



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



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.

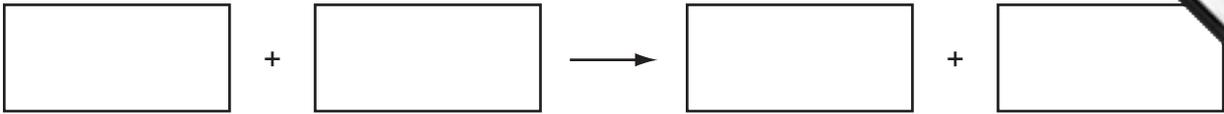
The number of marks is given in brackets [] at the end of each question or part question.

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

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



- 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**.

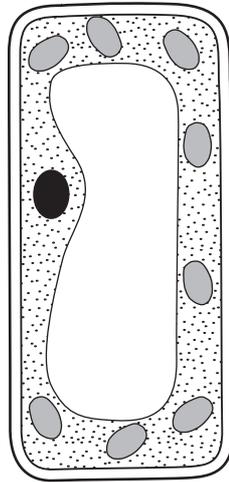


Fig. 1.1

[1]

- (c) A student fixed a piece of black paper over a leaf, which was still attached to the stem. 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.

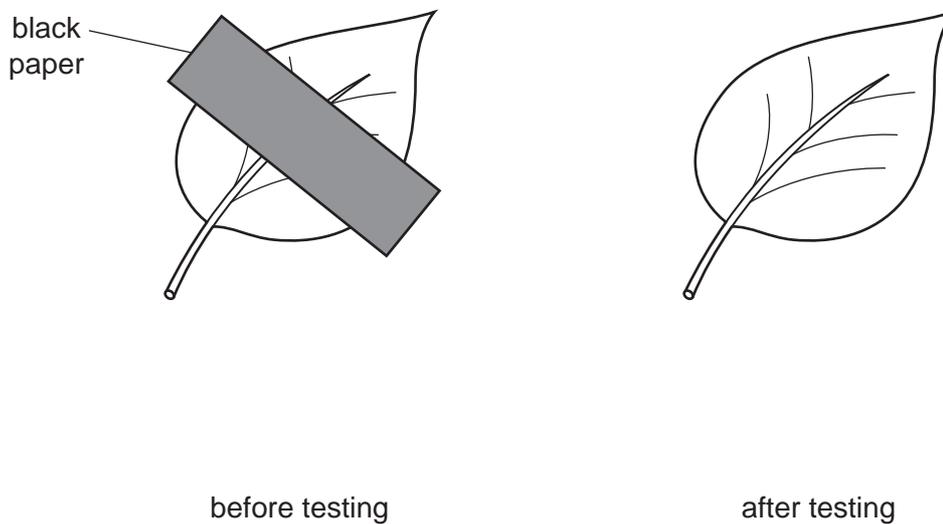


Fig. 1.2

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 powdered metal and dilute hydrochloric acid.

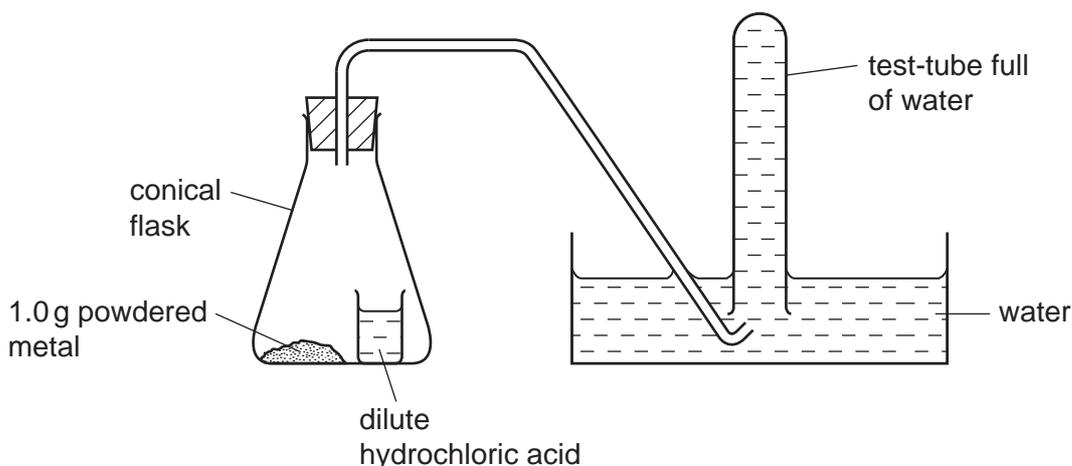


Fig. 2.1

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 **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.

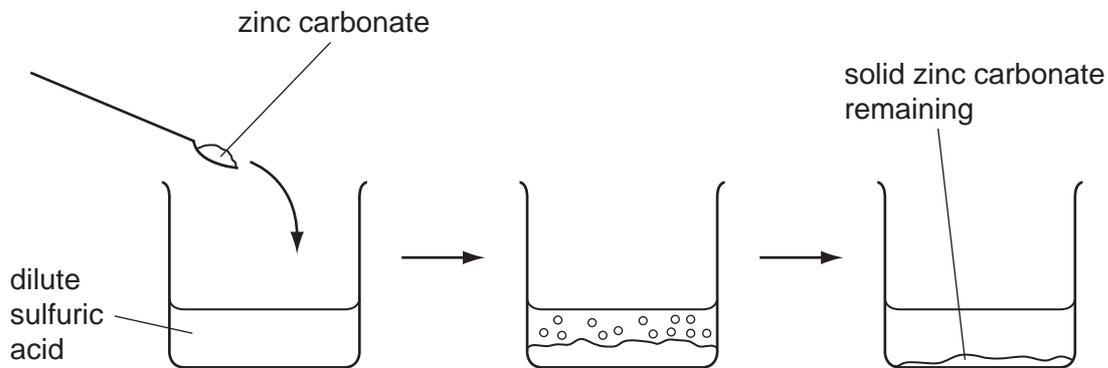


Fig. 2.2

- (i) State the chemical formula of sulfuric acid.

..... [1]

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

.....

..... [1]

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

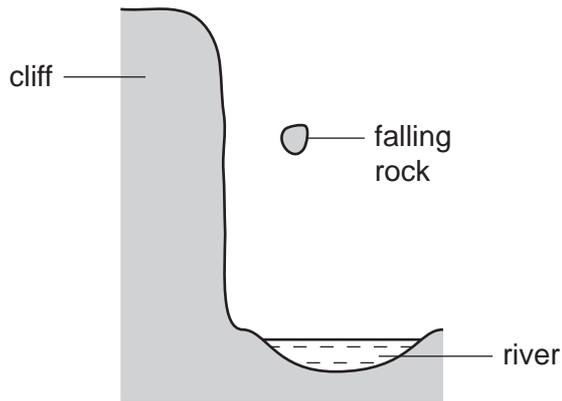


Fig. 3.1

(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.

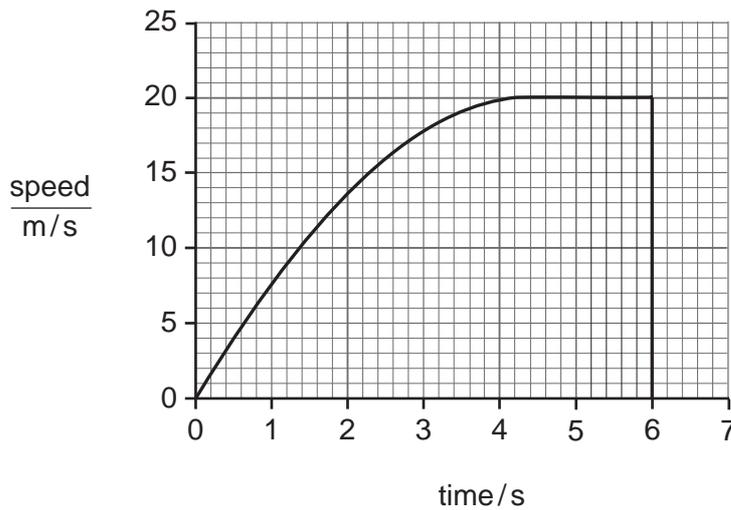
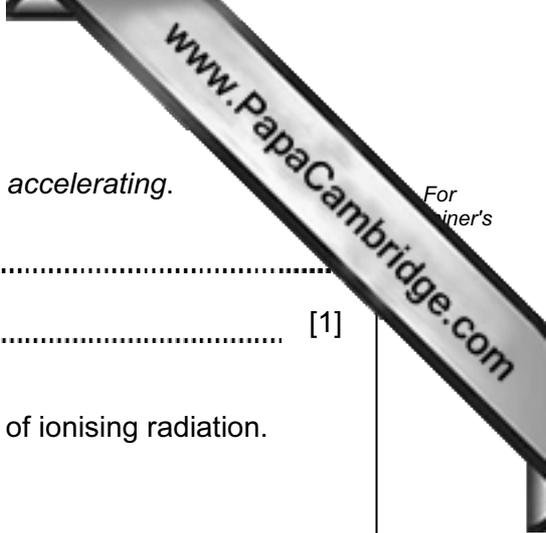


Fig. 3.2

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

.....s [1]



(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]

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.

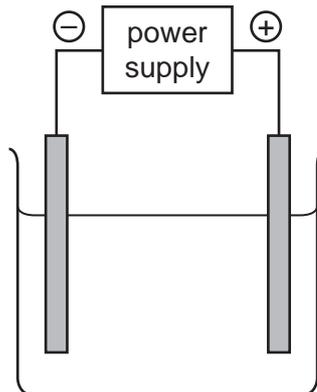


Fig. 4.1

(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]

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

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

observation at positive electrode

.....

observation at negative electrode

..... [2]

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.

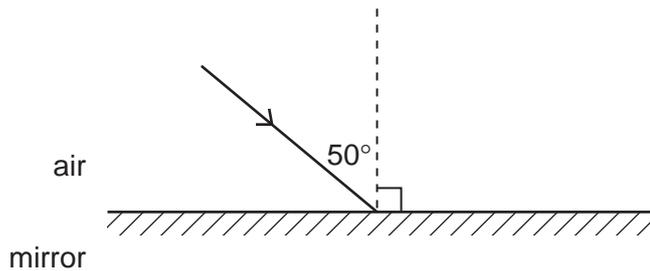


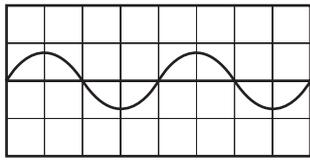
Fig. 5.2

- (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]

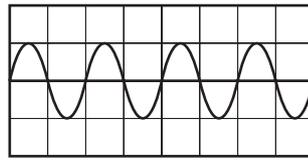
(c) A sound wave has a frequency of 500 Hz.

- (i) Explain the meaning of the term *frequency*.
..... [1]
- (ii) State the approximate range of audible frequencies detected by the normal human ear.
..... [1]

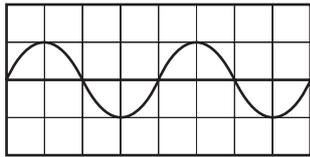
(d) Fig. 5.3 shows the wave traces made by four sounds.



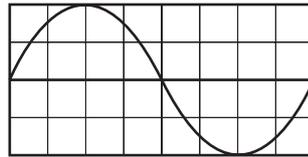
trace A



trace B



trace C



trace D

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]

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

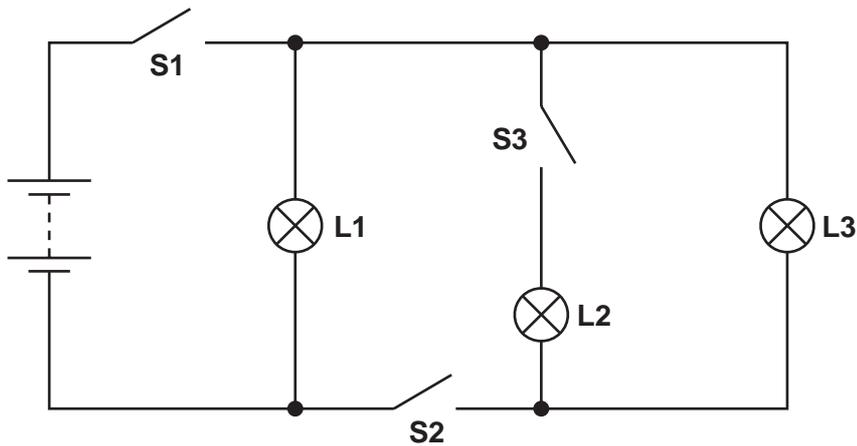


Fig. 7.1

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.

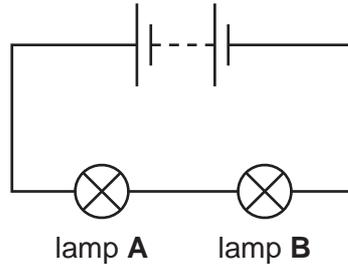


Fig. 7.2

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.

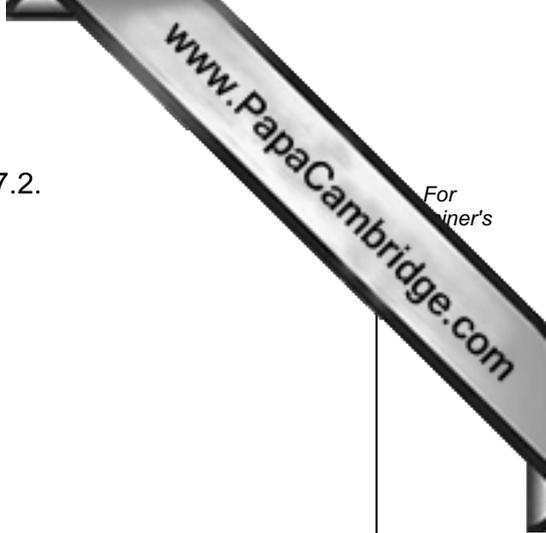
Calculate the combined resistance of both lamps in the working circuit.

State the formula that you use and show your working.

formula used

working

..... ohms [2]



(d) Fig. 7.3 shows an electrical device.

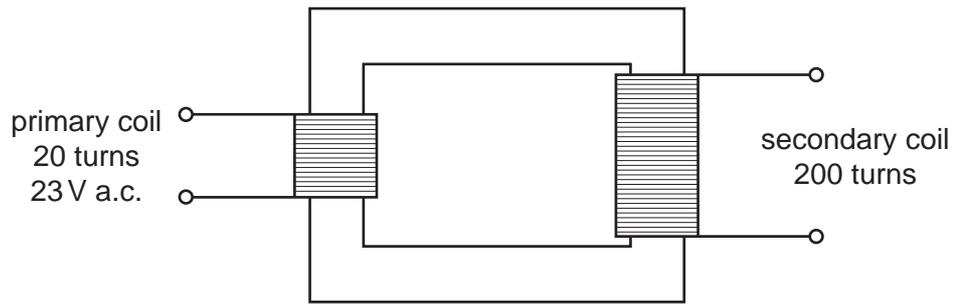


Fig. 7.3

(i) Name the device. [1]

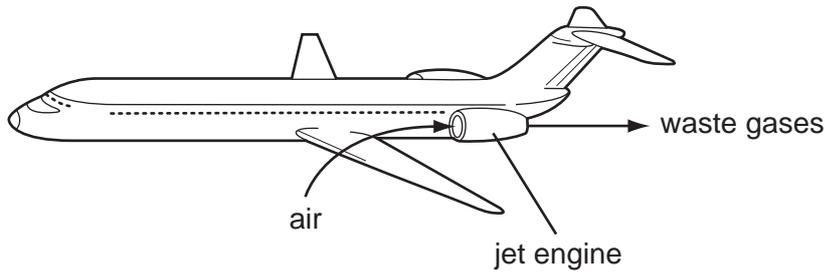
(ii) Calculate the output voltage.

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

Show your working.

..... V [1]

- 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.

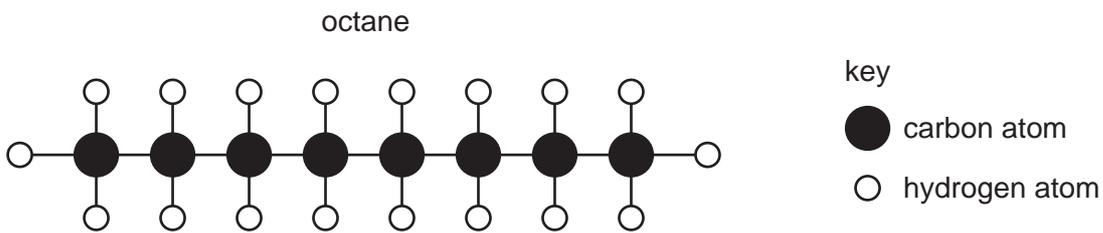
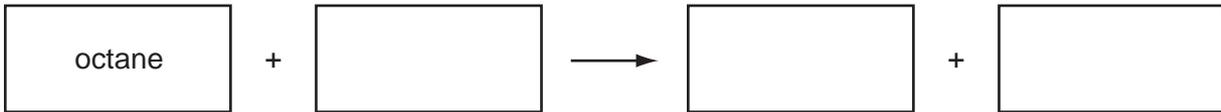


Fig. 8.1

- (i) State the chemical formula of octane.

..... [1]

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



[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]

- (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.

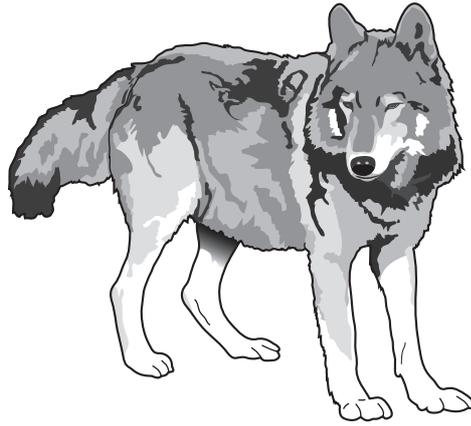
number of neutrons

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]

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]

(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	VIII	IX	X																																														
		1 H Hydrogen 1																																																							
7	9	Li Lithium 3	Be Beryllium 4																																																						
23	24	Na Sodium 11	Mg Magnesium 12																																																						
39	40	K Potassium 19	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	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	88	Rb Rubidium 37	Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	101 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	137	Cs Caesium 55	Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	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	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86																																							
		226 Ra Radium 88	227 Ac Actinium 89																																																						
		*58-71 Lanthanoid series †90-103 Actinoid series																																																							
Key	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">a</td> <td style="padding: 2px;">X</td> </tr> <tr> <td style="padding: 2px;">b</td> <td style="padding: 2px;"></td> </tr> </table>	a	X	b		<p>a = relative atomic mass X = atomic symbol b = proton (atomic) number</p>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">140</td> <td style="padding: 2px;">Ce Cerium 58</td> </tr> <tr> <td style="padding: 2px;">141</td> <td style="padding: 2px;">Pr Praseodymium 59</td> </tr> <tr> <td style="padding: 2px;">144</td> <td style="padding: 2px;">Nd Neodymium 60</td> </tr> <tr> <td style="padding: 2px;">150</td> <td style="padding: 2px;">Sm Samarium 62</td> </tr> <tr> <td style="padding: 2px;">152</td> <td style="padding: 2px;">Eu Europium 63</td> </tr> <tr> <td style="padding: 2px;">157</td> <td style="padding: 2px;">Gd Gadolinium 64</td> </tr> <tr> <td style="padding: 2px;">162</td> <td style="padding: 2px;">Dy Dysprosium 66</td> </tr> <tr> <td style="padding: 2px;">165</td> <td style="padding: 2px;">Ho Holmium 67</td> </tr> <tr> <td style="padding: 2px;">169</td> <td style="padding: 2px;">Tm Thulium 69</td> </tr> <tr> <td style="padding: 2px;">173</td> <td style="padding: 2px;">Yb Ytterbium 70</td> </tr> <tr> <td style="padding: 2px;">175</td> <td style="padding: 2px;">Lu Lutetium 71</td> </tr> <tr> <td style="padding: 2px;">232</td> <td style="padding: 2px;">Th Thorium 90</td> </tr> <tr> <td style="padding: 2px;">238</td> <td style="padding: 2px;">U Uranium 92</td> </tr> <tr> <td style="padding: 2px;">91</td> <td style="padding: 2px;">Pa Protactinium 91</td> </tr> <tr> <td style="padding: 2px;">93</td> <td style="padding: 2px;">Np Neptunium 93</td> </tr> <tr> <td style="padding: 2px;">94</td> <td style="padding: 2px;">Pu Plutonium 94</td> </tr> <tr> <td style="padding: 2px;">95</td> <td style="padding: 2px;">Am Americium 95</td> </tr> <tr> <td style="padding: 2px;">96</td> <td style="padding: 2px;">Cm Curium 96</td> </tr> <tr> <td style="padding: 2px;">97</td> <td style="padding: 2px;">Bk Berkelium 97</td> </tr> <tr> <td style="padding: 2px;">98</td> <td style="padding: 2px;">Cf Californium 98</td> </tr> <tr> <td style="padding: 2px;">99</td> <td style="padding: 2px;">Es Einsteinium 99</td> </tr> <tr> <td style="padding: 2px;">100</td> <td style="padding: 2px;">Fm Fermium 100</td> </tr> <tr> <td style="padding: 2px;">101</td> <td style="padding: 2px;">Md Mendelevium 101</td> </tr> <tr> <td style="padding: 2px;">102</td> <td style="padding: 2px;">No Nobelium 102</td> </tr> <tr> <td style="padding: 2px;">103</td> <td style="padding: 2px;">Lr Lawrencium 103</td> </tr> </table>	140	Ce Cerium 58	141	Pr Praseodymium 59	144	Nd Neodymium 60	150	Sm Samarium 62	152	Eu Europium 63	157	Gd Gadolinium 64	162	Dy Dysprosium 66	165	Ho Holmium 67	169	Tm Thulium 69	173	Yb Ytterbium 70	175	Lu Lutetium 71	232	Th Thorium 90	238	U Uranium 92	91	Pa Protactinium 91	93	Np Neptunium 93	94	Pu Plutonium 94	95	Am Americium 95	96	Cm Curium 96	97	Bk Berkelium 97	98	Cf Californium 98	99	Es Einsteinium 99	100	Fm Fermium 100	101	Md Mendelevium 101	102	No Nobelium 102	103	Lr Lawrencium 103
a	X																																																								
b																																																									
140	Ce Cerium 58																																																								
141	Pr Praseodymium 59																																																								
144	Nd Neodymium 60																																																								
150	Sm Samarium 62																																																								
152	Eu Europium 63																																																								
157	Gd Gadolinium 64																																																								
162	Dy Dysprosium 66																																																								
165	Ho Holmium 67																																																								
169	Tm Thulium 69																																																								
173	Yb Ytterbium 70																																																								
175	Lu Lutetium 71																																																								
232	Th Thorium 90																																																								
238	U Uranium 92																																																								
91	Pa Protactinium 91																																																								
93	Np Neptunium 93																																																								
94	Pu Plutonium 94																																																								
95	Am Americium 95																																																								
96	Cm Curium 96																																																								
97	Bk Berkelium 97																																																								
98	Cf Californium 98																																																								
99	Es Einsteinium 99																																																								
100	Fm Fermium 100																																																								
101	Md Mendelevium 101																																																								
102	No Nobelium 102																																																								
103	Lr Lawrencium 103																																																								

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).