

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	
8	
9	
TOTAL	



General Certificate of Secondary Education  
Higher Tier  
January 2011

# Applied Science (Double Award)

APSC/2H

H

Unit 2 Science for the Needs of Society

Written Paper

Thursday 13 January 2011 9.00 am to 10.30 am

For this paper you must have:

- a ruler.
- You may use a calculator.

### Time allowed

- 1 hour 30 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 90.
- 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 A P S C 2 H 0 1

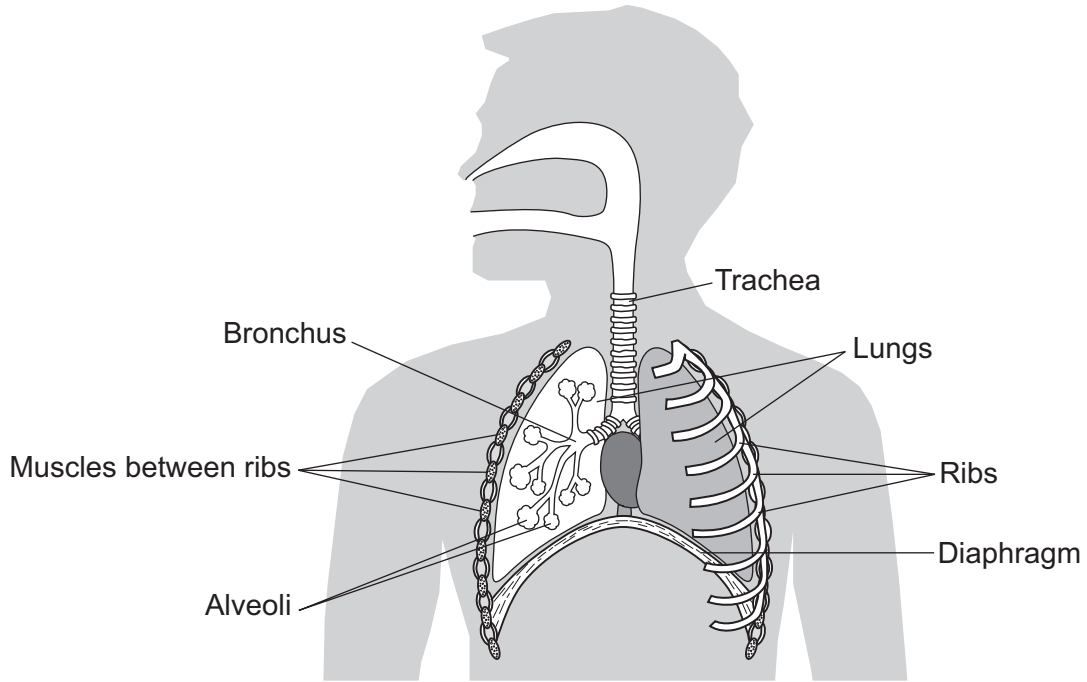
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APSC/2H

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

- 1 Sports scientists help athletes to improve their performance.  
One way they do this is by monitoring the athlete's breathing rate.

- 1 (a) The diagram shows the human breathing system.



Use the diagram to describe how we breathe in.

.....

.....

.....

.....

.....

.....

(3 marks)



**1 (b)** A sports scientist monitored an athlete’s breathing rate during a training course.

The data collected is shown in the table.

Breathing rate	Start of training	After 1 week of training	After 2 weeks of training	After 4 weeks of training	End of training
At rest	12	12	12	10	10
After 10 minutes of exercise	55	53	49	46	40

**1 (b) (i)** Suggest appropriate units for recording breathing rate.

.....  
(1 mark)

**1 (b) (ii)** The athlete’s breathing rate after 10 minutes of exercise was lower at the end of training than at the start of training.

What was the percentage decrease?

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

Breathing rate decrease = ..... %  
(3 marks)

**1 (b) (iii)** Explain how the data in the table could show that the training programme improved the athlete’s fitness.

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

(2 marks)



**2** Limestone is used to make slaked lime. Farmers use slaked lime on their fields to neutralise acids in rainwater.

**2 (a)** Limestone is made of calcium carbonate.

What is the chemical formula for calcium carbonate?

.....  
(1 mark)

**2 (b)** Limestone is converted to quicklime in a lime kiln.

**2 (b) (i)** What process is used to convert limestone to quicklime?

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

**2 (b) (ii)** Name the gas that is given off when limestone is converted to quicklime.

.....  
(1 mark)

**2 (b) (iii)** What environmental problem is caused by this gas?

.....  
(1 mark)

**2 (c)** Quicklime is converted into slaked lime by adding water.

An exothermic reaction takes place.

**2 (c) (i)** Complete the symbol equation for the conversion of quicklime to slaked lime.

..... + H<sub>2</sub>O → .....  
(2 marks)

**2 (c) (ii)** What is an *exothermic* reaction?

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



**2 (d)** Limestone can also be used in the manufacture of glass.

What **two** ingredients are added to limestone to make glass?

1 .....

2 .....

(2 marks)

9

**Turn over for the next question**

**Turn over ►**



**3** Astronomers are looking to see if there could be life on other objects in the Solar System.

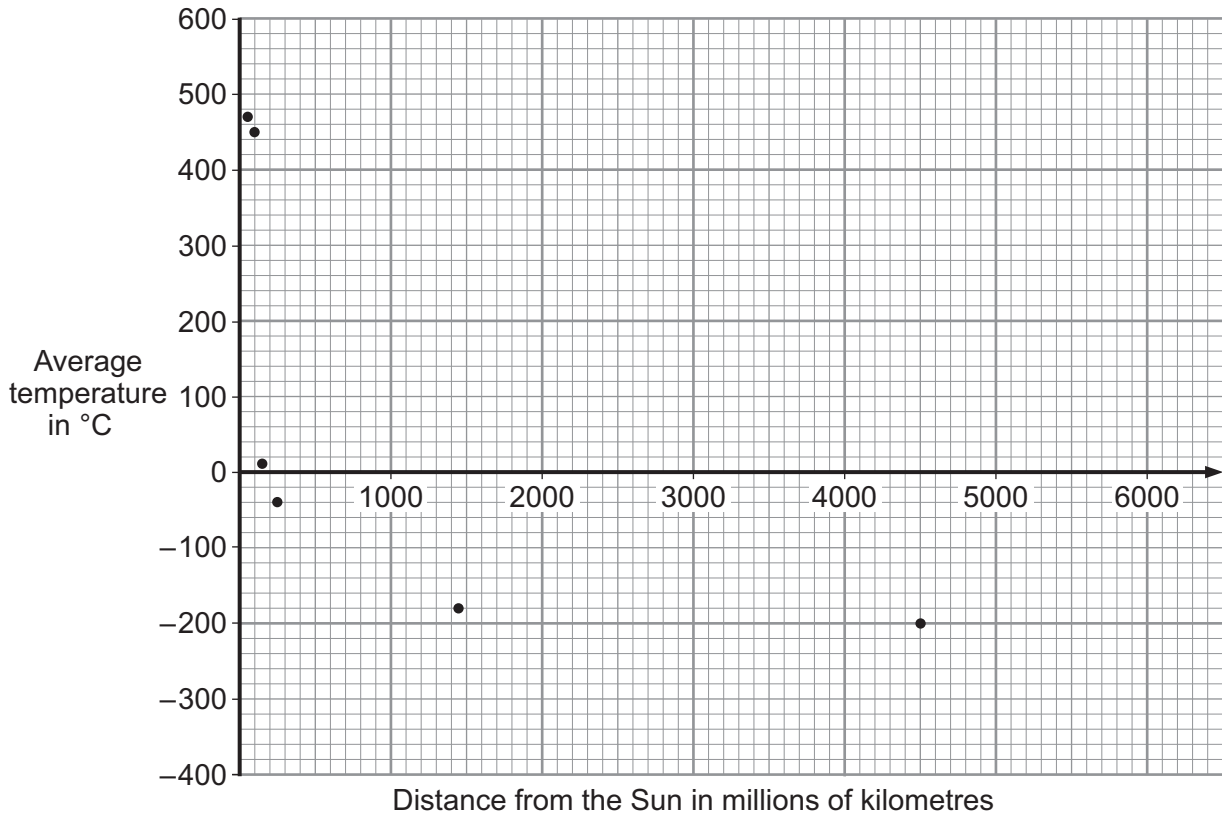
**3 (a)** Astronomers use infrared telescopes to measure the temperatures of objects in space because they want to know if the temperature is right for liquid water to be present.

The table shows information about some objects in the Solar System.

<b>Object</b>	<b>Distance from the Sun in millions of kilometres</b>	<b>Average temperature in °C</b>
Mercury	60	470
Venus	110	450
Earth	150	10
Mars	230	-40
Jupiter	780	-150
Saturn	1430	-180
Uranus	2870	
Neptune	4500	-200
Pluto	5910	-220



The graph shows the relationship between the distance of objects from the Sun and average temperature.



3 (a) (i) On the graph, plot the data for Jupiter and Pluto.

(2 marks)

3 (a) (ii) Use the information in the table and on the graph to predict the average temperature for Uranus.

..... °C  
(1 mark)

3 (a) (iii) Why is it hotter on Venus than it is on Earth?

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

3 (a) (iv) Why might the average temperature on Mars suggest that there is no life on Mars?

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

Question 3 continues on the next page

Turn over ►



**3 (b)** Infrared telescopes are usually in space on satellites above the Earth.

Give **two** advantages of using a telescope on a satellite rather than on the surface of the Earth.

1 .....

.....

2 .....

.....

*(2 marks)*

**3 (c)** Astronomers have noticed that the frequency of infrared waves coming from the stars is lower than expected.

**3 (c) (i)** Why is the frequency of infrared waves lower than expected?

.....

.....

*(1 mark)*

**3 (c) (ii)** What has this evidence led astronomers to believe is happening to the Universe?

.....

.....

*(1 mark)*

<b>9</b>



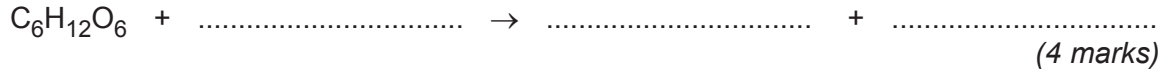


**4** Medical scientists need to know how living organisms work.

Living organisms are made up of cells.

**4 (a)** All living organisms respire.

**4 (a) (i)** Complete the symbol equation for respiration.  
Make sure you balance the equation.



**4 (a) (ii)** Name the process by which the reactants that are needed for respiration move into the cell.

..... (1 mark)

**4 (a) (iii)** Describe the process that you named in **4(a)(ii)**.

.....  
.....  
.....  
.....  
.....  
..... (3 marks)

**4 (b)** A low concentration of solutes in the blood can cause cells to swell.

Explain why.

.....  
.....  
.....  
.....  
.....  
..... (3 marks)



**5** A chemical company uses many types of mixture in the processes which it uses to make products.

**5 (a)** Too much methanol (an alcohol) was poured into a mixture that was being made by the company.

**5 (a) (i)** Describe how you would remove and collect the excess methanol so that it could be used again.

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

(4 marks)

**5 (a) (ii)** Methanol and propanone (acetone) are both examples of what type of solvent?

.....

(1 mark)

**5 (b)** The chemical company also makes toothpaste.

Toothpaste can be described as a suspension.

**5 (b) (i)** What is a suspension?

.....

(1 mark)

**5 (b) (ii)** Suggest **two** reasons why it is useful for toothpaste to be a suspension.

1.....  
.....

2.....  
.....

(2 marks)



**5 (c)** Other types of mixture that the chemical company uses are given in the table.

Fill in the missing information in the table.

Mixture	Composition
	Liquid spread out in a gas
Solution	
	Mixture of liquids that do not dissolve together

(3 marks)

11

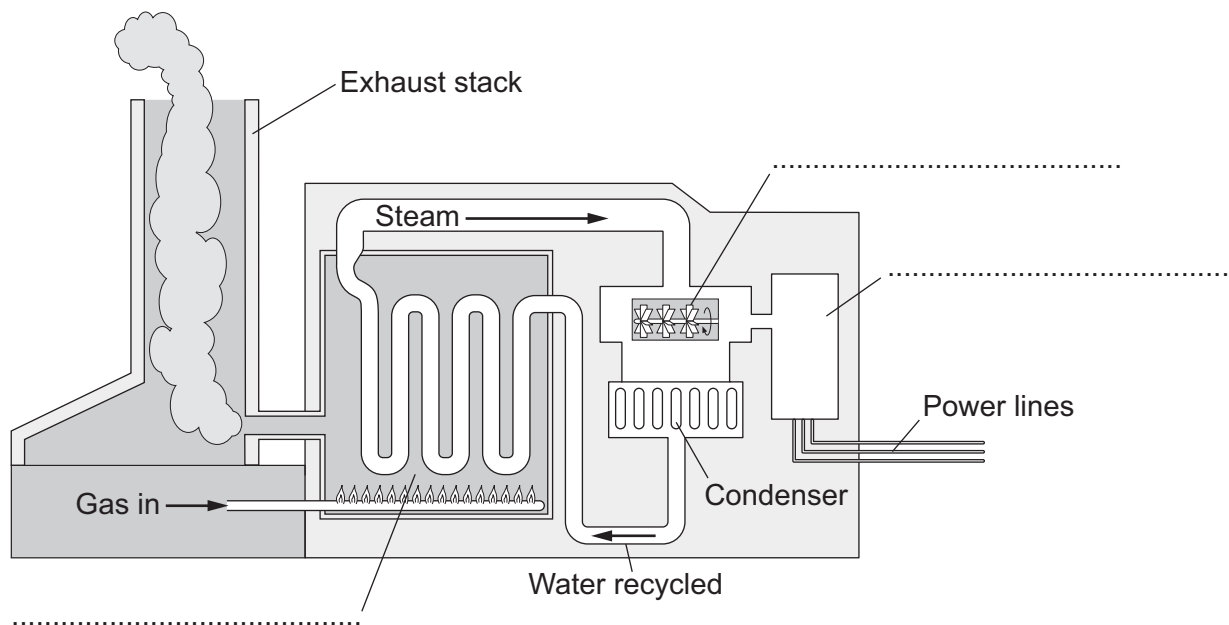
**Turn over for the next question**

**Turn over ►**



**6** In Britain, about 50% of electrical energy is obtained from power stations that burn methane gas to heat water.

**6 (a)** Label the main parts of a gas-burning power station on the diagram below.



(3 marks)

**6 (b)** Methane is a hydrocarbon.

**6 (b) (i)** Complete the word equation for the combustion of methane.

Methane + ..... → ..... + .....

(3 marks)

**6 (b) (ii)** Most methane is obtained from a non-renewable source.

What renewable fuel could be burnt in a power station instead of methane?

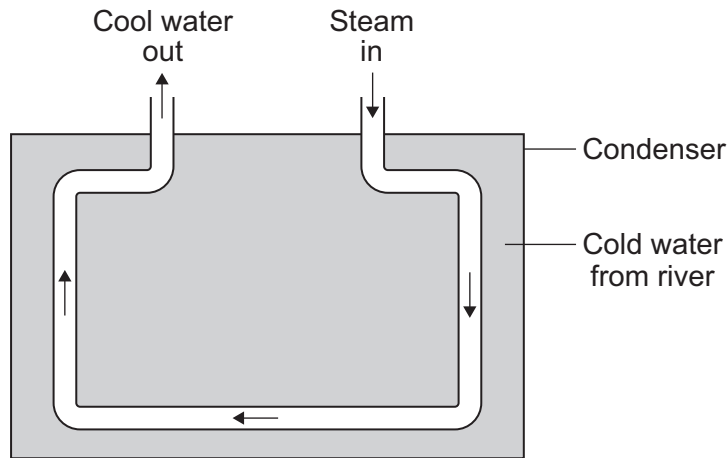
.....

(1 mark)



6 (c) The diagram below shows a condenser.

In the condenser, the steam is cooled by passing it through metal pipes that are surrounded by cold water from a local river.



6 (c) (i) Suggest **one** material that would be suitable for making the pipes.

.....  
(1 mark)

6 (c) (ii) Give **two** reasons for your choice.

Reason 1 .....

Reason 2 .....

(2 marks)

6 (d) A gas-burning power station is 58% efficient.

A cubic metre of gas contains 39 000 kJ of chemical energy.

Use the equation in the box to calculate how much of this chemical energy is turned into electrical energy in the power station.

$$\text{efficiency} = \frac{\text{useful energy produced by power station}}{\text{total energy supplied to power station}} \times 100$$

Show clearly how you work out your answer.

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

..... kJ  
(2 marks)

12

Turn over ▶



7 Humans use other living organisms to make many useful products.

Some living organisms are used to make drugs that treat medical conditions, such as diabetes.

People with diabetes cannot make insulin in their bodies.

7 (a) Explain how insulin controls blood glucose levels in a healthy body.

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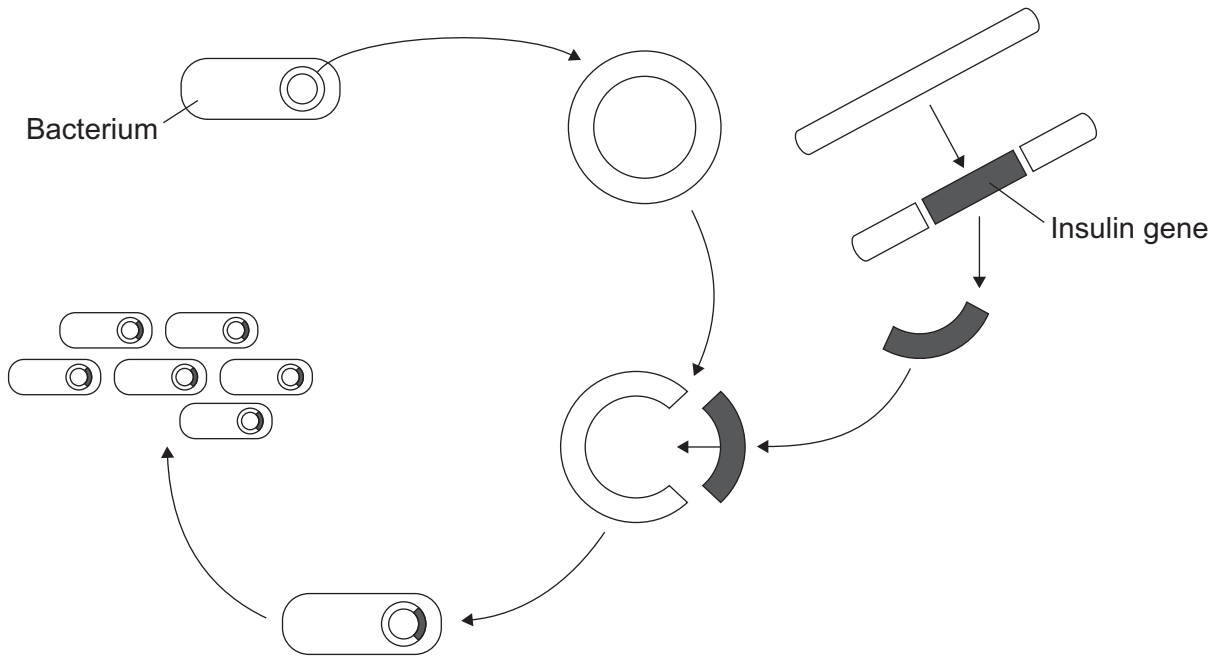
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(3 marks)

7 (b) The diagram shows the stages of genetically engineering bacteria so that they can make human insulin.



7 (b) (i) Where does the gene that carries the instructions on how to make insulin come from?

.....

(1 mark)



7 (b) (ii) Use the diagram to describe how the bacterial cells are genetically engineered to make human insulin.

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

(3 marks)

7 (c) Before human insulin was produced through genetic engineering, diabetics were treated with insulin from pigs.

Suggest **two** disadvantages of using insulin from pigs to treat humans.

1 .....

2 .....

(2 marks)

7 (d) Insulin is a hormone.

Complete the sentence to show how hormones act in the body.

Hormones are made in ..... and are then carried

by ..... to the target organ or cells.

(2 marks)

11

Turn over ►



**8** Scientists have discovered that the Earth's atmosphere is very different from what it was 4500 million years ago.

**8 (a)** The table lists some of the gases that were present in the Earth's early atmosphere.

Complete the table by writing in the chemical formula of each gas.

Gas	Chemical formula
Methane	
Carbon dioxide	
Ammonia	
Steam	

(2 marks)

**8 (b)** Explain why there is very little steam in the Earth's atmosphere now compared with the early atmosphere, and suggest where most of it has gone.

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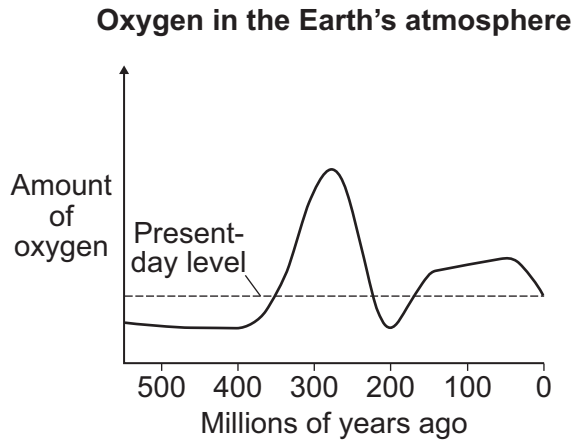
(2 marks)





8 (c) Since the atmosphere formed, there have been major changes in the amounts of the gases present.

The graph shows how the amount of oxygen has changed.



8 (c) (i) Explain the rise in oxygen between 400 and 300 million years ago.

.....

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(2 marks)

8 (c) (ii) At about the same time as the oxygen level changed, there was also a change in the amount of carbon dioxide.

Explain what happened to the amount of carbon dioxide during the same time as the amount of oxygen increased.

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.....

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(2 marks)

8
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Turn over ►



- 9** Doctors can diagnose and treat certain diseases using radioactive substances. Three main types of nuclear radiation are given out by radioactive substances. Some information about these types of nuclear radiation is given in **Table 1**.

**Table 1**

Type of radiation	Charge	Mass in kilograms	Stopped by	Shielding material
Alpha	+2	$6.644656 \times 10^{-27}$	Thin sheet of paper	Paper, skin, clothes
Beta	-1	$9.10938188 \times 10^{-31}$	Thin sheet of aluminium	Plastic, glass, light metals
Gamma	0	0	Many centimetres of lead	Dense material, concrete, earth

- 9 (a)** Complete **Table 2** by describing each type of nuclear radiation.

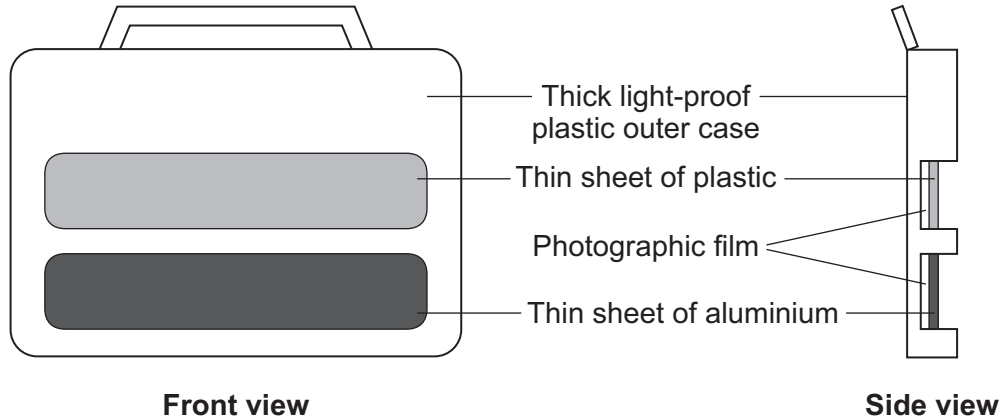
**Table 2**

Type of radiation	Description
Alpha	
Beta	
Gamma	

*(3 marks)*

9 (b) People who work with radioactive substances need to wear a film badge to monitor their exposure to radiation.

This is a diagram of a film badge.



9 (b) (i) Describe how the film badge would detect the amount and type of radiation someone has been exposed to.

.....

.....

.....

.....

.....

.....

(3 marks)

9 (b) (ii) One of the three types of nuclear radiation is **not** detected by the film badge.

Why do we **not** need to monitor our exposure to this type of radiation with a badge?

.....

.....

(1 mark)

Question 9 continues on the next page

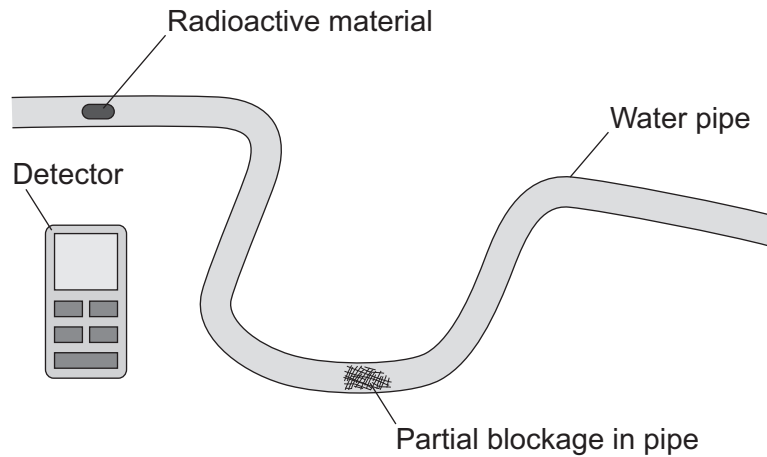
Turn over ►



**9 (c)** A radioactive substance can be used as a 'tracer'.

An engineer needs to find a partial blockage in a water pipe.

He places a small piece of radioactive material into the pipe and uses a detector to locate the material from outside the pipe.



**9 (c) (i)** Explain how the engineer could find the blockage in the pipe.

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(2 marks)

**9 (c) (ii)** Describe **one** medical use for a tracer.

.....

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(1 mark)

10
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**END OF QUESTIONS**

