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
June 2011

Science B
Unit Physics P1

PHY1H

H

Physics
Unit Physics P1

Friday 17 June 2011 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

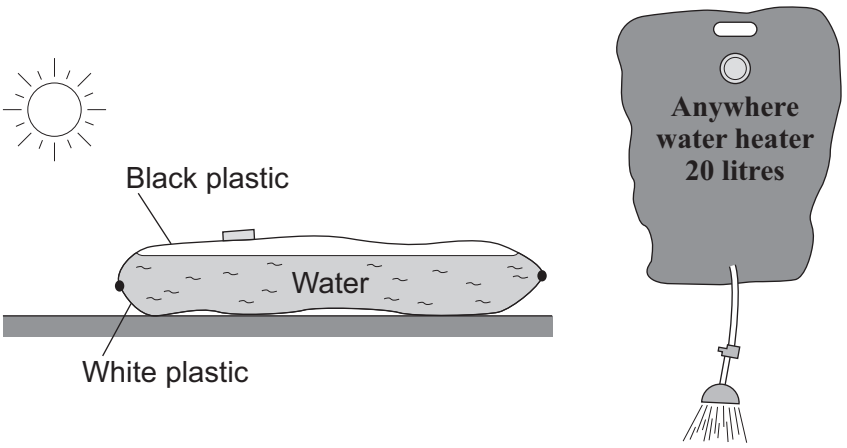
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work 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.

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

1 The diagram shows a simple type of portable shower. The water container is a strong plastic bag that is black on one side and white on the other. To warm the water, the bag is placed on the ground in direct sunlight, with the black side facing the Sun.



1 (a) (i) Name the process by which heat is transferred from the Sun to the outside of the bag.

.....

(1 mark)

1 (a) (ii) Explain why the black side of the bag and not the white side should face the Sun.

.....

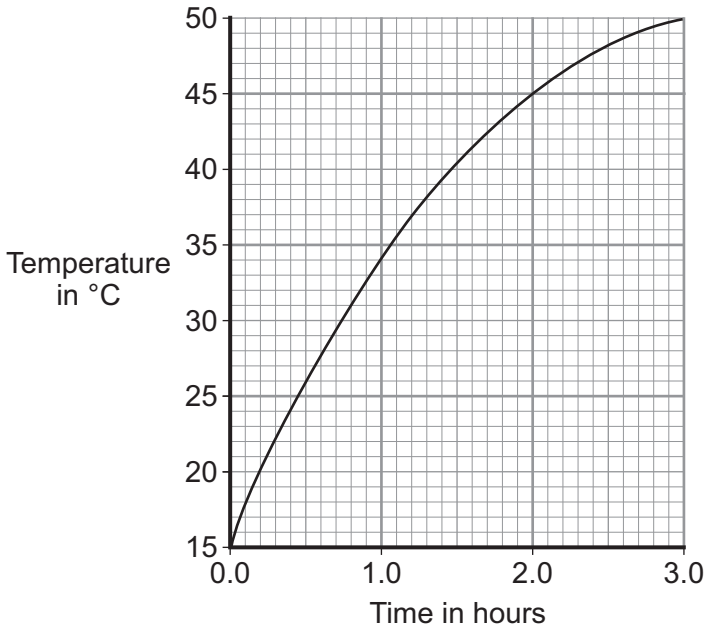
.....

.....

.....

(2 marks)

1 (b) The graph shows how the temperature of the water inside a full bag increases after the bag is placed outside on a sunny day.



1 (b) (i) How long does it take for the water to reach 37 °C?

.....

(1 mark)

1 (b) (ii) Describe how the temperature of the water changes during the three hours.

.....

.....

(1 mark)

1 (c) A different manufacturer makes the same type of portable shower but uses a bag with a larger surface area. The bag is made from the same coloured plastics and holds the same amount of water.

1 (c) (i) To compare the efficiency of the two bags at heating water, several variables need to be controlled.

Name **two** variables that need to be controlled.

1 .....

2 .....

(2 marks)

1 (c) (ii) The second bag has a larger surface area.
Draw a line on the graph to show how the temperature of the water inside the second bag would change over the first hour.
Assume that the two bags are tested in exactly the same way.

(1 mark)

8

2 (a) By 2023, nearly all of the existing nuclear power stations in the UK will be closed down.

2 (a) (i) Before a nuclear power station can be demolished, the remaining nuclear fuel, radioactive waste materials and reactor must be carefully removed.

What is this process called?

Put a tick (✓) in the box next to your answer.

decommissioning ☐

decontaminating ☐

dismantling ☐

(1 mark)

2 (a) (ii) The workers are exposed to radiation as they remove the reactor. One of the biggest risks is from the isotope cobalt-60, which has a half-life of 5.3 years.

Explain the advantage of waiting 11 years after a nuclear power station has closed down before starting to remove the reactor.

.....

.....

.....

.....

(2 marks)

2 (b) It is almost certain that new nuclear power stations will be built in the UK.

The table shows the results of surveys asking people in the UK whether they were in favour of, or against, the building of new nuclear power stations.

	2001	**2005**	**2007**
Percentage (%) in favour	20	41	65
Percentage (%) against	60	28	20
Percentage (%) not sure	20	31	15

2 (b) (i) From these surveys, how did public opinion on the building of new nuclear power stations change between 2001 and 2007?

.....

.....

(1 mark)

2 (b) (ii) Suggest a reason why some people may think that the results from these surveys are unreliable.

.....

.....

(1 mark)

2 (b) (iii) Give **one** reason in favour of building new nuclear power stations.

.....

.....

(1 mark)

Question 2 continues on the next page

2 (c) The government of one Middle Eastern country has decided to build its first nuclear power station. The oil that would have been used to generate electricity can then be sold to other countries.

On what is this decision based?

Put a tick (✓) in the box next to your answer.

economic issues ☐

ethical issues ☐

social issues ☐

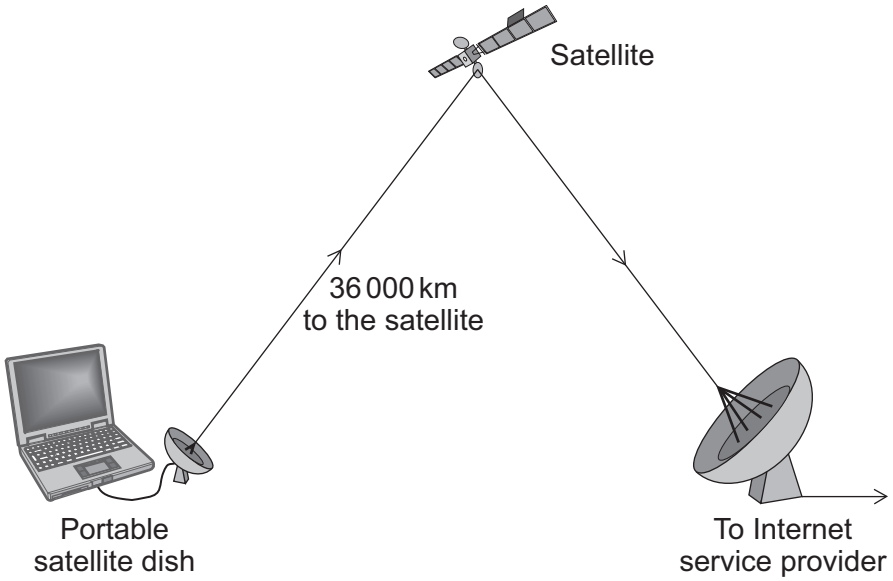
(1 mark)

7

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

3 (a) The diagram shows a computer connected to the Internet using a satellite link.



3 (a) (i) Name the type of electromagnetic wave used to send information to and from the satellite.

.....

(1 mark)

3 (a) (ii) The information is sent to and from the satellite using a *digital signal*.

Describe a *digital signal*.

You may draw a diagram to help you answer.

.....

.....

(1 mark)

3 (a) (iii) Give **one** advantage of sending information as a digital signal rather than as an analogue signal.

.....

.....

(1 mark)

3 (b) Electromagnetic waves travel at a speed of 300 000 000 m/s.
The waves travelling to and from the satellite have a wavelength of 15 cm.

Use the equation in the box to calculate the frequency of these waves.

wave speed = frequency × wavelength

Show clearly how you work out your answer and give the unit.

.....

.....

Frequency = ...

(3 marks)

3 (c) In 2009, parts of the African country Kenya, were linked to the Internet by a super-fast optical fibre. Before that, all Internet connections had to be made via a satellite link.

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

Signals can be sent along an optical fibre using either visible light or

..... .

(1 mark)

3 (c) (ii) Suggest a reason why signals sent through the optical fibre arrive faster than signals sent via a satellite link.

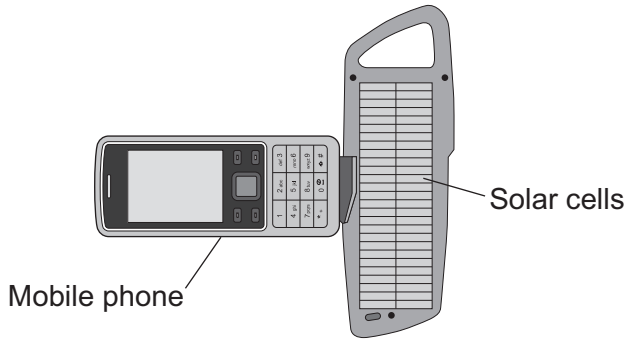
.....

.....

(1 mark)

8

4 (a) The diagram shows a solar powered device being used to recharge a mobile phone.



On average, the solar cells produce 0.6 joules of electrical energy each second.
The solar cells have an efficiency of 0.15.

4 (a) (i) Use the following equation to calculate the average energy input each second to the device.

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

Show clearly how you work out your answer.

.....

.....

Average energy input each second = ... J/s

(2 marks)

4 (a) (ii) Draw a labelled Sankey diagram for the solar cells.
The diagram does **not** need to be drawn to scale.

(1 mark)

4 (a) (iii) Energy from the Sun is stored by a rechargeable battery inside the device.

Suggest **one** factor that would affect the time it takes to fully charge the battery.

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

4 (b) Scientists have developed a new type of solar cell with an efficiency of over 40 %. The efficiency of the solar cell was confirmed independently by other scientists.

Suggest why it was important to confirm the efficiency independently.

.....

.....

(1 mark)

4 (c) The electricity used in homes in the UK is normally generated in a fossil fuel power station.

Outline some of the advantages of using solar cells to generate this electricity.

.....

.....

.....

.....

(2 marks)

8

Turn over for the next question

5 LOFAR is a new type of telescope designed to observe the lowest frequency radio waves. It consists of thousands of simple radio antennae linked to a super-computer. This combines all the signals to give a single output.

5 (a) (i) Give **one** reason, apart from its physical size, why a telescope such as LOFAR is positioned on the Earth and not on a satellite in space.

.....

.....

(1 mark)

5 (a) (ii) Why are the analogue signals from the antennae converted into digital signals before being sent to the computer?

.....

.....

(1 mark)

5 (b) One of the main purposes of the LOFAR telescope is to study the period of time a few hundred thousand years after the big bang. This is done by measuring the *red-shift* of the waves emitted by hydrogen atoms in very distant galaxies.

5 (b) (i) What is *red-shift*?

.....

.....

(1 mark)

5 (b) (ii) The LOFAR telescope has a sensitivity 20 times greater than other radio telescopes.

What does this statement mean?

.....

.....

(1 mark)

5 (b) (iii) The Ancient Greeks believed that the Universe went on forever; it never changed and had no beginning. It had always existed.

How are the ideas put forward by the big bang theory different from the beliefs of the Ancient Greeks?

.....

.....

.....

.....

(2 marks)

5 (c) Some scientists are using the LOFAR super-computer for Earth based investigations. For example, to study the effect of natural gas extraction on ground levels in the Netherlands.

Suggest **one** positive benefit of developing technologies that can be used by many different groups of scientists.

.....

.....

(1 mark)

7

Turn over for the next question

6 (a) Carbon has three naturally occurring isotopes. The isotope, carbon-14, is radioactive. An atom of carbon-14 decays by emitting a beta particle.

6 (a) (i) Complete the following sentences.

The atoms of the three carbon isotopes are the same as each other because

..... .

The atoms of the three carbon isotopes are different from each other because

..... .

(2 marks)

6 (a) (ii) What is a beta particle and from what part of an atom is it emitted?

.....

.....

(1 mark)

6 (b) Carbon-14 is constantly being made in the atmosphere, yet for most of the last million years, the amount of carbon-14 in the atmosphere has not changed.

How is this possible?

.....

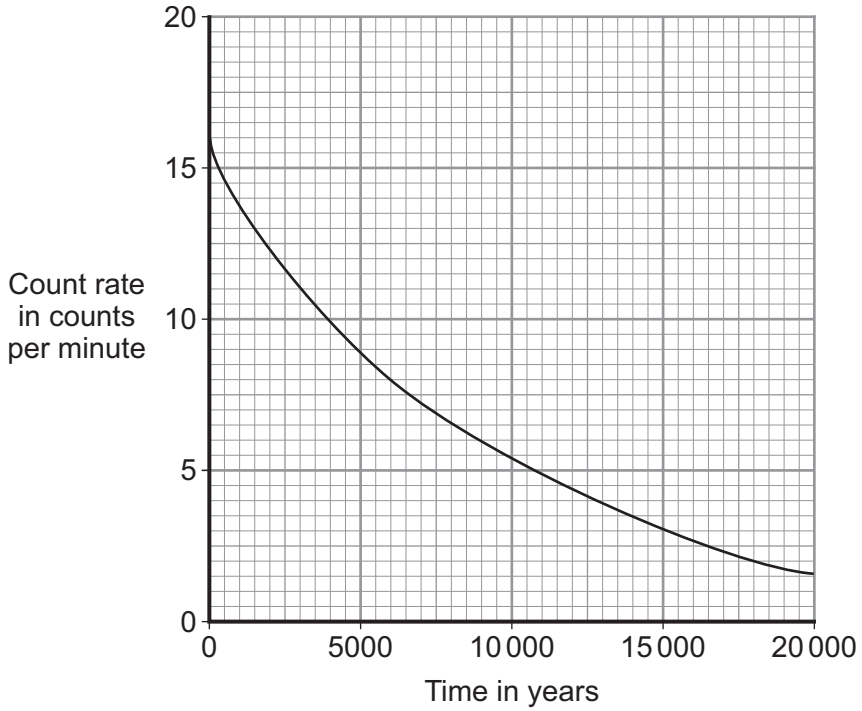
.....

(1 mark)

6 (c) Trees take in carbon-12 and carbon-14 from the atmosphere. After the tree dies, the proportion of carbon-14 that the tree contains decreases.

Graph **A** shows the decay curve for carbon-14.

Graph **A**



6 (c) (i) Lake Cuicocha in Ecuador was formed after a volcanic eruption.
Carbon taken from a tree killed by the eruption was found to have a count rate of 10.5 counts per minute.
At the time of the eruption, the count rate would have been 16 counts per minute.

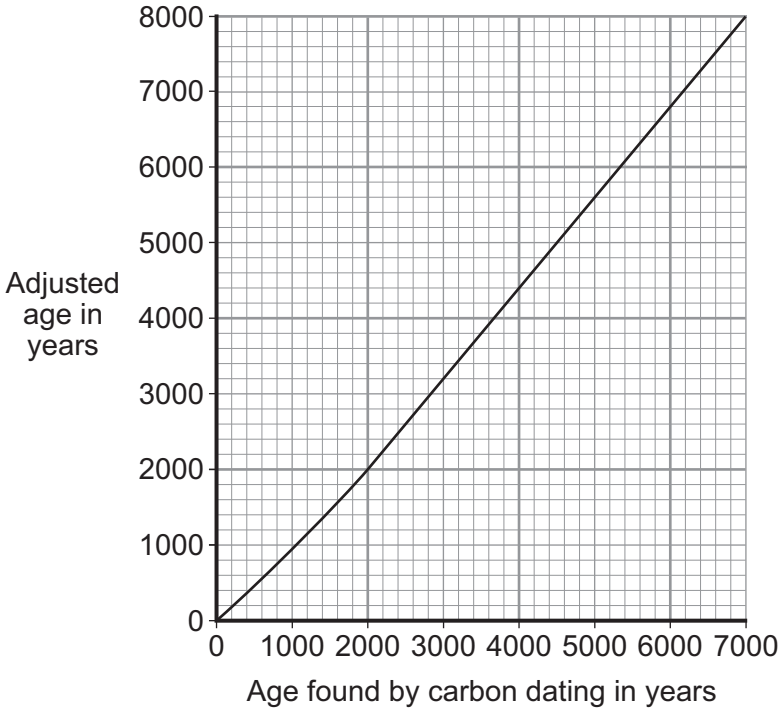
Use graph **A** to find the age of Lake Cuicocha.

Age of Lake Cuicocha = ... years
(1 mark)

Question 6 continues on the next page

6 (c) (ii) Finding the age of organic matter by measuring the proportion of carbon-14 that it contains is called carbon dating. This technique relies on the ratio of carbon-14 to carbon-12 in the atmosphere remaining constant. However, this ratio is not constant so the age found by carbon dating needs to be adjusted.

Graph **B**



Graph **B** is used to adjust the age of an object found by carbon dating.
The value obtained from graph **B** will be no more than 50 years different to the true age of the object.

Use graph **B** and the information above to find the maximum age that Lake Cuicocha could be.

Show clearly how you obtain your answer.

.....

.....

Maximum age of Lake Cuicocha = ... years

(2 marks)

7

END OF QUESTIONS