gas boiler is very efficient, some energy is wasted.

Explain what happens to the waste energy.

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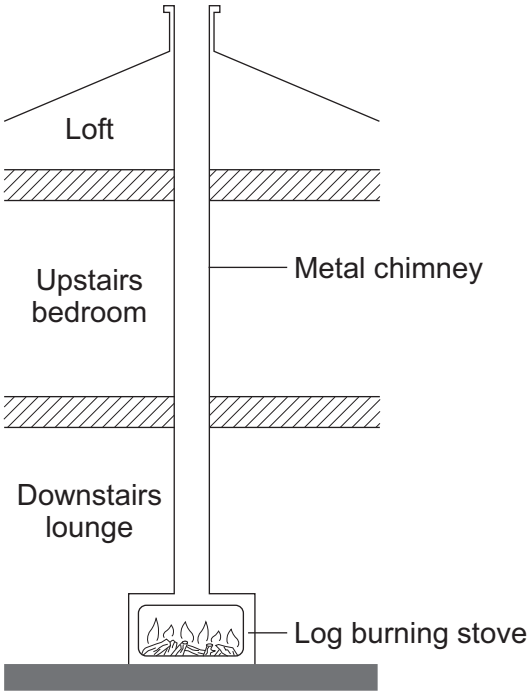
(2 marks)

6

Turn over for the next question

6 The diagram shows how the metal chimney from a log-burning stove passes through the inside of a house.



6 (a) Explain how heat is transferred by the process of convection from the inside of the stove to the top of the chimney.

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(2 marks)

6 (b) Although the outside of the chimney becomes very hot, there is no insulating material around the chimney.

6 (b) (i) Explain, in terms of the particles in a metal, how heat is transferred by conduction from the inside to the outside of the metal chimney.

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.....

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(2 marks)

6 (b) (ii) Suggest **one** advantage of having no insulation around the chimney.

.....

.....

(1 mark)

5

Turn over for the next question

7 Food irradiation is a process that exposes food to radiation. Irradiation can be used to kill the bacteria that cause food poisoning or to slow down the ripening of fresh fruit and vegetables. Frozen foods and food inside packaging can also be irradiated.

7 (a) The table gives information about five radioactive isotopes.

Isotope	Half-life	Radiation emitted
Caesium-134	2.1 years	beta
Cobalt-60	5.3 years	gamma
Curium-242	160 days	alpha
Strontium-90	28 years	beta
Technetium-99	6 hours	gamma

Which of these radioactive isotopes would be most suitable for irradiating food?

.....

Explain the reasons for your choice.

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(3 marks)

7 (b) Many people think that food should not be irradiated. Consumer groups have said that they are worried about the nutritional value and safety of eating irradiated foods.

7 (b) (i) Suggest **one** reason why some people may be concerned about the safety of eating irradiated food.

.....

.....

(1 mark)

7 (b) (ii) Independent scientific committees in several countries, including Sweden, Canada and the UK, have concluded that it is safe to eat irradiated food.

These scientific committees need to be independent from government influence.

Suggest why.

.....

.....

(1 mark)

7 (b) (iii) One group of scientists has compared the vitamin content of non-irradiated foods with irradiated foods.

The table below gives the data obtained for 1 kg of cooked chicken.

Vitamin	Non-irradiated food in milligrams	Irradiated food in milligrams
B6	1.22	1.35
B12	21.00	28.00
E	3.30	2.15
Niacin	58.00	55.50
Riboflavin	2.10	2.25

Considering only the data in the table, is it valid to conclude that irradiated food is less nutritional than non-irradiated food?

Explain your answer.

.....

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.....

(2 marks)

Question 7 continues on the next page

7 (b) (iv) In a restaurant, meals with ingredients that have been irradiated must be clearly identified on the menu.

It is important that people eating in a restaurant are given this information.

Suggest why.

.....

.....

(1 mark)

7 (c) The isotope caesium-137 decays by emitting beta radiation.
Caesium-137 has a half-life of 30 years.

7 (c) (i) What is a beta particle, and from which part of an atom is a beta particle emitted?

.....

.....

(1 mark)

7 (c) (ii) A sample containing caesium-137 has a count rate of 600 counts per minute.

Calculate how long it would take for the count rate from the sample to fall to 75 counts per minute.

Show clearly how you work out your answer.

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Time taken = ... years

(2 marks)

11

END OF QUESTIONS