Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4710629685

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **February/March 2021**

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.

[Turn over

1 **(a)** Fig. 1.1 is a diagram of parts of the alimentary canal and associated organs.

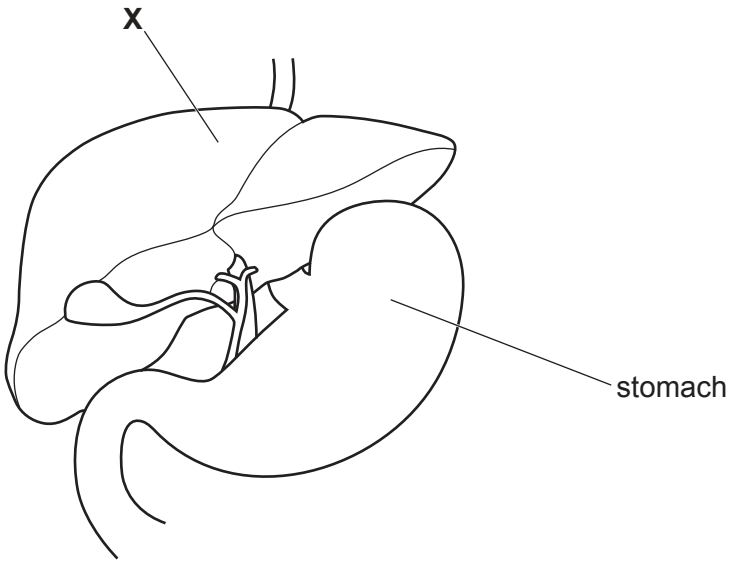


Fig. 1.1

(i) Identify the part labelled **X** on Fig. 1.1.

..... [1]

(ii) State two functions of hydrochloric acid in the stomach.

1 .....

.....

2 .....

.....

[2]

(iii) Name the **two** types of digestion that occur in the alimentary canal.

..... and ..... [1]

(b) Plants use photosynthesis to produce glucose.

(i) Complete the word equation for photosynthesis.

$$\text{.....} + \text{water} \xrightarrow{\text{light}} \text{glucose} + \text{.....}$$

.....

[2]

(ii) Glucose is converted to a different carbohydrate for storage in the leaf.

This means a leaf can be tested with iodine solution to show that photosynthesis has taken place.

Explain why iodine solution can be used to show photosynthesis has taken place.

.....

.....

.....

..... [2]

(c) Fig. 1.2 is a graph showing the effect of light intensity and temperature on the rate of photosynthesis.

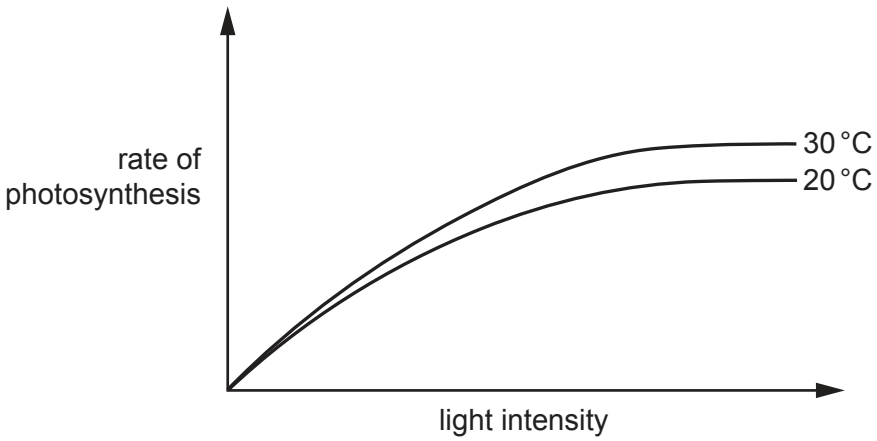


Fig. 1.2

Describe the patterns shown in Fig. 1.2.

.....

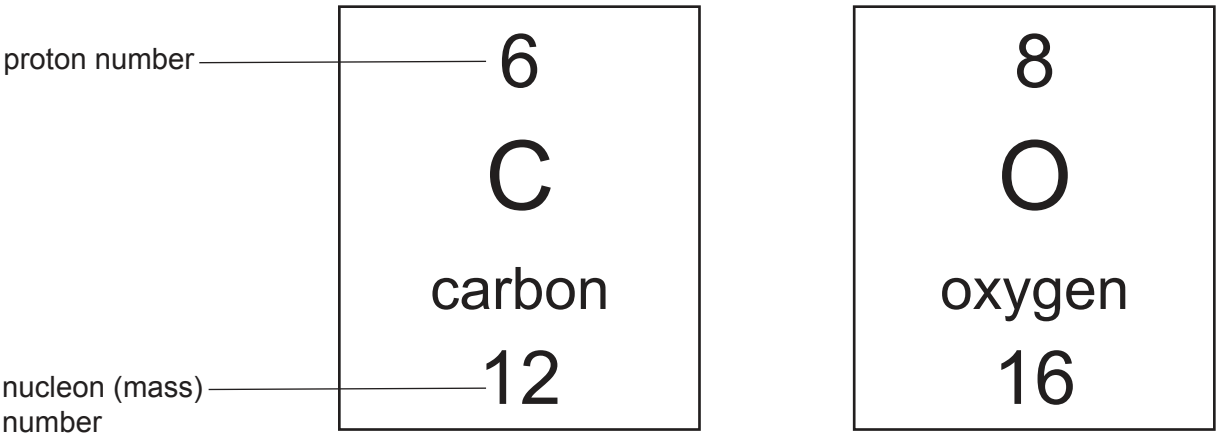
.....

.....

..... [2]

[Total: 10]

2 Carbon and oxygen are two elements in Period 2 of the Periodic Table.



(a) Complete Table 2.1 to show the numbers of neutrons, protons and electrons in an atom of carbon and in an atom of oxygen.

Table 2.1

	number of neutrons	number of protons	number of electrons
carbon			
oxygen			

[2]

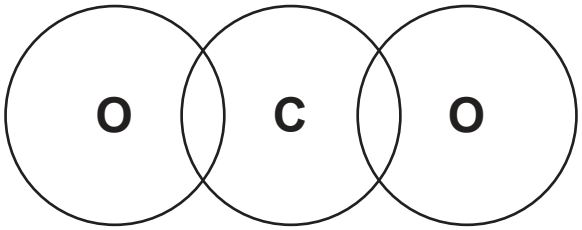
(b) Explain why carbon is in Group IV of the Periodic Table and why oxygen is in Group VI. Use ideas about electron arrangement in your answer.

.....

..... [1]

(c) One carbon atom and two oxygen atoms combine together to make carbon dioxide.

Complete the dot-and-cross diagram to show all outer shell electrons in a molecule of carbon dioxide.



[2]

(d) The boiling point of carbon dioxide is –78.5 °C.
Identify the physical state of carbon dioxide at –77 °C.

..... [1]

(e) Increased concentrations of carbon dioxide in the atmosphere cause environmental problems.

Explain why.

.....

.....

.....

..... [2]

[Total: 8]

3 Fig. 3.1 shows a car moving forward along a level road before the road goes over a hill.

not to scale

Fig. 3.1

Fig. 3.2 shows a speed–time graph of the journey shown in Fig. 3.1.

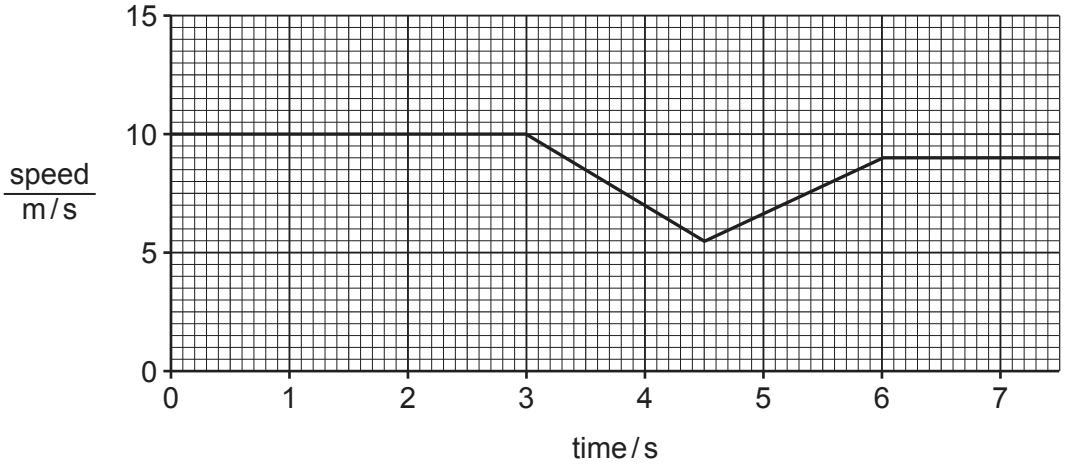


Fig. 3.2

(a) State the speed of the car when it is travelling on the level road **after** the hill.

speed = ... m/s [1]

(b) Use Fig. 3.2 to calculate the acceleration of the car down the hill.

Give the units of your answer.

acceleration = ... units ..... [3]

(c) Use Fig. 3.2 to calculate the distance travelled by the car between the start of the hill at time = 3 s and the top of the hill at time = 4.5 s.

distance = ... m [2]

(d) Fig. 3.3 shows the horizontal forces acting on the car moving along a level road at constant speed.

The driving force **P** is 500 N.

Fig. 3.3

(i) Name force **Q**.

..... [1]

(ii) State how the magnitude of force **Q** compares with the magnitude of force **P**.

Give a reason for your answer.

.....

.....

.....

..... [2]

(iii) Calculate the work done by the driving force in moving the car a distance of 30 m.

work = ... J [2]

[Total: 11]

4 **(a)** Fig. 4.1 shows part of a forest food web.

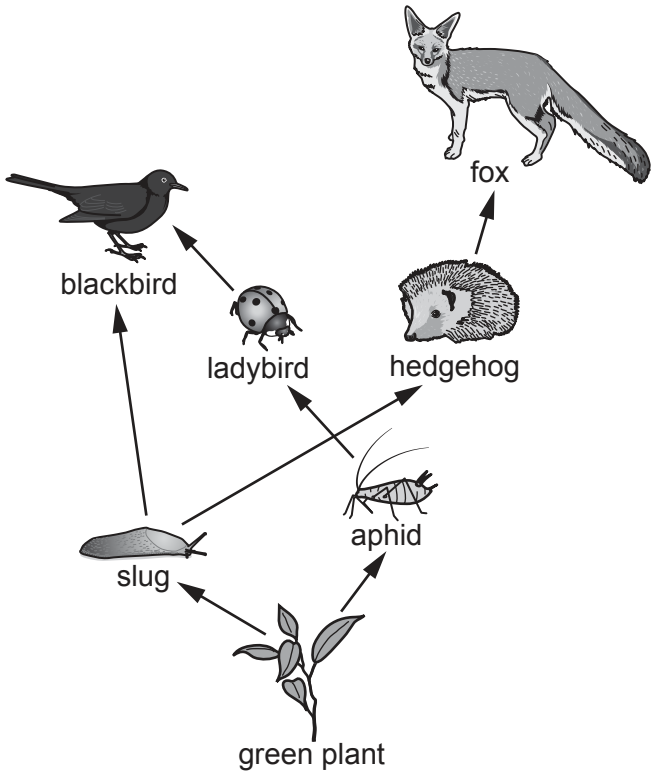


Fig. 4.1

(i) Use Fig. 4.1 to identify:

one producer .....

one herbivore .....

one tertiary consumer. .....
[3]

(ii) Define the term trophic level.

.....

..... [1]

(iii) Use Fig. 4.1 to describe how energy from the green plant reaches the fox.

.....

.....

.....

..... [2]

(b) Fig. 4.2 shows the percentage of gases in the atmosphere inside the forest.

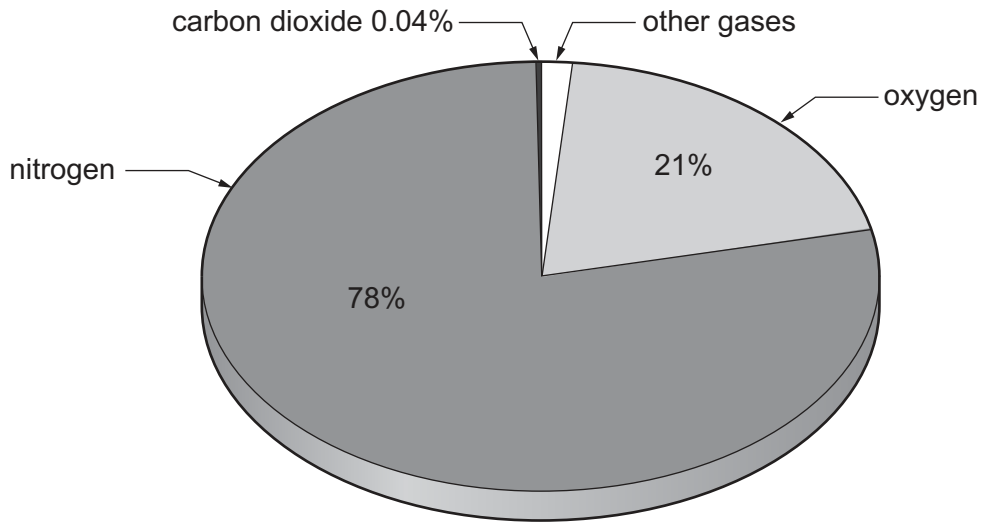


Fig. 4.2

Explain how cutting down and burning the forest would affect the concentration of carbon dioxide in Fig. 4.2.

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

5 Iron is extracted from hematite, an iron ore, in the blast furnace.

(a) Hematite contains Fe_2O_3.

Tick **one** box to show the name for Fe_2O_3.

iron oxide(II)	☐
iron oxide(III)	☐
iron(II) oxide	☐
iron(III) oxide	☐

[1]

(b) The three equations below show reactions that happen in the blast furnace.

Equation 1 $C + O_2 \rightarrow CO_2$

Equation 2 $CO_2 + C \rightarrow 2CO$

Equation 3 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

(i) State which equation shows combustion.

..... [1]

(ii) One of the reactions produces a toxic gas.
State the name of this toxic gas.

..... [1]

(iii) Complete the sentences below.

The substance that is oxidised in Equation 1 is ..... .

The substance that is reduced in Equation 2 is ..... .

The substance that is oxidised in Equation 3 is ..... , and the substance that is reduced in Equation 3 is ..... .

[3]

(c) The metals listed can also be extracted from their ores.

aluminium
copper
magnesium
sodium
zinc

(i) Identify **two** metals from this list which can be extracted by heating their ores with carbon.

..... and ..... [2]

(ii) Identify a metal from this list that **cannot** be extracted by heating its ore with carbon. Explain your answer.

metal .....

explanation .....
[1]

(iii) State the method used to extract the metal named in **(ii)** from its ore.

..... [1]

[Total: 10]

6 **(a)** Fig. 6.1 shows a gas cylinder. It is nearly empty.

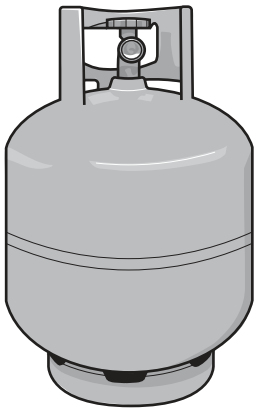


Fig. 6.1

(i) Describe the arrangement, separation and motion of the molecules in the gas inside the cylinder.

.....

.....

.....

..... [2]

(ii) More gas is put into the cylinder by a pump.

As the gas is pumped in, the pressure inside the cylinder increases.

Describe the change that takes place in the separation of the molecules.

.....

..... [1]

(iii) When gas is pumped into the cylinder, work is done on the gas pumped in. This increases the kinetic energy of the molecules.

Predict another change this increase in kinetic energy causes to the gas in the cylinder.

.....

..... [1]

(b) As the gas is pumped in, the pump emits a sound wave.

Fig. 6.2 shows a diagram of the sound wave.

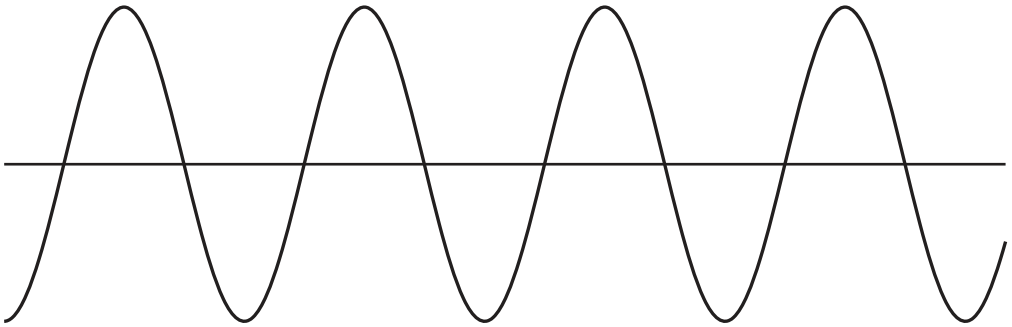


Fig. 6.2

(i) Show clearly on Fig. 6.2 the amplitude of the sound wave. Label it **A**. [1]

(ii) The frequency of the sound wave is 400 Hz. Calculate the wavelength of the sound wave.

Speed of sound in air = 330 m / s

wavelength = ... m [2]

(iii) A student hears the sound.

Describe how sound is transmitted through air from the pump to the student's ears. You may wish to draw a diagram as part of your answer.

.....

.....

..... [2]

[Total: 9]

7 **(a)** Fig. 7.1 shows a heart with coronary heart disease.

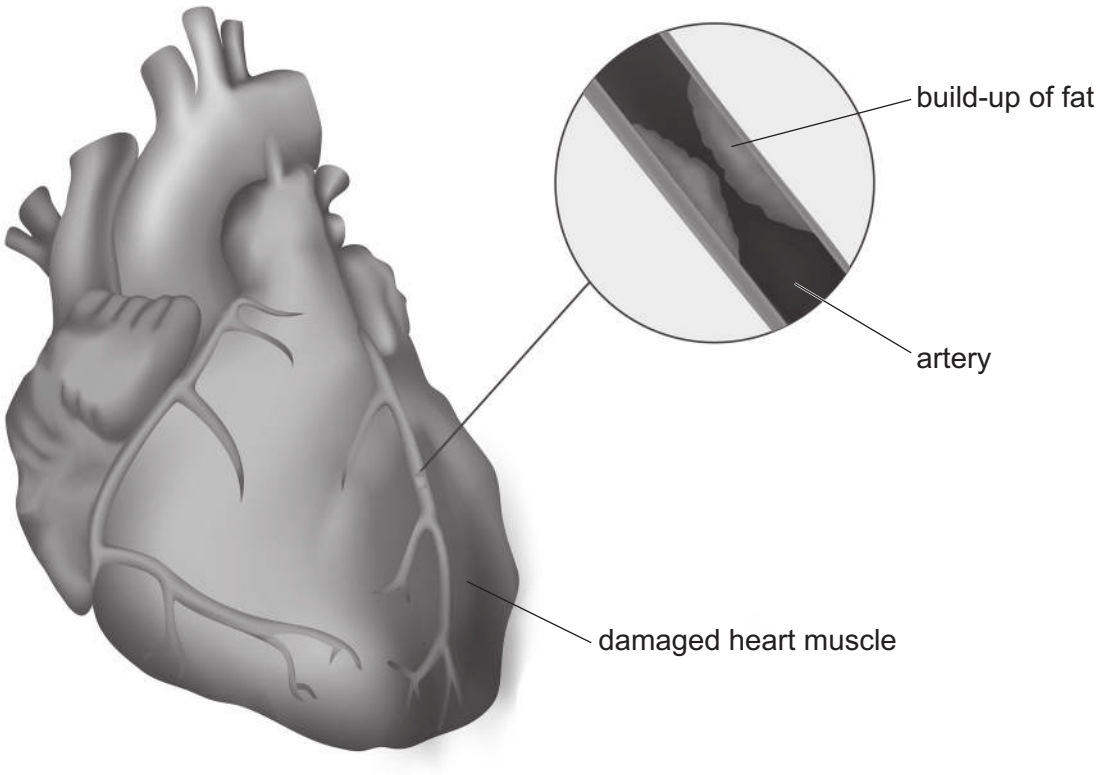


Fig. 7.1

(i) Suggest why the build-up of fat in the coronary artery causes the heart to become damaged.

.....

.....

.....

..... [2]

(ii) A high fat diet is one risk factor for coronary heart disease.

State **two** other risk factors for coronary heart disease.

1 .....

2 .....

[2]

(b) Arteries and capillaries have different functions.

Explain how arteries and capillaries are adapted to their functions.

arteries .....

.....

.....

capillaries .....

.....

.....

[4]

[Total: 8]

8 Sodium is an element in Group I of the Periodic Table.

A small piece of sodium is added to water containing Universal Indicator solution, as shown in Fig. 8.1.

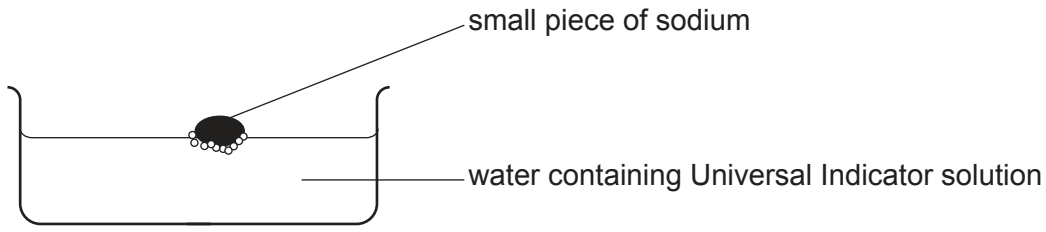


Fig. 8.1

The experiment is repeated using lithium and then repeated using potassium.

(a) The temperature of the water increases during all three of these reactions.

Explain this observation.

.....

..... [1]

(b) Some other observations for these reactions with water are shown in Table 8.1.

Table 8.1

metal	observations
sodium	fast fizzing Universal Indicator turns purple
lithium	slow fizzing Universal Indicator turns purple
potassium	very fast fizzing lilac flame around the potassium Universal Indicator turns purple

The general equation for the reaction between any Group I metal, M, and water is shown.

$$2M + 2H_2O \longrightarrow 2MOH + H_2$$

(i) Use this equation to explain why fizzing occurs in each reaction and why the Universal Indicator turns purple.

fizzing occurs because .....

.....

Universal Indicator turns purple because .....

.....

.....

[3]

(ii) State which metal, sodium, lithium or potassium, forms a positive ion most easily.

Explain your answer.

metal .....

explanation .....

.....

.....

[2]

(c) Rubidium is another metal in Group I of the Periodic Table.

(i) Name the products formed when rubidium reacts with water.

..... and ..... [1]

(ii) State how the rate of the reaction of rubidium with water compares to the rate of reaction of potassium with water.
Explain your answer.

rate of reaction is .....

explanation .....
[1]

[Total: 8]

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9 **(a)** Fig. 9.1 shows a street light. The street light has two identical lamps connected in series.

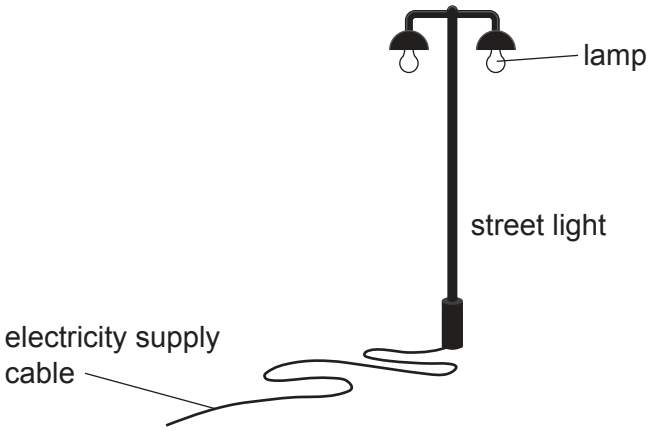
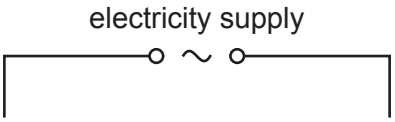


Fig. 9.1

(i) The street light has one switch to operate both lamps.

Complete the circuit diagram for the street light.



[2]

(ii) The filament in one of the two lamps breaks.

The other lamp in the street light also goes out.

Explain this observation.

.....

..... [1]

(b) A **different** street light has three identical lamps connected in parallel.

(i) The current flowing in each lamp when lit is 0.4 A.

Calculate the current in the electricity supply cable for this street light.

current = ... A [1]

(ii) The voltage of the electricity supply is 220 V.

State the potential difference (p.d.) across each lamp.

p.d. = ... V [1]

(iii) Use your answer to **(b)(ii)** to calculate the power used by each lamp.

power = ... W [2]

[Total: 7]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).