

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 2011

Science B
Unit Physics P1

PHY1H

H

Physics
Unit Physics P1

Wednesday 19 January 2011 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 1 P H Y 1 H O 1

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

- 1** Small sailing boats can be fitted with a passive radar device. The device increases the chance that the small boat will be seen on the radar screen of a large ship. The radar transmitter on the large ship emits microwaves.

- 1 (a)** Microwaves and radio waves are both part of the electromagnetic spectrum.

How are microwaves different from radio waves?

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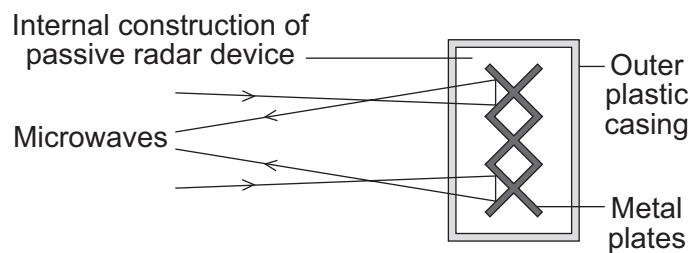
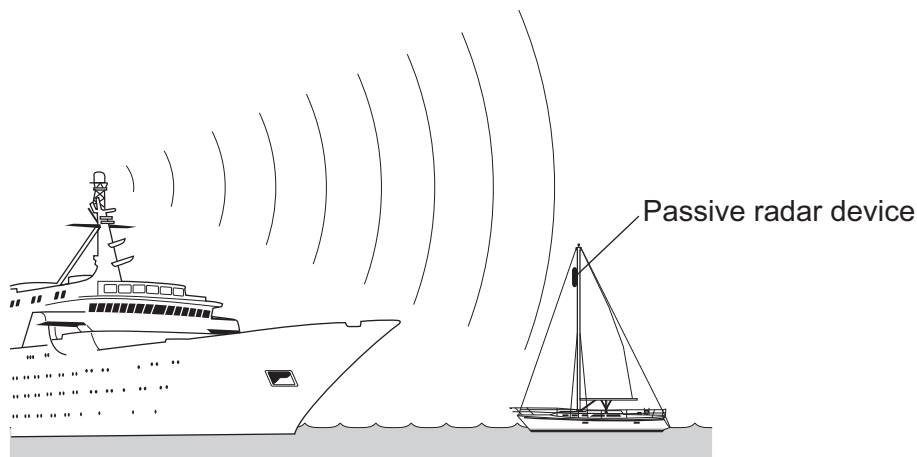
(1 mark)

- 1 (b)** How fast do microwaves travel through the air or a vacuum compared to radio waves?

.....

(1 mark)

- 1 (c)** The diagrams show the position of a passive radar device on a small boat and the internal construction of one type of passive radar device.



Microwaves can be absorbed, reflected or transmitted by different materials and types of surface.

Explain what happens to the microwaves from the ship's transmitter when they reach the passive radar device.

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(2 marks)

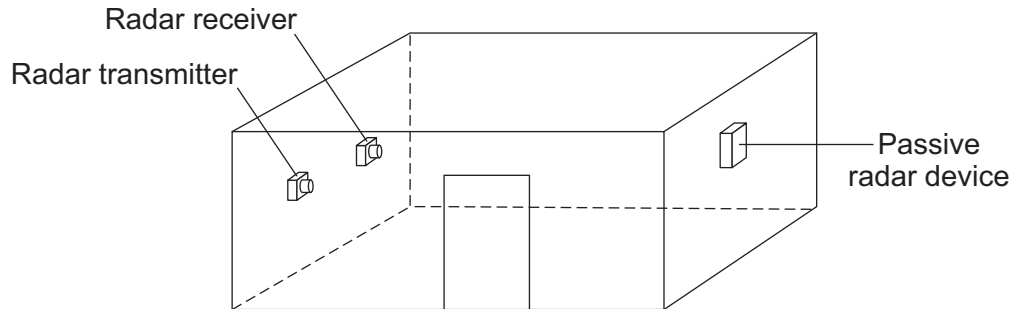
Question 1 continues on the next page

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- 1 (d)** Each type of passive radar device has an RCS value. The larger the RCS value, the easier it is for a small boat fitted with the device to be detected.

An independent group of scientists measured the RCS values of 4 different types of device. The RCS value for each device was measured in the same room using the same equipment.



- 1 (d) (i)** Why are the walls of the room covered in a material that absorbs the waves emitted by the radar transmitter?

.....

 (1 mark)

- 1 (d) (ii)** Why is it important to use the same room and the same equipment?

.....

 (1 mark)

- 1 (d) (iii)** Why is it important that the measurements are made by an independent group of scientists?

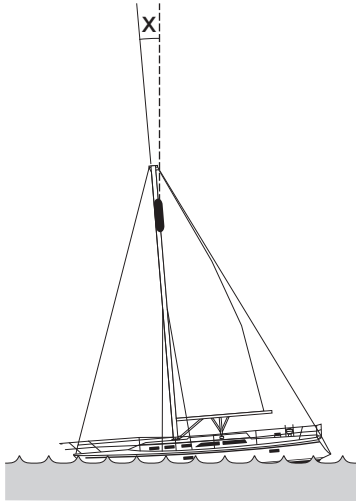
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 (1 mark)



1 (e) The movement of a small boat causes the mast and device to lean over, therefore the RCS values were measured at different angles.

The table gives the RCS values obtained by the scientists.



Device	Angle X			
	0°	5°	10°	15°
A	1.4	1.6	1.7	1.8
B	4.7	2.6	2.3	1.9
C	9.3	3.3	1.9	1.1
D	4.5	4.8	5.0	4.6

1 (e) (i) Describe how the RCS values for **device A** are different to the RCS values for **device B**.

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(2 marks)

1 (e) (ii) The scientists recommended that a passive radar device fitted to a small boat should have:

- the largest possible RCS value
- an RCS value consistently above 2.0

Which **one** of the devices, **A**, **B**, **C** or **D**, would you recommend that someone fits to their boat?

.....

Give a reason for your answer.

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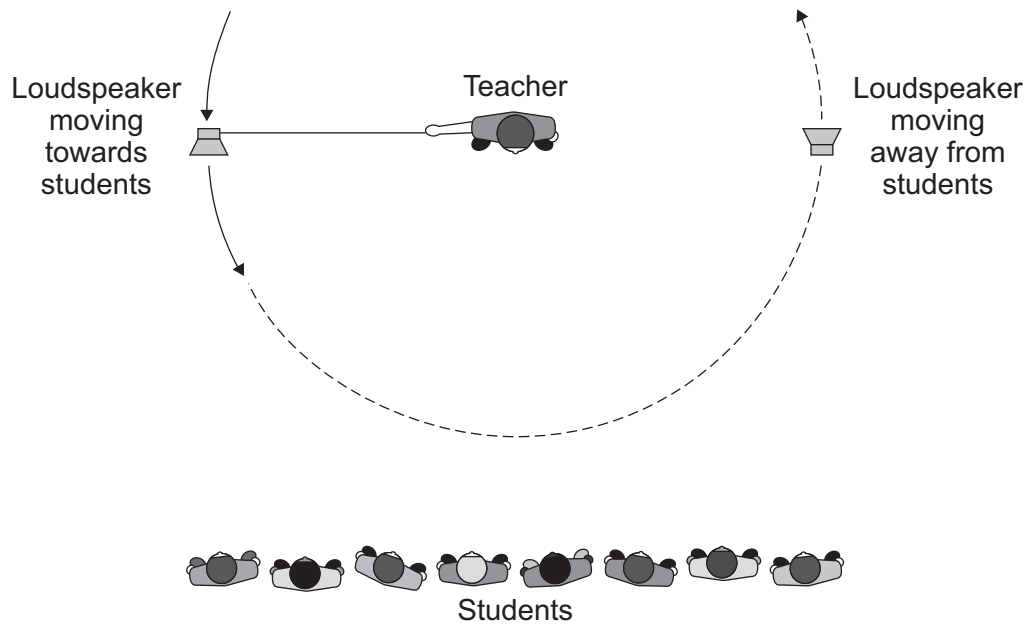
(1 mark)

10

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



- 2 (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?

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(1 mark)



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

2 (b) (i) 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 help to generate new ideas.

(1 mark)

2 (b) (ii) Explain how this demonstration can be used as a model for red-shift.

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(2 marks)

2 (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?

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(1 mark)

5

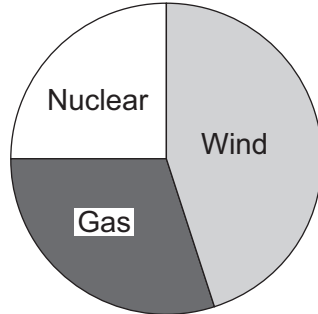
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3 (a) An electricity company claims to generate all of its electricity from environmentally friendly energy sources.

The energy sources used by the company are shown in the pie chart.



Do you think that the claim made by the company is correct?

Draw a ring around your answer.

Yes

No

Maybe

Explain the reasons for your answer.

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(2 marks)

3 (b) The government is committed to increasing the amount of electricity generated from renewable sources. A newspaper reported that:

More wind farms, wave powered generators, solar generators and nuclear power stations would need to be built

Why is the statement made in the newspaper incorrect?

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(1 mark)

3



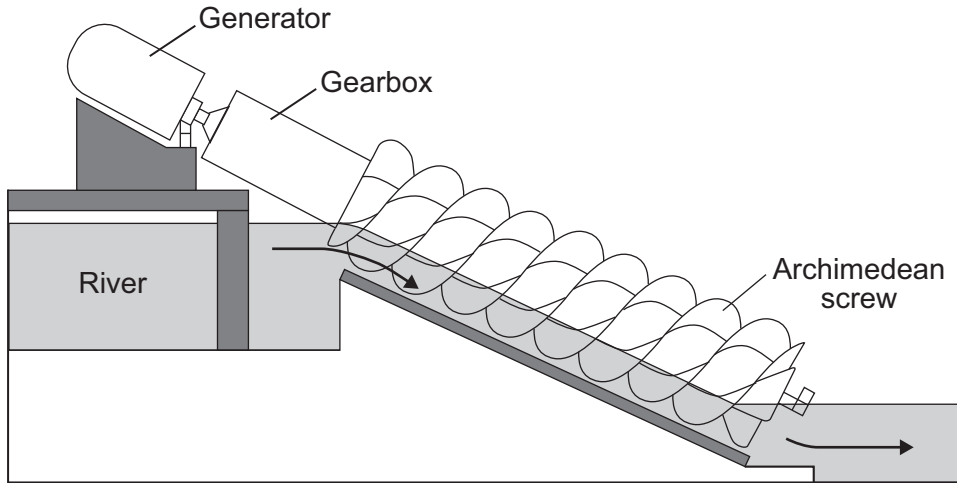
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ANSWER IN THE SPACES PROVIDED**

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- 4 The diagram shows a small-scale, *micro-hydroelectricity* generator which uses the energy of falling river water to generate electricity. The water causes a device, called an Archimedean screw, to rotate. The Archimedean screw is linked to the generator by a gearbox.



- 4 (a) Each second, the *micro-hydroelectricity* generator transforms 80 000 joules of gravitational potential energy into 60 000 joules of electrical energy.
- 4 (a) (i) Fill in the missing word to complete the energy transformation diagram.



(1 mark)

- 4 (a) (ii) Use the equation in the box to calculate the efficiency of the *micro-hydroelectricity* generator.

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

Show clearly how you work out your answer.

.....

.....

Efficiency =
(2 marks)



4 (b) The power output from a conventional large-scale hydroelectric power station is 100 000 times more than the power output from a micro-hydroelectric system.

Give **one** disadvantage of a conventional large-scale hydroelectric power station compared to the micro-hydroelectric system.

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(1 mark)

4 (c) The electricity generated by a micro-hydroelectric system is transferred via a transformer directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to the National Grid, which distributes the electricity to homes anywhere in the country.

4 (c) (i) What is the National Grid?

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(1 mark)

4 (c) (ii) Explain why transferring the electricity directly to local homes is more efficient than using the National Grid to distribute the electricity.

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(2 marks)

7

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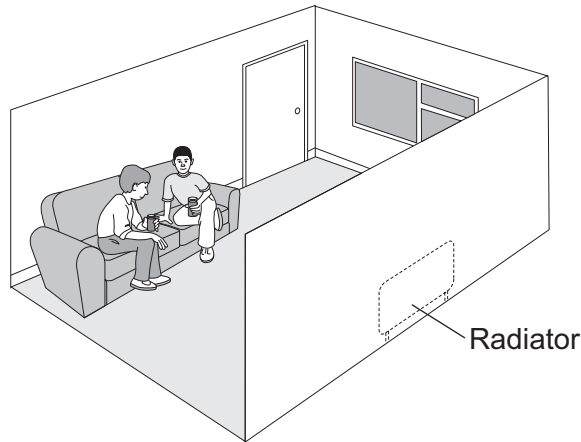


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5 (a) The diagram shows the position of a radiator inside a room. The radiator is made from metal and is painted white.



5 (a) (i) Heat is transferred from the hot water inside the metal radiator to the air touching the outside surface of the radiator.

What name is given to this method of heat transfer?

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(1 mark)

5 (a) (ii) Explain, in terms of the particles in the metal, how heat is transferred through the radiator.

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(2 marks)

5 (a) (iii) What name is given to the main method by which heat is transferred from the radiator to the people on the other side of the room?

.....
(1 mark)

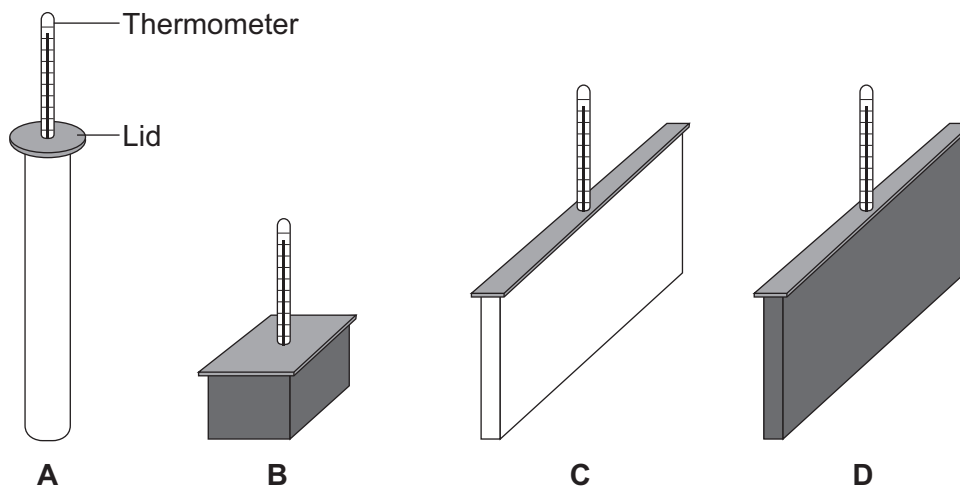
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5 (b) A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C. After 20 minutes the temperature of the water inside each container was measured.



The results from the investigation are given in the table.

Container	Colour	Temperature after 20 minutes in °C	Temperature fall in °C
A	White	86	14
B	Black	86	14
C	White	73	27
D	Black	60	40

5 (b) (i) The student uses the results in the table to see if shape has affected heat transfer.

Which containers should the student compare to do this?

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Give a reason for your answer.

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(1 mark)



5 (b) (ii) Explain why the temperature of the water in both containers **A** and **B** fell by the same amount.

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(2 marks)

5 (b) (iii) A central heating system has several radiators joined together. The hot water goes from the boiler, through each radiator in turn and then back to the boiler for reheating.

Give **one** reason, other than appearance, why it might **not** be a good idea to paint radiators black.

.....
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(1 mark)

8

Turn over for the next question

Turn over ►



- 6 (a)** The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	250	115
Jacket for hot water tank	12	35
Upgraded central heating controls	310	80

Show that over 5 years, the most cost-effective method of reducing energy consumption is to install cavity wall insulation.

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(2 marks)

- 6 (b)** Any device that transforms energy will waste energy.

Why must the total energy input to such a device always equal the total energy output from the device?

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(1 mark)



6 (c) A holiday cottage has a pre-payment electricity meter. The electricity is charged at the rate of 20p per kWh. A £2 coin is put into the meter and a 2.5kW fire switched on.

Use the equations in the box to work out how many hours it will be before £2 runs out. Assume that no other electrical device is switched on.

$\text{energy transferred} = \text{power} \times \text{time}$ $\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$
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Show clearly how you work out your answer.

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Time = hours
(2 marks)

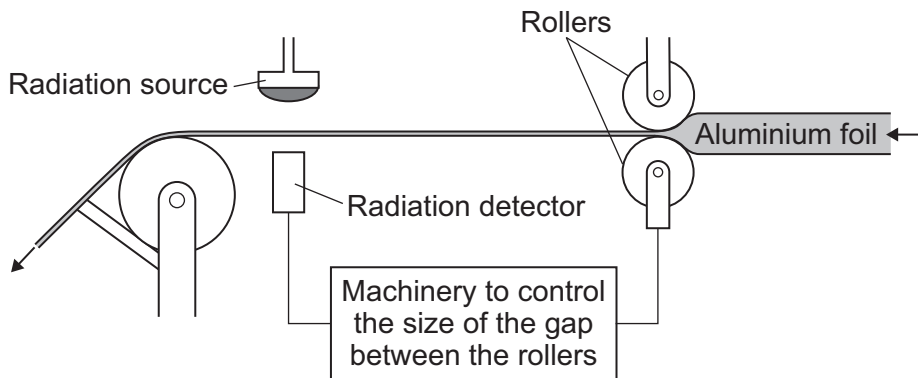
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Turn over for the next question

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- 7 The diagram shows a system used to control the thickness of aluminium foil as it is being rolled. A radiation source and detector are used to monitor the thickness of the foil.



- 7 (a) Which type of source, alpha, beta or gamma, should be used in this control system?

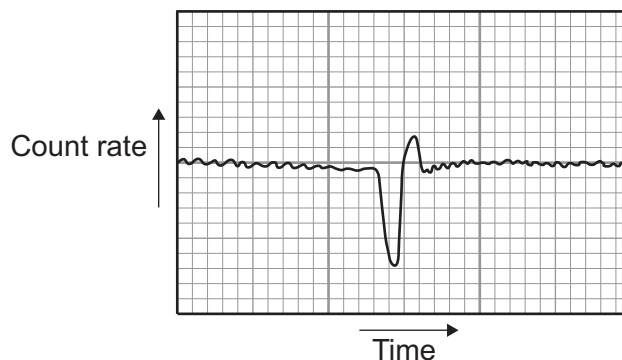
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Explain why each of the other two types of source would **not** be suitable.

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(3 marks)

- 7 (b) The chart shows how the count rate recorded by the detector varies over a short period of time.



Use the graph to explain how the thickness of the foil changes, and how the control system responds to this change.

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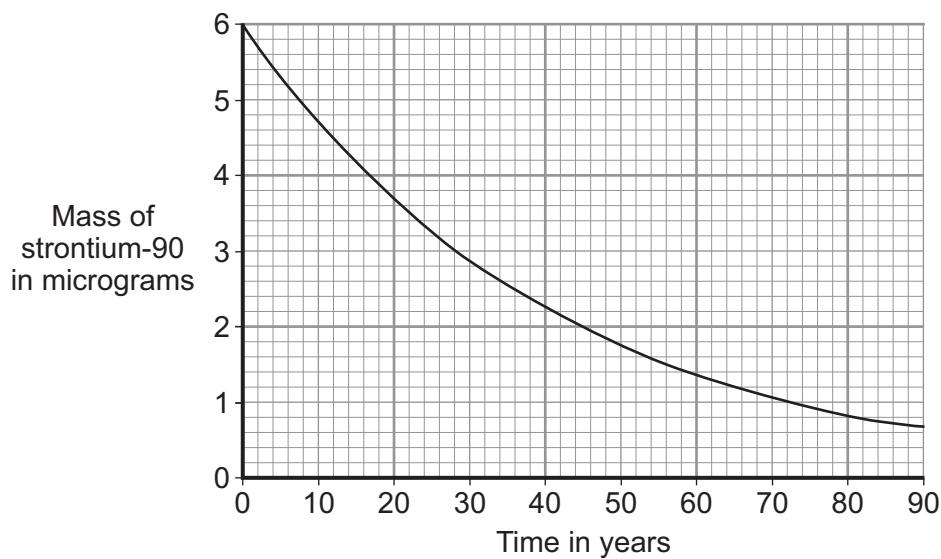
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(2 marks)

7 (c) When first used, the radiation source contains 6 micrograms of strontium-90. The graph shows how the mass of the strontium-90 will decrease as the nuclei decay.



The control system will continue to work with the same source until 75% of the original strontium-90 nuclei have decayed.

After how many years will the source need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

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Number of years =

(2 marks)

7

END OF QUESTIONS



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