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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.

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

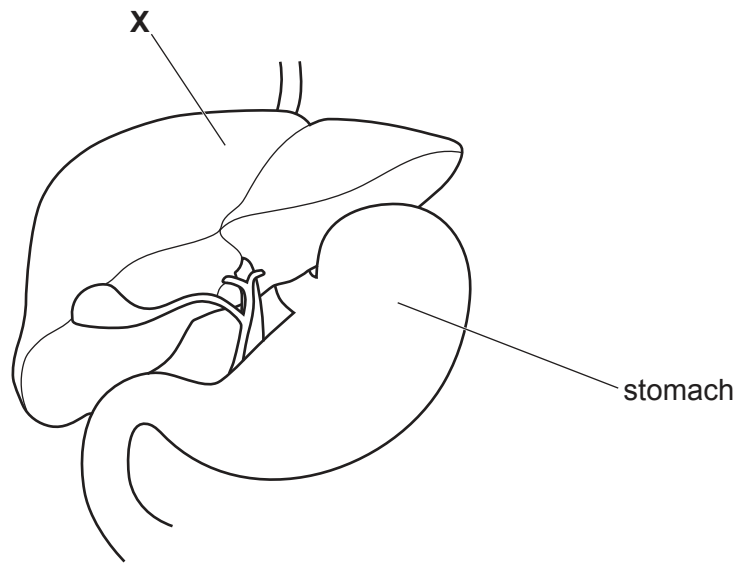


Fig. 1.1

- (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.

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

.....

[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.

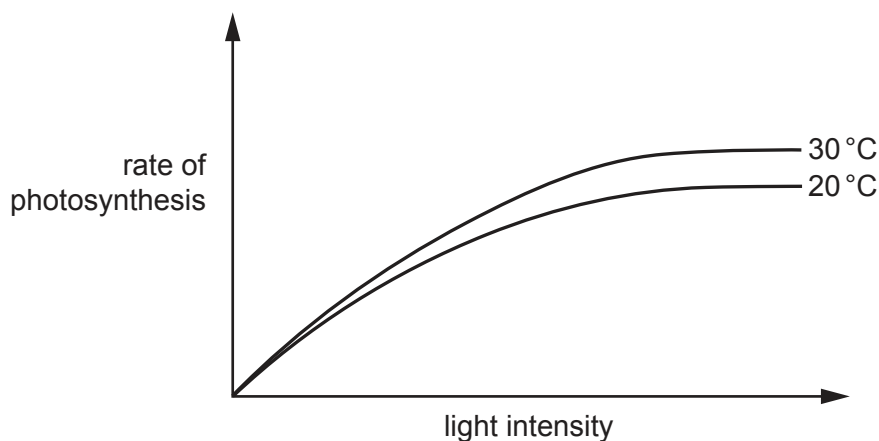


Fig. 1.2

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.

proton number

6

C

carbon

12

nucleon (mass) number

8

O

oxygen

16

(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]

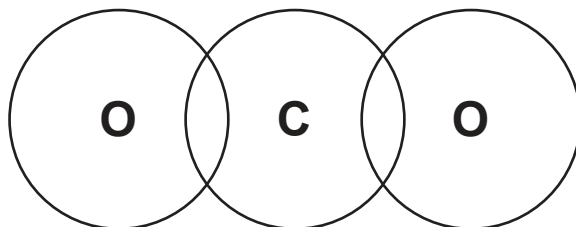
(b) Explain why carbon is in Group IV of the Periodic Table and why oxygen is in Group VI. Use ideas about electron arrangement in your answer.

.....

..... [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.

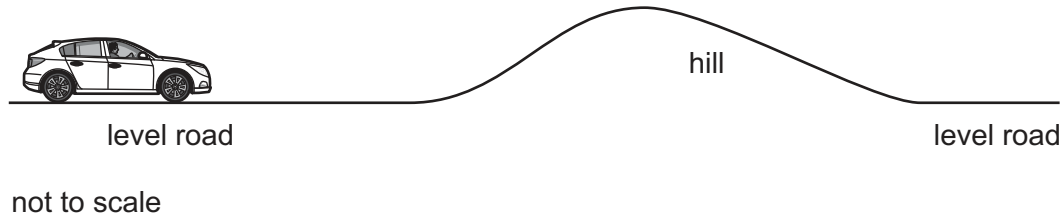


Fig. 3.1

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

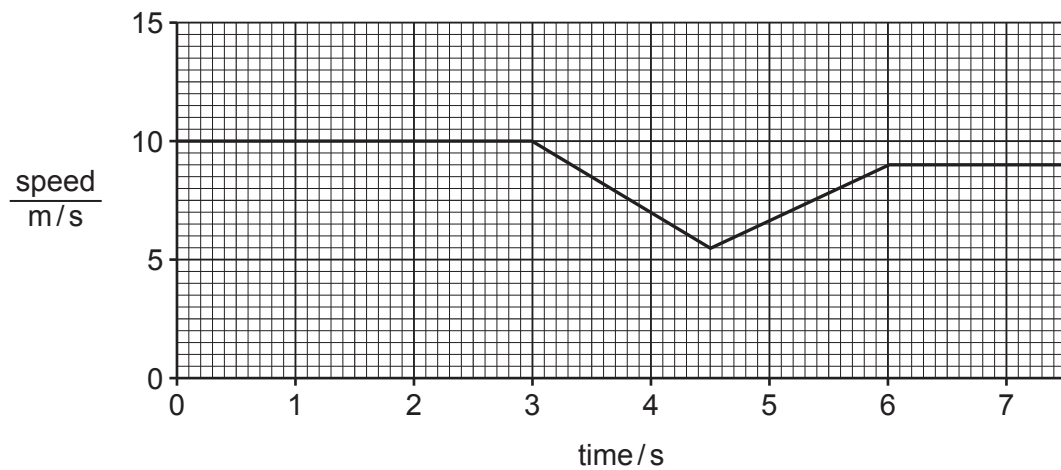


Fig. 3.2

- (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.

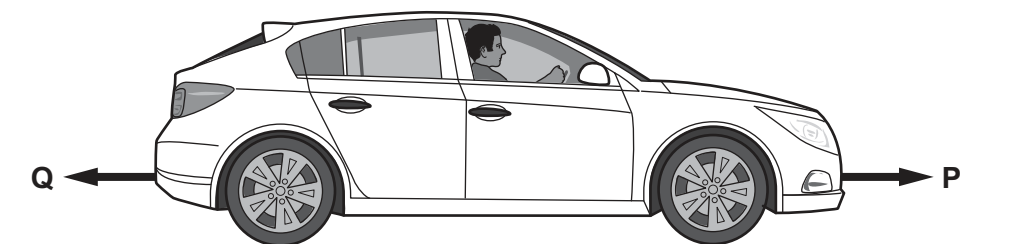


Fig. 3.3

- (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.

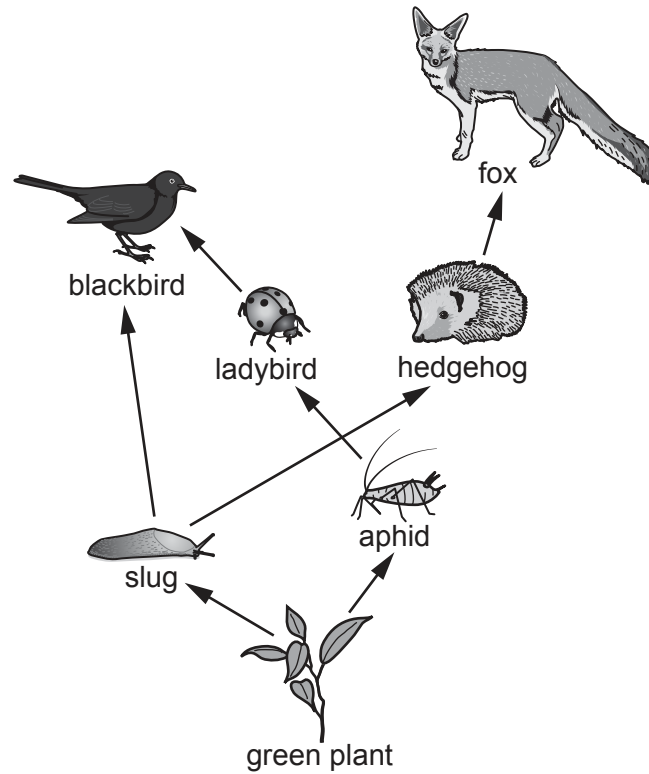


Fig. 4.1

- (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.

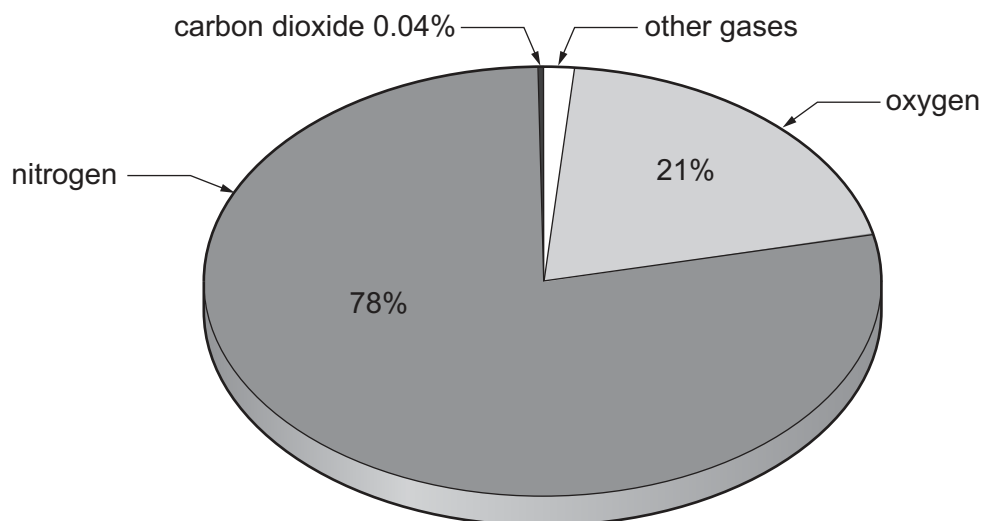


Fig. 4.2

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

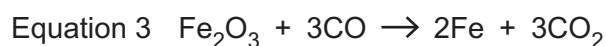
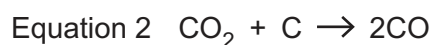
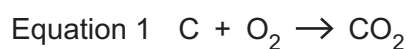
☐

iron(III) oxide

☐

[1]

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



(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.

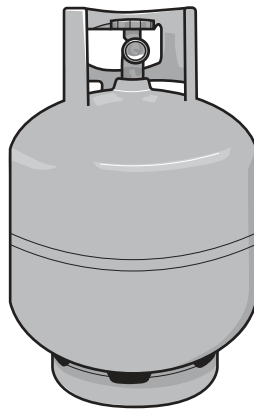


Fig. 6.1

- (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.

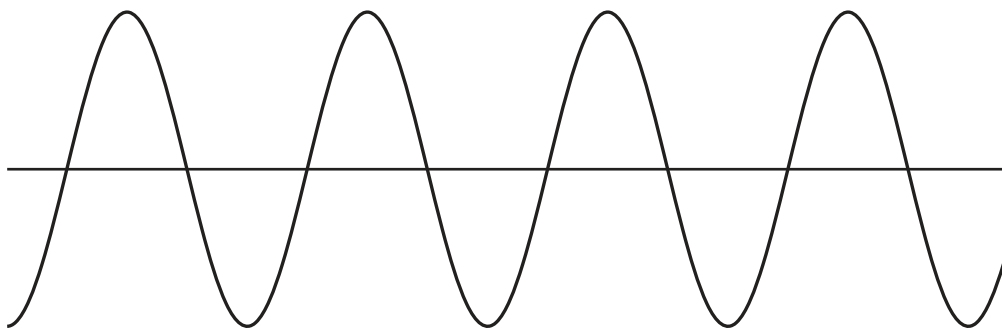


Fig. 6.2

- (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.

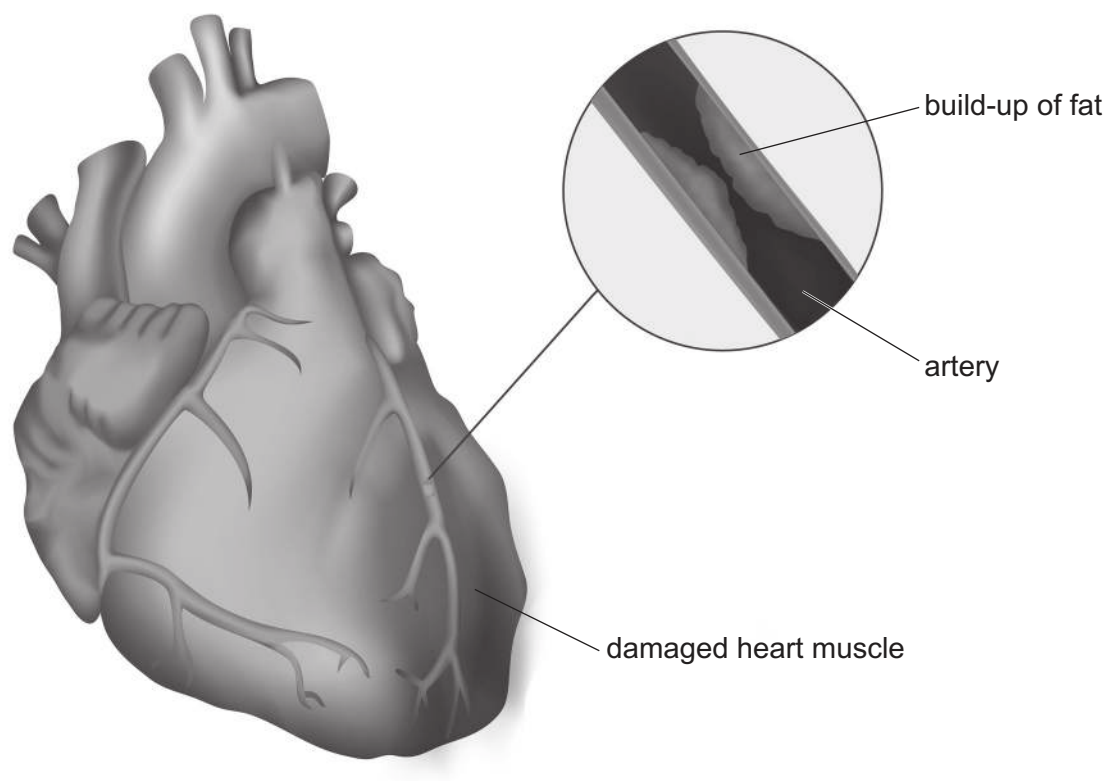


Fig. 7.1

(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.

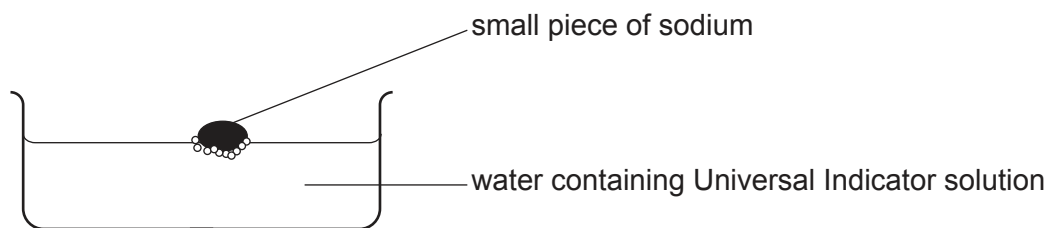


Fig. 8.1

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.

.....

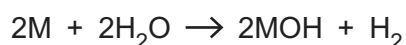
..... [1]

(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.



- (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]

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

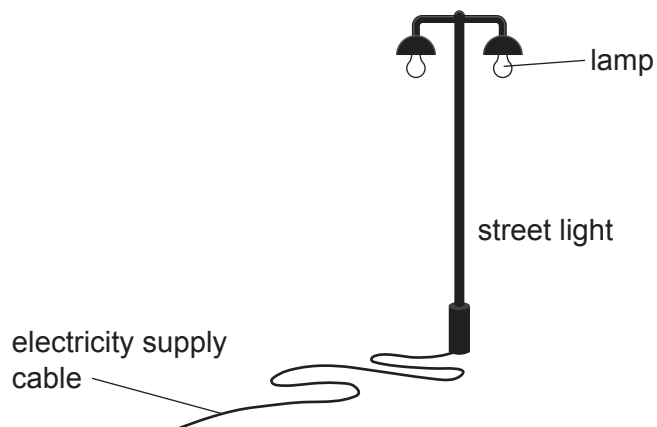
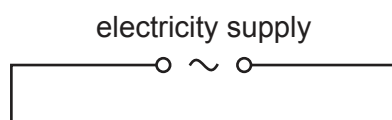


Fig. 9.1

- (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]