UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

1144188971

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **October/November 2010**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 20.

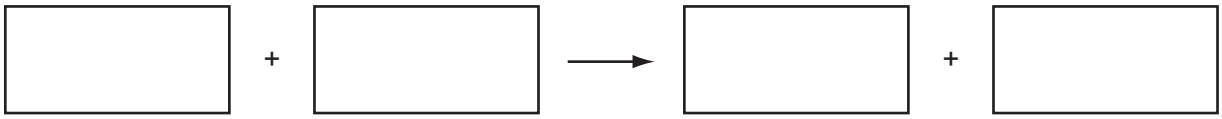
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **20** printed pages.

For Examiner's Use

1 **(a)** State the word equation for photosynthesis.



[2]

(b) **(i)** Name the green pigment found in plant leaves which absorbs energy from sunlight.

..... [1]

(ii) Fig. 1.1 is a diagram of a plant cell.

On the diagram, draw a label line to where this green pigment would be found, and label it **P**.

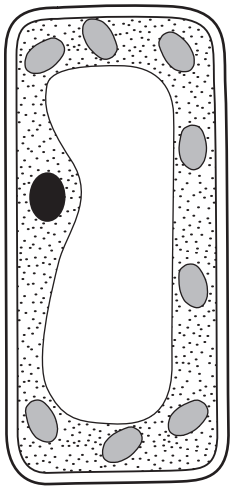


Fig. 1.1 [1]

(c) A student fixed a piece of black paper over a leaf, which was still attached to the plant. He left the plant in the sun for two days.

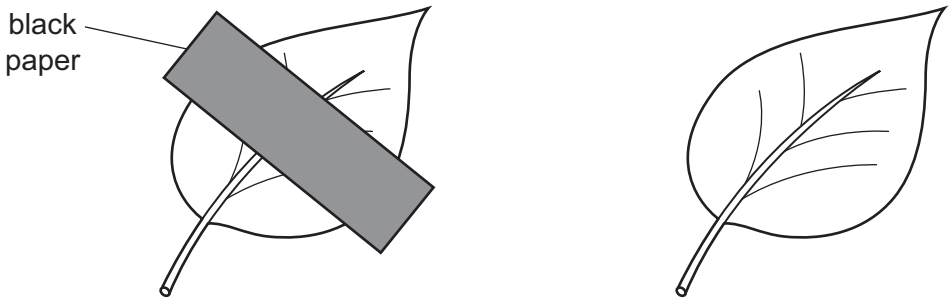
He then removed the leaf from the plant and tested it for starch, after removing the paper.

(i) Using the letters given, list the correct sequence of the steps he took.

A	Add iodine solution to the leaf.
B	Place the leaf in boiling water.
C	Dip the leaf into water to soften it.
D	Place the leaf in hot ethanol.
E	Spread the leaf on a white tile.

..... [3]

(ii) Fig. 1.2 shows the leaf before and after he did the starch test.



before testing after testing

Fig. 1.2

Iodine solution is orange-brown. It turns blue-black when it is in contact with starch.

Complete the diagram of the leaf after testing in Fig. 1.2. Do **not** colour the diagram.

Use labels to show which parts would look orange-brown and which parts would look blue-black. [2]

2 Fig. 2.1 shows the apparatus a student used to measure the rate of reaction between some powdered metal and dilute hydrochloric acid.

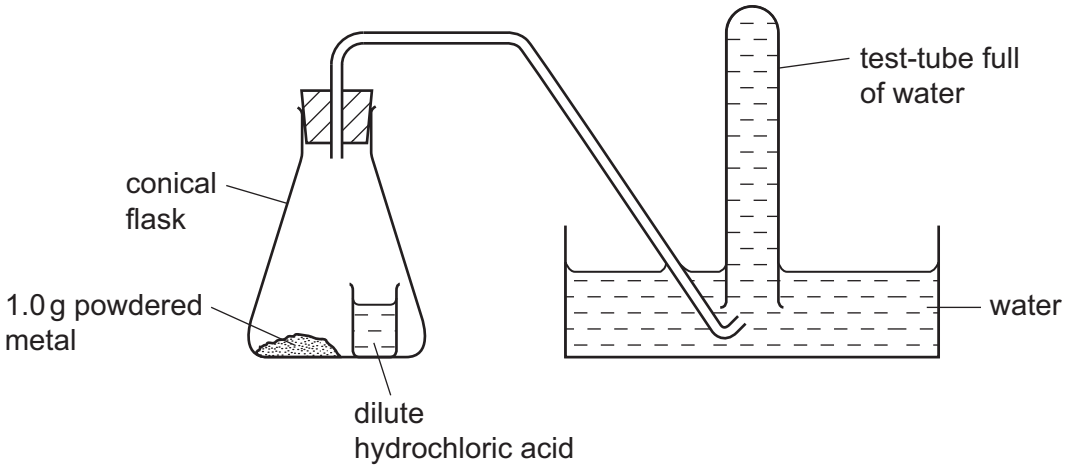


Fig. 2.1

When the student tilted the conical flask, the acid mixed with the powdered metal. If a reaction occurred, any gas which was produced bubbled up into the test-tube, pushing the water out. The student timed how long it took for the test-tube to fill with gas.

(a) Describe how the student could test the gas to show that it was hydrogen.

.....

..... [2]

(b) The student used the apparatus in Fig. 2.1 to compare the rates of reaction between dilute hydrochloric acid and three powdered metals, **X**, **Y** and **Z**.

The results the student obtained are shown in Table 2.1.

Table 2.1

metal	mass of metal / g	time for gas to fill the test-tube / seconds
X	1.0	150
Y	1.0	45
Z	1.0	no gas was produced

(i) One of the metals used was copper.

State and explain which metal, **X**, **Y** or **Z**, was copper.

metal .....

explanation .....

..... [2]

(ii) Suggest **two** ways, other than using a catalyst, in which the student could **increase** the rate of reaction between metal **X** and dilute hydrochloric acid.

1 .....

.....

2 .....

..... [2]

(c) Fig. 2.2 shows another experiment in which the student added zinc carbonate to dilute sulfuric acid. A gas was given off and, when the bubbling stopped, some solid zinc carbonate remained in the mixture.

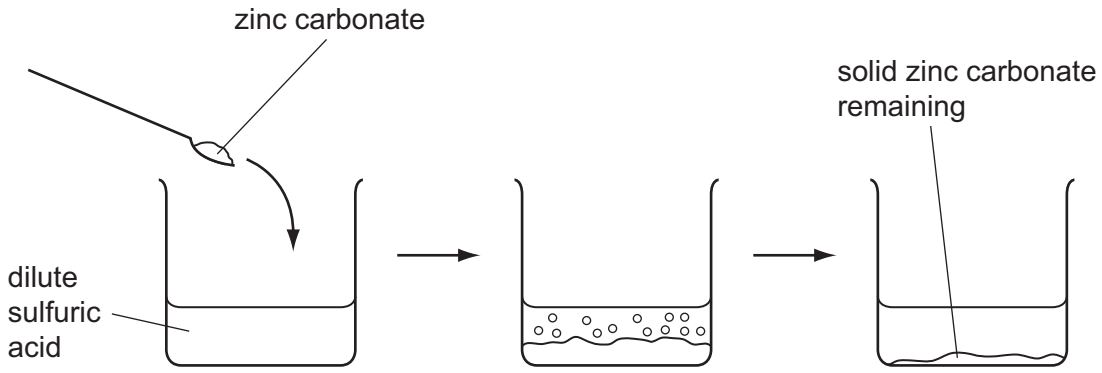


Fig. 2.2

(i) State the chemical formula of sulfuric acid.

..... [1]

(ii) Explain why the reaction eventually stopped even though some zinc carbonate powder remained.

.....

..... [1]

For Examiner's Use

3 Fig. 3.1 shows a rock that is falling from the top of a cliff into the river below.

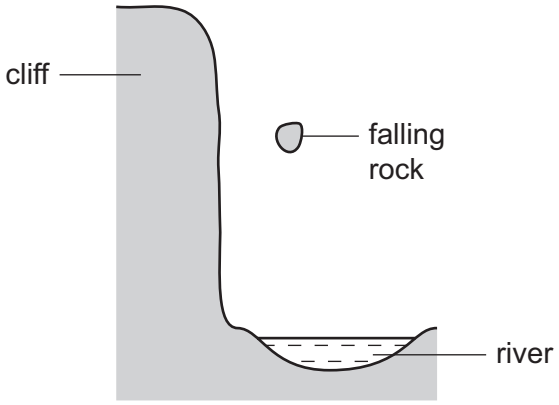


Fig. 3.1

(a) (i) As the rock falls, it gains kinetic energy.

Name the form of energy the rock had at the top of the cliff.

..... [1]

(ii) Suggest what happens to the kinetic energy of the rock when the rock hits the water.

.....

..... [2]

(b) Fig. 3.2 shows a speed-time graph for the motion of the rock.

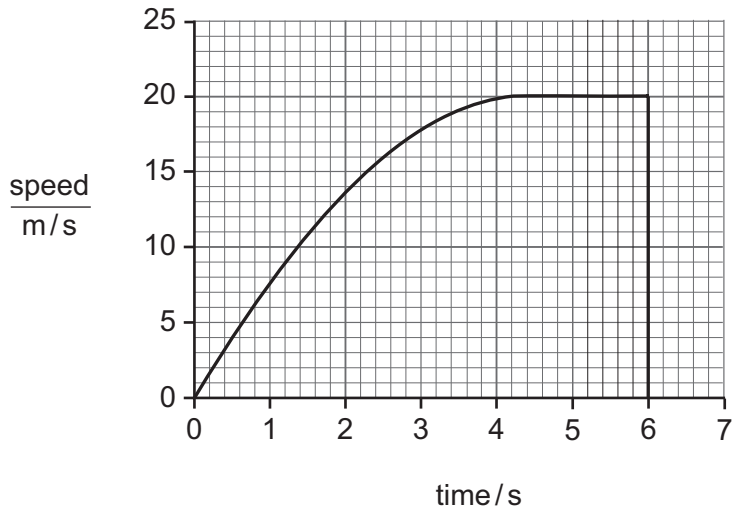


Fig. 3.2

(i) After how many seconds was the speed of the rock 15 m/s?

..... s [1]

For Examiner's Use

(ii) The rock is accelerating. Explain the meaning of the term *accelerating*.

.....

..... [1]

(c) The rock contains radioactive substances emitting high levels of ionising radiation.

(i) State how the radioactivity could be detected.

..... [1]

(ii) Explain why it would be dangerous for a person to handle this rock without proper protection.

.....

..... [1]

For Examiner's Use

4 Copper metal reacts with oxygen gas to form the black solid, copper oxide.

(a) (i) Use this example to describe **one** difference between *elements* and *compounds*.

.....

.....

..... [2]

(ii) State why this reaction is an example of *oxidation*.

.....

..... [1]

(iii) Name the type of chemical bonding found in copper oxide.

..... [1]

(b) Fig. 4.1 shows apparatus used in the electrolysis of copper chloride solution.

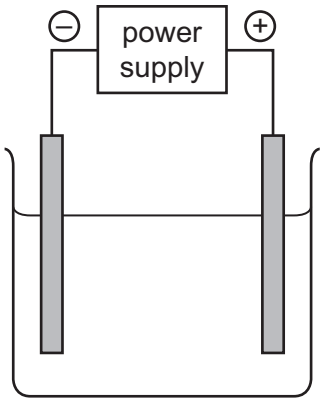


Fig. 4.1

(i) On the diagram, clearly label the **anode** and the **electrolyte**. [2]

(ii) Copper chloride solution contains copper ions and chloride ions in water.

State briefly **two** differences between a chlorine *atom* and a chloride *ion*.

.....

.....

..... [2]

For Examiner's Use

(iii) Copper is a pink/orange metal and chlorine is a gas.

Describe what would be **observed** at the positive and negative electrodes during electrolysis of copper chloride solution.

observation at positive electrode .....

.....

observation at negative electrode .....

..... [2]

For Examiner's Use

5 **(a)** Fig. 5.1 shows some of the different types of radiation in the electromagnetic spectrum.

gamma		ultra-violet	visible light	infra-red		radio waves

Fig. 5.1

Write the names of the missing types of radiation in the two empty spaces. [2]

(b) Fig. 5.2 shows a ray of light hitting a mirror.

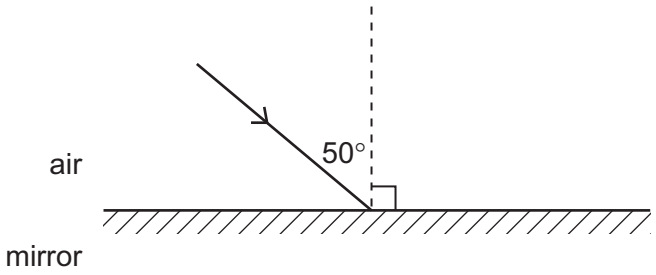


Fig. 5.2

(i) On Fig. 5.2, label the normal. [1]

(ii) On Fig. 5.2, draw the reflected ray. [1]

(iii) State the value of the angle of reflection. ..... ° [1]

(c) A sound wave has a frequency of 500 Hz.

(i) Explain the meaning of the term *frequency*.

.....

..... [1]

(ii) State the approximate range of audible frequencies detected by the normal human ear.

..... [1]

(d) Fig. 5.3 shows the wave traces made by four sounds.

For Examiner's Use

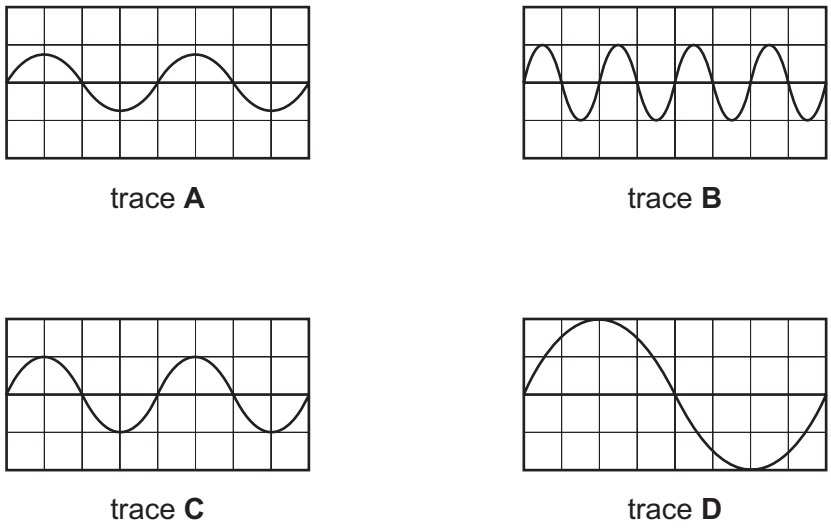


Fig. 5.3

(i) Which trace shows the sound wave with the lowest pitch?

..... [1]

(ii) Which trace shows the sound wave with the smallest amplitude?

..... [1]

For Examiner's Use

6 **(a)** Complete the sentences about the human nervous system, using some of the words in the list.

biceps **brain** **detectors** **effectors**

nerves **receptors**

Specialised cells in the human nervous system detect external stimuli. These cells are called ..... . They convert the stimulus into electrical impulses in ..... , which carry the impulse to the central nervous system.

The central nervous system then sends impulses to parts of the body that respond to the stimulus, such as muscles or glands. These parts are called ..... . [3]

(b) When we smell food, the salivary glands respond by secreting saliva.

Saliva contains the enzyme amylase, which breaks down large starch molecules to smaller sugar molecules.

(i) Explain what is meant by the term *enzyme*.

.....

.....

..... [2]

(ii) Name the process by which large molecules are broken down to small ones in the alimentary canal.

..... [1]

(iii) Explain why this process is necessary.

.....

.....

..... [2]

7 **(a)** Complete Table 7.1 to show the correct symbols of these electrical components. One symbol has been drawn for you.

Table 7.1

component	electrical symbol
lamp	
ammeter	
fixed resistor	

[2]

(b) A student set up the electric circuit in Fig. 7.1.

It contained three lamps **L1**, **L2** and **L3**.

It contained three switches **S1**, **S2** and **S3**.

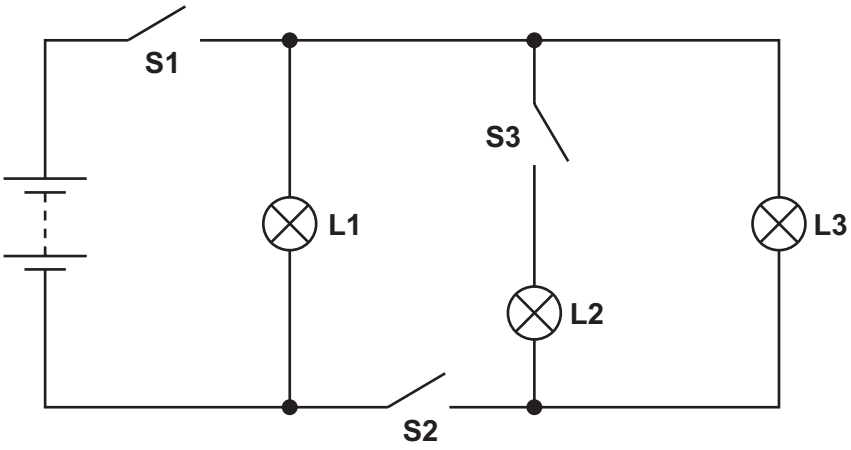


Fig. 7.1

In Table 7.2, write the words **'on'** or **'off'** to show when each lamp is lit or not lit for each set of switch positions.

Table 7.2

switch position			lamp 'on' or 'off'		
S1	**S2**	**S3**	**L1**	**L2**	**L3**
closed	closed	closed			
closed	closed	open			
closed	open	open			

[3]

(c) The student then set up another electric circuit shown in Fig. 7.2.

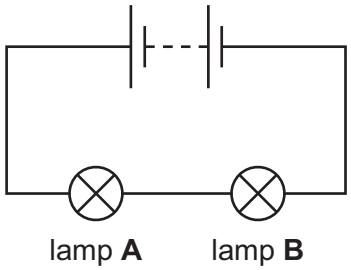


Fig. 7.2

She noticed that neither lamp **A** nor lamp **B** lit up. She found nothing wrong with lamp **A** but the filament in lamp **B** was broken.

(i) Explain why lamp **A** did not light up.

.....

..... [1]

(ii) She replaced lamp **B** with a new lamp **C**. The resistance of both lamp **A** and lamp **C** was 5 ohms when lit.

Calculate the combined resistance of both lamps in the working circuit.

State the formula that you use and show your working.

formula used

working

..... ohms [2]

For Examiner's Use

(d) Fig. 7.3 shows an electrical device.

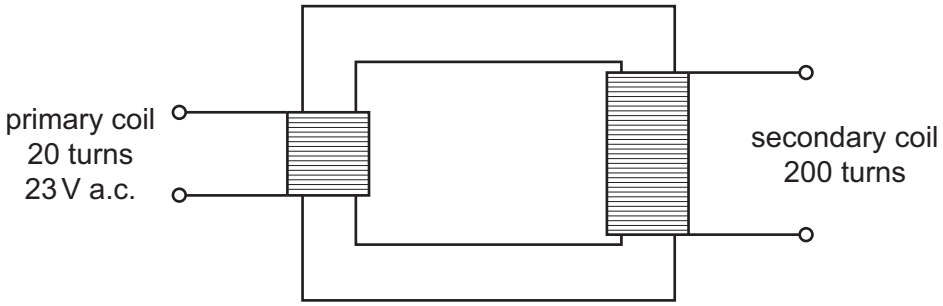


Fig. 7.3

(i) Name the device. ..... [1]

(ii) Calculate the output voltage.

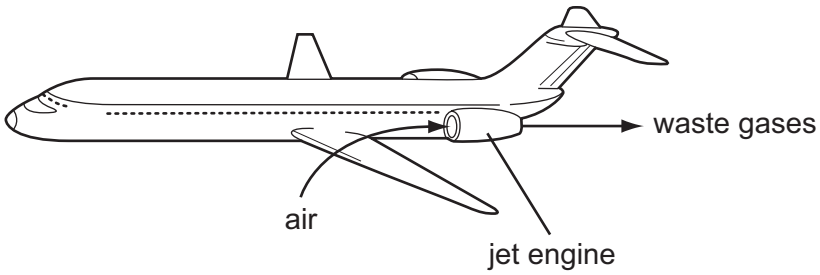
Use the formula $V_p / V_s = N_p / N_s$.

Show your working.

..... V [1]

For Examiner's Use

8 In jet engines, hydrocarbon molecules from the jet fuel mix with air and burn. This releases a large amount of energy and produces a mixture of waste gases. These waste gases pass out through the back of the jet engine into the atmosphere.



(a) Fig. 8.1 shows a molecule of octane, which is a typical hydrocarbon molecule in jet fuel.

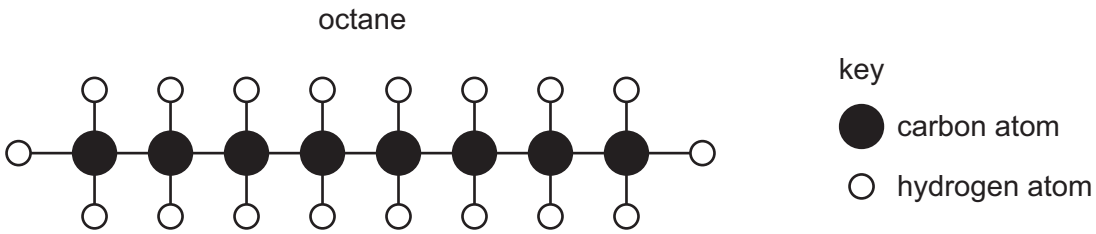


Fig. 8.1

(i) State the chemical formula of octane.

..... [1]

(ii) Complete the word equation below for the complete combustion of octane.

octane	+		→		+	

[2]

(iii) Explain why the mixture of gases coming from the rear of the jet engine contains a large amount of nitrogen.

.....

.....

..... [2]

(iv) Explain why the metallic parts of the jet engine become hot when it is working.

.....

..... [1]

For Examiner's Use

(b) (i) A carbon atom has a proton (atomic) number 6 and a nucleon (mass) number 12.

State the number of neutrons and electrons in this carbon atom.

number of neutrons .....

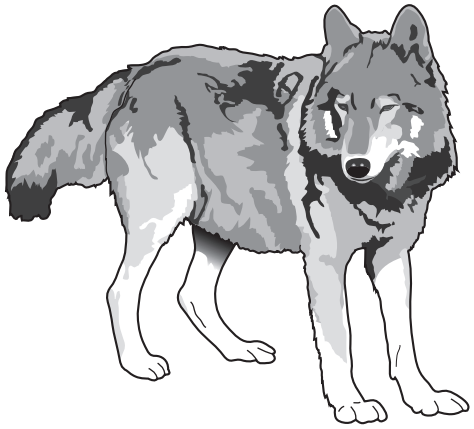
number of electrons ..... [2]

(ii) State the chemical symbol of another element which is in the same **group** in the Periodic Table as carbon.

..... [1]

For Examiner's Use

9 The gray wolf is a predator that lives in North America.



(a) The gray wolf's diet consists mainly of white-tailed deer, beavers and snowshoe hares.

These are all herbivores. They eat plants.

(i) Construct a food web including all the organisms mentioned above.

[3]

(ii) State what the arrows in your food web represent.

..... [1]

(iii) Name the producers in the food web you have drawn.

..... [1]

For Examiner's Use

(b) Some of the chemicals in a gray wolf's body contain carbon. When a wolf dies, its body is broken down by decomposers and the carbon is returned to the air.

(i) Name **one** type of chemical in a wolf's body that contains carbon.

..... [1]

(ii) Explain how the carbon from a wolf's body is returned to the air after the wolf dies.

.....

.....

..... [2]

(c) Some gray wolves are born with darker fur than others. They can pass this fur colour to their offspring.

If wolves live in cold places, they grow longer fur than wolves that live in warm places. They cannot pass their fur length to their offspring.

Tick **two** boxes to show the cause of each of these types of variation in wolves' fur.

cause	**fur colour**	**fur length**
genes only		
environment only		
genes and environment		

[2]

DATA SHEET
The Periodic Table of the Elements

Group																		
I	II										III	IV	V	VI	VII	0
																4 **He** Helium 2
					1 **H** Hydrogen 1						11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
7 **Li** Lithium 3	9 **Be** Beryllium 4										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
23 **Na** Sodium 11	24 **Mg** Magnesium 12										70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
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	64 **Cu** Copper 29	65 **Zn** Zinc 30	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
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						
	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).