FOR OFFICIAL USE

C

	KU	PS
Total Mark		

3700/403

NATIONAL QUALIFICATIONS 2009

THURSDAY, 28 MAY
1.00 PM – 2.30 PM

SCIENCE
STANDARD GRADE
Credit Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

1 Answer as many questions as you can.

2 Read the whole of each question carefully before you answer it.

3 Write your answers in the spaces provided. Showing working may help in some questions.

4 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

1. Increasing concentrations of certain gases in the atmosphere can damage the environment.

(*a*) Link the **gases** to their **effect on the environment**.

The first one has been done for you.

Gases	**Effect on the environment**
Oxides of nitrogen	Acid rain pollution
Carbon dioxide	Air pollution in city centres
Sulphur dioxide	Breakdown of the ozone layer
CFCs	Global warming

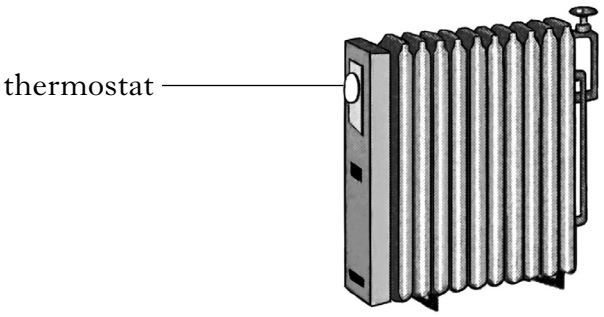
2

(*b*) One way in which air pollution can be reduced is by burning less fuel.

Give another way in which air pollution can be reduced.

..... **1**

2. The thermostat fitted to a radiator is used to maintain a steady temperature.



Explain how the thermostat maintains a steady temperature.

.....

.....

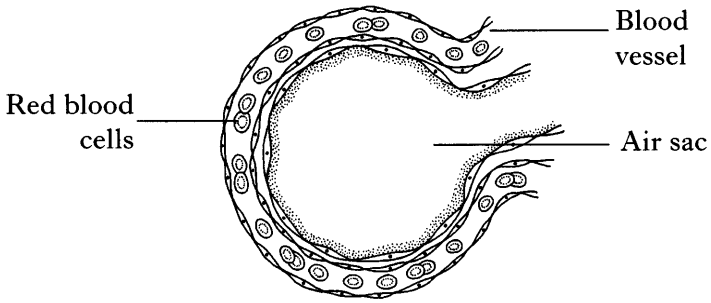
..... **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

3. Air sacs are found in the lungs.

The diagram shows a single air sac and the blood vessel surrounding it.



(*a*) What type of blood vessel surrounds the air sac?

..... **1**

(*b*) Name the substance in red blood cells which carries oxygen.

..... **1**

(*c*) Cigarette smoke contains harmful substances.

Name the substance that

(i) reduces gas exchange in the air sacs.

..... **1**

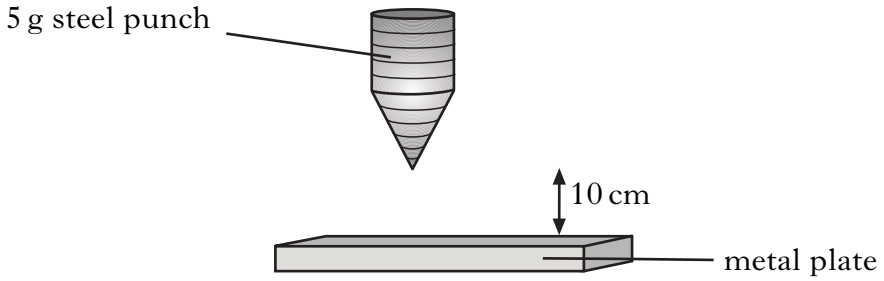
(ii) is addictive.

..... **1**

[Turn over

Marks | KU | PS

4. James carried out an investigation to compare the hardness of different metal plates.



He dropped a 5 g steel punch on to a metal plate from a height of 10 cm.

He measured the diameter of the dent.

Results

Metal plate	*Diameter of the dent* (mm)
brass	1
bronze	2

The investigation was **fair** but could be **improved** to make it more accurate and reliable.

Suggest **two improvements**.

1 .....

.....

2 .....

..... **2**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

5. (*a*) Different methods for detecting oil in rock formations are shown below.

test drilling	aerial survey
seismic survey	geological survey

Which method involves

(i) setting off small explosions and recording the echoes?

..... **1**

(ii) collecting and examining different rocks from an area?

..... **1**

(*b*) The fractions of crude oil can be separated by fractional distillation because they have different

A viscosities

B boiling points

C flammabilities

D colours.

Underline the correct answer. **1**

6. Complete the following sentences about toxic gases by circling the correct answer in each box.

Burning | polyvinylchloride (PVC) / polystyrene / polyurethane | produces hydrogen cyanide gas. **1**

Burning | polyvinylchloride (PVC) / polystyrene / polyurethane | produces hydrogen chloride gas. **1**

[Turn over

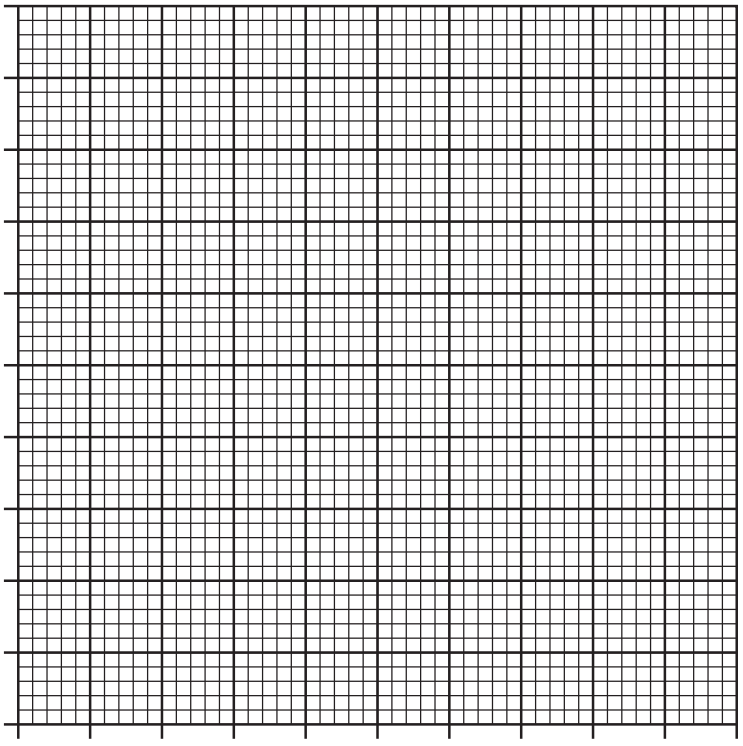
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

7. The table shows the minimum and maximum water levels in a reservoir, as a percentage of full capacity, in three different years.

Year	*Water level* (%)	
	Minimum	*Maximum*
1995	46	92
2000	80	96
2005	55	88

Construct a single bar graph to show all of this information.
(Additional graph paper, if required, may be found on page 24.)



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8. Read the passage and then answer the questions. *Marks*

Persistent Organic Pollutants

Adapted from *The British Isles: A Natural History* by Alan Titchmarsh.

Insecticides such as DDT, aldrin and dieldrin are known as persistent organic pollutants (POPs). They do not break down easily and remain in the environment for a long time, causing great damage. They have had a devastating impact on Britain's bird population.

POPs become incorporated into the food chain. When birds eat insects or seeds treated with POPs, the insecticides enter their bodies and accumulate in body fat. Insect-eating fish also take in the insecticides, passing them on to fish-eating birds. Because the insecticides accumulate in animals' bodies, they become increasingly concentrated and toxic higher up the food chain. In birds' bodies, high levels of POPs disrupt hormone production and reproductive processes. Many birds of prey have been affected by eggshell thinning. This makes eggshells too fragile to protect chicks. British populations of eagles, peregrine falcons and sparrowhawks were almost wiped out by POPs in the 1960s and 1970s.

POPs were banned in the 1990s and bird populations made a recovery. Peregrine falcon numbers quickly returned to their former levels in most parts of Britain. The white-tailed sea eagle, which had completely died out, has been reintroduced to Scotland and now has a stable population. Sparrowhawks had almost disappeared from eastern England, where insecticide use was highest, but they have now completely recovered, with 32 000 breeding pairs recorded.

(*a*) Name **three** persistent organic pollutants (POPs).

.....

..... **1**

(*b*) Why do POPs become increasingly concentrated and toxic higher up the food chain?

..... **1**

(*c*) Give **three** effects that POPs have on birds.

1 .....

2 .....

3 ..... **2**

(*d*) Why had sparrowhawks almost disappeared from eastern England?

..... **1**

DO NOT WRITE IN THIS MARGIN

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9. Before installing a new central heating system, a house owner compared

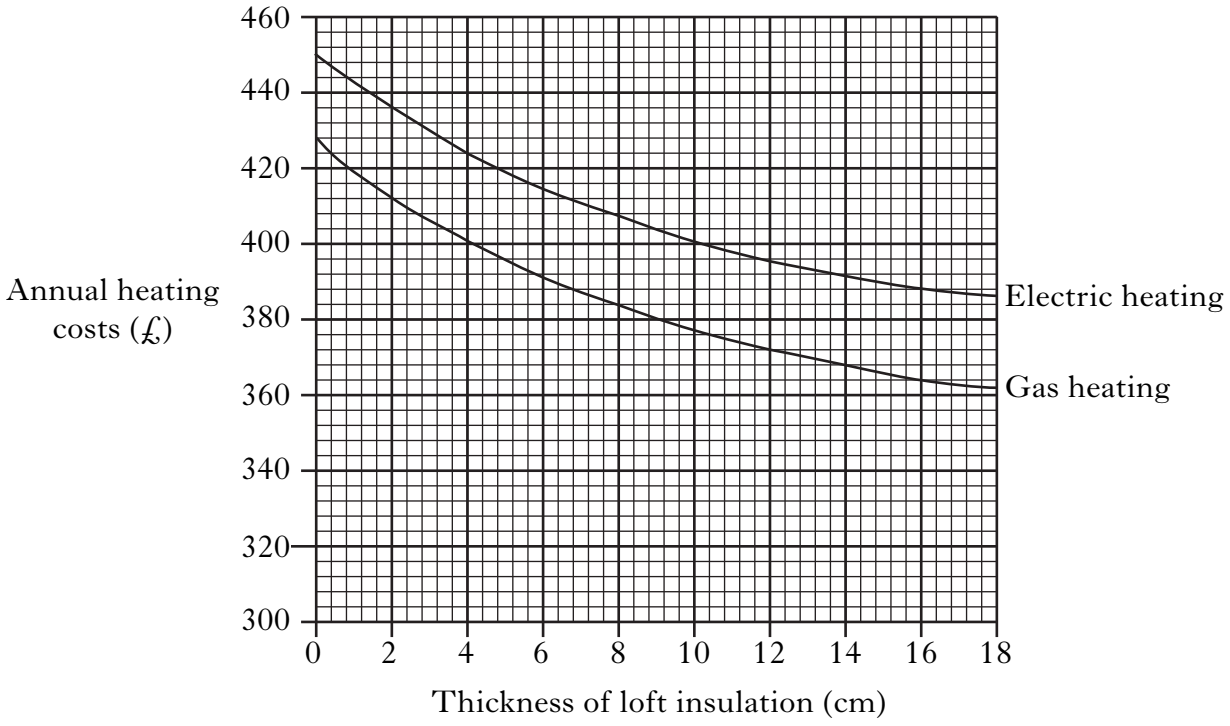
- the annual cost of gas and electricity
- the savings from installing insulation.

(*a*) Give **two** other factors which the house owner should consider before choosing the new system.

1 .....

2 ..... **2**

(*b*) The graph shows how the annual heating costs change with different thicknesses of loft insulation.



(i) Draw **two** conclusions from the graph.

1 .....

.....

2 .....

..... **2**

DO NOT WRITE IN THIS MARGIN

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9. (*b*) (continued)

(ii) How much money would be saved annually if the thickness of the loft insulation in the gas heated house was increased from 2 cm to 14 cm?

Space for working

Answer £ **2**

10. Methods of protecting materials are shown below.

electroplating	pesticide treatment	anodising
galvanising	packaging	water-proofing

(*a*) Which method is best for protecting

(i) a box of light bulbs?

..... **1**

(ii) a wooden bench against attack by woodworm?

..... **1**

(iii) the aluminium frame of a bicycle?

..... **1**

(*b*) One of the methods also involves coating computer components with a thin layer of gold to improve their conductivity.

Name this method.

..... **1**

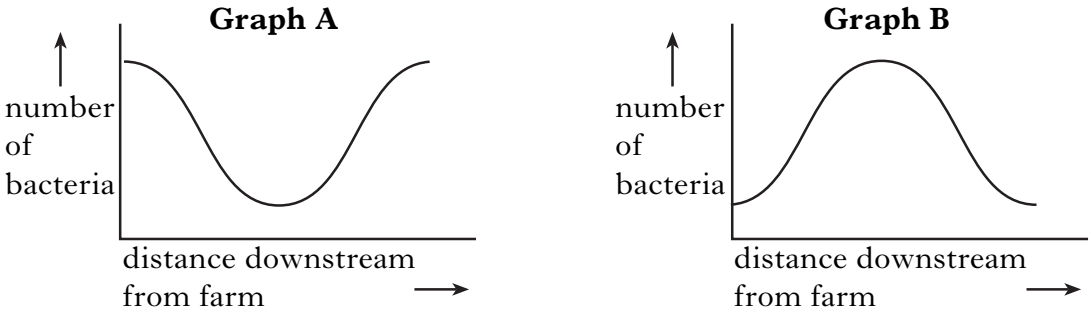
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

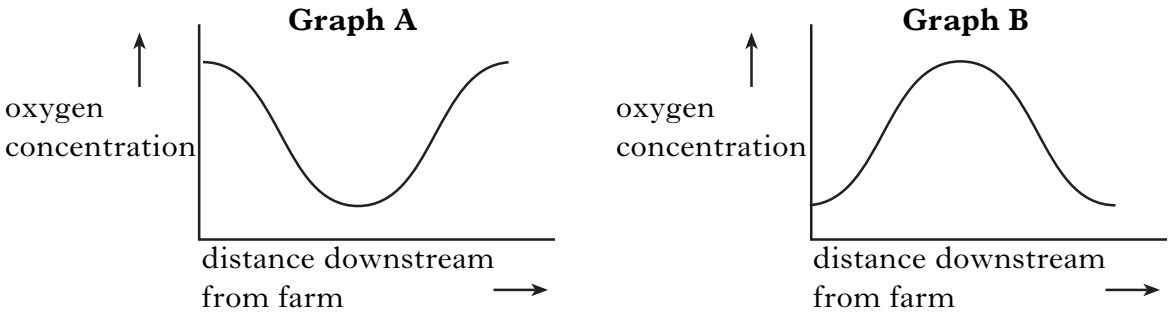
11. Organic waste from a farm was accidentally spilled into a river.

(*a*) Which graph below shows how the **number of bacteria** in the river would be affected?



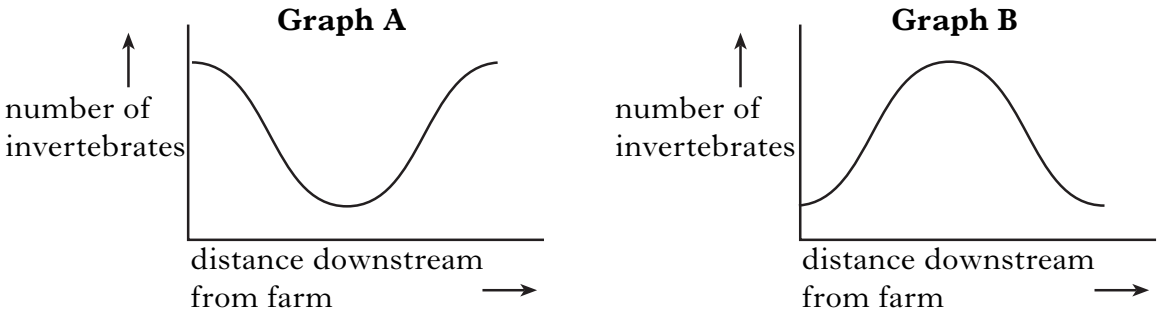
Answer **Graph** **1**

(*b*) Which graph below shows how the **oxygen concentration** in the river would be affected?



Answer **Graph** **1**

(*c*) Which graph below shows how the **number of invertebrates** in the river would be affected?

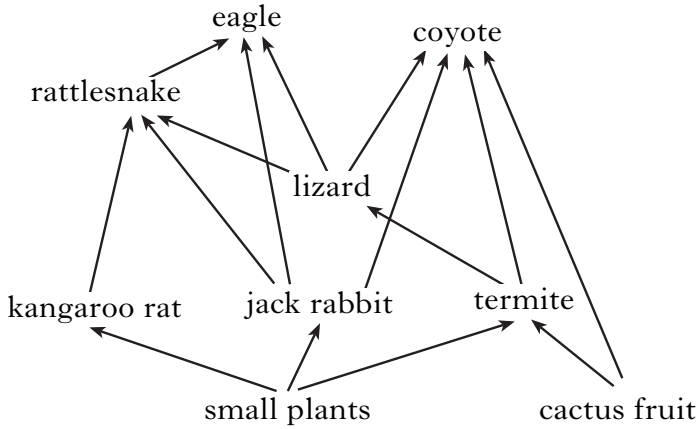


Answer **Graph** **1**

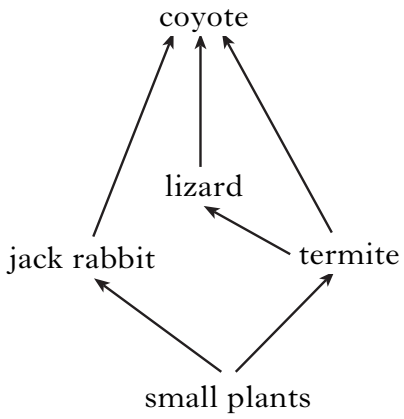
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

12. Two food webs from a desert habitat are shown below.



Food web A



Food web B

(*a*) Circle the correct answers in the following sentence.

Food web **B** is [more stable / less stable] because it has [more links / fewer links].

1

(*b*) This is a food chain from food web **A**.

small plants ⟶ kangaroo rat ⟶ rattlesnake ⟶ eagle

Describe **two** ways in which energy can be lost at each step in this food chain.

1 .....

2 ..... **2**

(*c*) The rattlesnake population is wiped out by disease. How will this affect the number of

(i) kangaroo rats? .....

Explain your answer. .....

..... **1**

(ii) eagles? .....

Explain your answer. .....

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

13. (*a*) Complete the table below to show the **fuse rating** for each appliance.

Appliance	*Power rating* (W)	*Fuse rating* (A)
Table lamp	100	
Kettle	2000	

1

(*b*) The boxes below describe possible positions for the **switch** and the **fuse** in the electrical supply to a kettle.

1 switch in the live wire fuse in the neutral wire	2 switch in the earth wire fuse in the earth wire
3 switch in the live wire fuse in the live wire	4 switch in the earth wire fuse in the live wire

Which box describes the correct position for the switch **and** the fuse?

Box number **1**

14. Select the correct word to complete each sentence below.

hypothermia	immunisation	hypertension
tuberculosis	circulation	anorexia

(*a*) ..... is a way of improving the body's defence against disease. **1**

(*b*) ..... is an inability to maintain core body temperature. **1**

(*c*) ..... is a disorder resulting from a refusal to eat sufficient food. **1**

DO NOT WRITE IN THIS MARGIN

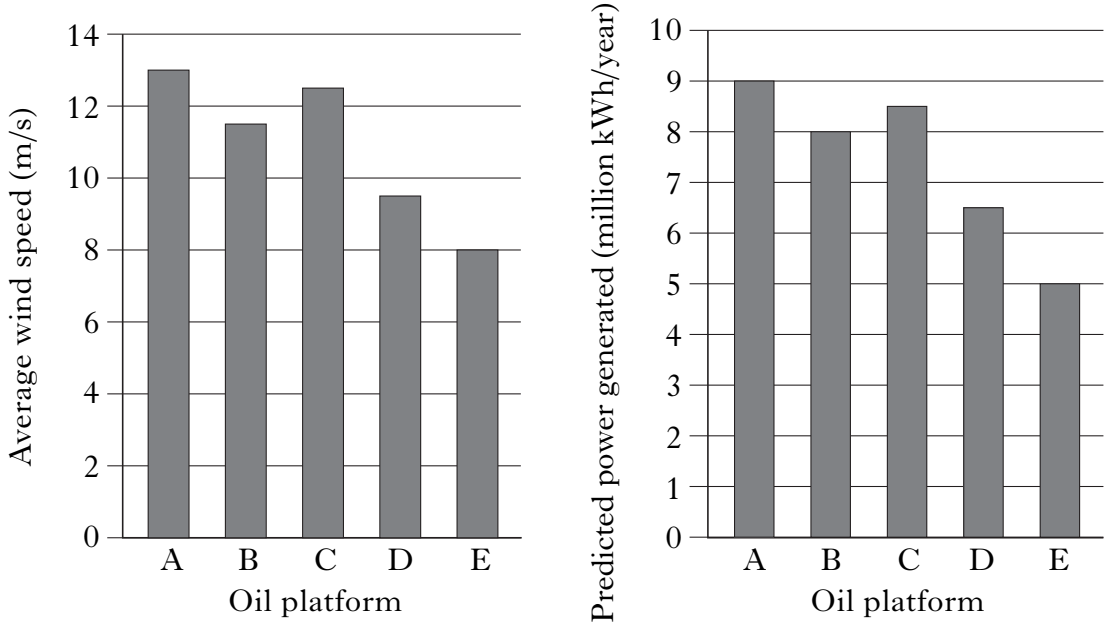
Marks	KU	PS

15. An oil company was investing in alternative technologies.

One plan involved placing wind turbines on oil platforms.

Five oil platforms were surveyed to find the average wind speed and the predicted power generated at each site.

The results are shown below.



(*a*) Draw **one** conclusion between average wind speed and predicted power generated.

..... **1**

(*b*) What is the predicted power generated by a wind turbine on the oil platform with an average wind speed of 8 m/s?

..... million kWh/year **1**

(c) Predict the power generated by a wind turbine on an oil platform with an average wind speed of 10 m/s.

..... million kWh/year **1**

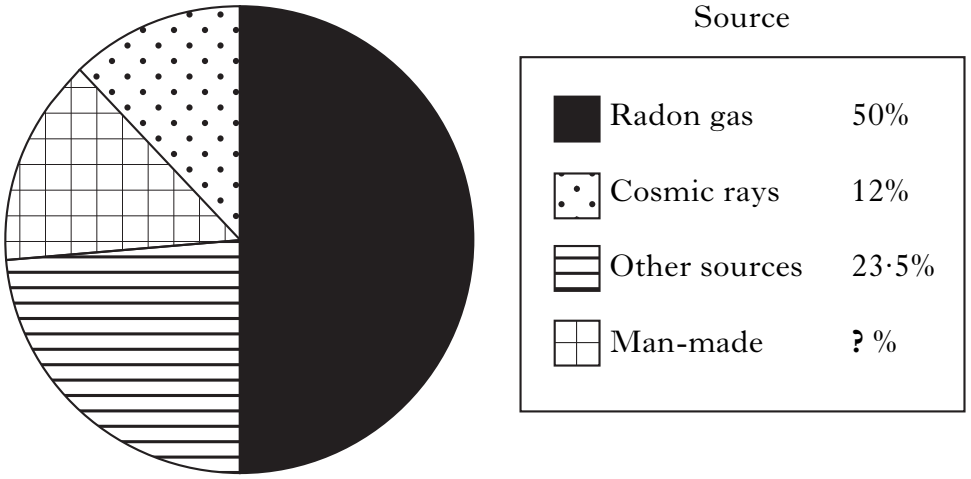
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

16. The average annual radiation dose absorbed by a person in the UK is 2·5 millisieverts (mSv). Most of this radiation is natural but some comes from man-made sources. Radon, a gas produced by rocks such as granite, is the biggest natural source of radiation.

The pie chart shows the percentage of the annual radiation dose absorbed from different sources.



(*a*) Use the pie chart to calculate the percentage of the annual radiation dose from man-made sources.

Space for working

..... % **2**

(*b*) What is the average annual radiation dose, in millisieverts, obtained from the biggest source of natural radiation?

Space for working

..... mSv **2**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

17. Some properties of materials are shown below.

resistance to corrosion	flexibility	electrical resistance
thermal conductivity	strength	electrical conductivity
wear resistance	hardness	heat resistance

(*a*) Which **two** properties would be **most** important for a new material being developed for making kitchen work surfaces?

1 .....

2 ..... **2**

(*b*) Which property fits each of the descriptions below?

(i) The ability of a material to allow heat to pass through it.

..... **1**

(ii) The ability of a material to support heavy loads without breaking.

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

18. There are four different types of blood groups. The blood group you have depends on the genes inherited from your parents.

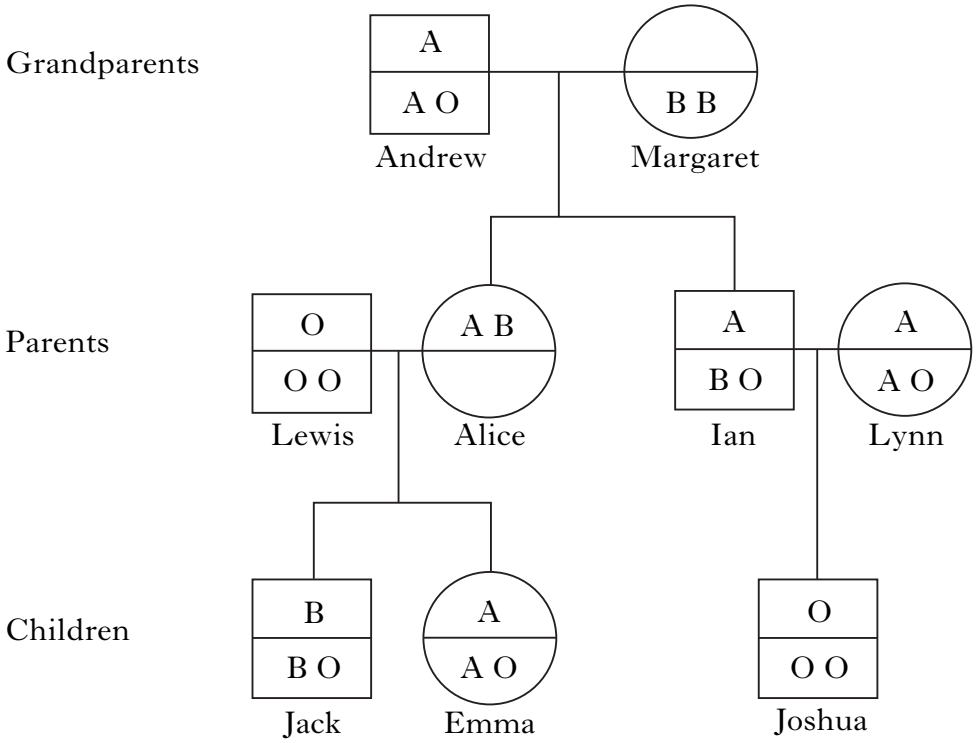
Blood group	*Genes inherited from parents*
O	OO
A	AA or AO
B	BB or BO
AB	AB

The diagram below shows a family tree.

A circle stands for a female. A square stands for a male.

The top half of each circle or square shows the person's blood group.

The bottom half of each circle or square shows the genes inherited from the person's parents, one from each parent.



DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

18. (continued)

Use all of the information to answer the following questions.

(*a*) What blood group does Andrew have?

..... **1**

(*b*) How many males in the family tree have blood group O?

..... **1**

(*c*) Complete the family tree to show

(i) Margaret's blood group

(ii) the genes passed on to Alice from her parents. **1**

(*d*) Joshua marries a woman with AO genes.
Their children could have

1 only blood group O

2 either blood group O or blood group A

3 either blood group O or blood group B

4 only blood group A.

Underline the correct answer. **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

19. Some information about British coins is given below.

Coin	*Composition*	*Mass* (g)	*Thickness* (mm)	*Shape*
One pound	70% copper 5·5% nickel 24·5% zinc	9·50	3·15	circular
Fifty pence	75% copper 25% nickel	8·00	1·78	heptagonal
Twenty pence	84% copper 16% nickel	5·00	1·70	heptagonal
Ten pence	75% copper 25% nickel	6·50	1·85	circular
Five pence	75% copper 25% nickel	3·25	1·70	circular
Two pence (before September 1992)	97% copper 0·5% tin 2·5% zinc	7·12	1·85	circular
One pence (before September 1992)	97% copper 0·5% tin 2·5% zinc	3·56	1·65	circular

There are three groups of British coins. One and two pence coins belong to a group called "copper" coins. Before September 1992 these were made from an alloy called bronze. Since September 1992 one and two pence coins have been made from copper-plated steel. "Silver" coins are made from an alloy, called cupro-nickel. Silver coins include the five, ten, twenty and fifty pence coins. The one pound coin is in another group called "yellow metal" coins. The one pound coin is made from an alloy called nickel-brass.

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

19. (continued)

Use all of the information to answer the following questions.

(*a*) (i) Which coin is 1·70 mm thick and is circular in shape?

..... coin **1**

(ii) Which "silver" coin has a different composition from the others?

..... coin **1**

(iii) What is the name of the alloy from which the coins with a heptagonal shape are made?

..... **1**

(*b*) Calculate the mass of copper in a one pound coin.

Space for working

Answer ..... g **2**

[Turn over

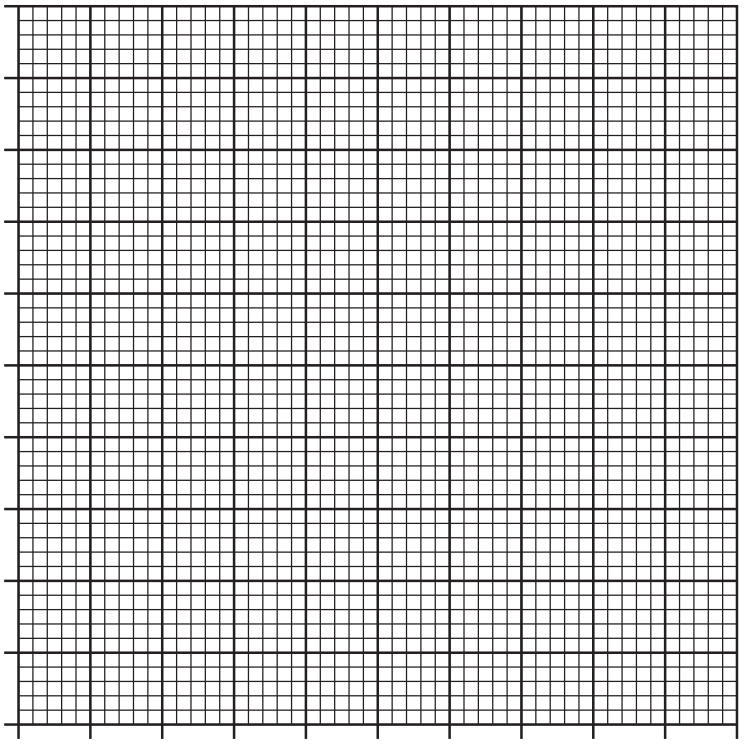
DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

20. The effect of different concentrations of nitrate fertiliser on the yield of two different crops is shown in the table below.

Concentration of fertiliser (kg/Ha)	*Yield of crop* (kg/Ha)	
	Crop A	*Crop B*
0	150	100
40	290	200
80	400	270
120	460	300
160	470	310

(*a*) Using the same axes, show these results as **two line graphs**.
(Additional graph paper, if required, is provided on page 24.)



3

(*b*) Draw **two** conclusions from this information.

1 .....

.....

2 .....

..... **2**

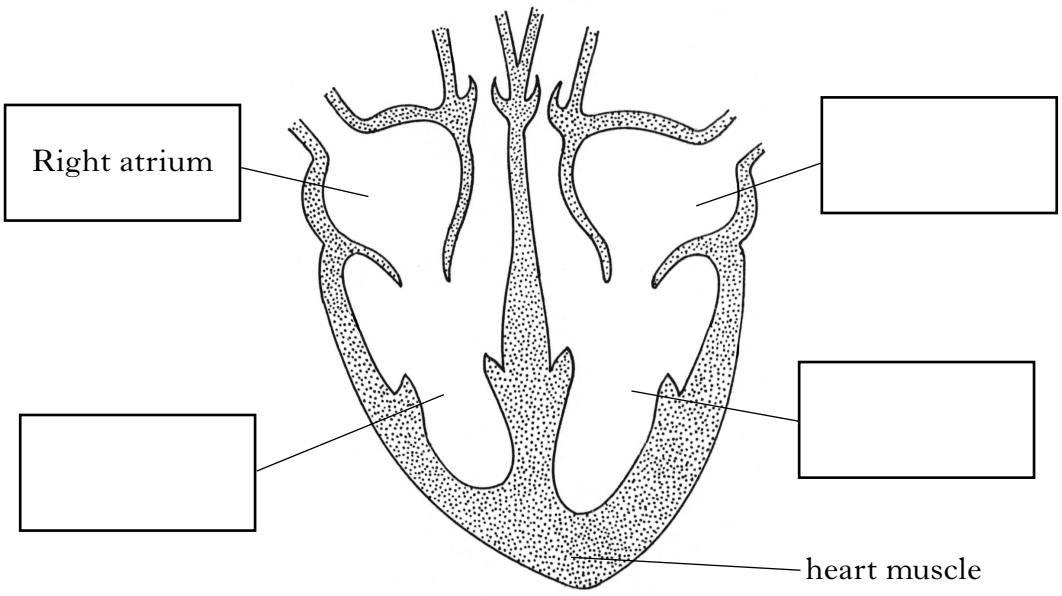
(*c*) Predict the yield of crop A when the concentration of fertiliser is 180 kg/Ha.

..... kg/Ha **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

21. The diagram shows the four chambers inside the heart.



(*a*) Label the diagram to show the names of the other three chambers. **2**

(*b*) A heart attack can be caused by a lack of food and oxygen in blood getting to the heart muscle.

Name the blood vessel which carries blood to the heart muscle.

..... **1**

(*c*) The heart contains valves.

What is the function of a valve?

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

22. Computer controlled tests can be carried out to investigate what happens when a lorry crashes into a stationary car. No human drivers are involved in these tests.

When a lorry crashes into a stationary car they stick together and move off together. The speed at which they move off together can be found using this equation.

$$\mathbf{S}_{L+C} = \frac{\mathbf{m}_L \times \mathbf{S}_L}{\mathbf{m}_{L+C}}$$

where

$\mathbf{S}_{L+C}$ = the speed at which the **lorry** and **car** move off together

$\mathbf{m}_L$ = the mass of the **lorry**

$\mathbf{S}_L$ = the speed of the **lorry** before the crash

$\mathbf{m}_{L+C}$ = the **total** mass of the **lorry** and the **car** when they stick together

(*a*) A lorry has a mass of 5 000 kg and a speed of 12 m/s.
It crashes into a stationary car which has a mass of 1 000 kg.

(i) Calculate the value of $\mathbf{m}_{L+C}$.

Space for working

Answer ..... kg **1**

(ii) Calculate the speed at which the lorry and car move off together.

Space for working

Answer ..... m/s **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

22. (continued)

(*b*) A lorry has a mass of 6 000 kg.

It crashes into a stationary car which has a mass of 2 000 kg and they move off together with a speed of 24 m/s.

Calculate the speed of the lorry before the crash.

Space for working

Answer ..... m/s **2**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

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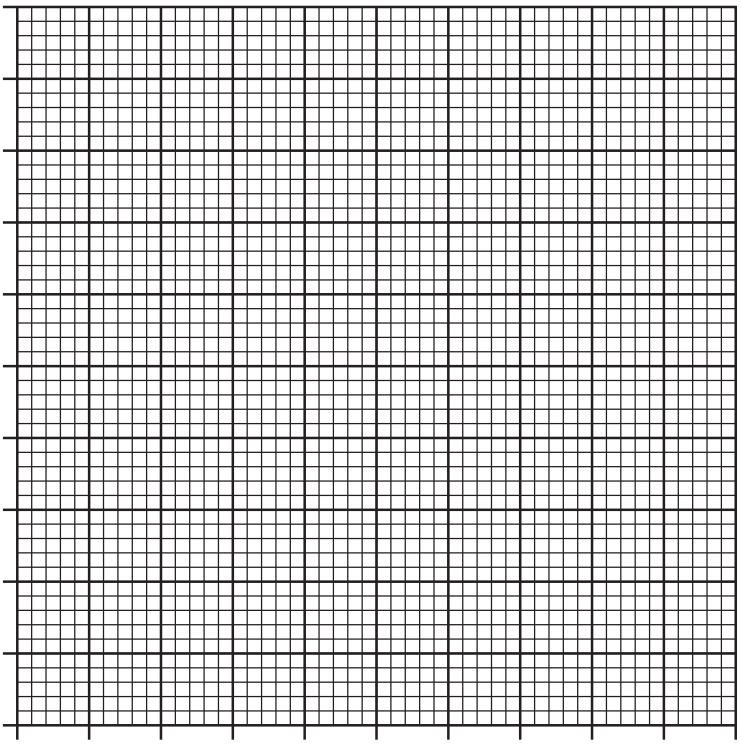
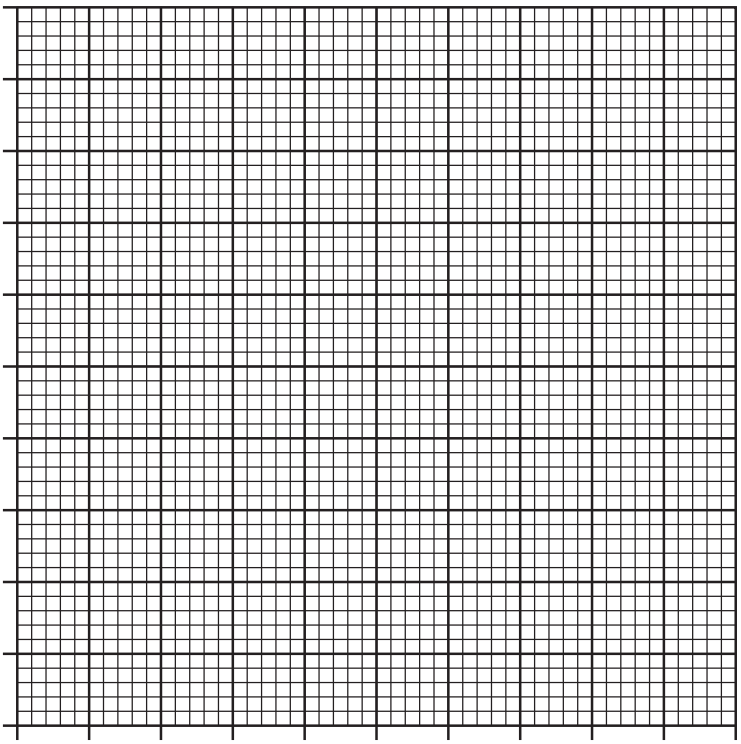
ADDITIONAL GRAPH PAPER FOR USE IN QUESTION 7



ADDITIONAL GRAPH PAPER FOR USE IN QUESTION 20(*a*)



ACKNOWLEDGEMENTS

Question 8—Extract is taken from *The British Isles: a Natural History* by Alan Titchmarsh, published by BBC Books. Reprinted by permission of The Random House Group Ltd.