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Centre number						Candidate number				
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**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

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

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

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

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

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

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

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

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

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

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

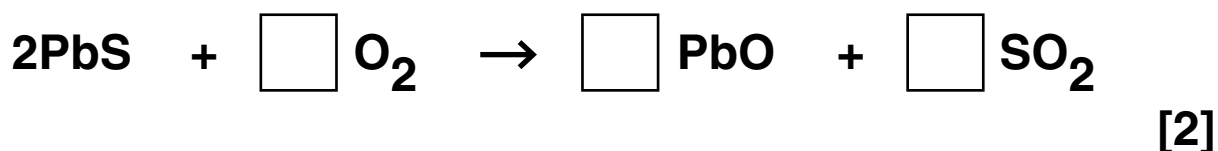
Answer ALL the questions.

- 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.



- (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.

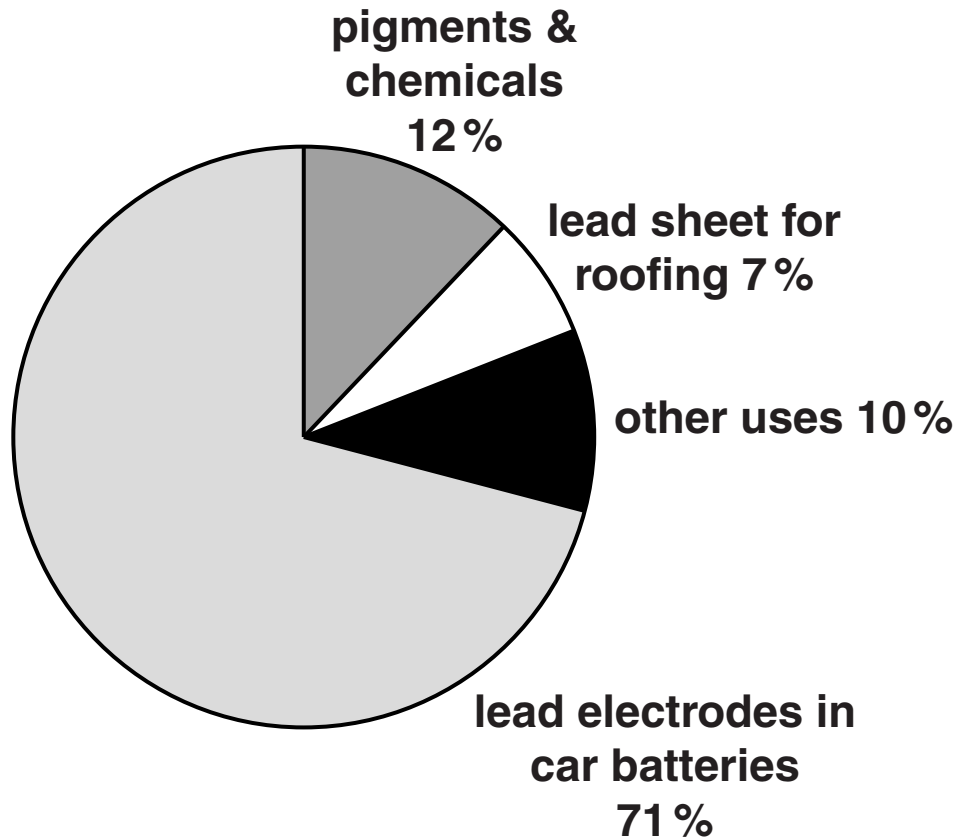
Complete the table about solid silicon dioxide and sulfur dioxide gas.

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.

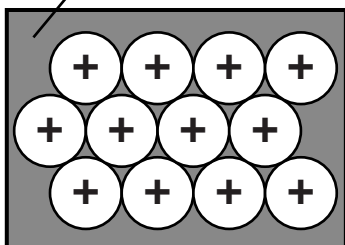
Explain your reasoning.

[2]

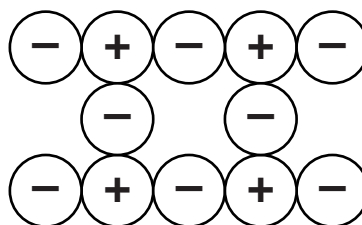
(f) Lead conducts electricity.

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

'sea' of electrons

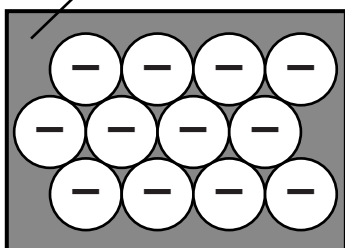


A

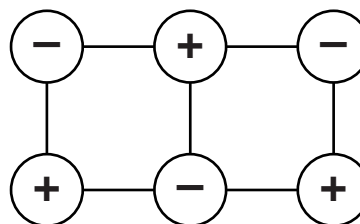


B

'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.

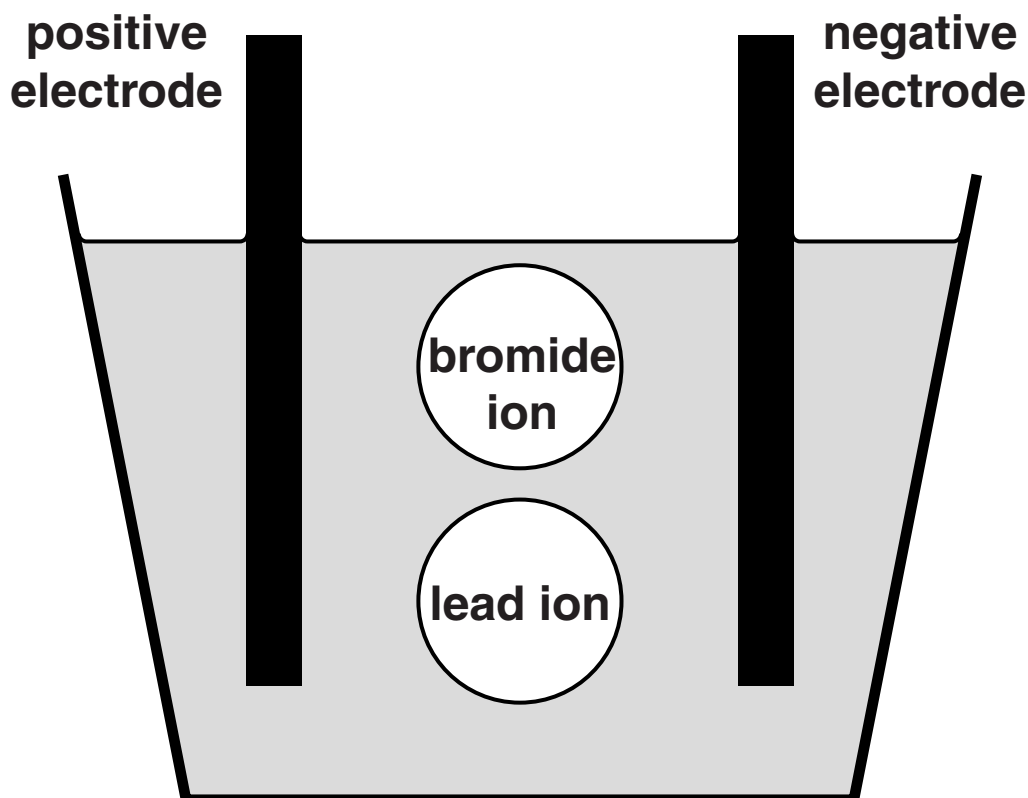
(i) The symbol for a lead ion is Pb^{2+} .

Write the symbol for a bromide ion.

answer _____ [1]

(ii) Draw labelled arrows on the diagram to show

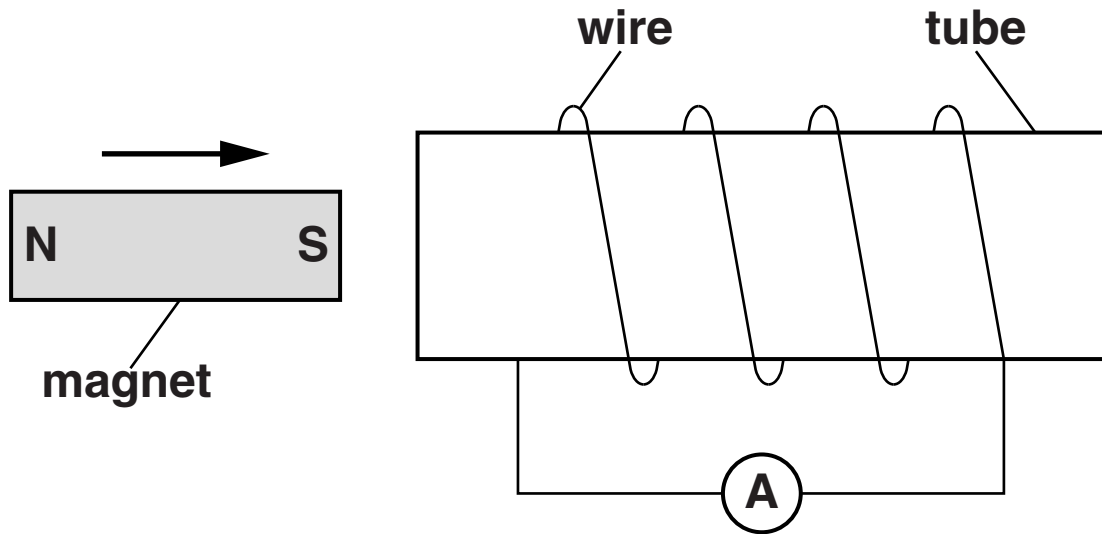
- the movement of a lead ion
- the movement of a bromide ion.



[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.

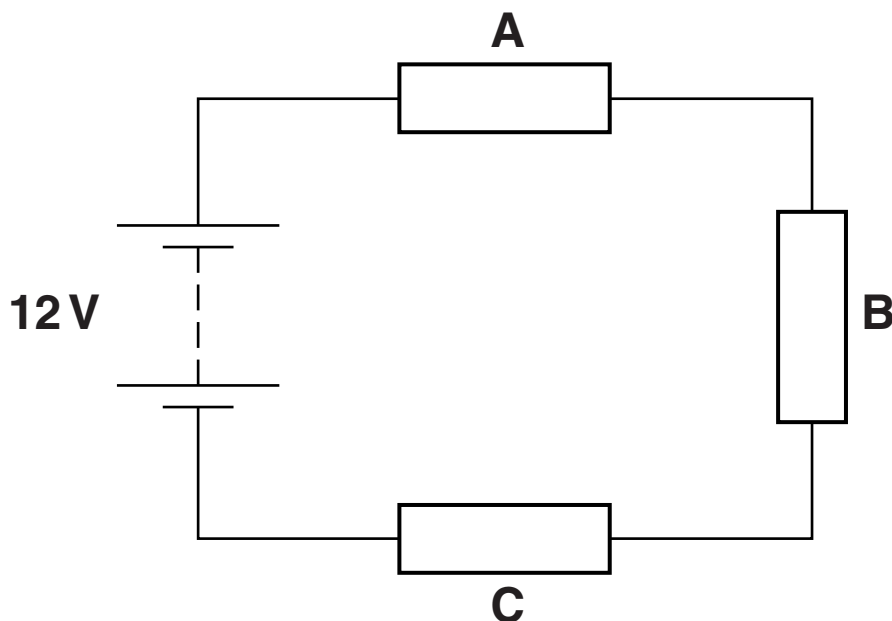
Increase the number of turns of wire in the coil.

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.

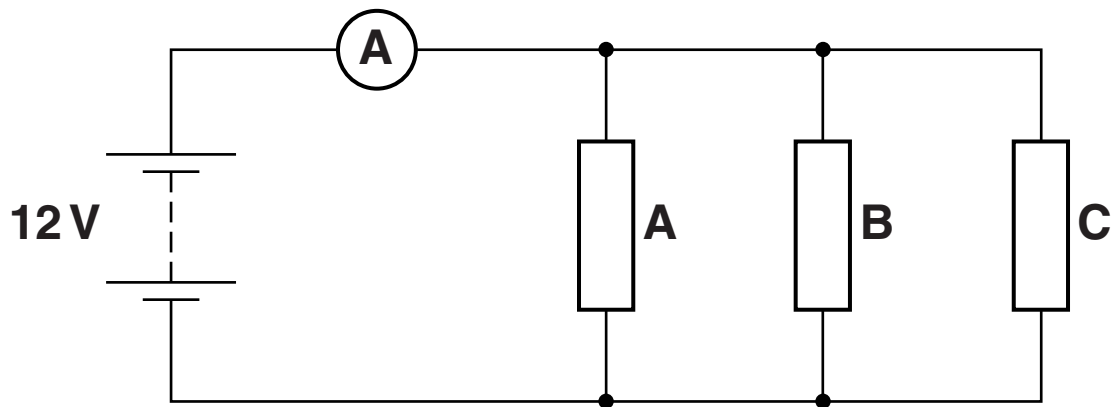
atoms

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.

2W

6W

8W

24W

72W

[1]

[Total: 5]

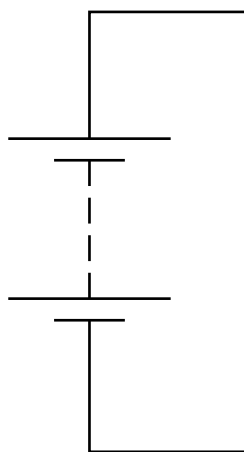
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Turn over for question 4

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]

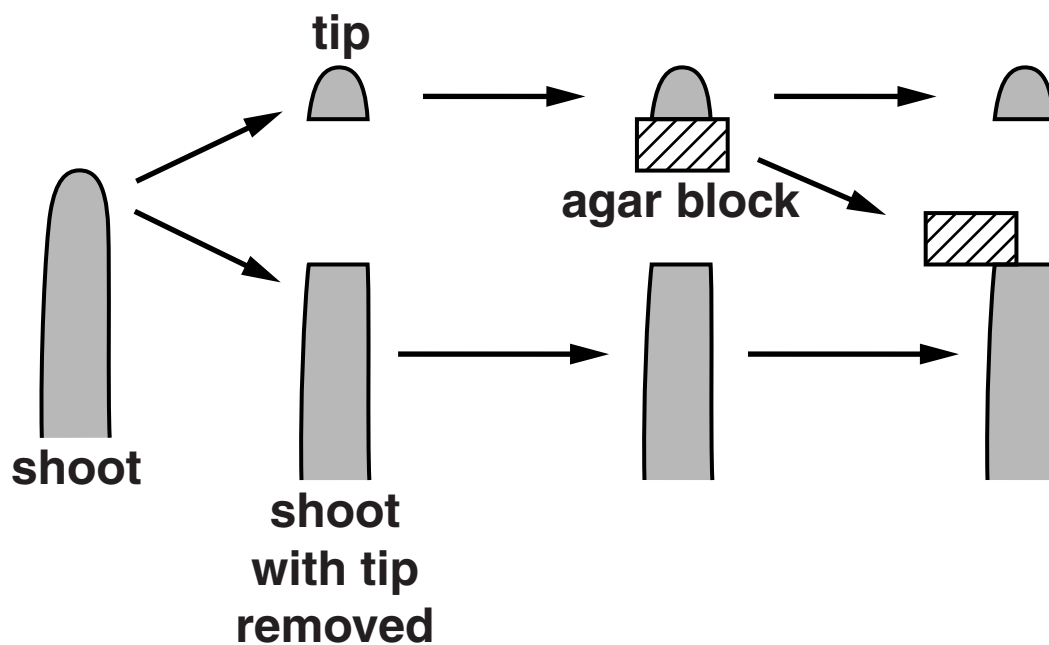
[Total: 5]

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.

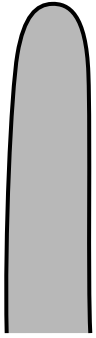
He places the agar block over PART of the end of the shoot where the tip was cut from.



(a) The shoot is left to grow.

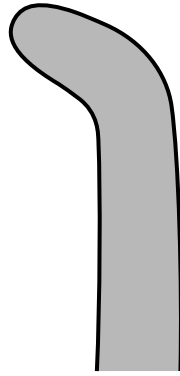
Which way will it grow?

Choose from A, B, C and D.



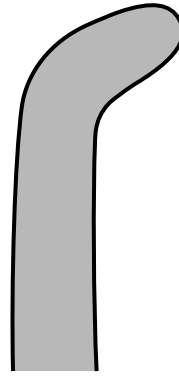
A

**tall and
straight**



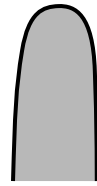
B

**tall and
to the left**



C

**tall and
to the right**



D

**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.

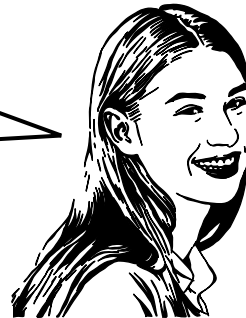
REUBEN
Plants keep on growing by meiosis.



ZARAH
Plants' meristems fuse and stop growing.



WENDY
Plants keep on growing in height by mitosis.



DAVID
Plants stop all mitosis when they are fully grown.



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	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109
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
223 Fr francium 87	226 Ra radium 88	227 Ac* actinium 89	261 Rf rutherfordium 104	262 Db dubnium 105	266 Sg seaborgium 106	268 Bh bohrium 107	277 Hs hassium 108	281 Mt meitnerium 109
285 Fr francium 87	286 Ra radium 88	289 Ac* actinium 89	311 Rf rutherfordium 104	312 Db dubnium 105	315 Sg seaborgium 106	315 Bh bohrium 107	315 Hs hassium 108	315 Mt meitnerium 109
349 Fr francium 87	350 Ra radium 88	351 Ac* actinium 89	381 Rf rutherfordium 104	382 Db dubnium 105	385 Sg seaborgium 106	385 Bh bohrium 107	385 Hs hassium 108	385 Mt meitnerium 109
401 Fr francium 87	402 Ra radium 88	405 Ac* actinium 89	431 Rf rutherfordium 104	432 Db dubnium 105	435 Sg seaborgium 106	435 Bh bohrium 107	435 Hs hassium 108	435 Mt meitnerium 109
481 Fr francium 87	482 Ra radium 88	485 Ac* actinium 89	511 Rf rutherfordium 104	512 Db dubnium 105	515 Sg seaborgium 106	515 Bh bohrium 107	515 Hs hassium 108	515 Mt meitnerium 109
549 Fr francium 87	550 Ra radium 88	555 Ac* actinium 89	581 Rf rutherfordium 104	582 Db dubnium 105	585 Sg seaborgium 106	585 Bh bohrium 107	585 Hs hassium 108	585 Mt meitnerium 109
609 Fr francium 87	610 Ra radium 88	615 Ac* actinium 89	641 Rf rutherfordium 104	642 Db dubnium 105	645 Sg seaborgium 106	645 Bh bohrium 107	645 Hs hassium 108	645 Mt meitnerium 109
679 Fr francium 87	680 Ra radium 88	685 Ac* actinium 89	711 Rf rutherfordium 104	712 Db dubnium 105	715 Sg seaborgium 106	715 Bh bohrium 107	715 Hs hassium 108	715 Mt meitnerium 109
739 Fr francium 87	740 Ra radium 88	745 Ac* actinium 89	771 Rf rutherfordium 104	772 Db dubnium 105	775 Sg seaborgium 106	775 Bh bohrium 107	775 Hs hassium 108	775 Mt meitnerium 109
809 Fr francium 87	810 Ra radium 88	815 Ac* actinium 89	841 Rf rutherfordium 104	842 Db dubnium 105	845 Sg seaborgium 106	845 Bh bohrium 107	845 Hs hassium 108	845 Mt meitnerium 109
879 Fr francium 87	880 Ra radium 88	885 Ac* actinium 89	911 Rf rutherfordium 104	912 Db dubnium 105	915 Sg seaborgium 106	915 Bh bohrium 107	915 Hs hassium 108	915 Mt meitnerium 109
939 Fr francium 87	940 Ra radium 88	945 Ac* actinium 89	971 Rf rutherfordium 104	972 Db dubnium 105	975 Sg seaborgium 106	975 Bh bohrium 107	975 Hs hassium 108	975 Mt meitnerium 109
1009 Fr francium 87	1010 Ra radium 88	1015 Ac* actinium 89	1041 Rf rutherfordium 104	1042 Db dubnium 105	1045 Sg seaborgium 106	1045 Bh bohrium 107	1045 Hs hassium 108	1045 Mt meitnerium 109
1079 Fr francium 87	1080 Ra radium 88	1085 Ac* actinium 89	1111 Rf rutherfordium 104	1112 Db dubnium 105	1115 Sg seaborgium 106	1115 Bh bohrium 107	1115 Hs hassium 108	1115 Mt meitnerium 109
1149 Fr francium 87	1150 Ra radium 88	1155 Ac* actinium 89	1181 Rf rutherfordium 104	1182 Db dubnium 105	1185 Sg seaborgium 106	1185 Bh bohrium 107	1185 Hs hassium 108	1185 Mt meitnerium 109
1219 Fr francium 87	1220 Ra radium 88	1225 Ac* actinium 89	1251 Rf rutherfordium 104	1252 Db dubnium 105	1255 Sg seaborgium 106	1255 Bh bohrium 107	1255 Hs hassium 108	1255 Mt meitnerium 109
1289 Fr francium 87	1290 Ra radium 88	1295 Ac* actinium 89	1321 Rf rutherfordium 104	1322 Db dubnium 105	1325 Sg seaborgium 106	1325 Bh bohrium 107	1325 Hs hassium 108	1325 Mt meitnerium 109
1359 Fr francium 87	1360 Ra radium 88	1365 Ac* actinium 89	1391 Rf rutherfordium 104	1392 Db dubnium 105	1395 Sg seaborgium 106	1395 Bh bohrium 107	1395 Hs hassium 108	1395 Mt meitnerium 109
1429 Fr francium 87	1430 Ra radium 88	1435 Ac* actinium 89	1461 Rf rutherfordium 104	1462 Db dubnium 105	1465 Sg seaborgium 106	1465 Bh bohrium 107	1465 Hs hassium 108	1465 Mt meitnerium 109
1499 Fr francium 87	1500 Ra radium 88	1505 Ac* actinium 89	1531 Rf rutherfordium 104	1532 Db dubnium 105	1535 Sg seaborgium 106	1535 Bh bohrium 107	1535 Hs hassium 108	1535 Mt meitnerium 109
1569 Fr francium 87	1570 Ra radium 88	1575 Ac* actinium 89	1601 Rf rutherfordium 104	1602 Db dubnium 105	1605 Sg seaborgium 106	1605 Bh bohrium 107	1605 Hs hassium 108	1605 Mt meitnerium 109
1639 Fr francium 87	1640 Ra radium 88	1645 Ac* actinium 89	1671 Rf rutherfordium 104	1672 Db dubnium 105	1675 Sg seaborgium 106	1675 Bh bohrium 107	1675 Hs hassium 108	1675 Mt meitnerium 109
1709 Fr francium 87	1710 Ra radium 88	1715 Ac* actinium 89	1741 Rf rutherfordium 104	1742 Db dubnium 105	1745 Sg seaborgium 106	1745 Bh bohrium 107	1745 Hs hassium 108	1745 Mt meitnerium 109
1779 Fr francium 87	1780 Ra radium 88	1785 Ac* actinium 89	1811 Rf rutherfordium 104	1812 Db dubnium 105	1815 Sg seaborgium 106	1815 Bh bohrium 107	1815 Hs hassium 108	1815 Mt meitnerium 109
1849 Fr francium 87	1850 Ra radium 88	1855 Ac* actinium 89	1881 Rf rutherfordium 104	1882 Db dubnium 105	1885 Sg seaborgium 106	1885 Bh bohrium 107	1885 Hs hassium 108	1885 Mt meitnerium 109
1919 Fr francium 87	1920 Ra radium 88	1925 Ac* actinium 89	1951 Rf rutherfordium 104	1952 Db dubnium 105	1955 Sg seaborgium 106	1955 Bh bohrium 107	1955 Hs hassium 108	1955 Mt meitnerium 109
1989 Fr francium 87	1990 Ra radium 88	1995 Ac* actinium 89	2021 Rf rutherfordium 104	2022 Db dubnium 105	2025 Sg seaborgium 106	2025 Bh bohrium 107	2025 Hs hassium 108	2025 Mt meitnerium 109
2059 Fr francium 87	2060 Ra radium 88	2065 Ac* actinium 89	2091 Rf rutherfordium 104	2092 Db dubnium 105	2095 Sg seaborgium 106	2095 Bh bohrium 107	2095 Hs hassium 108	2095 Mt meitnerium 109
2129 Fr francium 87	2130 Ra radium 88	2135 Ac* actinium 89	2161 Rf rutherfordium 104	2162 Db dubnium 105	2165 Sg seaborgium 106	2165 Bh bohrium 107	2165 Hs hassium 108	2165 Mt meitnerium 109
2199 Fr francium 87	2200 Ra radium 88	2205 Ac* actinium 89	2231 Rf rutherfordium 104	2232 Db dubnium 105	2235 Sg seaborgium 106	2235 Bh bohrium 107	2235 Hs hassium 108	2235 Mt meitnerium 109
2269 Fr francium 87	2270 Ra radium 88	2275 Ac* actinium 89	2301 Rf rutherfordium 104	2302 Db dubnium 105	2305 Sg seaborgium 106	2305 Bh bohrium 107	2305 Hs hassium 108	2305 Mt meitnerium 109
2339 Fr francium 87	2340 Ra radium 88	2345 Ac* actinium 89	2371 Rf rutherfordium 104	2372 Db dubnium 105	2375 Sg seaborgium 106	2375 Bh bohrium 107	2375 Hs hassium 108	2375 Mt meitnerium 109
2409 Fr francium 87	2410 Ra radium 88	2415 Ac* actinium 89	2441 Rf rutherfordium 104	2442 Db dubnium 105	2445 Sg seaborgium 106	2445 Bh bohrium 107	2445 Hs hassium 108	2445 Mt meitnerium 109
2479 Fr francium 87	2480 Ra radium 88	2485 Ac* actinium 89	2511 Rf rutherfordium 104	2512 Db dubnium 105	2515 Sg seaborgium 106	2515 Bh bohrium 107	2515 Hs hassium 108	2515 Mt meitnerium 109
2549 Fr francium 87	2550 Ra radium 88	2555 Ac* actinium 89	2581 Rf rutherfordium 104	2582 Db dubnium 105	2585 Sg seaborgium 106	2585 Bh bohrium 107	2585 Hs hassium 108	2585 Mt meitnerium 109
2619 Fr francium 87	2620 Ra radium 88	2625 Ac* actinium 89	2651 Rf rutherfordium 104	2652 Db dubnium 105	2655 Sg seaborgium 106	2655 Bh bohrium 107	2655 Hs hassium 108	2655 Mt meitnerium 109
2689 Fr francium 87	2690 Ra radium 88	2695 Ac* actinium 89	2721 Rf rutherfordium 104	2722 Db dubnium 105	2725 Sg seaborgium 106	2725 Bh bohrium 107	2725 Hs hassium 108	2725 Mt meitnerium 109
2759 Fr francium 87	2760 Ra radium 88	2765 Ac* actinium 89	2791 Rf rutherfordium 104	2792 Db dubnium 105	2795 Sg seaborgium 106	2795 Bh bohrium 107	2795 Hs hassium 108	2795 Mt meitnerium 109
2829 Fr francium 87	2830 Ra radium 88	2835 Ac* actinium 89	2861 Rf rutherfordium 104	2862 Db dubnium 105	2865 Sg seaborgium 106	2865 Bh bohrium 107	2865 Hs hassium 108	2865 Mt meitnerium 109
2899 Fr francium 87	2900 Ra radium 88	2905 Ac* actinium 89	2931 Rf rutherfordium 104	2932 Db dubnium 105	2935 Sg seaborgium 106	2935 Bh bohrium 107	2935 Hs hassium 108	2935 Mt meitnerium 109
2969 Fr francium 87	2970 Ra radium 88	2975 Ac* actinium 89	3001 Rf rutherfordium 104	3002 Db dubnium 105	3005 Sg seaborgium 106	3005 Bh bohrium 107	3005 Hs hassium 108	3005 Mt meitnerium 109
3039 Fr francium 87	3040 Ra radium 88	3045 Ac* actinium 89	3071 Rf rutherfordium 104	3072 Db dubnium 105	3075 Sg seaborgium 106	3075 Bh bohrium 107	3075 Hs hassium 108	3075 Mt meitnerium 109
3109 Fr francium 87	3110 Ra radium 88	3115 Ac* actinium 89	3141 Rf rutherfordium 104	3142 Db dubnium 105	3145 Sg seaborgium 106	3145 Bh bohrium 107	3145 Hs hassium 108	3145 Mt meitnerium 109
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