General Certificate of Secondary Education
June 2004

SCIENCE DOUBLE AWARD (MODULAR)   **3468/1H**
HIGHER TIER
Paper 1

AQA
ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Monday 7 June 2004   1.30 pm to 3.00 pm

H

In addition to this paper you will require:
• the Data Sheet (enclosed);
• a ruler.
You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
● Use blue or black ink or ball-point pen.
● Fill in the boxes at the top of this page.
● Answer **all** questions in the spaces provided.
● Do all rough work in this book. Cross through any work you do not want marked.

Information
● The maximum mark for this paper is 90.
● Mark allocations are shown in brackets.
● You are reminded of the need for good English and clear presentation in your answers.

3468/1H

INHERITANCE AND SELECTION

1 (a) This question is about the hormones that control the monthly cycle in women.

Complete the sentences.

Hormones control the monthly release of an egg from a woman's ....

They also control the thickness of the lining of her ....

Hormones that are given to women to stimulate the release of eggs are called

.... drugs.

Hormones that are given to women to prevent the release of eggs are called

oral ....

(4 marks)

(b) In humans, one of the pairs of chromosomes in each cell carries the genes which determine sex.

What is the difference between the sex chromosomes of a man and a woman?

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(2 marks)

6

2 In some methods of reproduction, clones are made.

(a) Explain what is meant by a clone.

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(2 marks)

(b) *To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Describe, in as much detail as you can, **one** way in which an embryo can be cloned.

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(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

STRUCTURES AND BONDING

3   Use the Periodic Table of Elements on the Data Sheet to help you to answer this question.

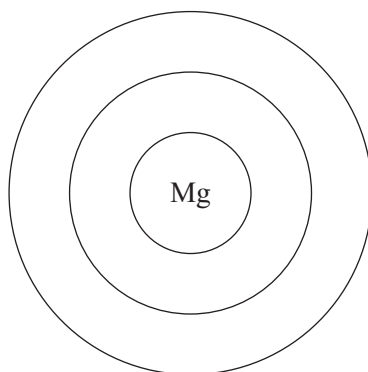(a)   Describe, in as much detail as you can, the structure of a fluorine atom.

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....

(3 marks)

(b)   Complete the diagram to show the electronic structure of a magnesium atom.

Mg

(1 mark)

4

4 (a) Magnesium burns in oxygen, forming magnesium oxide.

This equation represents the reaction.

$$Mg(s) \quad + \quad O_2(g) \quad \rightarrow \quad MgO(s)$$
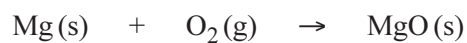
(i) Balance the equation. *(1 mark)*

(ii) Give the meaning of the state symbols (s) and (g).

(s)...

(g) .... *(2 marks)*

(b) Use the Formulae of Some Common Ions table on the Data Sheet to help you to answer this question.

Magnesium also reacts with chlorine to form magnesium chloride.

Give the formula of magnesium chloride .... *(1 mark)*

$\frac{}{4}$

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

5 In the nineteenth century, the scientist Gay-Lussac electrolysed water and got the results shown in the diagram.
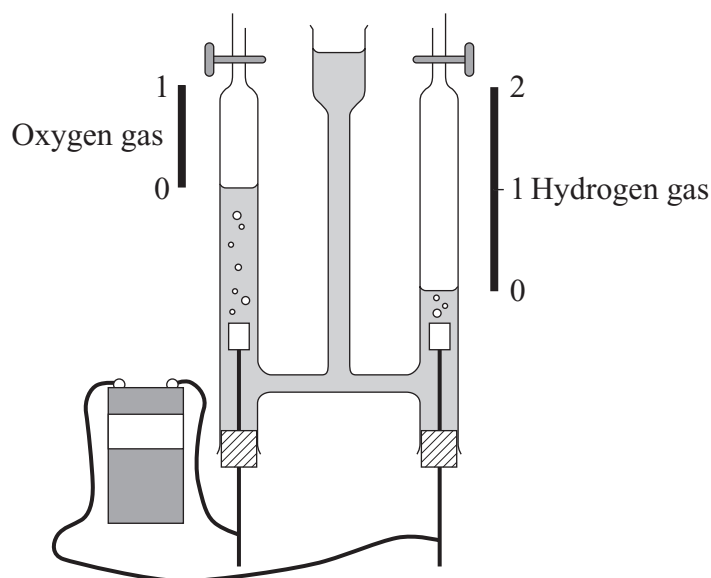
He did experiments on other compounds. His results are shown in the table.

Volumes of reacting gases in cm^3				Ratio of reacting gases in compound	
hydrogen	100	oxygen	50	H:O	2:1
hydrogen	90	nitrogen	30	H:N	3:1
nitrogen	50	oxygen	100	N:O	

(a) Complete the table.   *(1 mark)*

(b) What does this tell you about the way in which gases combine?

....

....
                                                                                        (1 mark)

(c)   Gay-Lussac suggested that the formula of water is H_2O.

Dalton thought it was HO.

Look at the results for the electrolysis of water. Which scientist was correct?

....

Give the reason for your answer.

....

....

(1 mark)

(d)   Dalton believed that atoms of the same element would repel each other.

A scientist called Avogadro said that gases such as oxygen existed as pairs of atoms linked to form molecules.

What holds the two oxygen atoms together in an oxygen molecule?

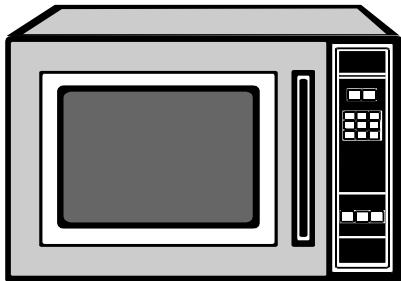...

....

(1 mark)

4

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

WAVES AND RADIATION

6 (a) Microwave ovens can be used to heat many types of food.

(i) Describe, in as much detail as you can, how microwaves heat food.

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(2 marks)

(ii) Microwaves have a frequency of 10 000 million Hz. Their wavelength is 0.03 m.

Calculate the speed of microwaves.

Show clearly how you work out your answer.

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Speed of microwaves.. m/s

(2 marks)
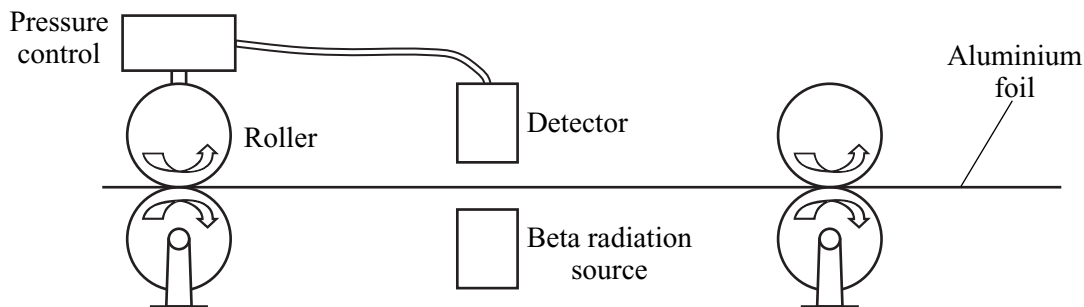
(b) Another type of wave has been used to investigate the structure of the inside of the Earth.

(i) Name this type of wave. ....

(ii) Name the instrument used to detect this type of wave. ....

(2 marks)

6

7 The diagram shows how the thickness of aluminium foil is controlled. The thicker the aluminium foil, the more radiation it absorbs.

(a) The designers used a beta radiation source for this control system.

(i) Why would an alpha radiation source be unsuitable in this control system?

....

....
(1 mark)

(ii) Why would a gamma radiation source be unsuitable in this control system?

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(1 mark)

(b) The substance used in the beta radiation source is radioactive.

(i) Why are some atoms radioactive?

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(1 mark)

(ii) Explain why radiation is dangerous to humans.

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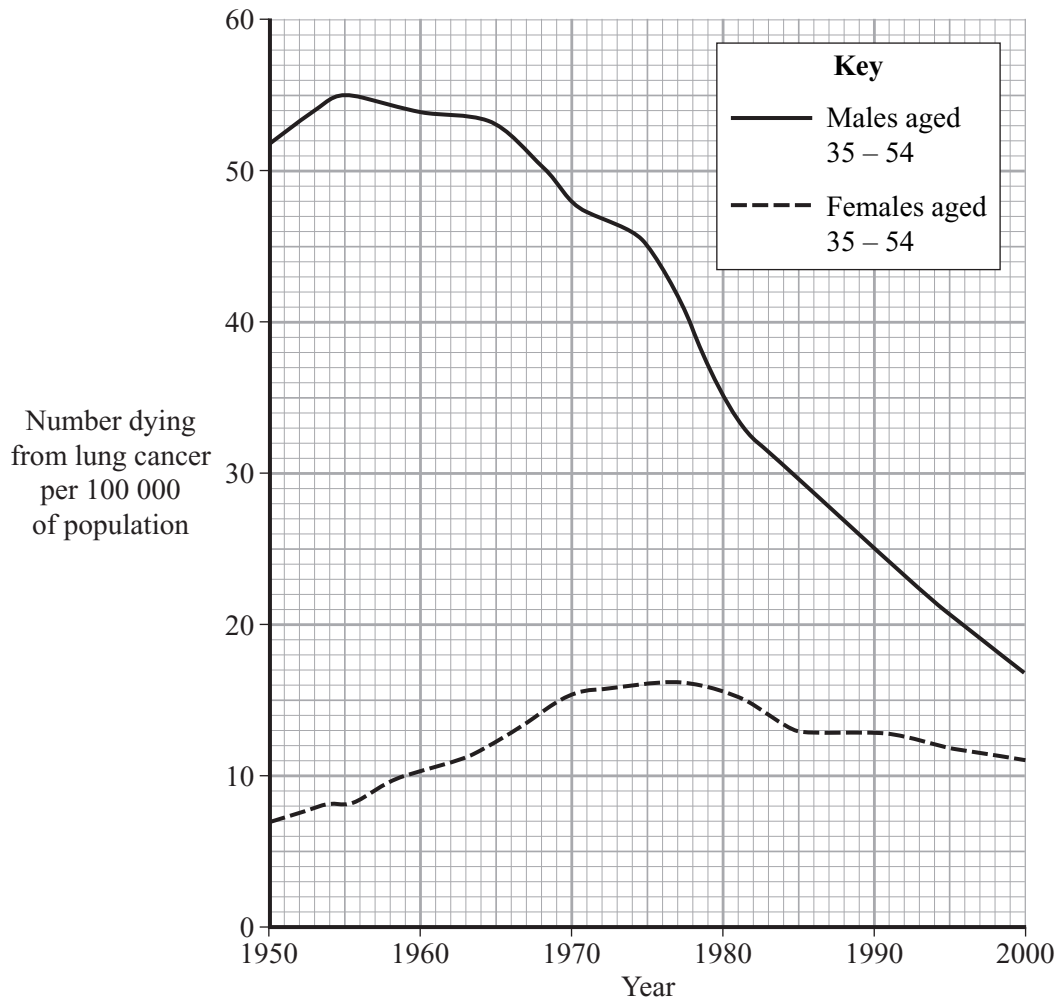*(2 marks)*

5

Turn over ▶

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

8 Scientists study the effect of smoking on the number of people dying from lung cancer.

Graph 1 shows the number of people who died from lung cancer in this country between 1950 and 2000.

Graph 1

(a) Describe how the number of men who died from lung cancer changed between 1960 and 2000.

....

....

....

....

(2 marks)

(b)   Describe **two** differences between the numbers of men and women who died from lung cancer between 1960 and 2000.

1 ....

....

2 ....

....

(2 marks)

(c)   A town in this country had 500 000 inhabitants in 1955.

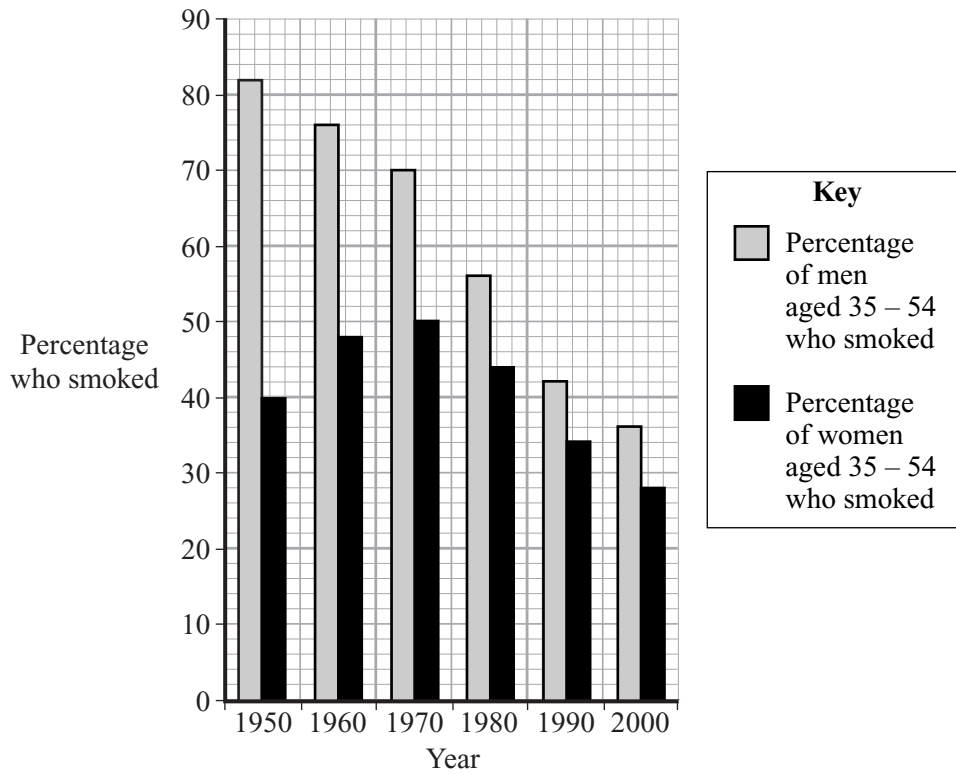How many men aged 35–54 from that town are likely to have died from lung cancer in 1955?

....

....

Number of men..

(1 mark)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ▶

(d) **Graph 2** shows the percentage of the population who smoked between 1950 and 2000.

Graph 2

Explain how the data from **graphs 1** and **2** support the hypothesis that smoking increases the risk of getting lung cancer.

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(2 marks)

**NO QUESTIONS APPEAR ON THIS PAGE**

TURN OVER FOR THE NEXT QUESTION

INHERITANCE AND SELECTION

9   Huntington's disease is a rare inherited disorder of the nervous system.

It is caused by a dominant allele **H**. The recessive allele of this gene is represented by **h**.

The diagram shows the inheritance of Huntington's disease in a family.

Key

■ Affected male

□ Unaffected male

● Affected female

○ Unaffected female
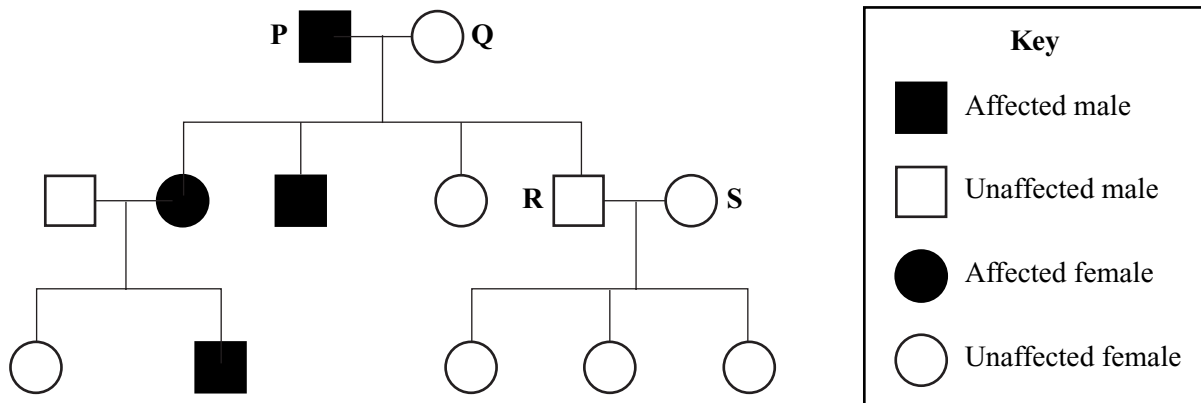
(a)   Use a genetic diagram to show the inheritance of the Huntington's disease allele by the children of parents **P** and **Q**.

(3 marks)

(b)   Explain why none of the children of **R** and **S** inherited Huntington's disease.

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(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

10 (a) Sex cells are produced by meiosis.

Describe what happens to the chromosomes when a cell divides by meiosis.

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(2 marks)

(b) Darwin's theory of natural selection depends on the fact that individual organisms within a species may show a wide range of variation.

Explain how meiosis and sexual reproduction give rise to variation.

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(2 marks)

(c) Mutation may also give rise to variation.

(i) What is meant by mutation?

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(1 mark)

(ii) Are all mutations harmful? Explain the reason for your answer.

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(2 marks)

STRUCTURES AND BONDING

11 Use the Periodic Table of Elements on the Data Sheet to help you to answer this question.

Francium (Fr) is a very rare element. It is estimated that there is only 25 g of francium in the Earth's crust. Francium is radioactive and has a half-life of only a few minutes.

Mendeleev predicted the existence of francium in the 1870s but the element was not discovered until 1939.

(a) Explain why Mendeleev was able to predict the existence of francium in the 1870s.

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(2 marks)

(b) Suggest why there is not much experimental evidence for the properties of francium.

....

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(1 mark)

(c) (i) If you could react francium with water, how would the reaction compare with that of sodium with water?

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(1 mark)

(ii) Explain the reason for your answer.

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(2 marks)

6

Turn over ▶

12 The diagram shows the structure of diamond.

Carbon atoms
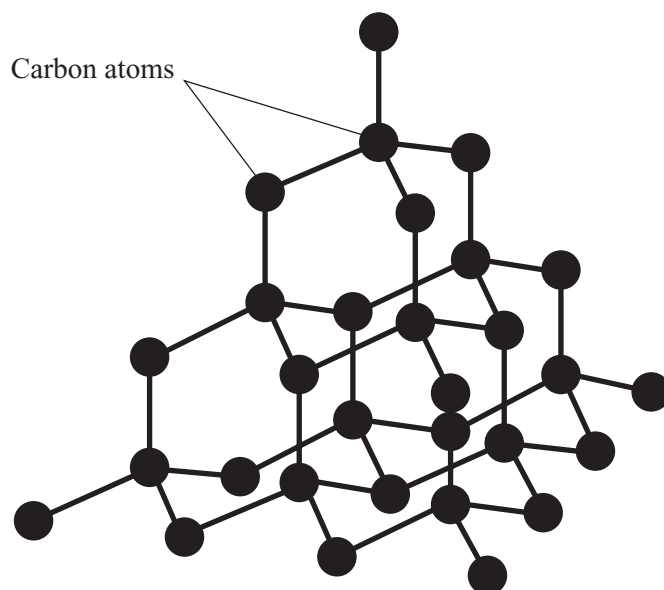
(a) *To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Explain, as fully as you can, why diamond has a high melting point.
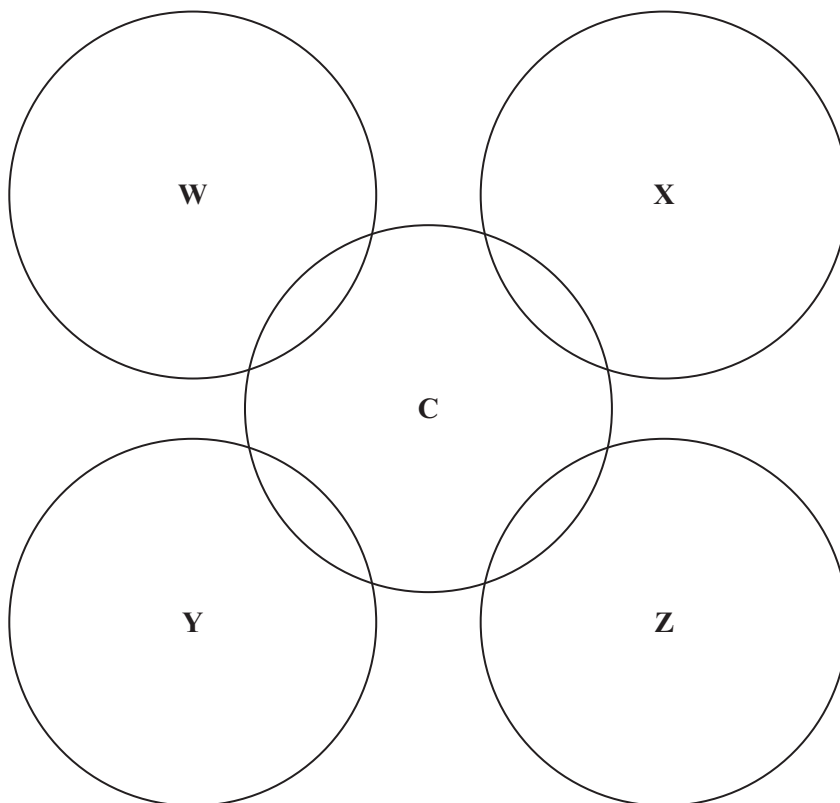
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(3 marks)

(b) The diagram below shows the outer electron shells of five carbon atoms in the giant lattice of diamond.

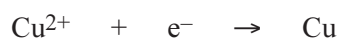Carbon atom **C** forms bonds with each of the carbon atoms **W**, **X**, **Y** and **Z**.

Draw the positions of all the electrons in the outer shells of each of carbon atoms **C**, **W**, **X**, **Y** and **Z**.

(3 marks)

(c) Copper chloride is an ionic compound. During the electrolysis of copper chloride solution, copper is deposited at the negative electrode.

Complete the half equation for this reaction.

$$Cu^{2+} \quad + \quad e^- \quad \rightarrow \quad Cu$$

(1 mark)

7

Turn over ▶

WAVES AND RADIATION

13 Pigs have a layer of fat in their skin. Underneath the fat is a layer of muscle. Ultrasonic waves are used to measure the thickness of the layer of fat. An ultrasound transmitter and detector are attached to the skin of the pig.

Ultrasound transmitter

Ultrasound detector connected to oscilloscope
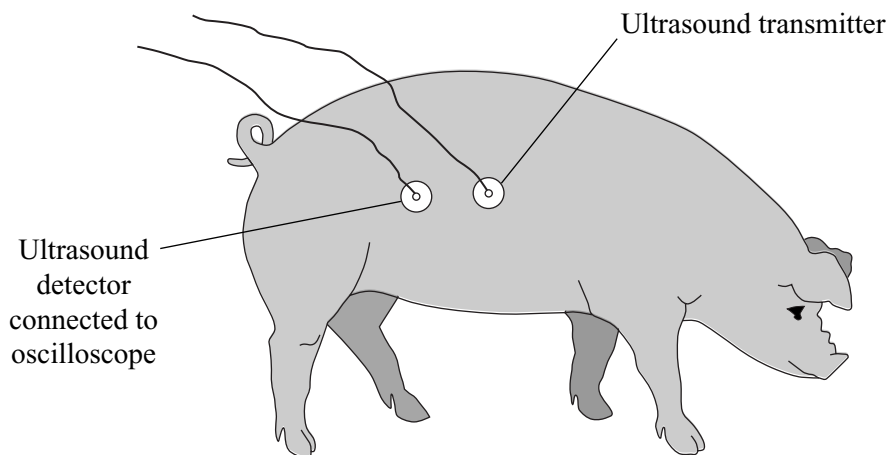
(a) Explain why ultrasound can be used to measure the thickness of the layer of fat.

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(2 marks)

(b) The oscilloscope does not measure distance directly.

(i) What does the oscilloscope measure in this case?

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(1 mark)

(ii) What other information is needed to calculate the thickness of the layer of fat in a pig?

....

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(1 mark)

4

NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

14 (a) (i) Describe the structure of alpha particles.

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(2 marks)

(ii) What are beta particles?

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(1 mark)

(b) Describe how beta radiation is produced by a radioactive isotope.

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(1 mark)

(c) Iodine-131 (^{131}I) is a radioactive isotope used in medicine.

The graph shows how the count rate of a sample of iodine-131 changed over 24 days.
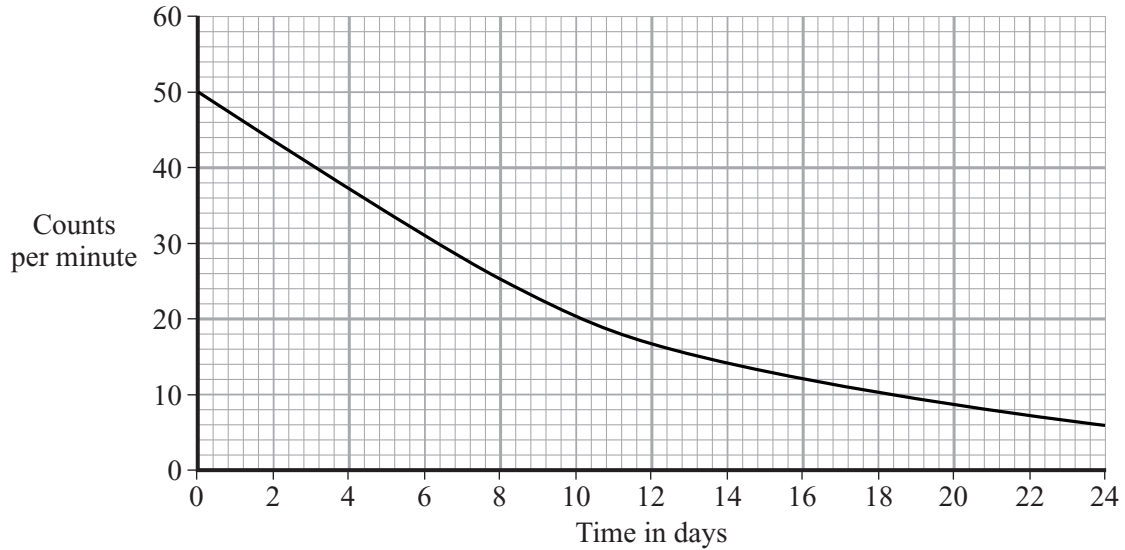
(i) Use the graph to calculate the half-life of iodine-131. To obtain full marks you should show clearly how you work out your answer.

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Half-life .... days

(2 marks)

(ii) Iodine-131 is used to destroy cancer cells in the human thyroid gland.

Explain why the length of the half-life of iodine-131 is important in this use.

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(2 marks)

8

Turn over ▶

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

15 The table shows the amounts of some of the substances filtered, reabsorbed and excreted by the kidneys in one day.

Substance	Amount filtered	Amount reabsorbed	Percentage reabsorbed	Amount excreted
water		178.5 litres	99.2%	1.5 litres
urea	56 g	28 g	50%	28 g
glucose	800 units	800 units	100%	0
sodium	25 200 units	25 050 units		150 units
chloride	18 000 units	17 850 units	99.2%	150 units

(a) Calculate the amount of water filtered by the kidneys in one day.

....

Amount .... litres

(1 mark)

(b) Calculate the percentage of the filtered sodium that was reabsorbed. Show clearly how you work out your answer.

....

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Percentage reabsorbed ....

(1 mark)

(c) What effect, if any, does increased secretion of ADH have on:

(i) the volume of urine?

....

(ii) the concentration of urine?

....

....

(2 marks)

16 The diagram shows some plants growing in a greenhouse on a hot summer's day.
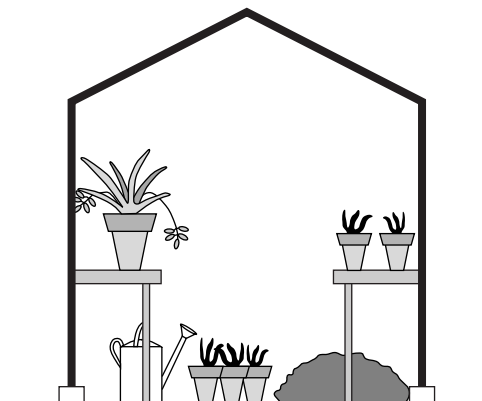
Which **one** of the following factors is most likely to limit the rate of photosynthesis at this time?

- carbon dioxide concentration

- light intensity

- temperature

Factor ....

Explain the reason for your answer.

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(4 marks)

Turn over ▶

17 Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.

The table gives information about the extraction of some metals.

Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with
Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

(a) Explain why gold is found mainly as the metal itself in the Earth.

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....

(1 mark)

(b) One of the reactions involved in producing zinc is represented by this equation.

$$ZnO \quad + \quad C \quad \rightarrow \quad Zn \quad + \quad CO$$
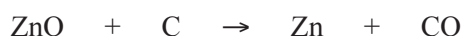
Explain why carbon can be used to extract zinc.

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(1 mark)

(c) Sodium is one of the most abundant metals on Earth.

Explain, as fully as you can, why sodium was not extracted until 1807.

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(2 marks)

END OF QUESTIONS

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