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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)

MONDAY 24 JANUARY 2011: Afternoon

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 4–5.**
- **The Periodic Table is provided.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

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

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

$$\begin{aligned} &\text{work done by a force} \\ &= \text{force} \times \text{distance moved by the force} \end{aligned}$$

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

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

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

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 Air is a mixture of different gases.

Each year we extract thousands of tonnes of gases from the air.

Many of these gases are very useful.

(a) We extract each gas by cooling the air until the gas turns into a liquid.

Different gases turn into liquids at different temperatures.

Here is some information about the gases.

gas	melting point in K	boiling point in K
argon	84	87
nitrogen	63	77
oxygen	55	90
water vapour	273	373

Which gas turns from a gas into a liquid at the LOWEST temperature?

answer _____

[1]

(b) Oxygen is made of molecules.

Liquid oxygen turns into a gas at extremely low temperatures.

Explain why.

Use your understanding of forces and molecules in your answer.

[3]

[Total: 4]

2 We have extracted iron since the Iron Age.

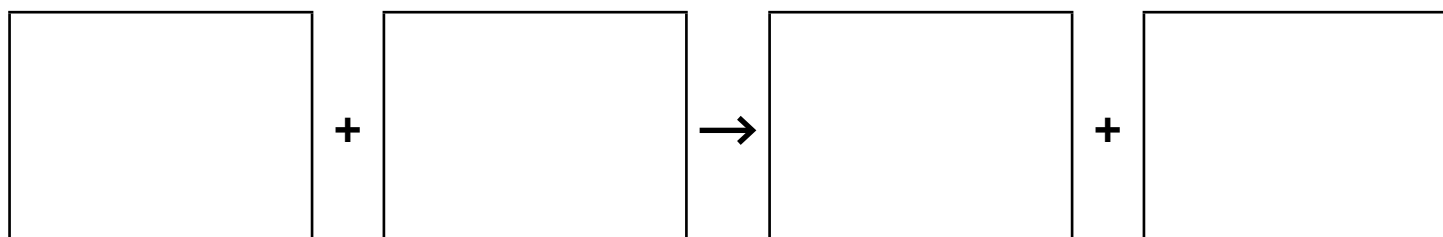
We still use the same method.

We extract the iron by heating iron oxide with carbon in a furnace.

Different reactions take place in the furnace.

(a) In one reaction, carbon takes the oxygen away from iron oxide.

(i) Fill in the boxes to write a word equation for this reaction.



[2]

(ii) Use words from this list to complete the sentences below.

combined

electrolysed

melted

oxidised

precipitated

reduced

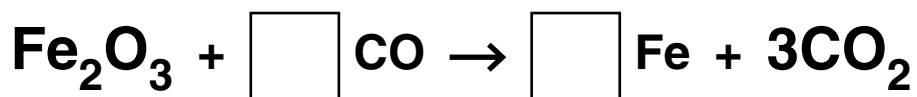
When carbon gains oxygen we say that the carbon has been _____ .

When a metal oxide loses oxygen we say that the metal has been _____ .

[1]

(iii) Another reaction for making iron is between iron oxide and carbon monoxide gas.

Put numbers in the boxes to balance the equation for this reaction.



[2]

(b) Not all metals are extracted by heating their ores with carbon.

Some metals are extracted by electrolysis.

metal	extracted by	melting point of the metal in K
lead	heating with carbon	601
magnesium	electrolysis	922
aluminium	electrolysis	933
calcium	electrolysis	1112
cobalt	heating with carbon	1768
iron	heating with carbon	1808

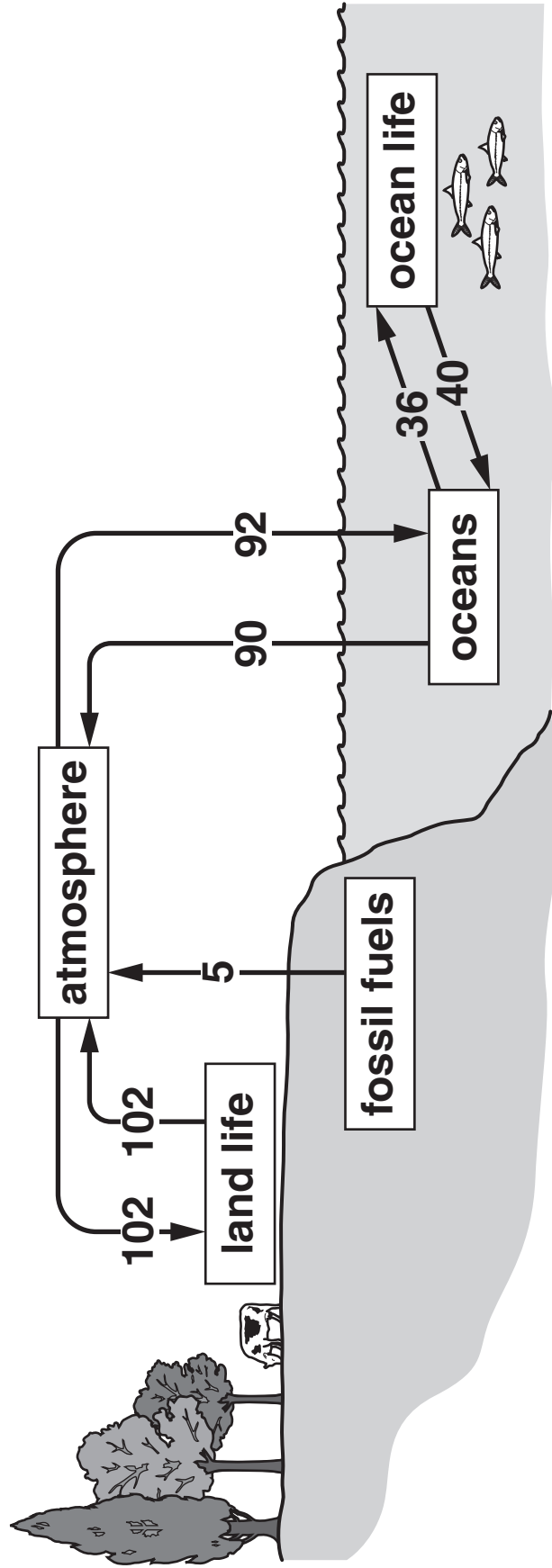
Use the table to decide which three metals are likely to be more reactive than the others.

answer _____ and _____

and _____ [1]

[Total: 6]

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3 Scientists are worried about the increasing amounts of carbon in our atmosphere.

Look at the diagram of the carbon cycle, on the facing page.

The numbers show how many gigatonnes of carbon move in each direction every year.

(a) The amount of carbon in the atmosphere is increasing.

By how many gigatonnes does it increase every year?

Put a ring around the correct answer.

2

3

5

90

102

[1]

- (b) Most of the carbon in the atmosphere is in the form of carbon dioxide.

The diagram shows that 92 gigatonnes of carbon dissolve in the oceans every year.

How many gigatonnes of carbon dioxide does this represent?

Put a **ring** around the answer.

$$\frac{12}{44} \times 92$$

$$\frac{12}{32} \times 92$$

$$\frac{32}{12} \times 92$$

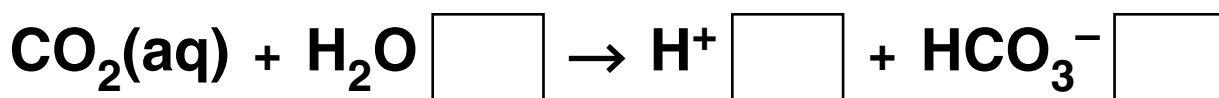
$$\frac{44}{12} \times 92$$

[1]

- (c) Carbon dioxide dissolves in seawater.

Carbon dioxide in solution reacts with water to form ions.

- (i) Put STATE SYMBOLS in the boxes to complete the equation for this reaction.



[1]

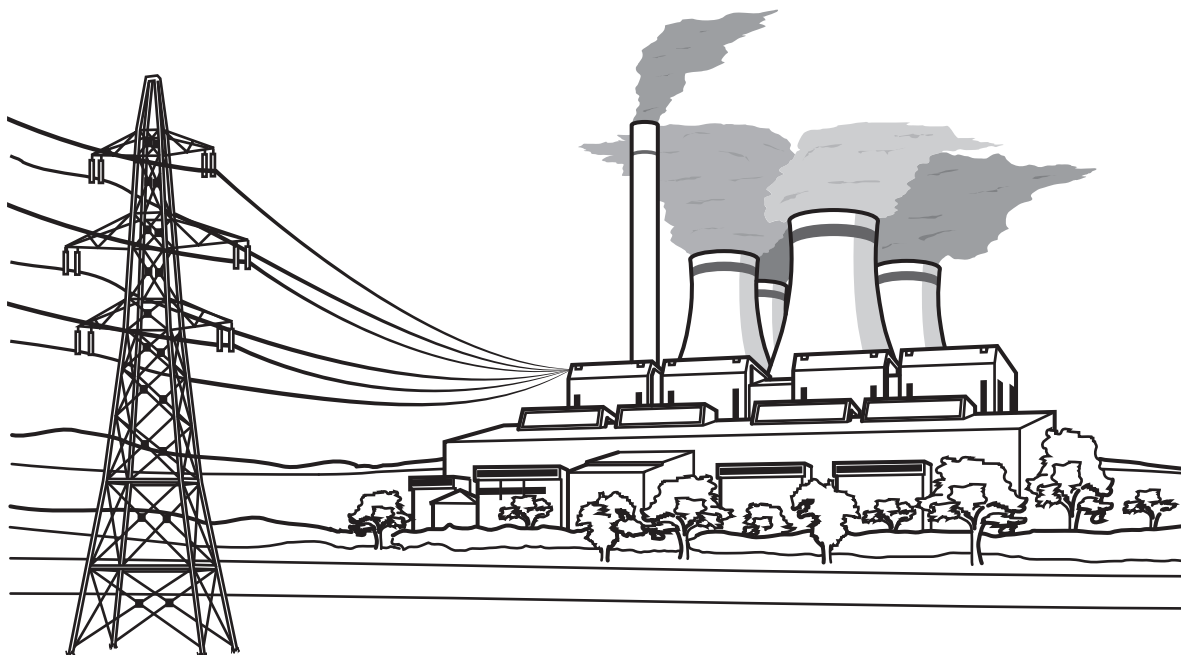
(ii) Mary wants to see if sea water really is an ionic solution.

What could she measure to show that it contains ions?

_____ **[1]**

[Total: 4]

4 Mains electricity is produced by generators in power stations.



Each generator contains a magnet and a coil of wire.

(a) Describe how the magnet and the coil of wire are used to make electricity.

Include the name of the process.

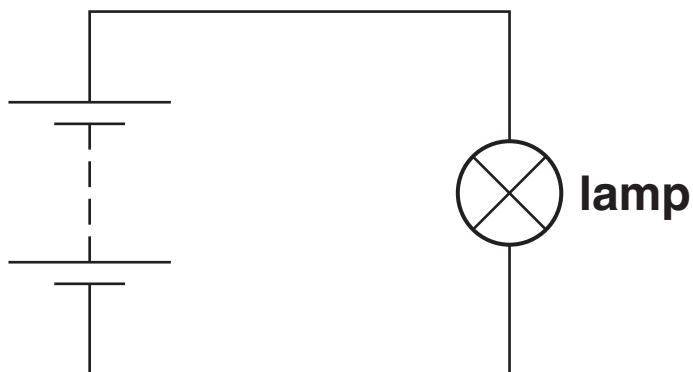
[2]

(b) State TWO ways that you could increase the voltage of the electricity produced by a generator.

[2]

[Total: 4]

5 Charles puts this circuit together.



(a) The lamp glows.

Here are some statements about the circuit.

Which TWO statements, when taken together, explain why the lamp glows?

Put ticks (✓) in the boxes next to the TWO statements required.

The wires have some resistance.

The current in the lamp heats it up.

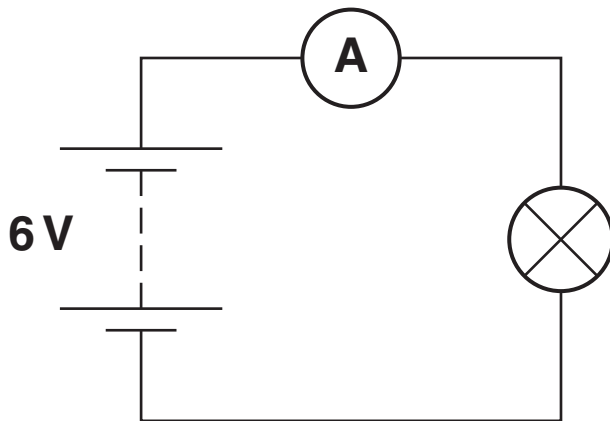
The battery pushes charges through the lamp.

The wires have charges that are free to move.

Only the lamp has charges that are free to move.

[2]

(b) Charles adds an ammeter to measure the current in the lamp.



The lamp has a power of 3W.

What does the ammeter read?

Put a **ring** around the correct answer.

0.5 A

2.0 A

6.0 A

18 A

[1]

(c) There is not enough current in the circuit to make the lamp glow brightly.

Charles adds another battery and the lamp glows brightly.

Complete the sentences. Choose words from this list.

decreases

increases

parallel

series

Charles adds the second battery in

_____ to the first one.

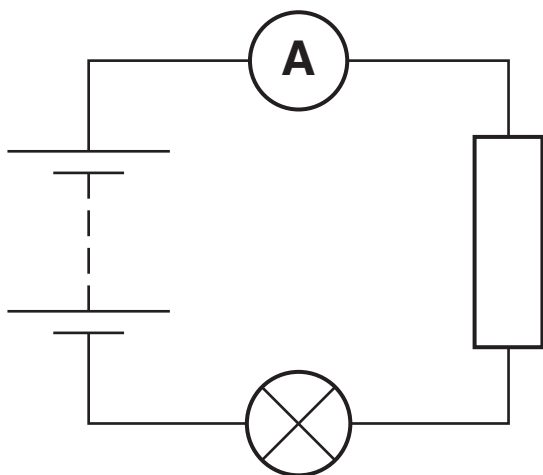
This _____ the potential difference

across the lamp.

[1]

[Total: 4]

6 Fleur assembles this circuit.



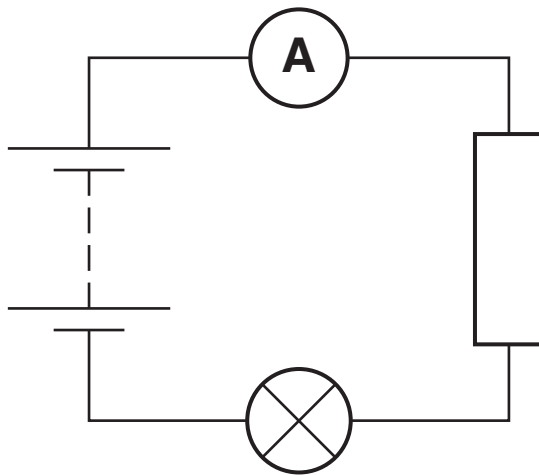
(a) The resistor, ammeter and lamp are IN SERIES.

Explain why all three components have exactly the same current.

[2]

(b) Fleur wants to add a voltmeter to measure the potential difference across the resistor.

(i) Draw on this circuit diagram to show how Fleur should connect the voltmeter.



[1]

- (ii) Fleur finds that the potential difference across the resistor is 6V.

The potential difference across the battery is 9V.

The ammeter reads 0.5 A.

What is the resistance of the LAMP?

Put a **ring** around the correct answer.

6 Ω

12 Ω

18 Ω

30 Ω

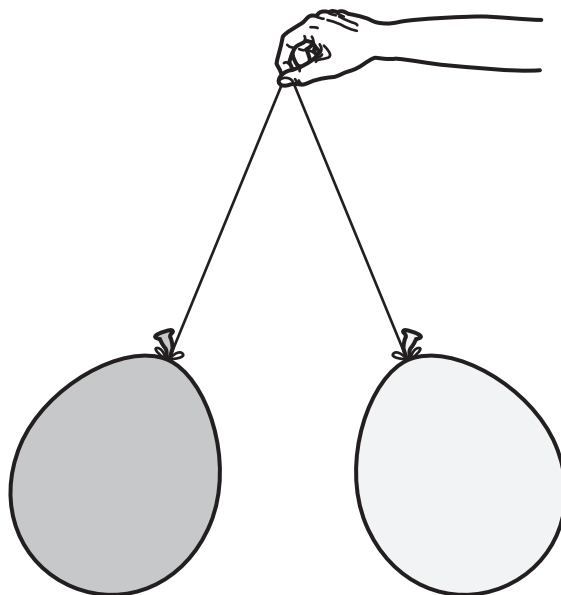
[1]

[Total: 4]

7 Zara does an experiment with a pair of balloons on strings.

She rubs each balloon against her clothing.

Zara then holds the balloons up by their strings.



Complete this explanation of why the balloons hang like this.

Choose the best words from the list.

atoms	attract	different	electrons
identical	shield	negative	neutral
positive	protons	repel	

The rubbing transfers some _____ from each balloon to Zara's clothing so,

this leaves each balloon with a _____ charge.

The reason the balloons _____ each other

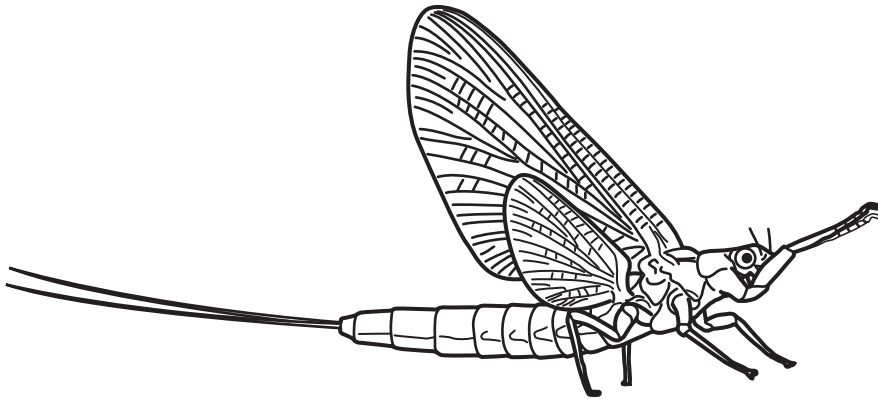
is because they have _____ kinds of charge.

[2]

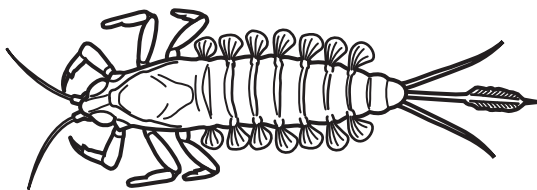
[Total: 2]

8 Martin is studying mayflies.

He looks at an adult mayfly and a mayfly nymph.



adult mayfly

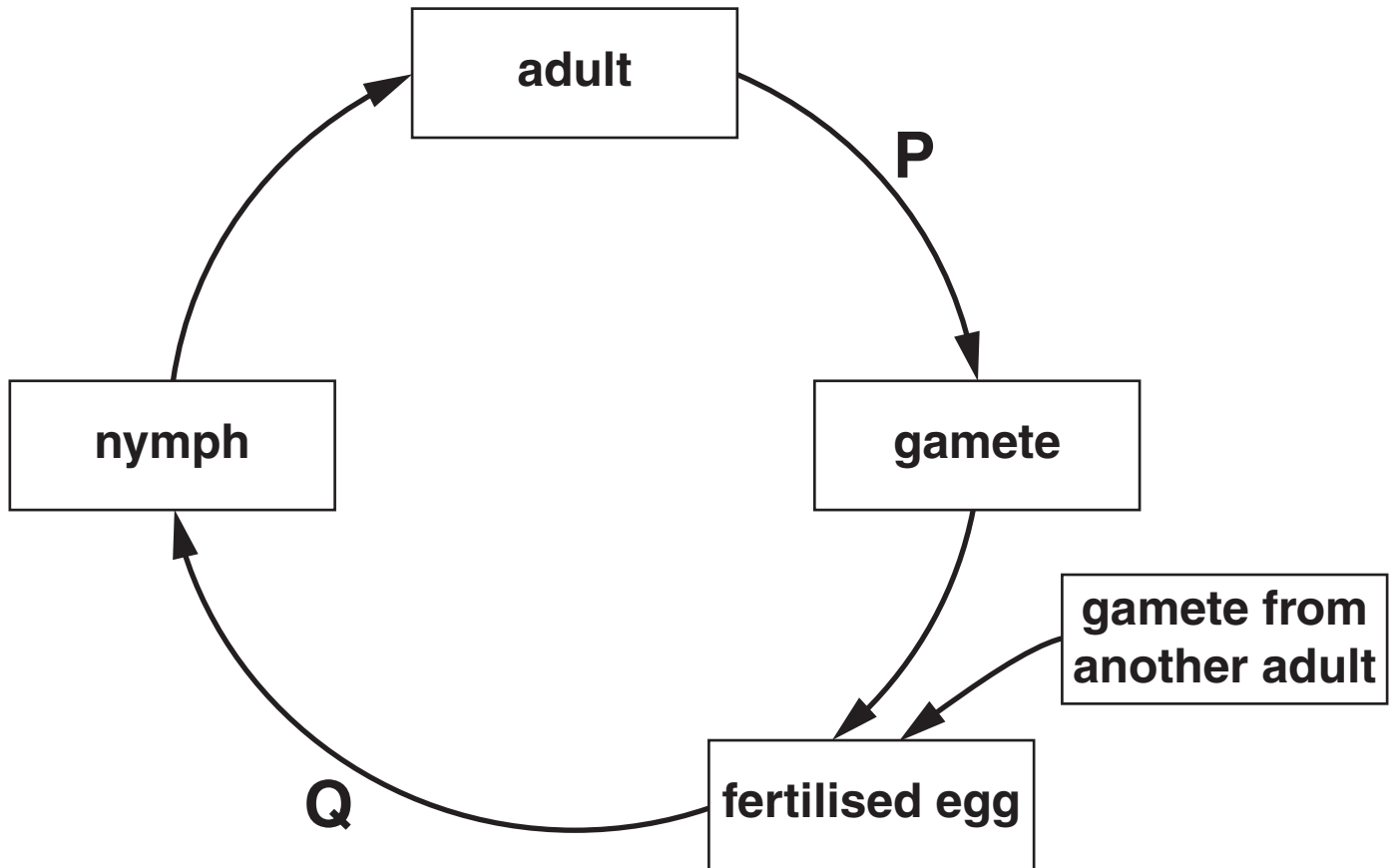


mayfly nymph

(a) (i) The adult mayfly lays eggs in the water.

The eggs hatch into nymphs.

The nymphs grow bigger.



Complete the sentences.

The type of cell division at P is

_____ , which makes cells that have

_____ number of chromosomes as the adult cells.

The type of cell division at Q is

_____ , which makes cells that have

_____ number of chromosomes as the fertilised egg. [2]

(ii) The statements A to D are about processes of the cell cycle.

Put the letters A, B, C and D in the correct column of the table to show whether the processes occur during CELL GROWTH or CELL DIVISION.

A the numbers of organelles increase

B copies of the chromosomes separate

C new strands of DNA form

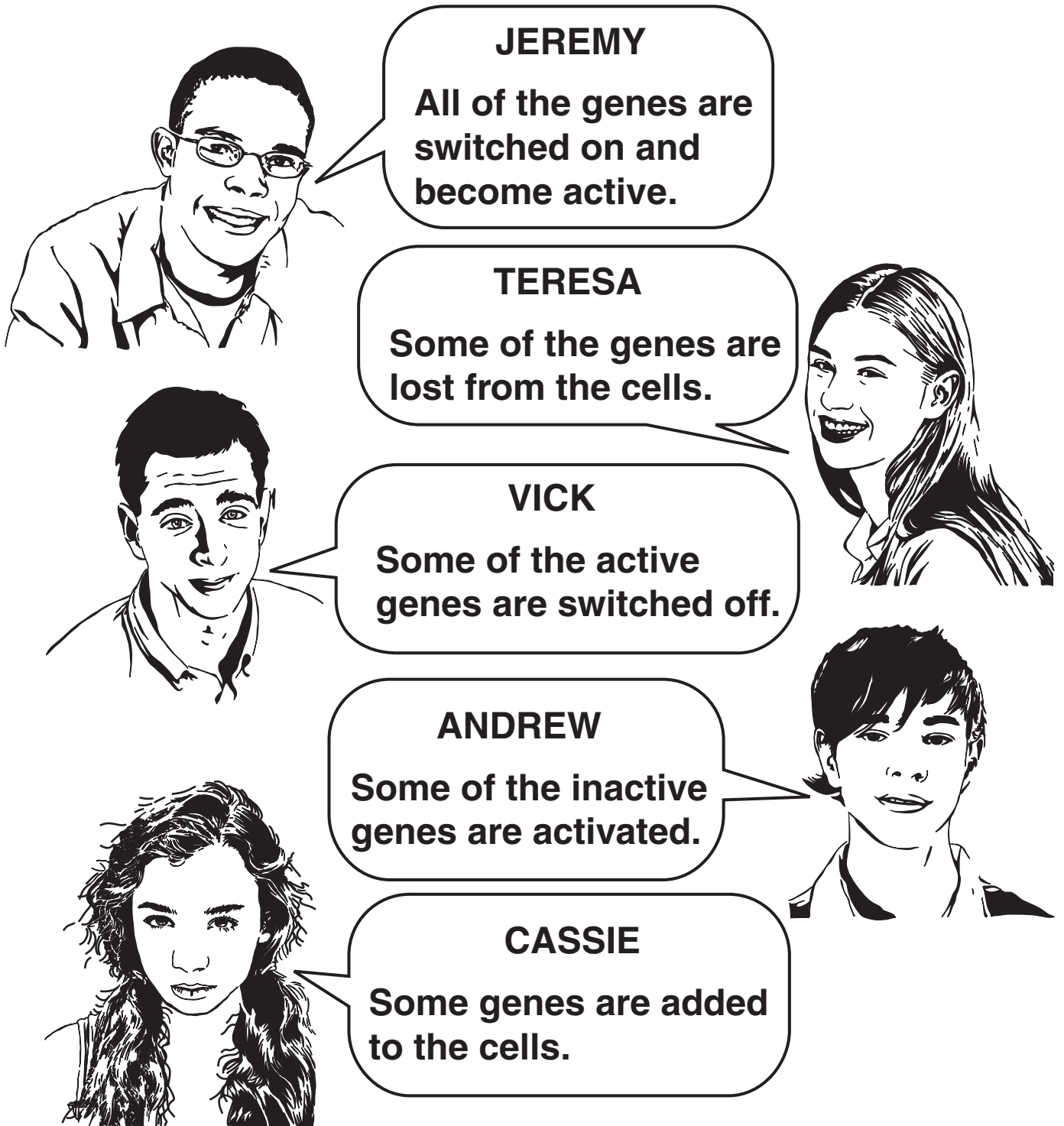
D strands of each DNA molecule separate

cell growth	cell division

[2]

(b) Once a nymph grows into an adult, it has different specialised tissues.

Five people are asked to explain this.



JEREMY
All of the genes are switched on and become active.

TERESA
Some of the genes are lost from the cells.

VICK
Some of the active genes are switched off.

ANDREW
Some of the inactive genes are activated.

CASSIE
Some genes are added to the cells.

Which TWO people give the best explanations?

answer _____ and _____

[1]

[Total: 5]

9 Susie sees a plant she likes in a friend's garden.

She asks if she can take a cutting.

(a) Which part of her friend's plant should Susie use to grow an identical plant?

Put a ring around the correct answer.

flower

fruit

seed

stem

[1]

(b) Susie dips the bottom of her cutting in some rooting powder.

She then puts the cutting into a pot of soil.

What does the rooting powder contain that helps the cutting grow roots?

_____ **[1]**

(c) Susie's cutting grows into a new plant.

Which statements explain how this is possible?

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

Some unspecialised cells develop into other tissues.

Some unspecialised cells develop into organs.

Some xylem cells become phloem cells.

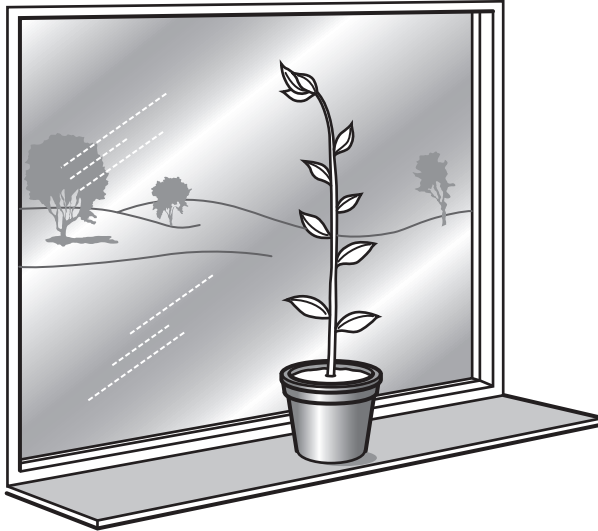
Some plant cells become unspecialised.

Some leaf cells become root cells.

[2]

(d) Susie keeps her new plant in a pot near a window.

The shoot grows towards the light.



Draw ONE line to join the EFFECT OF LIGHT on the distribution of auxin to its EFFECT ON THE CELLS in the shoot.

effect of light

**more auxin on
lit side**

or

**more auxin on
shaded side**

effect on the cells

**makes these cells
grow more slowly**

or

**makes these cells
grow more quickly**

[1]

[Total: 5]

10 DNA carries genetic information.

(a) What is the name given to the shape of DNA?

_____ [1]

(b) DNA in one part of the cell codes for the production of molecules in another part of the cell.

Explain how this happens.

In your answer write about

- **the code in DNA**
- **different sites in the cell**
- **the type of molecule produced.**

_____ [3]

[Total: 4]

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

* 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.