Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

5202377203

COMBINED SCIENCE **0653/32**

Paper 3 (Extended) **October/November 2015**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

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.

This document consists of **24** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 Fig. 1.1 shows a van being driven along a flat road at a constant speed. The arrows on the diagram represent the four main forces acting on the van.

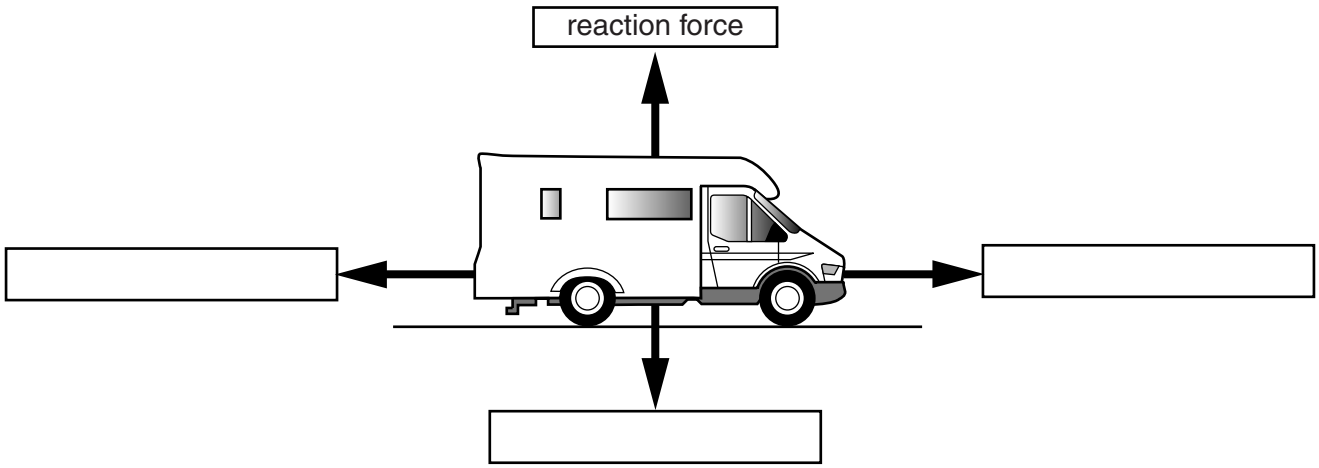

Fig. 1.1

(a) (i) On Fig. 1.1, use words from the list to complete the boxes next to the arrows to label the three missing forces.

Each word from the list can be used once, more than once or not all.

driving **friction** **gravity**

mass **pressure** **weight**

[2]

(ii) The reaction force is 30 000 N.

State the value of the downward force. Give a reason for your answer.

downward force = ... N

reason .....

.....[2]

(iii) Explain where the downward force in **(a)(ii)** comes from.

.....

.....[1]

(b) Fig. 1.2 shows a speed/time graph for the van for a short journey.

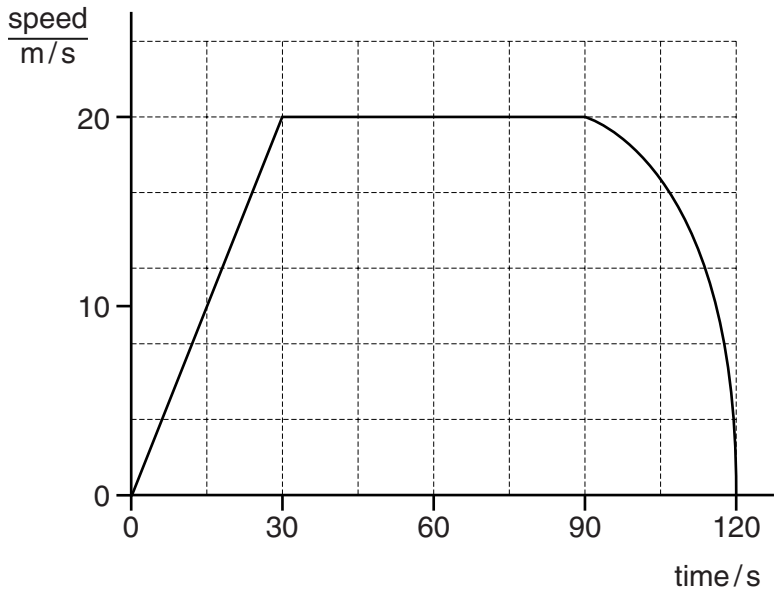

Fig. 1.2

(i) Describe the motion of the van between 30 s and 120 s

.....

.....

.....[2]

(ii) Use the speed/time graph in Fig. 1.2 to calculate the distance travelled in kilometres in the first 90 s of the journey.

Show your working.

distance travelled = ... km [3]

2 **(a)** Yoghurt is made by adding bacteria to milk.

- The milk is heated to 85 °C, then allowed to cool before adding the bacteria.
- The bacteria use the nutrients in the milk as their food source.
- Lactic acid is a waste product which lowers the pH of the milk.
- This causes the yoghurt to be made.

Explain why

(i) the milk used to make yoghurt is heated to 85 °C before it is used,

.....

.....[1]

(ii) the milk is then cooled before adding the bacteria.

.....

.....[1]

(b) Many manufacturers use two types of bacteria to make yoghurt instead of just one. Both types produce lactic acid. They also produce other chemicals which are helpful in the process of making yoghurt as shown in Fig. 2.1.

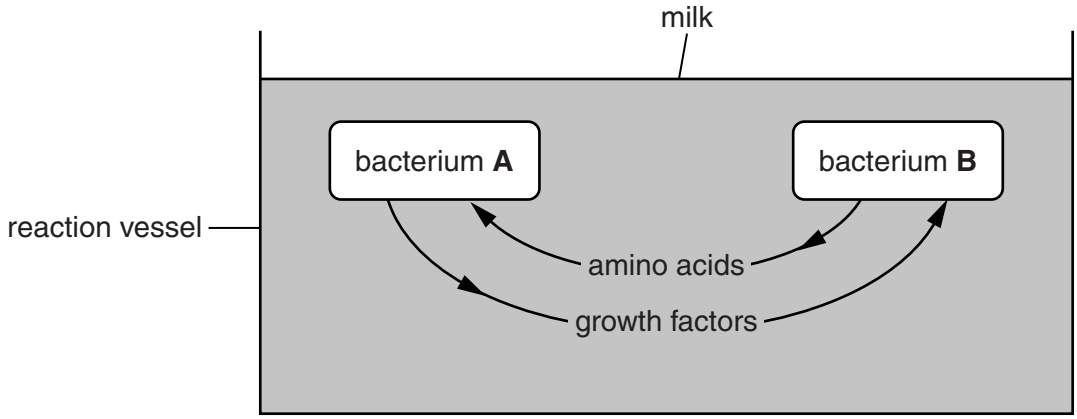

Fig. 2.1

Bacterium **B** produces amino acids by breaking down much larger molecules that are present in the milk.

(i) Name these larger molecules.

.....[1]

(ii) Suggest how bacterium **B** breaks down these larger molecules into amino acids.

.....

.....[1]

(iii) Use the information in Fig. 2.1 to explain why manufacturers prefer to use two types of bacteria instead of one.

.....

.....

.....

.....[2]

(c) Some of the nutrients in two types of yoghurt are illustrated in Table 2.1.

Table 2.1

nutrient	amount in 100 g	
	yoghurt **C**	yoghurt **D**
protein / g	3.6	4.7
carbohydrate / g	10.6	8.8
fat / g	4.2	0.2
calcium / mg	124	202

Suggest and explain which type of yoghurt would be the better choice

(i) for avoiding coronary heart disease,

.....

.....[1]

(ii) for building strong bones.

.....

.....[1]

[Turn over

3 Petroleum (crude oil) is a mixture of compounds.

Some of these compounds are used as fuels.

(a) (i) Name the process used to separate the petroleum mixture into useful fractions.

.....[1]

(ii) State and explain whether this process involves a physical or a chemical change.

.....

.....[1]

(b) Fig. 3.1 shows how petroleum fractions can be separated in the laboratory.

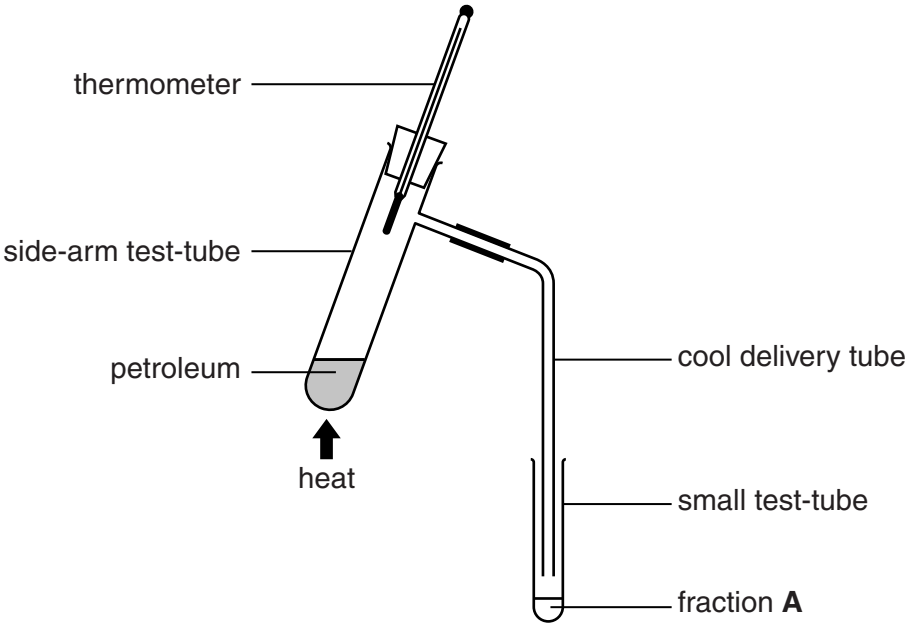

Fig. 3.1

The petroleum is heated and petroleum vapour is formed.

When the thermometer shows a temperature of 100 °C, fraction **A** collects in the small test-tube.

The small test-tube used to collect the fraction is replaced with a fresh test-tube. Heating is continued, and three further fractions, **B**, **C**, and **D**, are collected. All four fractions are shown in Fig. 3.2.

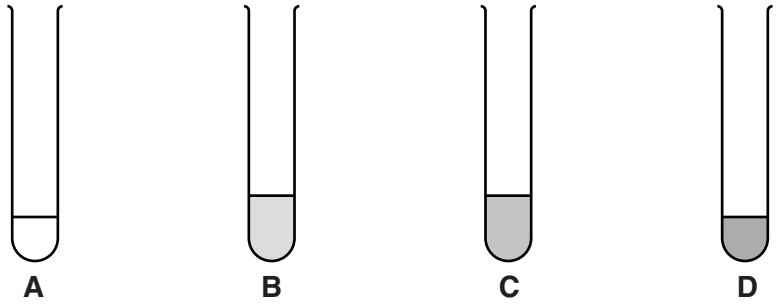

Fig. 3.2

The fractions become darker from **A** to **D**.

The fractions are collected over the temperature ranges shown in Table 3.1.

Table 3.1

fraction	temperature range / °C
A	room temperature to 100
B	100 to 150
C	150 to 200
D	200 to 250

(i) Use the information in Table 3.1 to state **one** trend in a physical property of the fractions **A** to **D** apart from colour.

.....

.....[1]

(ii) Suggest how the average size of the molecules in the fractions changes from **A** to **D**.

Explain your answer.

.....

.....

.....

.....[2]

[Turn over

(c) Ethane is one of the compounds found in petroleum.

Complete the drawing of the structure of a molecule of ethane.

[2]

(d) The cracking of petroleum produces compounds which react readily with bromine.

State the **type** of compound produced by cracking that reacts with bromine.

.....[1]

Please turn over for Question 4.

4 Fig. 4.1 shows an electric fan heater used to keep people warm.

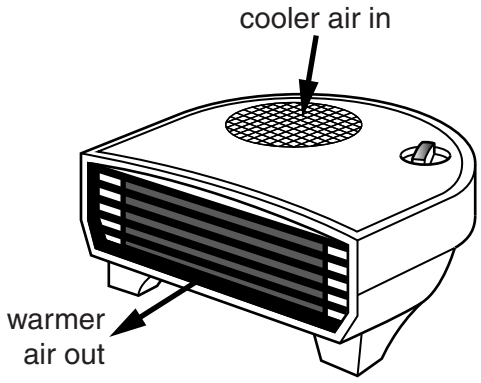

Fig. 4.1

(a) The fan heater contains

- a switch to control the mains electricity supply,
- an electric heater to warm the air,
- an electric motor to drive the fan,
- a fuse to protect the circuit.

The fan must continue to work, even when the heater is not working.

Fig. 4.2 shows the circuit symbols for a heater, an electric motor and a fuse.

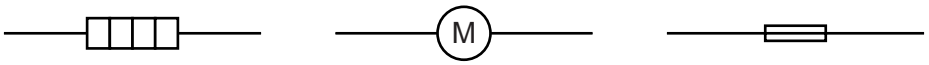

Fig. 4.2

On Fig. 4.3 complete the circuit diagram for the fan heater connected to the mains electricity supply, using the correct circuit symbols for the components listed above.

The mains electricity supply has been drawn for you.

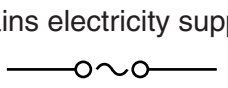

Fig. 4.3

[3]

(b) Another type of switch is also needed in the circuit as a safety device to cut off the heater if the temperature rises too much. This is called a thermal cut-out.

The thermal cut-out must switch off the heater but not the fan. The fan must continue to operate to reduce the temperature.

Fig. 4.4 shows the structure of this switch.

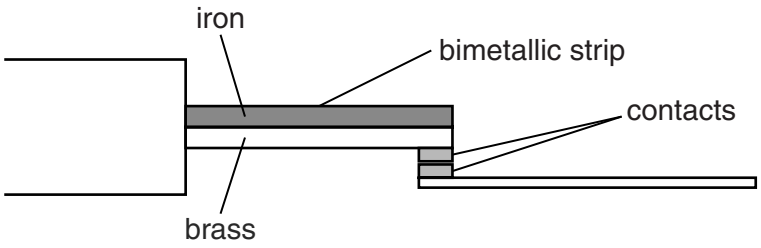

Fig. 4.4

(i) On Fig. 4.3 in **(a)**, mark with an **X** a point in your completed circuit where this switch could be put into the circuit to switch off the heater but not the fan. [1]

(ii) As the temperature rises, the bimetallic strip bends upwards, so breaking the contact and switching off the heater.

Explain in terms of the particles in the brass and iron why the strip bends in this way.

.....

.....

.....[2]

(iii) Suggest a suitable position inside the fan heater to place the thermal cut-out so that, when the temperature of the room is warm enough, the heater is switched off.

Give a reason for your answer.

.....

.....

.....[2]

[Turn over

5 **(a)** Fig. 5.1 shows a male and a female gamete. They are **not** drawn to scale.

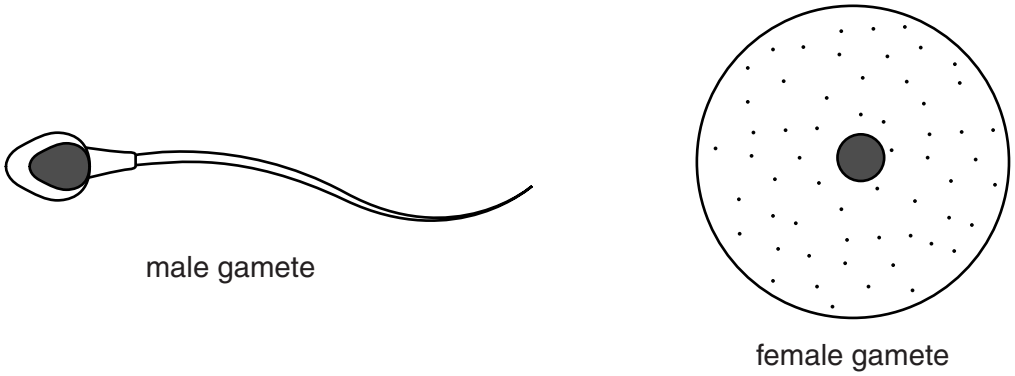

Fig. 5.1

(i) The actual diameter of the female gamete is 100 micrometres.

Estimate a value for the length of the male gamete.

..... micrometres [1]

(ii) Estimate how many gametes are produced during the lifetime of the average human

male, ...

female. .....[2]

(iii) State how the nucleus of the male gamete differs from the nucleus of a zygote.

.....

.....[1]

(b) Fig. 5.2 shows a fetus developing in the uterus of a pregnant woman.

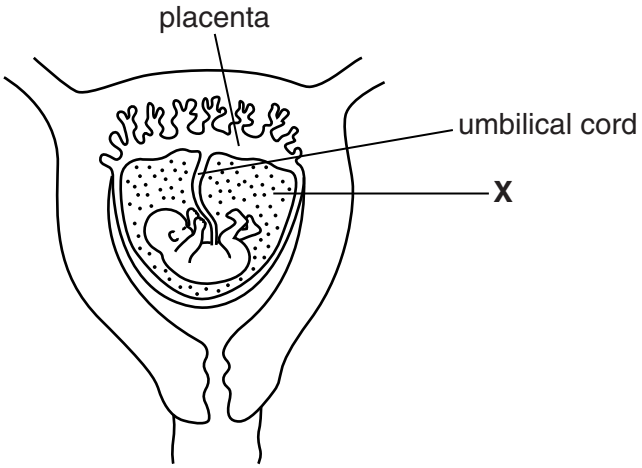

Fig. 5.2

Name part **X** and describe its function.

name .....

function .....

.....[2]

(c) During pregnancy a possible complication is narrowing of the blood vessels in the umbilical cord.

(i) Explain why this affects the amount of blood flowing to and from the placenta.

.....

.....[1]

(ii) Describe how this will affect the fetus.

.....

.....

.....[2]

[Turn over

6 Table 6.1 shows some elements placed in order of reactivity.

Table 6.1

potassium
sodium
calcium
magnesium
zinc
iron
hydrogen
copper

(a) Table 6.2 shows the reactions of some of the elements when added to dilute hydrochloric acid.

Table 6.2

element added to acid	observation
calcium	bubbles vigorously
copper	no reaction
zinc	

(i) Complete Table 6.2 by adding the observation you would expect when zinc is added to the acid. [1]

(ii) Explain your answer to **(a)(i)** by referring to the reactivity series.

.....

.....

.....[2]

(b) Fig. 6.1 shows what happens when a student places a zinc rod in copper sulfate solution.

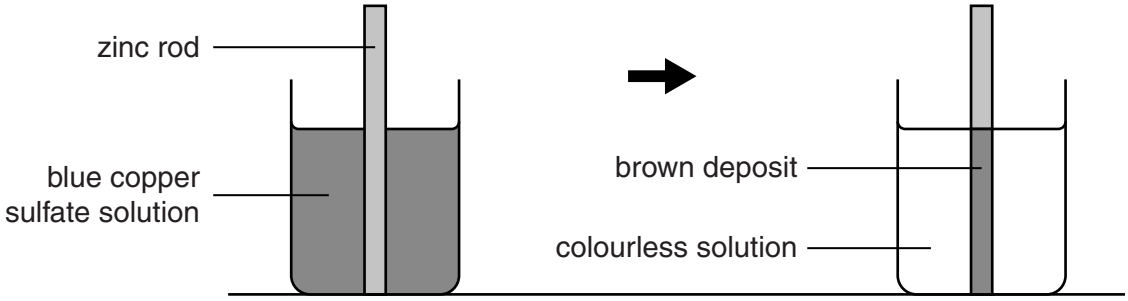

Fig. 6.1

The rod becomes coated in a brown deposit and the solution slowly changes from blue to colourless.

The zinc rod consists of zinc atoms.
Copper sulfate solution contains aqueous copper ions, Cu^{2+}, which are coloured blue.

(i) State the type of particles which form the brown coating on the zinc rod.

..... [1]

(ii) Suggest why the colour of the solution changes during the reaction.

.....

.....[1]

(iii) Use the reactivity series in Table 6.1 to explain why this reaction occurs.

.....

.....

.....[2]

[Turn over

(c) A student investigates the position of tin in the reactivity series. Her experiments are shown in Fig. 6.2.

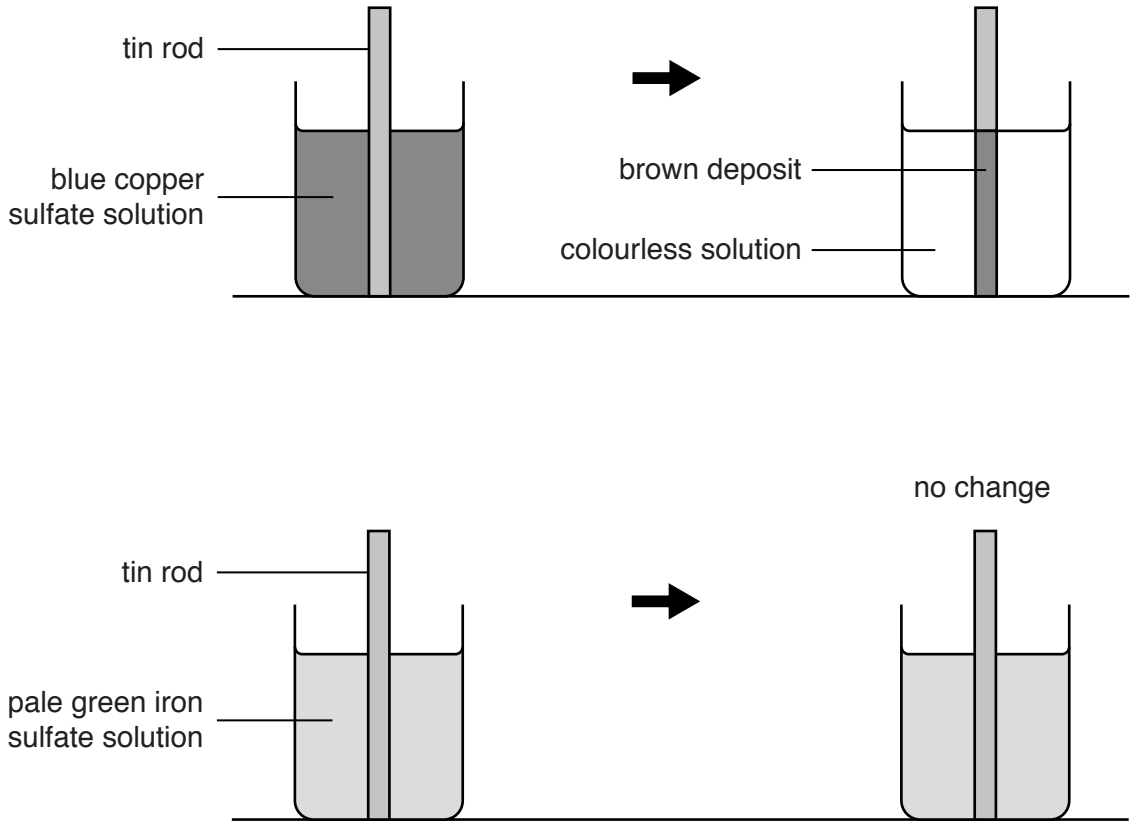

Fig. 6.2

(i) Add tin to the section of the reactivity series in Table 6.3.

Table 6.3

zinc
iron
copper

[1]

(ii) By referring to Fig. 6.2, explain your answer to **(c)(i)**.

.....

.....

.....

.....[2]

7 **(a)** A motorcyclist needs to see other vehicles and pedestrians.

Fig. 7.1 shows a motorcyclist from above and a car some distance behind him.

The motorcyclist looks in his rear view mirror to see the car.

Fig. 7.1

On Fig. 7.2 construct an accurate ray diagram for the reflection in the motorcycle's rear view mirror. Use arrowheads to show the direction of the ray

Fig. 7.2

[2]

(b) The motorcyclist follows directions to his destination using his satellite navigation system (Satnav). The Satnav picks up signals from satellites orbiting the Earth to show the position of the motorcycle on a map displayed on the Satnav screen in front of him.

State the type of electromagnetic wave used by satellites sending signals to Earth.

.....[1]

(c) The motorcyclist travels along a street at night.

The street is lit by lamps which emit yellow light with a wavelength of 589 nanometres (nm) or 589×10^{-9} m.

(i) State the formula that relates the speed, frequency and wavelength of a wave motion.

.....[1]

(ii) Calculate the frequency of the electromagnetic waves of yellow light from the street lights.

Speed of light = 3×10^{8} m/s.

Show your working and state the unit of your answer.

frequency = ... unit = ... [2]

(d) The motorcycle has two headlamps and a rear lamp, powered by a 6V battery.

The headlamps are identical, and are rated at 6V 36W.

The rear lamp is rated at 6V 6W and takes a current of 1A.

(i) Calculate the current taken by one headlamp when lit.

State the formula used and show your working.

formula

working

current = ... A [2]

(ii) The lamps are all connected in parallel.

Calculate the total current drawn from the battery by the three lamps when all are lit.

total current = ... A [1]

[Turn over

8 **(a)** Fig. 8. 1 shows part of a simple food chain in a field of wheat.

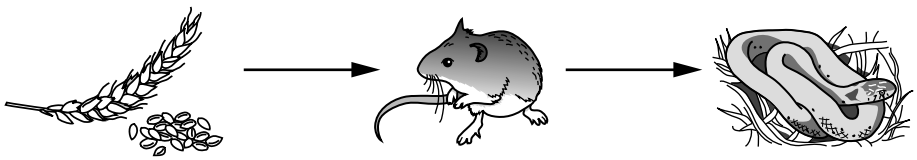

Fig. 8.1

(i) There are three trophic levels in the food chain shown in Fig. 8.1.

Define the term *trophic level*.

.....

.....[1]

(ii) Explain why food chains usually have fewer than five trophic levels.

.....

.....

.....[2]

(iii) A badger also lives in the habitat. The badger eats **all** of the organisms in the food chain. These organisms and the badger form a food web.

Complete Fig. 8.2 to show the food web.

wheat seeds ⟶ mouse ⟶ grass snake

Fig. 8.2

[2]

(b) All food chains must have decomposers, though they are not always included in diagrams.

Explain the importance of decomposers in the habitat.

.....

.....

.....[2]

(c) The wheat is harvested. Suggest **two** possible ways in which the mice respond to the removal of their food supply.

1 .....

.....

2 .....

.....[2]

9 A copy of the Periodic Table is printed on page 24.

(a) (i) State how the position of chlorine in the Periodic Table shows that it is a non-metal.

.....

.....[1]

(ii) State how the Periodic Table is used to predict the number of outer shell electrons in a fluorine atom.

.....

.....[1]

(iii) State how the number of outer shell electrons in an atom of an element can be used to predict whether the element is likely to be a metal or a non-metal.

.....

.....[1]

(b) Hydrogen and chlorine react to form hydrogen chloride gas.

(i) Write a balanced chemical equation for the reaction between hydrogen and chlorine.

.....[2]

(ii) Fig. 9.1 shows the outer shell electrons in a hydrogen atom and in a chlorine atom.

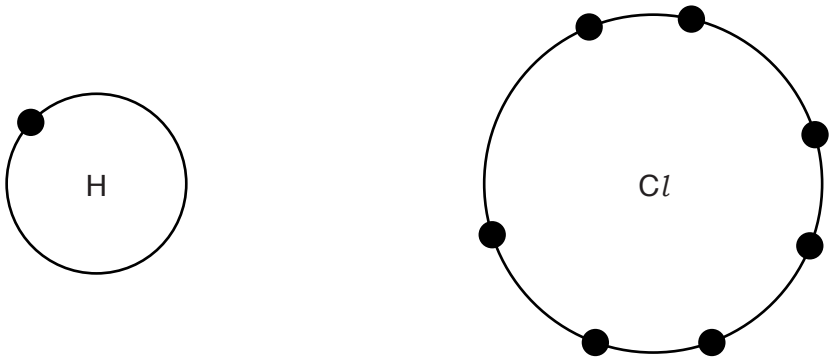

Fig. 9.1

Draw a diagram to show how these atoms form a hydrogen chloride molecule.

[2]

(c) Fig. 9.2 shows apparatus used to dissolve hydrogen chloride gas in water to form hydrochloric acid.

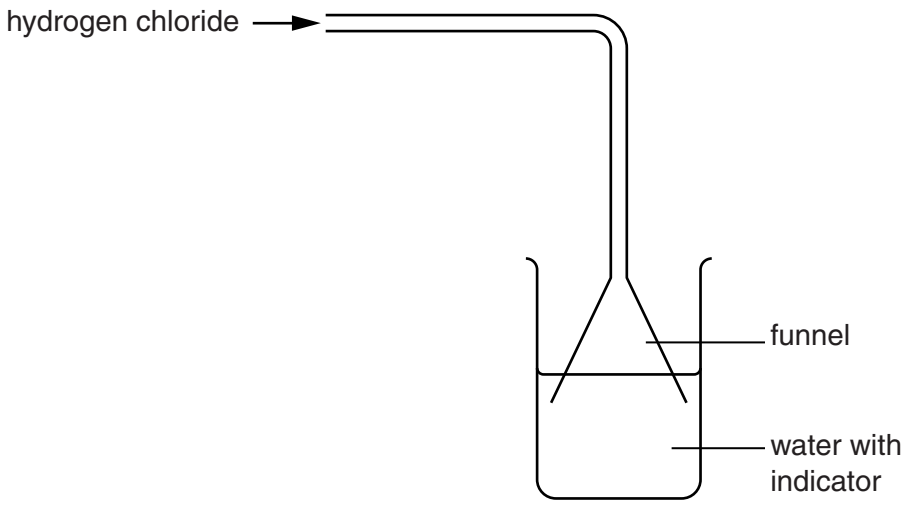

Fig. 9.2

The water contains full-range indicator (Universal Indicator) added before the hydrogen chloride dissolves.

(i) State the colour of the indicator in pure water.

.....[1]

(ii) The indicator turns red. Suggest the change in pH.

from pH ..... to pH ..... [1]

DATA SHEET
The Periodic Table of the Elements

Group

I	II											III	IV	V	VI	VII	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	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 **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	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 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	147 **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	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

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

Key

a		a = relative atomic mass
	X	**X** = atomic symbol
b		b = atomic (proton) number

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