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Tuesday 31 January 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A216/02 Unit 2: Modules B5 C5 P5 (Higher Tier)

A213501122

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)

Duration: 40 minutes

A216021

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- 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).
- Do **not** write in the bar codes.

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 page **2**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

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

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

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Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 In 2010 a volcano in Iceland erupted.

It sent clouds of sulfur dioxide gas and volcanic ash into the atmosphere.

Airports closed because planes could not fly through the ash from the volcano.

(a) Sulfur dioxide has covalent bonds.

Put a tick (✓) in each set of boxes to complete the sentence to explain how a covalent bond is made.

A covalent bond is made when

electrons	
ions	
neutrons	
protons	

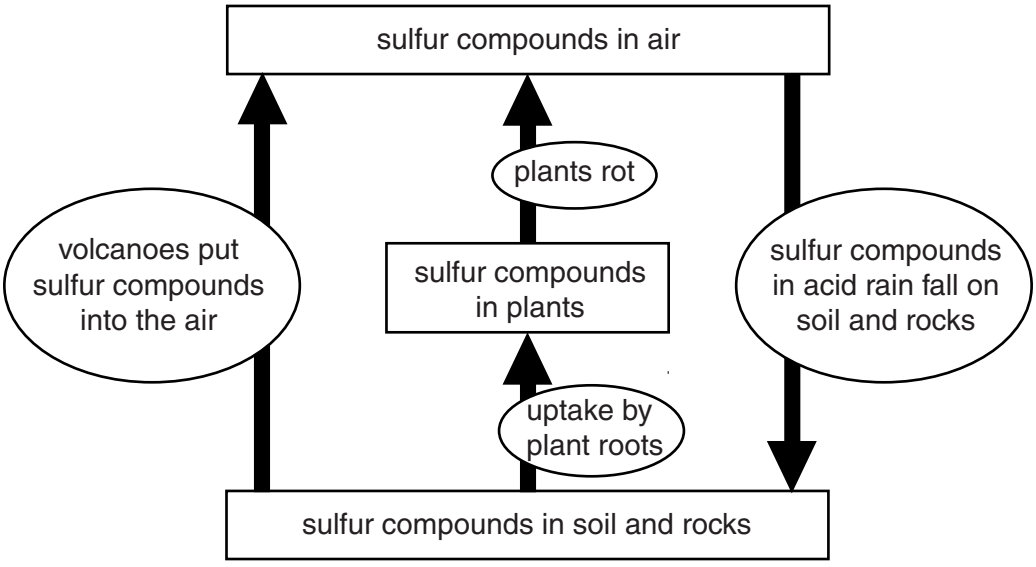
are

all in one atom.	
shared between two atoms.	
spread out between many atoms.	
transferred from one atom to another.	

[2]

(b) Volcanic eruptions are not the only way that sulfur compounds get into the air.

The diagram shows how some sulfur compounds moved into and out of the air over a period of 4 weeks.



Over the 4 week period, the mass of sulfur compounds in the air did not change overall.

However, the mass of sulfur compounds moving into the air, from volcanoes and rotting plants, was **not** the same as the mass of sulfur compounds moving out of the air as acid rain.

Put a tick (✓) in the box next to the **best** reason for this.

Rainfall varied over the 4-week period.	☐
Volcanoes convert sulfur in rocks into other elements.	☐
Not all processes are shown on the diagram.	☐
Sulfur dioxide molecules are not as heavy as the sulfur-containing molecules taken up by plant roots.	☐

[1]

(c) The volcanic ash also contained silicon dioxide.

Silicon dioxide has a high melting point.

Explain why silicon dioxide has a high melting point.

Use your understanding of the structure and bonding of silicon dioxide in your answer.

.....

.....

.....

.....

.....

..... **[3]**

[Total: 6]

2 Iron is extracted by heating iron oxide with carbon.

During this reaction the carbon takes the oxygen away from the iron oxide.

(a) What do we call a reaction in which a metal oxide loses oxygen?

Put a (ring) around the correct answer.

electrolysis **extraction** **oxidation** **reduction**

[1]

(b) The formula of one oxide of iron is Fe_2O_3.

What mass of iron is contained in 160 g of Fe_2O_3?

[relative atomic masses: O = 16, Fe = 56]

Put a (ring) around the correct answer.

48 g **56 g** **64 g** **112 g**

[1]

(c) Put numbers in the boxes to balance the equation for the formation of iron from iron oxide.

$2Fe_2O_3$ + ☐ C → ☐ Fe + ☐ CO_2 **[2]**

(d) Other metals are also extracted by heating their oxides with carbon.

Put ticks (✓) in the boxes next to **two** metals that are extracted in this way.

copper ☐

magnesium ☐

potassium ☐

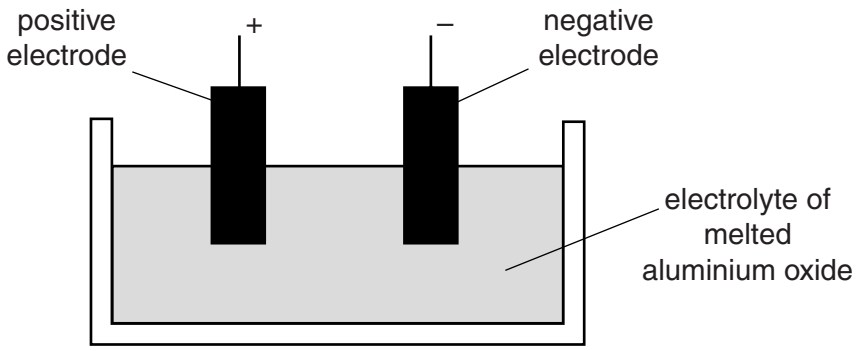
sodium ☐

zinc ☐

[2]

[Total: 6]

3 Aluminium is made when melted aluminium oxide is electrolysed.



The aluminium oxide, Al_2O_3, breaks down into aluminium and oxygen.

Here is part of a description of what happens during electrolysis.

Put a (ring) around the correct **word** in each pair to complete each sentence.

Oxygen ions have a **negative** / **positive** charge.

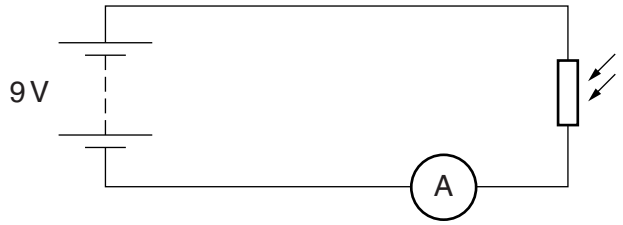
They move towards the **negative** / **positive** electrode where they **lose** / **gain** some **electrons** / **protons** and turn into neutral **atoms** / **molecules**.

These then combine to form **atoms** / **molecules** of oxygen gas.

[2]

[Total: 2]

4 Alan builds this circuit.

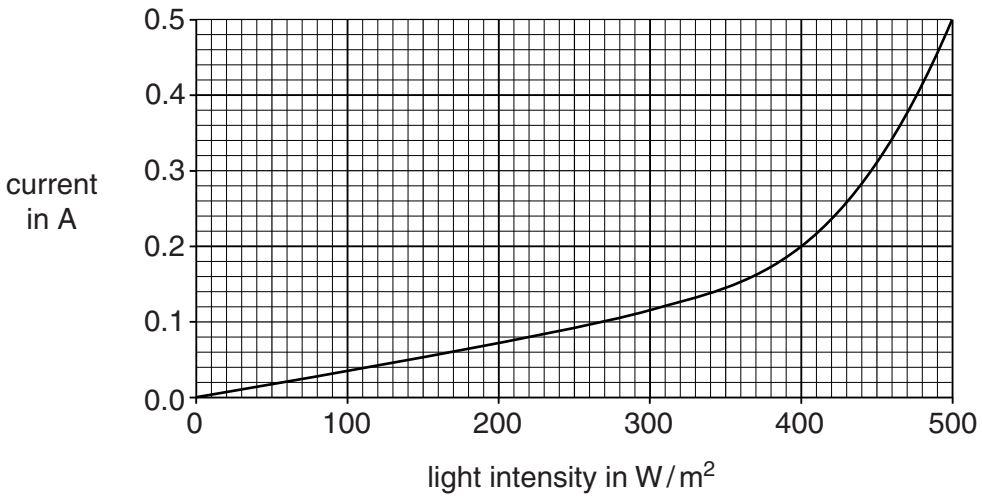


(a) Alan uses a voltmeter to check that the potential difference across the battery is 9 V.

Draw on the circuit diagram to show how the voltmeter should be connected. **[1]**

(b) Alan measures the current in the LDR at different light intensities.

Here is a graph of his results.



(i) Use data from the graph to calculate the resistance of the LDR at a light intensity of 400 W / m^2. The potential difference across the LDR is 9 V.

resistance = ... Ω **[1]**

(ii) The pattern of the graph can be explained by the sentences below.

Complete the sentences. Choose words from this list.

You may use each word once, more than once or not at all.

decreases **increases** **stays the same**

As the light intensity increases, the current ..... .

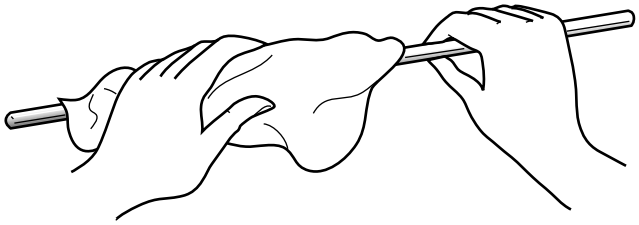
This is because the number of charges that are free to move ..... .

Therefore the resistance of the LDR ..... .

[2]

[Total: 4]

5 Sal rubs a glass rod with a silk cloth.



This gives the rod a **negative** charge.

(a) Here are some statements about the rod and the cloth.

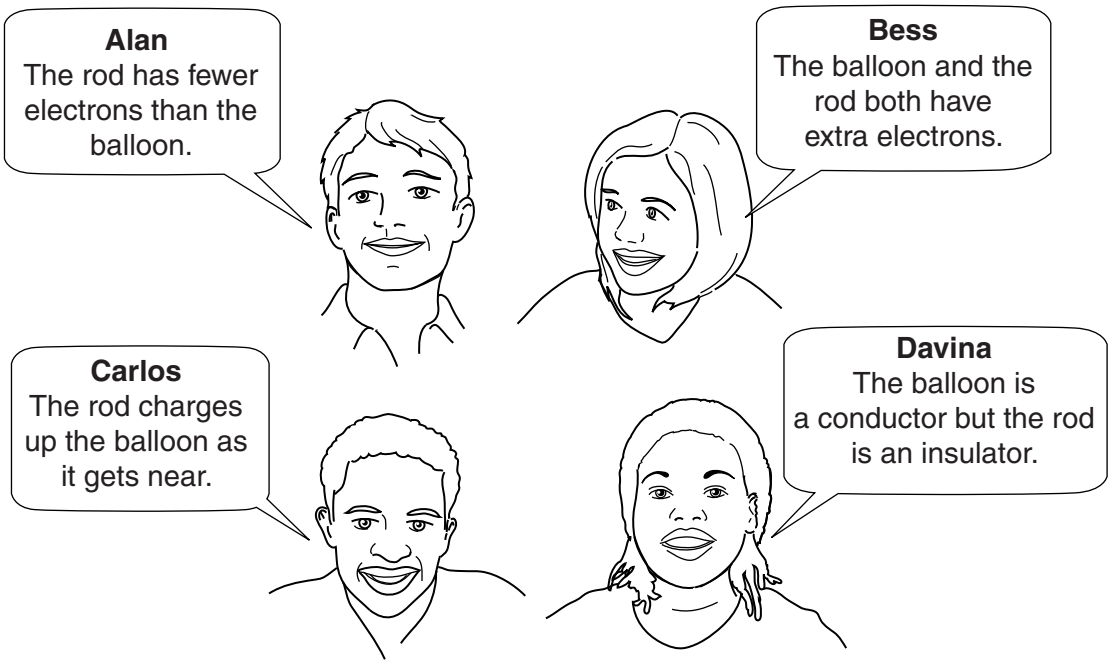
Put ticks (✓) in the boxes next to the **two** correct statements.

Electrons transfer from the cloth to the rod.	☐
Negative atoms transfer from the cloth to the rod.	☐
Positive electrons transfer from the rod to the cloth.	☐
The cloth gains a positive charge as it loses electrons.	☐
The rod and cloth both end up with the same negative charge.	☐

[2]

(b) Sal holds the charged rod near to a balloon. The rod **repels** the balloon.

Her friends discuss why this happens.

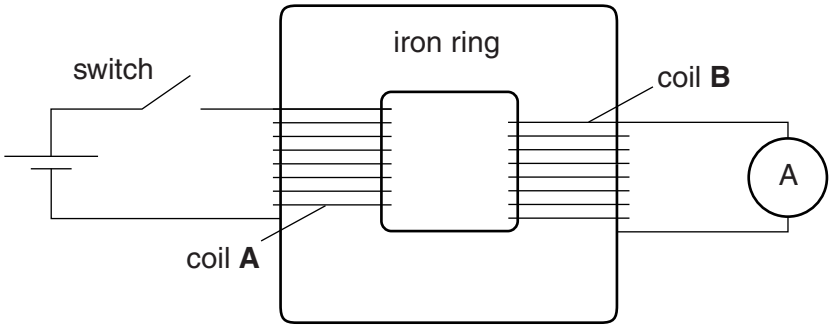


Who correctly explains why the rod repels the balloon?

answer ..... **[1]**

[Total: 3]

6 Zabu builds this circuit with two coils of insulated copper wire and an iron ring.



(a) Here are some properties of the materials used in the circuit.

Choose the correct word from this list to complete the statement.

a conductor **an insulator** **magnetic** **a solid**

The ring is made of iron because iron is ..... . **[1]**

(b) She closes the switch.

The ammeter shows that there is a **brief** pulse of current in coil **B**.

Explain why there is a brief pulse of current.

Your answer should include what happens

- in coil **A**
- in the iron ring
- in coil **B**.

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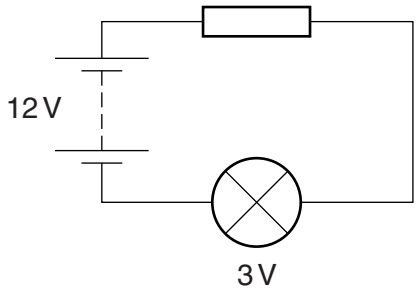
..... **[3]**

[Total: 4]

7 Celina builds this circuit.

She uses a battery, wires, a resistor and a lamp.



(a) The current in the lamp is 0.5 A when the potential difference across it is 3 V.

Calculate the power of the lamp.

power = ...W **[1]**

(b) The potential difference across the battery is 12 V.

The resistor ensures that the potential difference across the lamp is 3 V.

Suggest how the resistor does this.

.....

..... **[1]**

(c) The potential difference across the lamp is 3 V.

The potential difference across the battery is 12 V.

What is the resistance of the resistor if the current in the lamp is 0.5 A?

Put a (ring) around the correct answer.

6 Ω **18 Ω** **24 Ω** **30 Ω**

[1]

[Total: 3]

8 Roy is a farmer.

He breeds pigs.

The sperm from his male pig is used to fertilise a female pig.

(a) Each sperm cell from the male pig contains 19 chromosomes.

How many chromosomes are in each unfertilised egg cell of the female pig?

Put a (ring) around the correct answer.

9 **19** **36** **38** **54**

[1]

(b) Once the sperm fertilises the egg, a zygote is formed.

How many chromosomes are in the zygote nucleus?

Put a (ring) around the correct answer.

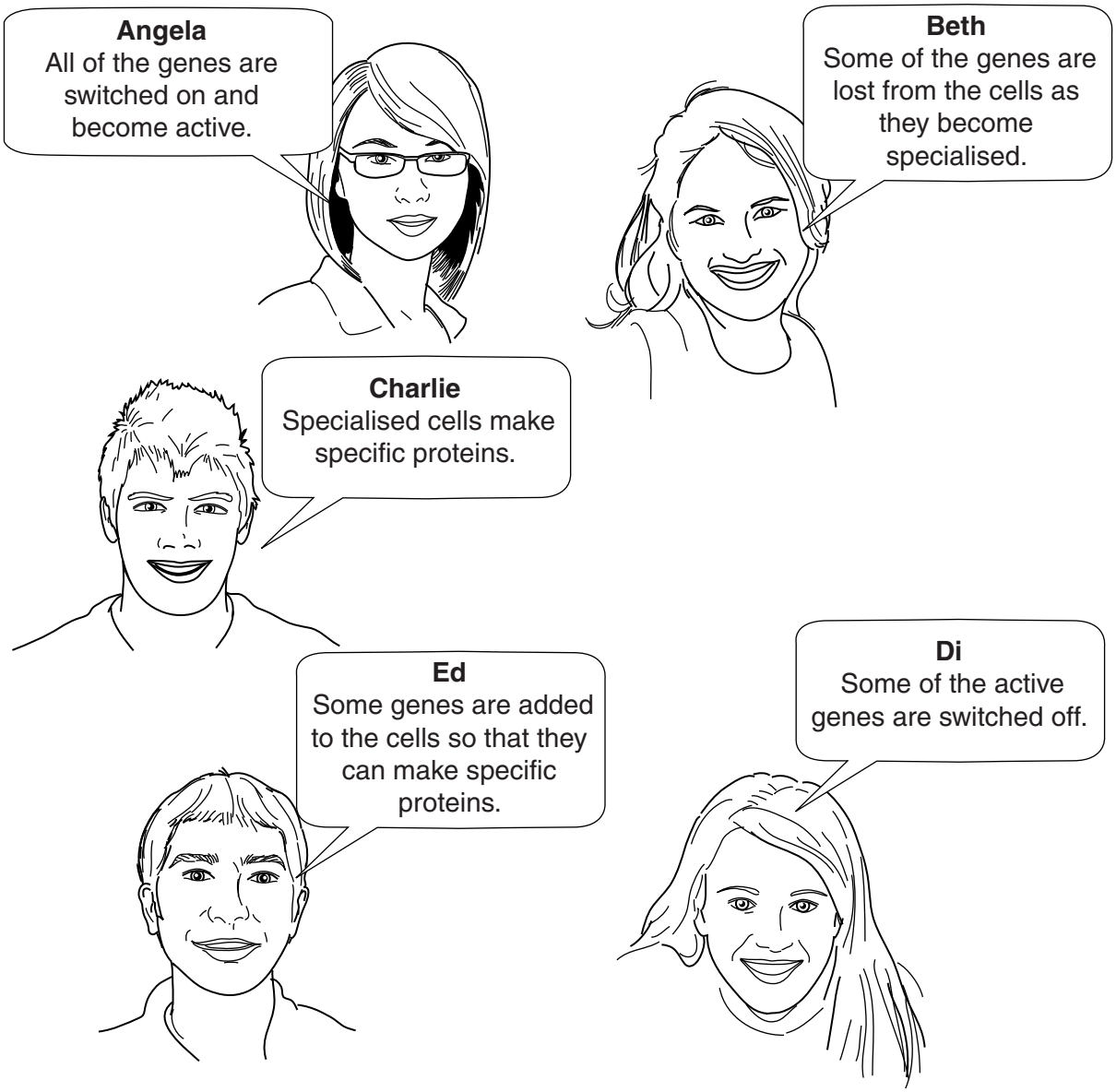
9 **19** **36** **38** **54**

[1]

(c) The zygote develops into an embryo.

As the embryo develops, the cells become specialised and form different tissues.

Five people suggest how this can happen.



Which **two** people give correct explanations?

answer ..... and ..... **[2]**

[Total: 4]

9 Red blood cells produce a protein called haemoglobin.

Mature red blood cells do not have a nucleus.

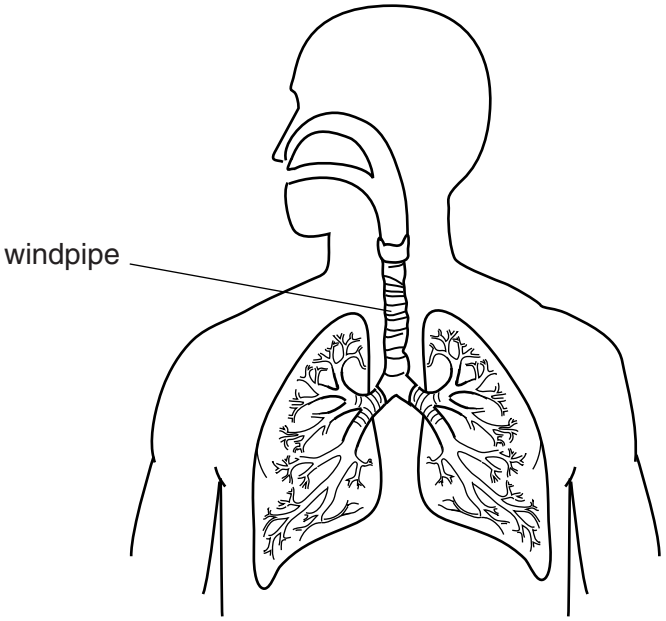
Put ticks (✓) in the boxes next to the **two** correct statements about red blood cells.

Red blood cells make haemoglobin all of the time.	☐
Red blood cells have a nucleus at an early stage.	☐
Red blood cells collect haemoglobin in the lungs.	☐
Red blood cells only have a nucleus at the end of their life.	☐
Red blood cells make haemoglobin only when they have a nucleus.	☐

[2]

[Total: 2]

10 Doctors can replace a patient's damaged windpipe.



A windpipe is collected from a dead donor.

All of the donor's cells are removed to leave a protein framework.

Stem cells from the patient's bone marrow are placed in the framework.

Once the stem cells have developed, the windpipe is transplanted into the patient.

Explain why stem cells and not muscle cells are used to grow the new cells for the windpipe.

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..... **[3]**

[Total: 3]

11 A gene is a length of DNA.

How do different genes make different proteins?

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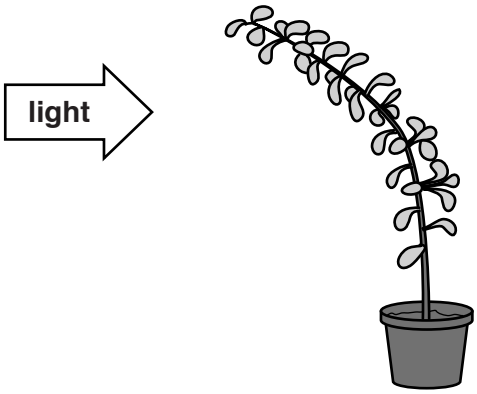
..... **[3]**

[Total: 3]

12 A plant is grown in a pot.

The shoot grows towards the light.



Put a tick (✓) in the box next to the correct word to complete each sentence.

This curve is caused by a change in

auxin	
meristem	
xylem	

concentration.

There is an increase in concentration on the

lit	
shaded	
leafy	

side of the shoot tip.

Its effect is to make cells on this side become

longer.	
greener.	
smaller.	

[2]

[Total: 2]

END OF QUESTION PAPER

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.