

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
January 2013

Science B
Unit Physics P1

PHY1H
H

Physics
Unit Physics P1

Wednesday 30 January 2013 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

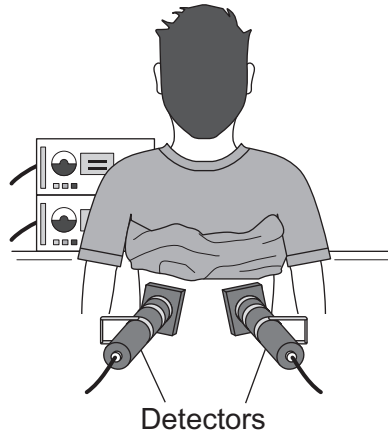
- In all calculations, show clearly how you work out your answer.



J A N 1 3 P H Y 1 H 0 1

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

- 1** A doctor uses the radioactive isotope technetium-99 to find out if a patient's kidneys are working correctly.

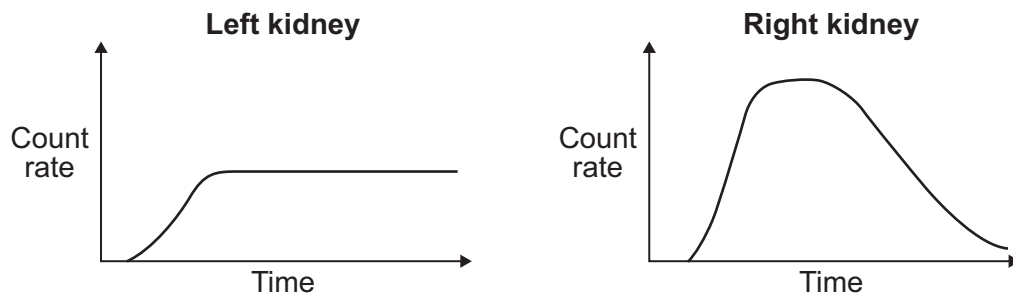


The doctor injects a small amount of technetium-99 into the patient's bloodstream. Technetium-99 emits gamma radiation.

If the patient's kidneys are working correctly, the technetium-99 will pass from the bloodstream into the kidneys and then into the patient's urine.

Detectors are used to measure the radiation emitted from the kidneys.

The level of radiation emitted from each kidney is recorded on a graph.



- 1 (a)** How do the graphs show that technetium-99 is passing from the bloodstream into each kidney?

.....

.....

(1 mark)



1 (b) By looking at the graphs, the doctor is able to tell if there is a problem with the patient's kidneys.

Which **one** of the following statements is correct?

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

Only the right kidney is working correctly.

Only the left kidney is working correctly.

Both kidneys are working correctly.

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

4

Turn over for the next question

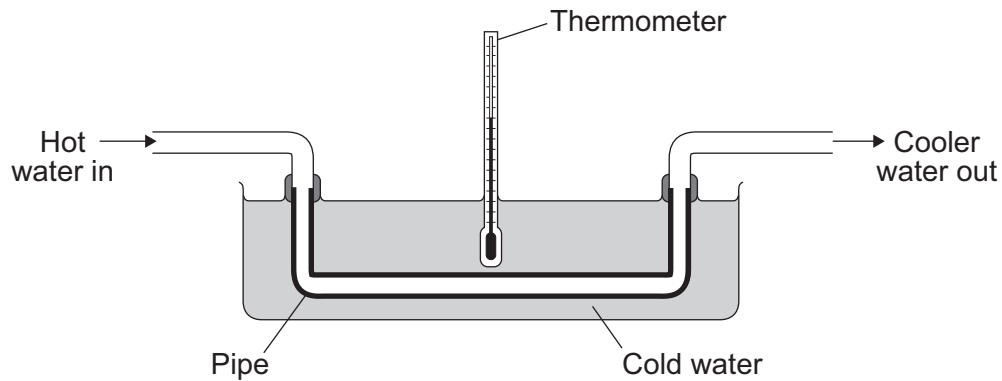
Turn over ▶



2 Heat exchangers are devices used to transfer heat from one place to another.

The diagram shows a pipe being used as a simple heat exchanger by a student in an investigation.

Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.



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

Heat is transferred from the hot water inside the pipe

to the cold water outside the pipe by

conduction.

convection.

radiation.

(1 mark)

2 (b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

The student's results are recorded in the table.

Material	Temperature of the cold water at the start in °C	Temperature of the cold water after 10 minutes in °C
Copper	20	36
Glass	20	23
Plastic	20	21



2 (b) (i) The rate of flow of hot water through the pipe was one of the control variables in the investigation.

Give **one** other control variable in the investigation.

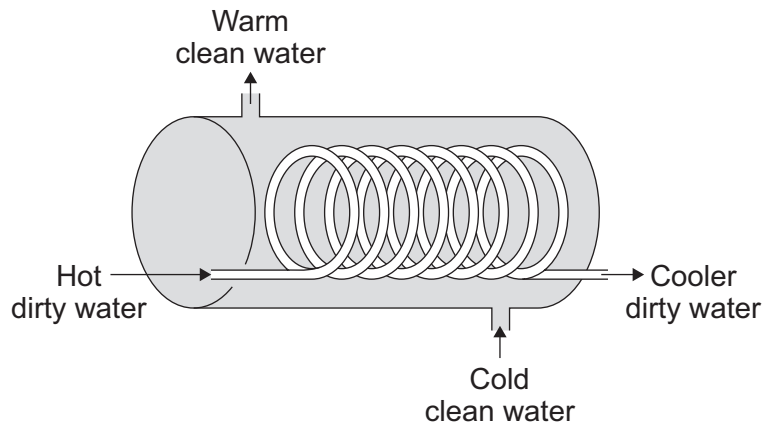
.....
 (1 mark)

2 (b) (ii) Which **one** of the three materials made the best heat exchanger?

.....
 Give a reason for your answer.

 (2 marks)

2 (c) The student finds a picture of a heat exchanger used in an industrial laundry. The heat exchanger uses hot, dirty water to heat cold, clean water.



This heat exchanger transfers heat faster than the heat exchanger the student used in the investigation.

Explain why.

.....

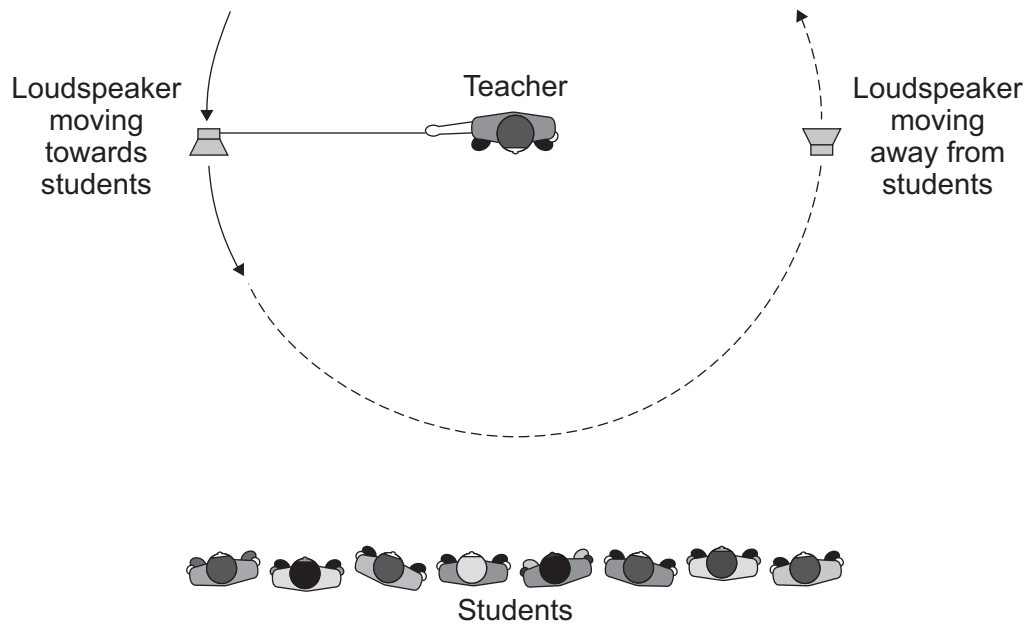
 (2 marks)

6

Turn over ►



- 3** The diagram shows a teacher using a loudspeaker to demonstrate an important effect. The loudspeaker produces a note of constant frequency and is swung around in a circle.



- 3 (a)** As the loudspeaker moves towards the students, the frequency of the note heard by the students increases.

What happens to the note heard by the students as the loudspeaker moves away from them?

.....

(1 mark)

- 3 (b)** The teacher is using the demonstration to model the red-shift in light observed from most distant galaxies.

- 3 (b) (i)** Which part of the demonstration:
 represents a moving galaxy?

.....

is like the red-shift?

.....

(2 marks)



3 (b) (ii) Which **one** of the following statements gives the main reason why models are used in science?

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

Models can help to explain an effect or theory.

Models can prove that a theory is correct.

Models can prove that a theory is wrong.

(1 mark)

3 (c) Red-shift provides evidence to support the theory that the Universe began from a very small initial point.

What name is given to this theory?

.....

(1 mark)

5

Turn over for the next question

Turn over ►



- 4 The picture shows a washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



- 4 (a) Complete the following sentences.

- 4 (a) (i) An electric motor is designed to transform electrical energy into

..... energy.
(1 mark)

- 4 (a) (ii) Some of the electrical energy supplied to the motor is wasted as

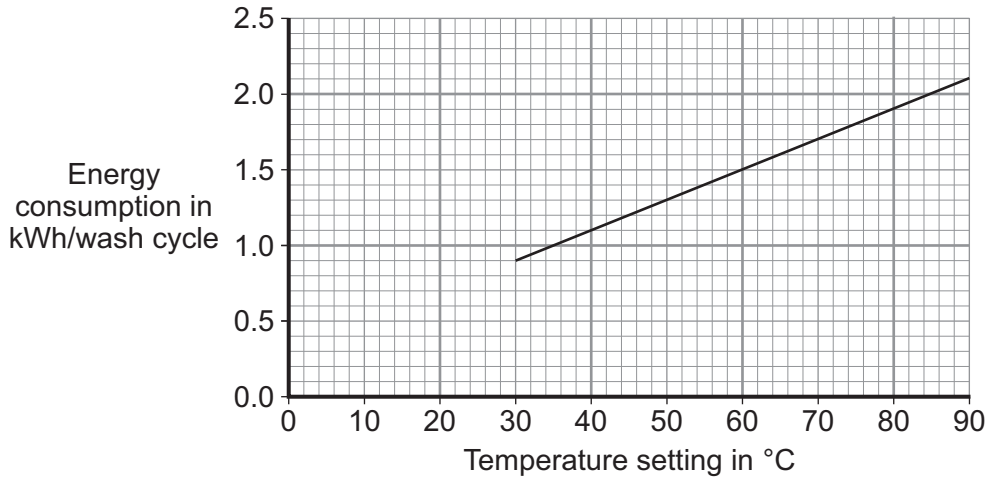
..... energy and energy.
(1 mark)

- 4 (b) What happens to the energy wasted by the electric motor?

.....
.....
(1 mark)



4 (c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



4 (c) (i) Electricity costs 15p per kilowatt-hour (kWh).

The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

Show clearly how you work out your answer.

.....

.....

Money saved = p
(2 marks)

4 (c) (ii) Reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

Explain why.

.....

.....

.....

.....

(2 marks)

7

Turn over ►



5 (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B**, or **C**, is an infra red wave?

.....

(1 mark)

5 (b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Show clearly how you work out your answer.

.....

Wavelength = m
 (2 marks)

5 (c) What happens when a metal aerial absorbs radio waves?

.....

(2 marks)



5 (d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

.....
.....

(1 mark)

6

Turn over for the next question

Turn over ►



6 (a) Solar energy is a *renewable* energy source used to generate electricity.

6 (a) (i) What is meant by an energy source being *renewable*?

.....

(1 mark)

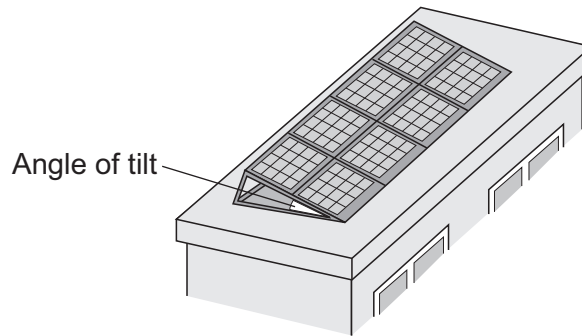
6 (a) (ii) Name **two** other renewable energy sources used to generate electricity.

1

2

(1 mark)

6 (b) A householder uses panels of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410



6 (b) (i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....
.....
.....
.....

(2 marks)

6 (b) (ii) The total area of the solar cell panels used by the householder is 5 m².

The efficiency of the solar cells is 0.18.

Use the equation in the box to calculate the average **maximum** electrical energy available from the solar cell panels each second in June.

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

Show clearly how you work out your answer.

.....
.....

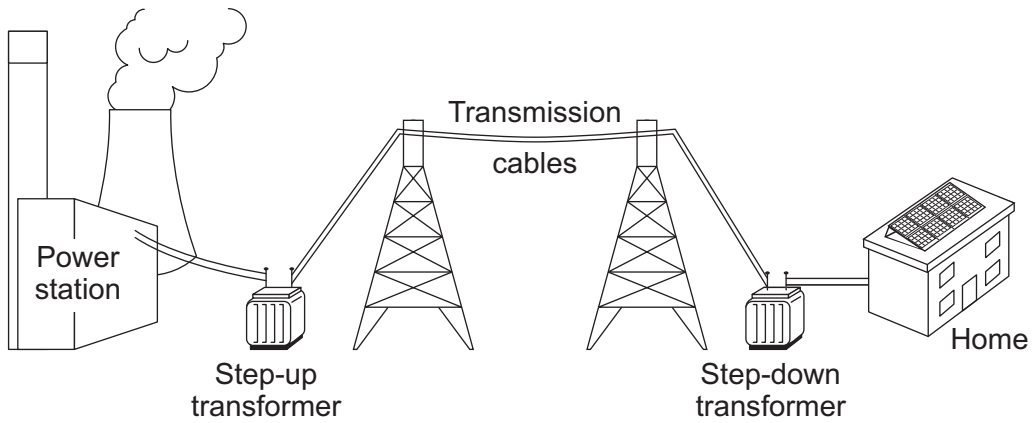
Maximum energy = joules/second
(3 marks)

Question 6 continues on the next page

Turn over ►



6 (c) The diagram shows part of the National Grid.



6 (c) (i) Even though the householder uses solar cells to generate electricity for his home, the home stays connected to the National Grid.

Give **one** reason why the householder should stay connected to the National Grid.

.....

(1 mark)

6 (c) (ii) The step-up transformer increases the efficiency of the National Grid.

Explain how.

.....

(2 marks)

10



Turn over for the next question

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



7 There are many different isotopes of gold. The isotope, gold-198, is radioactive. An atom of gold-198 decays by emitting a beta particle.

7 (a) Complete the following sentences.

All atoms of gold have the same number of

and the same number of

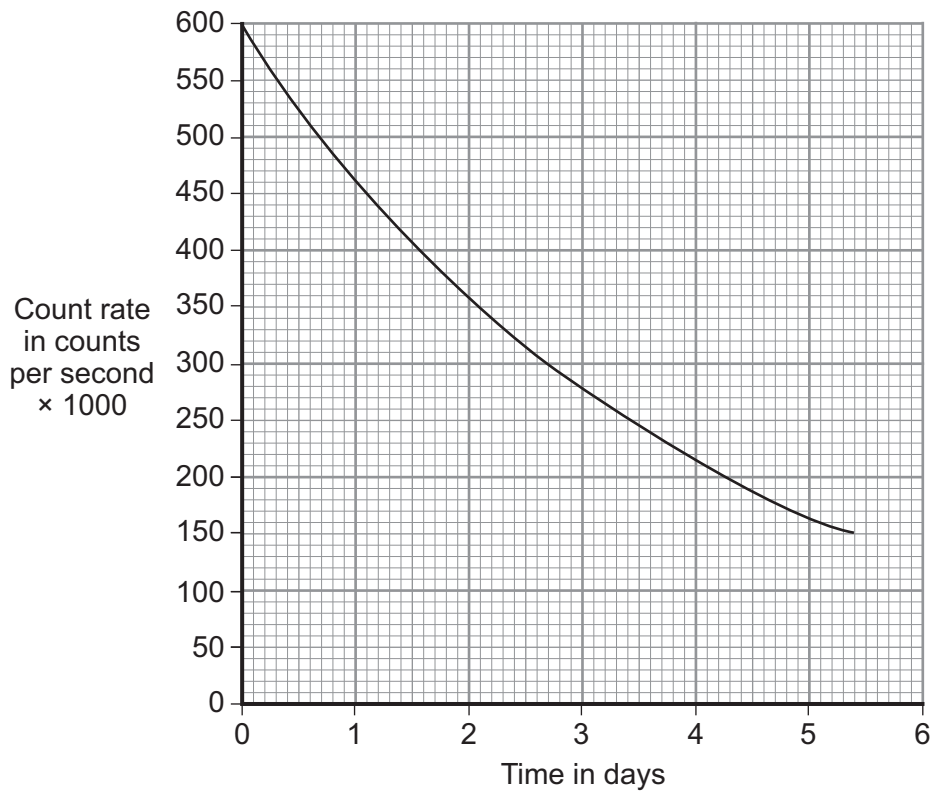
The atoms from different isotopes of gold have different numbers of

A beta particle is an emitted

from the of an atom.

(3 marks)

7 (b) The graph shows how the count rate from a sample of gold-198 changes with time.



Use the graph to calculate the half-life of gold-198.

Show clearly on the graph how you obtain your answer.

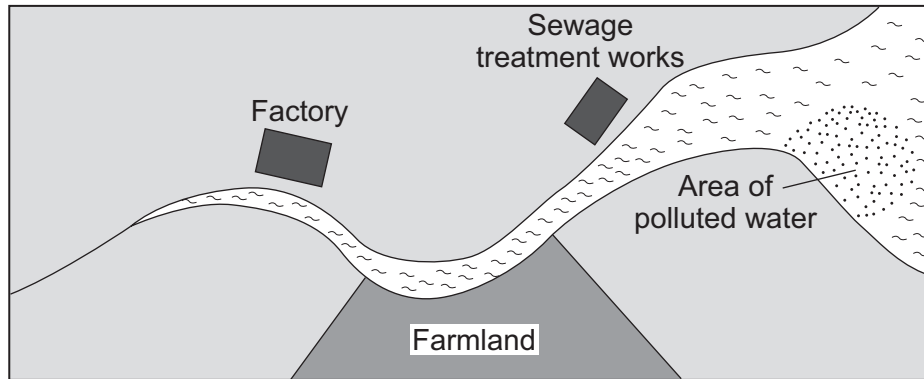
.....
.....

Half-life = days
(2 marks)



7 (c) The diagram shows a map of a river and the river estuary.

Environmental scientists have found that water flowing into one part of the river estuary is polluted. To find where the pollution is coming from, the scientists use a radioactive isotope, gold-198.



The gold-198 is used to find where the pollution is coming from.

Explain how.

.....

.....

.....

.....

(2 marks)

7

END OF QUESTIONS



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

