Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/32**

Paper 3 Theory (Core) **May/June 2024**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

DC (PB/KN) 331081/3

[Turn over

1 **(a)** Fig. 1.1 is a diagram of the male reproductive system in humans.

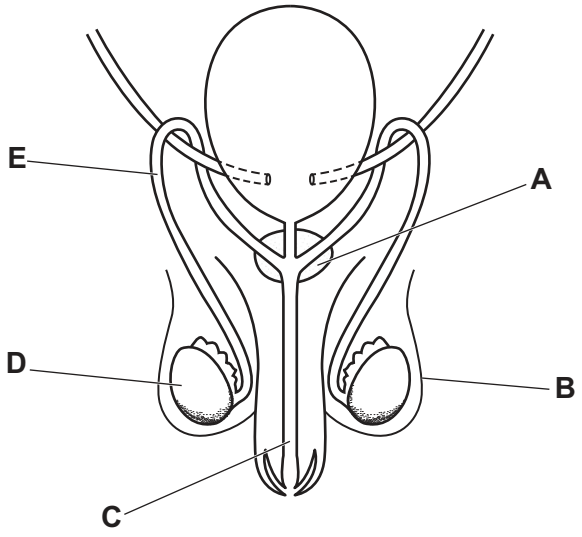

Fig. 1.1

State the letter on Fig. 1.1 that identifies the:

urethra .....

scrotum. .....

[2]

(b) Fertilisation occurs inside the human female reproductive system.

(i) Circle the site of fertilisation in the female reproductive system.

cervix **oviduct** **uterus** **vagina**

[1]

(ii) Complete the sentences about fertilisation and early development in humans.

Fertilisation is the fusion of the ..... from a sperm and an ovum.

After fertilisation the cell that forms is called a ..... .

This then develops into a ball of cells called an ..... .

[3]

(c) Sexual reproduction in plants results in the formation of seeds.

A student investigates the effect of temperature on seed germination in one type of plant.

They place seeds at different temperatures and record the number of seeds that germinate.

Fig. 1.2 shows the percentage number of seeds that germinate at each temperature.

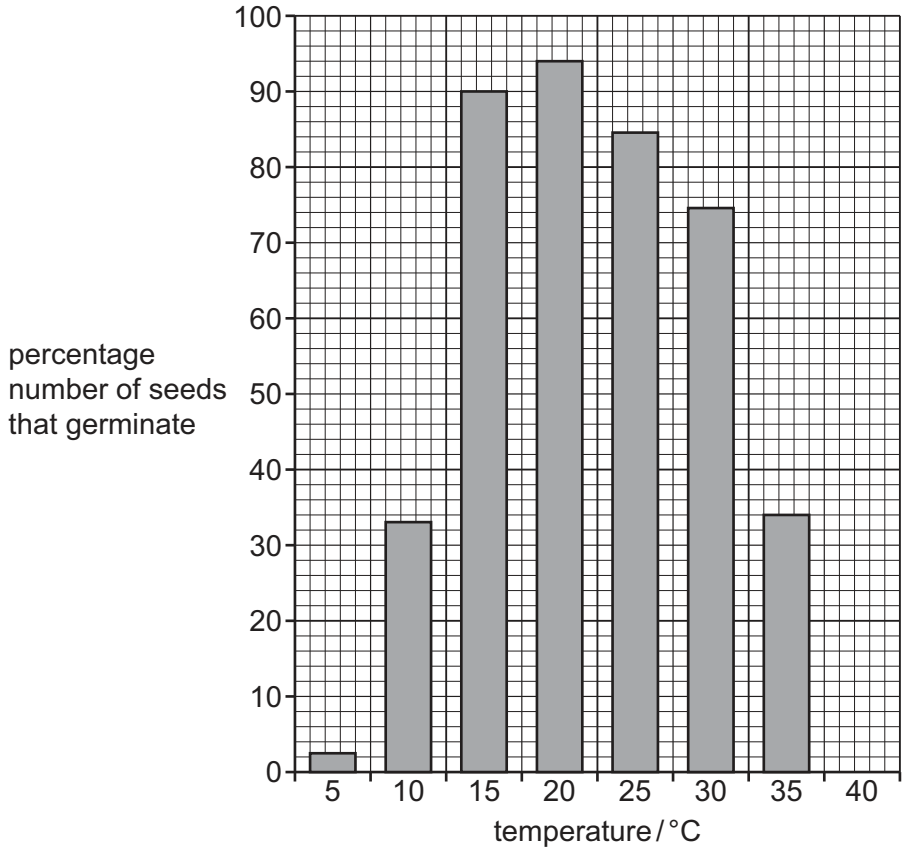

Fig. 1.2

(i) Describe the effect of temperature on seed germination shown in Fig. 1.2.

Include data in your answer.

.....

.....

.....

..... [2]

(ii) State **one other** environmental condition needed for the germination of seeds.

..... [1]

(iii) Seeds contain carbohydrates.

Suggest why plant seeds need carbohydrates to germinate.

..... [1]

[Total: 10]

2 A student investigates the reaction of magnesium with excess dilute hydrochloric acid using the apparatus shown in Fig. 2.1.

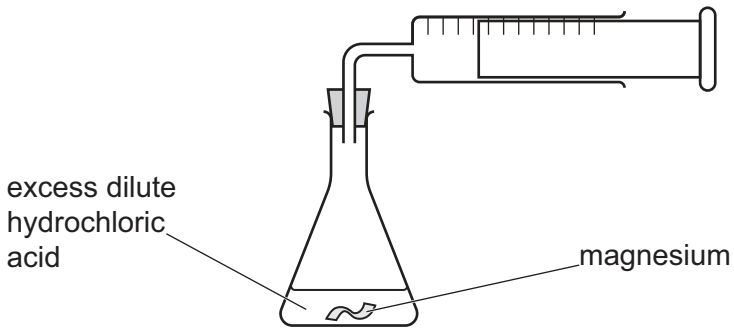

Fig. 2.1

The equation for the reaction is shown.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(a) The student repeats the experiment at the same temperature, using the same volume of acid with a lower concentration.

Describe the effect of this change on the rate of the reaction.

..... [1]

(b) Describe the effect of dilute hydrochloric acid on litmus paper.

..... [1]

(c) Describe a chemical test for hydrogen gas.

State the observation for a positive result.

test .....

observation .....

.....

[2]

(d) One alloy contains copper and magnesium.

(i) State what is meant by an alloy.

.....

..... [1]

(ii) Copper is extracted from copper oxide by heating with carbon.

Magnesium **cannot** be extracted from magnesium oxide by heating with carbon.

Explain these observations.

copper .....

.....

magnesium .....

.....

[2]

[Total: 7]

3 Fig. 3.1 shows an old-fashioned room heater made of iron. The heater burns oil as a fuel. A pan of water is being heated on top.

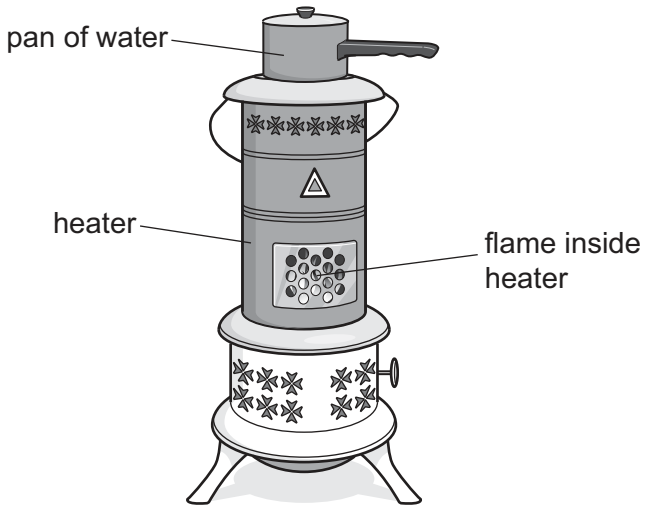

Fig. 3.1

(a) **(i)** The oil is a source of stored energy.

State the form in which the energy is stored.

..... [1]

(ii) State the form of energy produced when the oil burns.

..... [1]

(b) Energy from the flame is transferred to the top surface of the heater.

State the method of energy transfer.

..... [1]

(c) The top surface of the heater is at 75 °C.

(i) State the name of the process that forms water vapour inside the pan.

..... [1]

(ii) State if the water in the pan will boil. Explain your answer.

.....

..... [1]

(d) Fig. 3.2 shows a person warming their hand near the side of the heater.
The person sees light from the flame of the burning oil through the holes in the side of the heater.

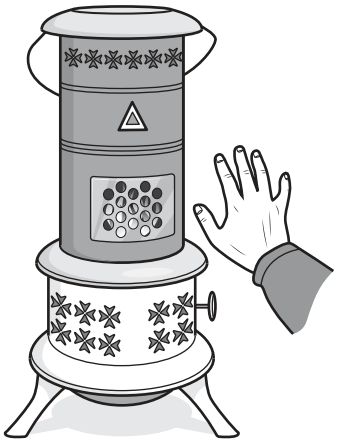

Fig. 3.2

(i) State the method of energy transfer that is warming the hand.

..... [1]

(ii) The person has noticed the **two** main forms of electromagnetic wave emitted by the flame.

Add these to Fig. 3.3 in the correct places in the electromagnetic spectrum.

← increasing frequency						
gamma rays	X-rays				microwaves	radio waves

Fig. 3.3 [2]

(e) The person holds their hand in front of a mirror.
Fig. 3.4 shows the image seen in the mirror.

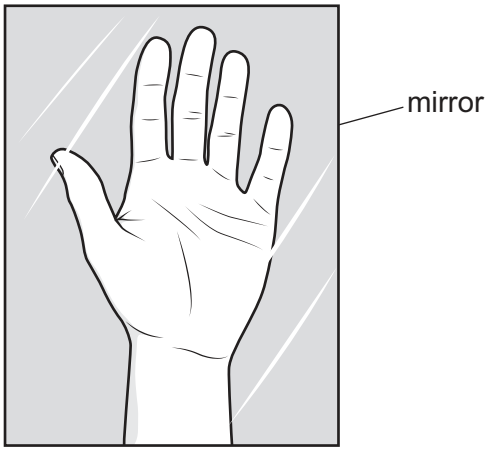

Fig. 3.4

State which hand, left or right, the person is holding in front of the mirror.

Give a reason for your answer in terms of the characteristics of plane mirrors.

hand .....

reason .....
[1]

[Total: 9]

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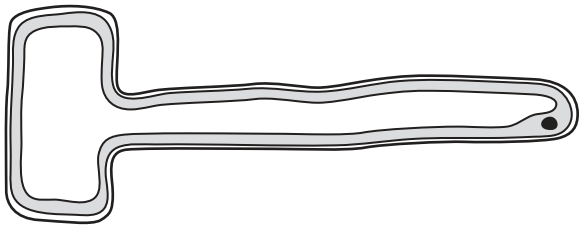
4 **(a)** Fig. 4.1a shows a white blood cell. Fig. 4.1b shows a type of plant cell.

Fig. 4.1a



NOT TO SCALE

Fig. 4.1b

(i) State the type of plant cell shown in Fig. 4.1b.

..... [1]

(ii) Identify one **visible** structure in the plant cell in Fig. 4.1b that is:

also visible in the white blood cell .....

not present in the white blood cell. .....
[2]

(b) Water moves into the plant cell from the soil.

(i) Describe the process of water movement into the plant cell.

.....

.....

.....
[2]

(ii) State the name of the vessels that transport water up the stem to the leaves.

..... [1]

(c) White blood cells are part of the circulatory system.

(i) State two functions of white blood cells.

1 .....

2 .....

[2]

(ii) Fig. 4.2 shows a photomicrograph of blood vessels from the circulatory system.

Fig. 4.2

Complete these sentences about Fig. 4.2.

The artery has a much ..... wall compared to the vein.

This is because the artery transports blood away from the ..... at high pressure.

[2]

[Total: 10]

5 Aluminium ore contains aluminium oxide.

Aluminium is extracted from aluminium oxide in the process shown in Fig. 5.1.

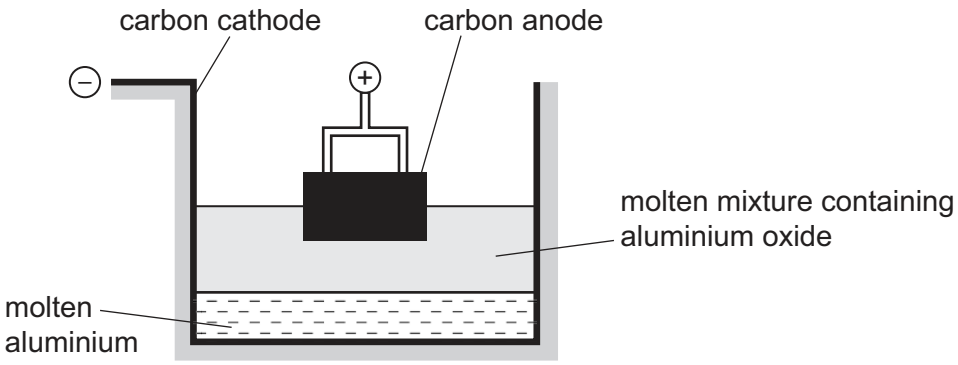


Fig. 5.1

(a) (i) Circle the name of the process shown in Fig. 5.1.

chromatography **crystallisation** **electrolysis** **filtration** [1]

(ii) State the name of the ore that contains aluminium oxide.

..... [1]

(b) Explain why the extraction of aluminium from aluminium oxide is a reduction reaction.

.....

..... [1]

(c) An atom of aluminium is represented as shown.

$$^{27}_{13}Al$$

(i) Describe what is meant by nucleon number.

.....

..... [1]

(ii) Deduce the number of neutrons in this atom.

..... [1]

(d) The electronic structure of an aluminium atom is shown in Fig. 5.2.

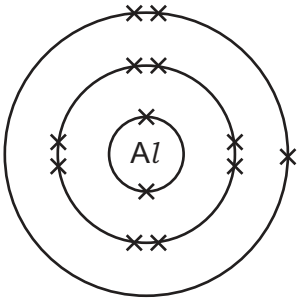


Fig. 5.2

When aluminium reacts, aluminium atoms form aluminium ions.

Complete Fig. 5.3 to show the electronic structure of an aluminium ion.

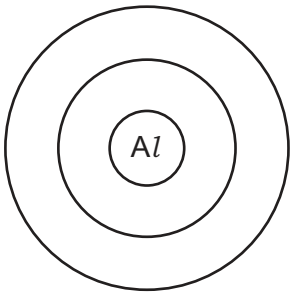


Fig. 5.3

[1]

(e) Aluminium oxide, Al_2O_3, is an ionic compound.

Ammonia, NH_3, is a covalent compound.

Complete Table 5.1 to show the electrical conductivity of aluminium, aluminium oxide and ammonia as solids and as liquids.

Use a tick (✓) to show an electrical conductor.
Use a cross (✗) to show an electrical non-conductor.
Two have been done for you.

Table 5.1

	aluminium	aluminium oxide	ammonia
solid	✓		✗
liquid			

Key
✓ = electrical conductor
✗ = electrical non-conductor

[2]

[Total: 8]

6 Fig. 6.1 shows a rover vehicle on the planet Mars.

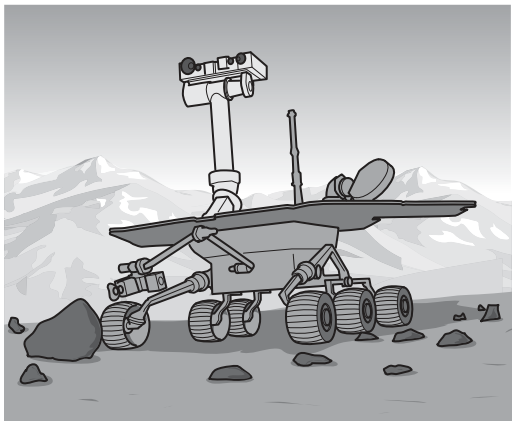


Fig. 6.1

(a) The vehicle travels at an average speed of 0.0089 m / s.

Show that the average speed of the vehicle is 0.032 km / h.

[1]

(b) Fig. 6.2 shows a speed–time graph for the vehicle on one of its journeys on Mars.

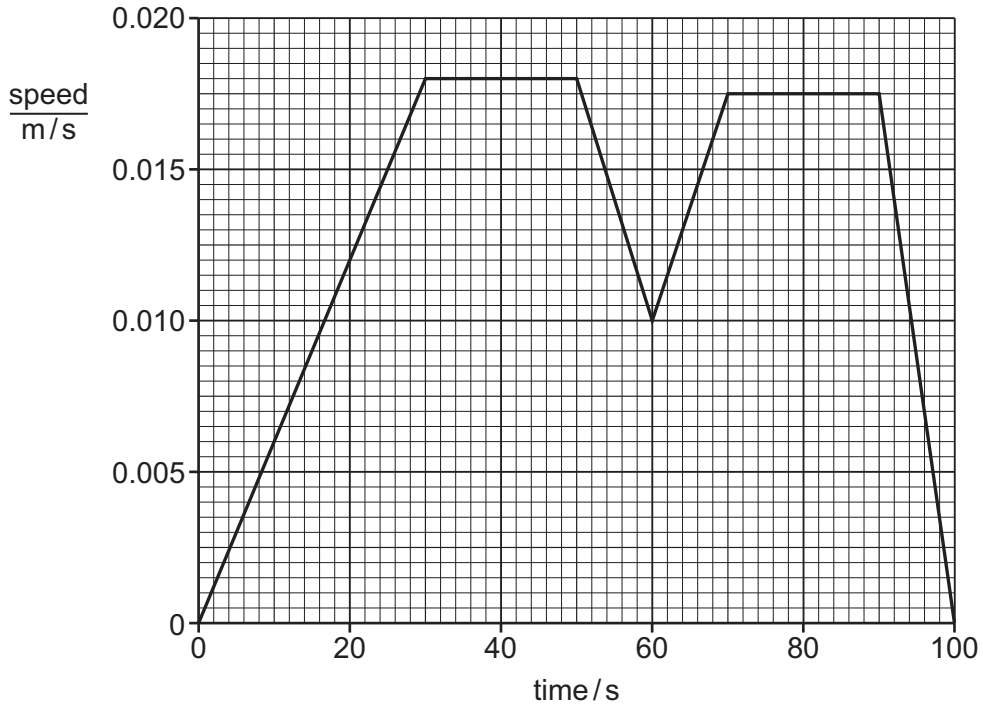


Fig. 6.2

(i) Use Fig. 6.2 to find the maximum speed of the vehicle on this journey.

speed = ... m / s [1]

(ii) During its journey, the vehicle climbs over a large rock. This causes a change in the motion of the vehicle before it continues.

Describe the motion using data from the graph in Fig. 6.2.

.....

.....

.....

.....

..... [3]

(c) The vehicle carries a video camera to record pictures and a microphone to record sound.

The camera records the fall of a rock from a cliff at a distance of 120 m.

Energy is transferred by sound waves to the microphone. The microphone records the sound 0.5 s after the rock hits the ground.

(i) Complete the sequence of energy transfers that occur as the rock falls.

Energy stored as ..... potential energy of the rock on the cliff is transferred to ..... energy of the falling rock. As the rock hits the ground, energy is transferred by sound waves.

[2]

(ii) Calculate the speed of sound on Mars.

speed = ... m/s [2]

[Total: 9]

7 **(a)** Fig. 7.1 describes the feeding relationships in one food chain.

• robins are small birds that eat caterpillars
• caterpillars are primary consumers
• a merlin is a large bird that eats robins
• the producer in the food chain is an oak tree

Fig. 7.1

(i) Draw the food chain using the names of **all** the organisms in Fig. 7.1.

..... [2]

(ii) Using the information in Fig. 7.1, identify **all** the organisms that are:

herbivores .....

carnivores. .....
[2]

(b) Fig. 7.2 shows part of the carbon cycle.

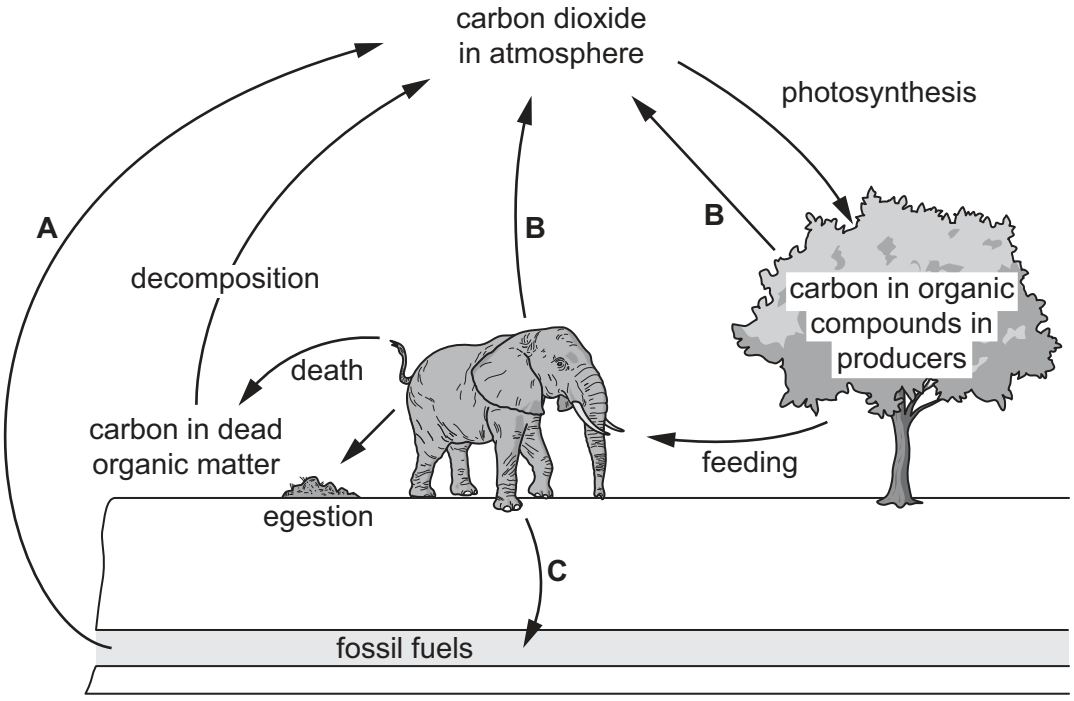


Fig. 7.2

State the name of the processes labelled **A**, **B** and **C**.

A .....

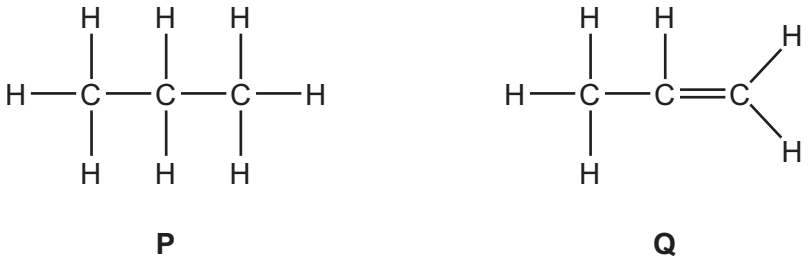
B .....

C .....

[3]

[Total: 7]

8 The structures of compounds **P** and **Q** are shown in Fig. 8.1.



P **Q**

Fig. 8.1

(a) (i) The formula for compound **P** is C_3H_8.

Deduce the formula of compound **Q**.

..... [1]

(ii) The combustion of compound **P** is an exothermic reaction.

Describe the meaning of exothermic.

.....

..... [1]

(iii) Complete the word equation for the complete combustion of compound **P**.

compound **P**	+		→		+	

[2]

(b) Describe the effect, if any, of compounds **P** and **Q** on the colour of aqueous bromine.

P .....

Q .....

[2]

(c) Compound **P** is in refinery gas.

Refinery gas is obtained from petroleum using a separation process.

(i) State the name of the separation process used to obtain refinery gas from petroleum.

..... [1]

(ii) During this separation process, some hydrocarbons change state from a liquid to a gas.

State if this change is a chemical change or a physical change.

Explain your answer.

type of change .....

explanation .....

.....

[1]

(iii) State **one** use for refinery gas.

..... [1]

(d) Petroleum is one example of a fossil fuel.

State the name of **two** other fossil fuels.

1 .....

2 .....

[2]

[Total: 11]

9 A student investigates the current in different resistors by connecting them in a circuit with a battery and an ammeter.

(a) When a 4.0 Ω resistor is connected in this circuit, the reading on the ammeter is 1.5A.

Calculate the potential difference (p.d.) across the resistor.

Give the unit of your answer.

p.d. = ... unit ..... [3]

(b) The student then connects a 6.0 Ω resistor and a 2.0 Ω resistor in series with the 4.0 Ω resistor and the battery.

Calculate the total resistance connected to the battery.

resistance = ... Ω [1]

(c) Next, the student connects a different circuit.

The 6.0 Ω resistor is connected in parallel with the 4.0 Ω resistor. Both are connected to the battery and the ammeter.

The reading on the ammeter is greater than 1.5A.

(i) Fig. 9.1 shows part of this circuit.

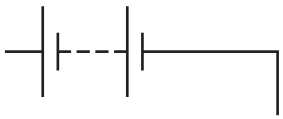


Fig. 9.1

On Fig. 9.1, complete the circuit diagram to show the two resistors and the ammeter connected in the circuit.

[3]

(ii) Explain why the reading on the ammeter is greater than 1.5A.

.....

.....

.....

..... [2]

[Total: 9]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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