Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A216/02

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

Unit 2: Modules B5 C5 P5 (Higher Tier)

TUESDAY 28 JUNE 2011: Morning
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (LEO/SW) 11MEP06480 49730/3

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Answer ALL the questions.**

INFORMATION FOR CANDIDATES

- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 42.**
- **A list of physics equations is printed on pages 4 and 5.**
- **The Periodic Table is printed on the back page.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

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

Answer ALL the questions.

1 When the Romans came to Britain they extracted lead from mines in Somerset.

Lead ore contains lead sulfide.

(a) The first stage in extracting the lead is to heat the lead sulfide with oxygen.

Fill in the boxes to balance the equation for this reaction.

$$2PbS + \square\, O_2 \rightarrow \square\, PbO + \square\, SO_2$$

[2]

(b) The relative atomic mass of lead is 207.

The relative atomic mass of sulfur is 32.

Use this information to calculate the mass of lead that can be obtained from 71.7 tonnes of pure lead sulfide, PbS.

mass = _____ tonnes [2]

(c) The Romans could extract 10 tonnes of lead from 100 tonnes of ore.

A modern mine can only extract 3 tonnes of lead from 100 tonnes of ore.

Suggest why modern mines get less lead from their ore than the Romans did.

Puts ticks (✓) in the boxes next to the TWO statements that best explain why.

Roman ores were easier to get at. ☐

Romans mined higher quality ores. ☐

Romans were more skilled at getting the lead from the ore. ☐

There are no easily mined ores left which have high quantities of lead. ☐

We no longer need to get so much lead out of the ore. ☐

Roman ores did not contain impurities. ☐

[1]

(d) Some substances are left over after the lead is extracted.

One of these is silicon dioxide – silicon dioxide is a solid.

Sulfur dioxide is also produced – sulfur dioxide is a gas.

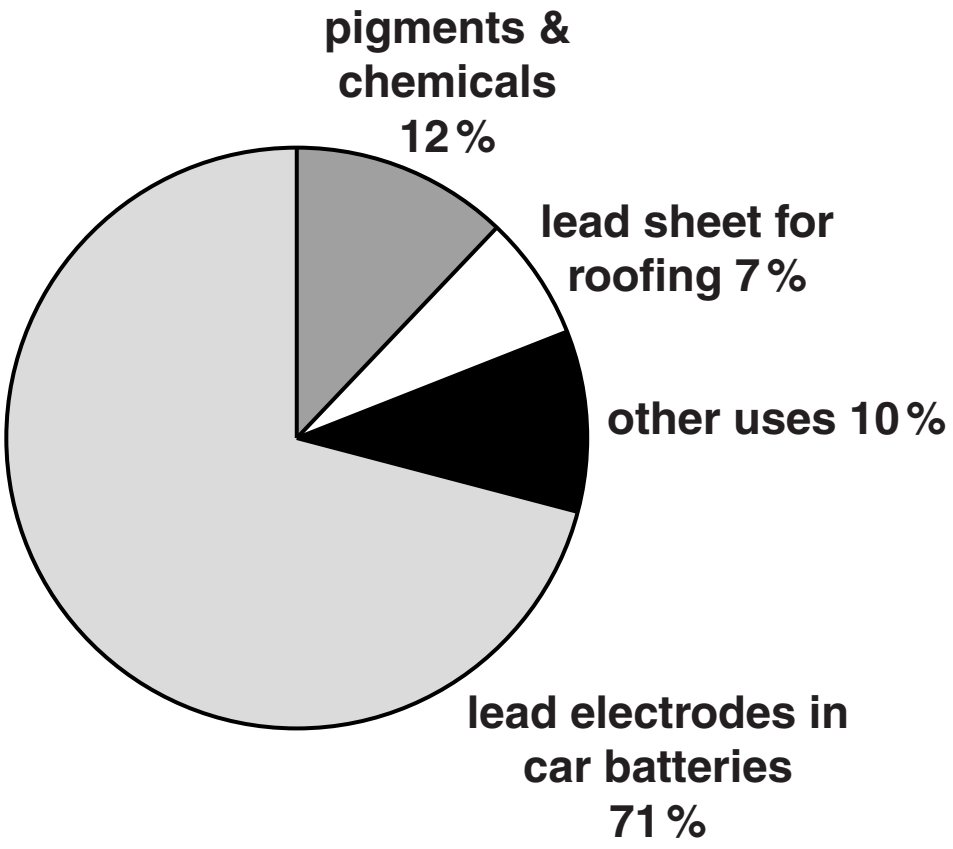
Complete the table about solid silicon dioxide and sulfur dioxide gas.

For EACH description put ONE tick (✓) in the correct column to show whether it is true for SILICON DIOXIDE ONLY, SULFUR DIOXIDE ONLY, BOTH or NEITHER.

description	silicon dioxide only	sulfur dioxide only	both	neither
has a high melting point				
has a low melting point				
has covalent bonds				
has ionic bonds				
is a giant structure				
is a simple molecular compound				
has weak forces between molecules				

[4]

(e) The chart shows the main uses of lead.



About 8500 million tonnes of lead are used every year.

Only 4000 million tonnes of this lead are produced from ore every year.

Suggest where the remaining lead comes from.

Explain your reasoning.

_____

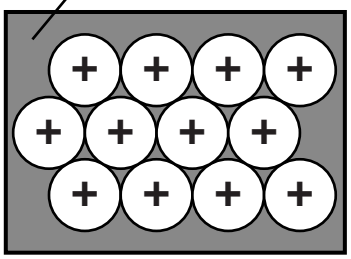
_____

_____ **[2]**

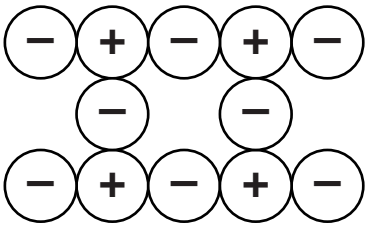
(f) Lead conducts electricity.

Which of the diagrams, A, B, C or D, BEST shows the structure of lead?

'sea' of electrons

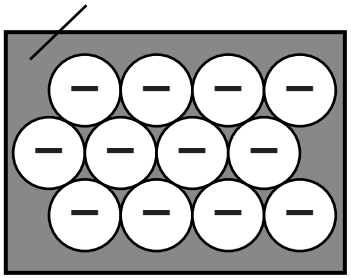


A

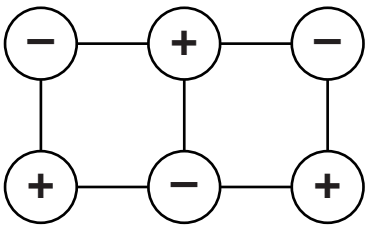


B

'sea' of ions



C



D

answer _____ **[1]**

(g) Lead bromide, $PbBr_2$, is an ionic compound.

Sarah passes an electric current through melted lead bromide.

It breaks down into bromine gas and molten lead.

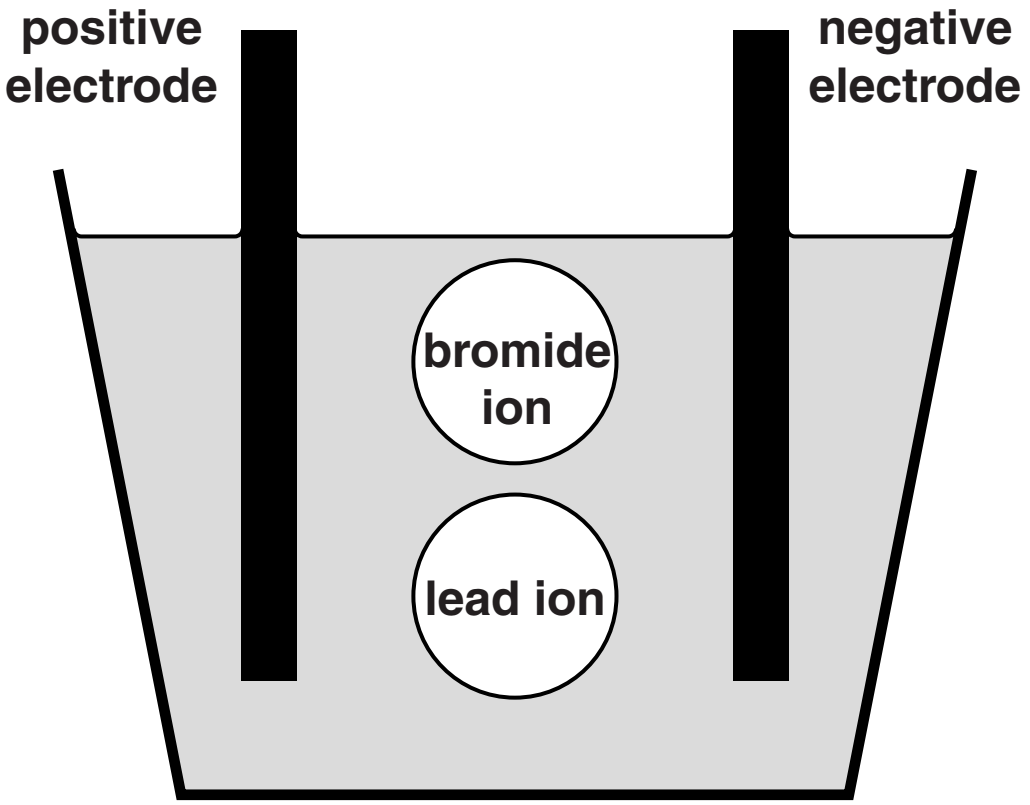
(i) The symbol for a lead ion is Pb^{2+}.

Write the symbol for a bromide ion.

answer _____ **[1]**

(ii) Draw labelled arrows on the diagram to show

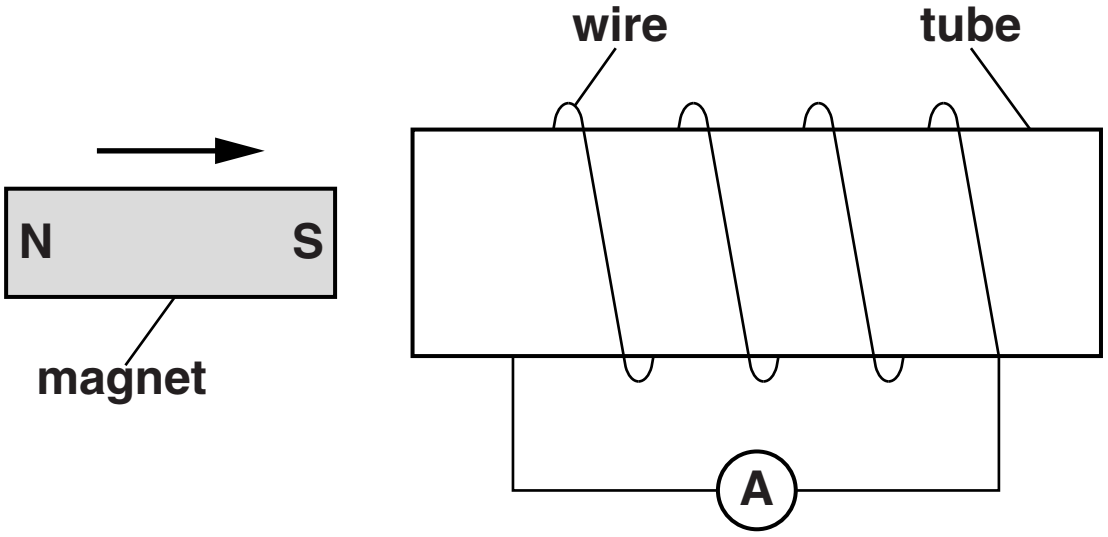
- **the movement of a lead ion**
- **the movement of a bromide ion.**



[1]

[Total: 14]

2 Pete pushes a magnet into a tube.



(a) There is a coil of wire around the tube.

Complete the sentences. Choose from these words.

charge

current

voltage

power

As the magnet moves into the tube, a

_____ is induced across the ends of the coil.

This results in a _____ in the ammeter.

[2]

(b) Here are some ways of changing the reading of the ammeter.

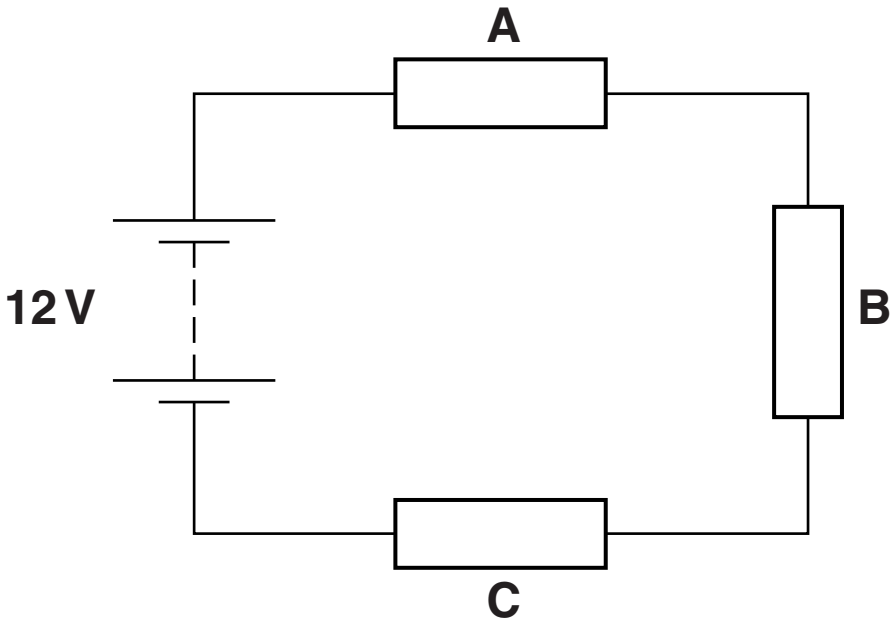
Put ticks (✓) in the boxes next to the TWO ways which would INCREASE the reading.

Increase the length of the tube.	☐
Decrease the length of the tube.	☐
Move the magnet more slowly into the tube.	☐
Move the magnet more quickly into the tube.	☐
Increase the number of turns of wire in the coil.	☐
Decrease the number of turns of wire in the coil.	☐

[2]

[Total: 4]

3 This circuit has three identical resistors, A, B and C, in series with a battery.



(a) Here are some statements about the circuit.

Put a tick (✓) in the box next to the correct statement.

Resistor C has 0V across it. ☐

Resistor B has 12V across it. ☐

Resistor A has a greater current than the other resistors. ☐

All three resistors have the same current. ☐

[1]

(b) Resistors A, B and C get hot. Explain why.

Use these words in your answer.

atoms

electrons

energy

_____

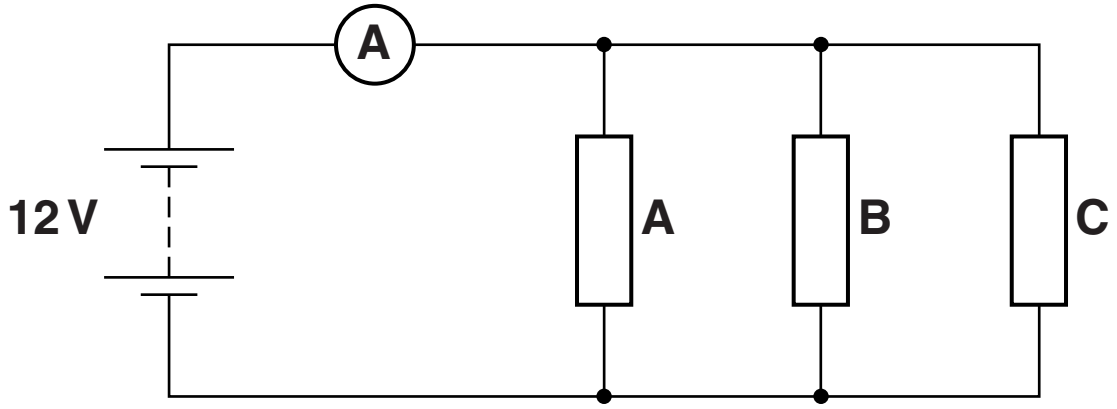
_____

_____

_____

_____ **[3]**

(c) The three identical resistors are now connected in parallel to the battery.



The ammeter in the circuit reads 6 A.

What is the heating power of resistor C?

Put a (ring) around the correct answer.

2 W

6 W

8 W

24 W

72 W

[1]

[Total: 5]

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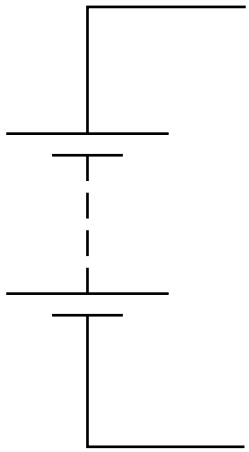
Turn over for question 4

4 Jo builds a circuit with a battery, a lamp and a switch in series.

(a) Complete the circuit diagram.

Use the correct symbols for the lamp and the switch.



[1]

(b) Complete the sentences by putting a (ring) around the correct words in capitals.

Before Jo closes the switch, it has a very high

CHARGE / CURRENT / POWER / RESISTANCE.

Closing the switch allows the BATTERY / LAMP /

SWITCH / WIRES to push charge around the

circuit.

This movement of charge in the wires is called a

CURRENT / POWER / RESISTANCE / VOLTAGE.

[3]

(c) The lamp does not light up when the switch is open.

Put a tick (✓) in the box next to the correct reason why.

There is only charge in the switch when it is closed.	☐
Charge is not able to flow through part of the open switch.	☐
The charge gets used up as it passes through the open switch.	☐
The potential difference across the open switch is reduced to zero.	☐

[1]

[Total: 5]

5 Labradors and poodles are breeds of dog.

A labrador mates with a poodle and produces a puppy.

The puppy has chromosomes from both the labrador and the poodle.

(a) The labrador has 78 chromosomes in each body cell.

The table shows chromosome numbers in each body cell of the labrador, the poodle and the puppy.

	chromosomes in labrador	chromosomes in poodle	chromosomes in puppy
A	**78**	**78**	**156**
B	**78**	**78**	**78**
C	**78**	**46**	**46**
D	**78**	**39**	**39**

Which row, A, B, C or D, is correct?

answer _____ [1]

(b) The puppy cells have chromosomes from both parents.

Explain why the cells have chromosomes from both parents.

Include in your answer

- **what type of cell division produces gametes**
- **what happens to the chromosome number when a gamete is formed**
- **what happens when the gametes fuse.**

_____

_____

_____

_____ **[3]**

[Total: 4]

6 The snowshoe hare lives in forests which have a lot of snow in winter.

(a) The cells of the snowshoe hare contain the genetic code.

The genetic code controls the formation of proteins in each cell.

Complete the sentences.

The genetic code is found in the cell

_____ .

Proteins are formed in the cell

_____ .

The genetic code is found on DNA.

The number of strands in a DNA molecule is

_____ .

The number of different bases in DNA is

_____ . **[2]**

(b) In the summer the snowshoe hare has a dark coat, which is due to certain proteins being produced by hair-producing cells.

In winter it grows a white coat with different proteins colouring the hair.

Explain how the same animal can produce different colours of coat at different times of the year.

In your answer use ideas about genes and proteins.

_____

_____

_____ **[2]**

(c) A scientist tests a sample of snowshoe hare DNA. She finds these proportions of two of the bases.

base C 23%
base A 27%

What proportion of the bases will she find to be base T?

Put a (ring) around the correct answer.

23% 25% 27% 46% 50%

[1]

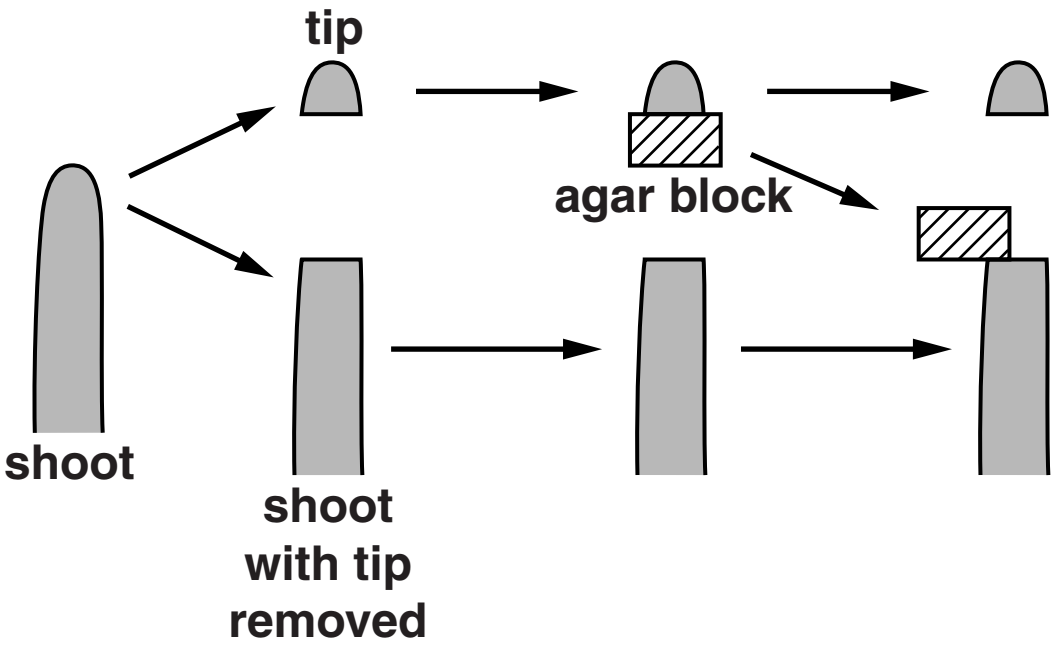
[Total: 5]

7 Harry does an experiment with some plant tips.

He cuts the tip from a shoot and places it on a block of agar for several hours.

He then throws away the tip.

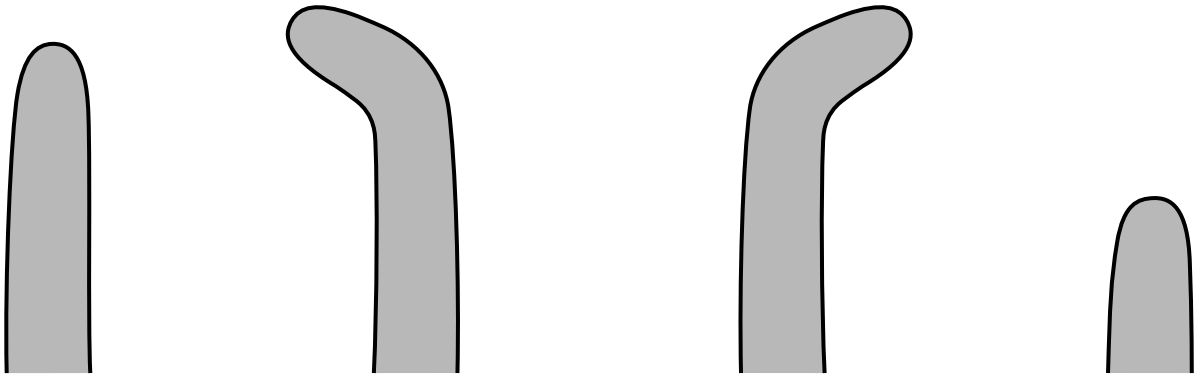
He places the agar block over PART of the end of the shoot where the tip was cut from.



(a) The shoot is left to grow.

Which way will it grow?

Choose from A, B, C and D.



A	B	C	D
tall and straight	tall and to the left	tall and to the right	short and stumpy

answer _____ **[1]**

(b) What is the correct explanation for this result?

Put ticks (✓) in the boxes next to the TWO correct answers.

Agar stopped all of the light to one side of the tip.	☐
Auxin diffused from the cut tip into the agar.	☐
Auxin diffused from the cut shoot into the agar.	☐
The side of the shoot with most auxin grew more.	☐
The side of the shoot with most auxin grew less.	☐
Auxin made no difference to the growth of the shoot.	☐
Auxin absorbed more light under the agar.	☐

[2]

(c) When growing shoots receive light from one side only, they grow towards the light.

This is called phototropism.

Phototropism increases a plant's chance of survival.

Complete the sentence.

Use a word from the list.

MEIOSIS

PHOTOSYNTHESIS

POLLINATION

REPRODUCTION

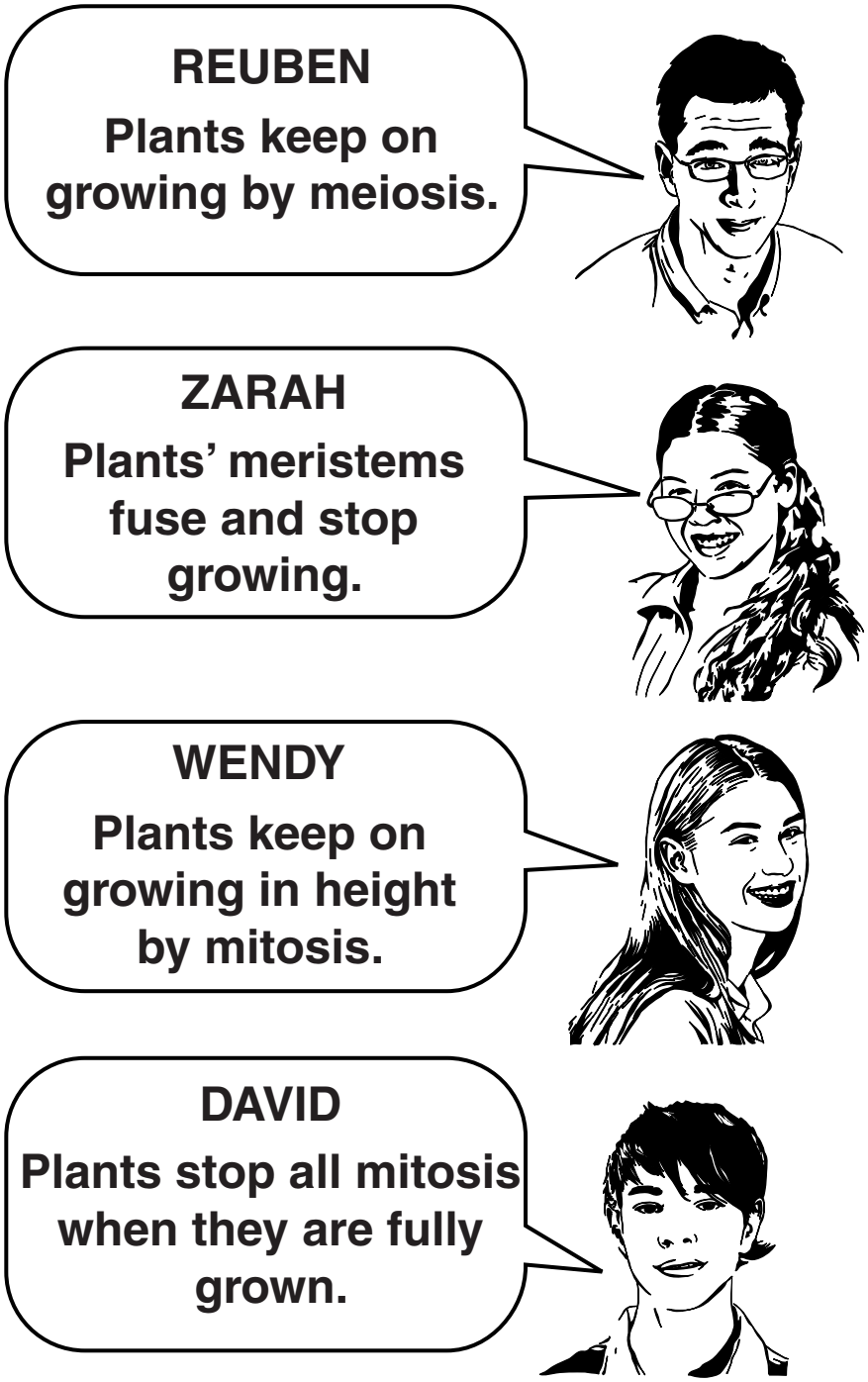
The increased chance of survival is due to the increased rate

of _____ .

[1]

(d) Harry's shoots grow into full sized plants.

A group of students were asked how plants grow.



Which student gave the correct answer?

answer _____ **[1]**

[Total: 5]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.