Cambridge Assessment International Education

Cambridge IGCSE™

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CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **October/November 2025**

2 hours

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / s^2).

INFORMATION

- The total mark for this paper is 120.
- 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 **28** pages. Any blank pages are indicated.

[Turn over

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

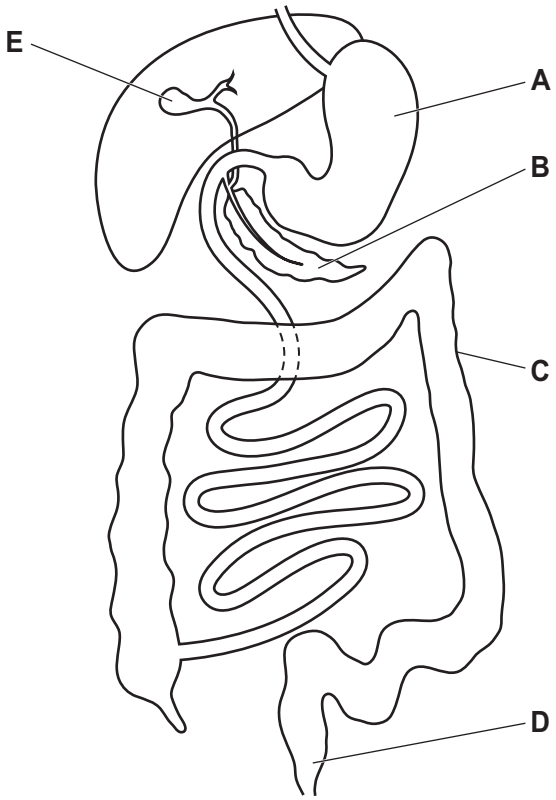


Fig. 1.1

(i) Identify the parts labelled **A**, **C** and **E** in Fig. 1.1.

A .....

C .....

E .....

[3]

(ii) Egestion occurs through structure **D**.

Complete the sentence to describe egestion.

Egestion is the removal of ..... food from the

body as ..... .

[2]

(iii) State the name of a **hormone** produced by the part labelled **B**.

..... [1]

(b) (i) Reducing sugars are absorbed into the blood from the alimentary canal.

Describe the test for reducing sugar and the colour change observed for a positive result.

test .....

colour change:

starting colour .....

final colour .....

[3]

(ii) Complete the word equation for photosynthesis:

..... + carbon dioxide → ..... + ...

[2]

(iii) The carbon dioxide needed for photosynthesis diffuses into the plant through the stomata.

Place ticks (✓) in **two** boxes to show the statements that correctly describe diffusion.

Diffusion is described as the net movement of particles.	☐
Diffusion is the result of random movement of particles.	☐
Diffusion is the movement of particles from a lower to higher concentration.	☐
Diffusion is the movement of particles up a concentration gradient.	☐
In diffusion the particles always move through a partially permeable membrane.	☐

[2]

[Total: 13]

2 **(a)** Fig. 2.1 shows an ancestor of the modern-day elephant. This is called a *Gomphotherium*.

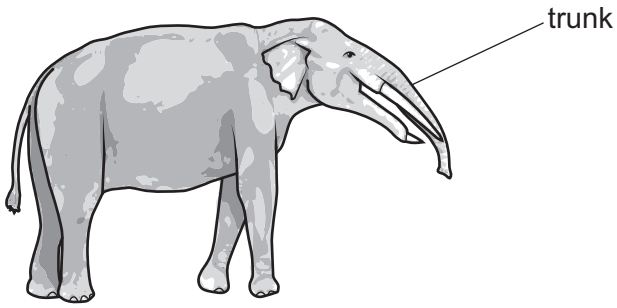


Fig. 2.1

Fig. 2.2 shows a modern-day elephant.

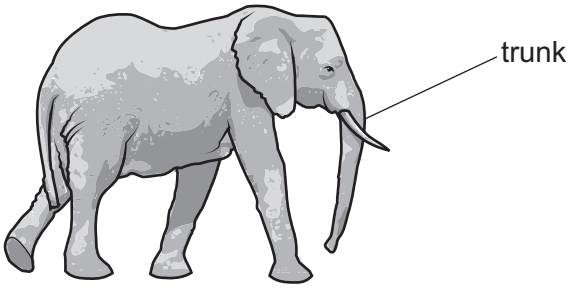


Fig. 2.2

Both *Gomphotherium* and the modern-day elephant use their trunk to reach leaves to eat.

The elephant's trunk evolved by natural selection from the trunk seen in the *Gomphotherium* to the trunk of the modern-day elephant.

Use words from the list to complete the sentences about natural selection.

alleles **breeding** **competition** **died**

offspring **pedigree** **species** **survived**

The population of *Gomphotherium* had different lengths of trunks. Within the population there was ..... for food. *Gomphotherium* with longer trunks could reach more leaves and ..... . They then passed on their ..... to the next generation.

[3]

(b) Fig. 2.3 shows a group of African forest elephants.

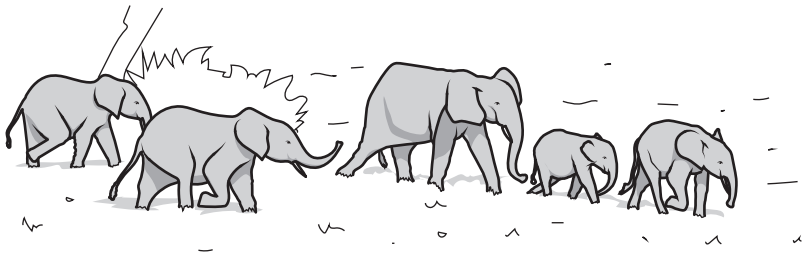


Fig. 2.3

The population of African forest elephants has become critically endangered due to deforestation leading to the destruction of their habitat.

(i) Describe **one other** reason for habitat destruction in the world.

.....

..... [1]

(ii) Habitat destruction is a result of deforestation.

State **two other** undesirable effects of deforestation.

1 .....

.....

2 .....

.....

[2]

(iii) Protecting the habitat of the African forest elephants is one way to conserve their population.

Suggest **two other** ways to conserve the African forest elephant populations.

1 .....

.....

2 .....

.....

[2]

[Total: 8]

3 **(a)** Fig. 3.1 is a diagram of the human breathing system.

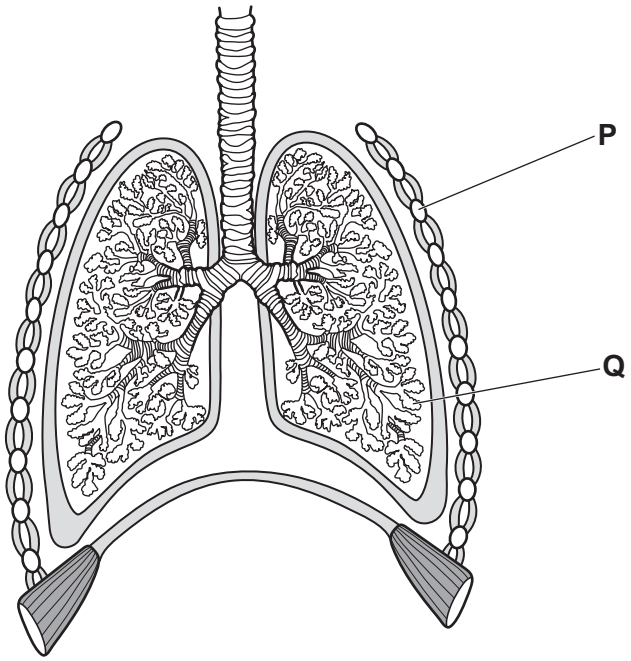


Fig. 3.1

(i) Identify the parts labelled **P** and **Q** in Fig. 3.1.

P .....

Q .....

[2]

(ii) On Fig. 3.1 draw a label line and the letter **D** to identify the diaphragm. [1]

(iii) Complete the sentence to describe aerobic respiration.

Aerobic respiration is the chemical reaction in cells that uses ..... to break down nutrient molecules to release energy. [1]

(iv) Some of the energy released by aerobic respiration is used in active transport.

State **two other** uses of the energy released from aerobic respiration in living organisms.

1 .....

2 .....

[2]

(b) Cystic fibrosis is an inherited condition that affects the gas exchange system.

(i) A person with cystic fibrosis produces thick sticky mucus in their gas exchange system.

Their ciliated cells have difficulty moving this sticky mucus.

State **one** part of the gas exchange system where ciliated cells are found.

..... [1]

(ii) Cystic fibrosis is caused by a recessive allele, **f**.

Two people that do **not** have cystic fibrosis have a child with cystic fibrosis.

Complete the Punnett square to show why the child has cystic fibrosis.

		mother's genotype	
		F	**f**
father's genotype	.....	.....	.....
	.....	.....	.....

[2]

(iii) Identify if the mother's genotype in part **(b)(ii)** is heterozygous or homozygous.

Circle the correct answer.

heterozygous **homozygous**

Explain your answer.

.....

.....

[1]

[Total: 10]

4 **(a)** Fig. 4.1 shows a food web.

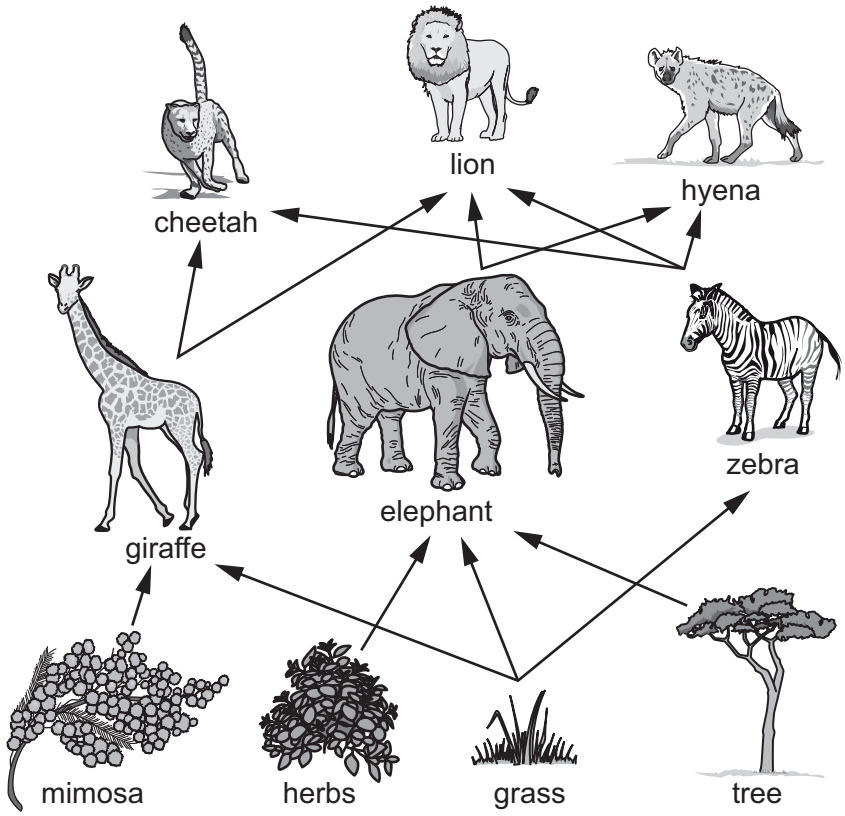


Fig. 4.1

(i) Identify **one** herbivore shown in Fig. 4.1.

..... [1]

(ii) Identify **one** secondary consumer shown in Fig. 4.1.

..... [1]

(iii) State the number of producers shown in Fig. 4.1.

..... [1]

(b) Fig. 4.2 is a diagram of an insect-pollinated flower.

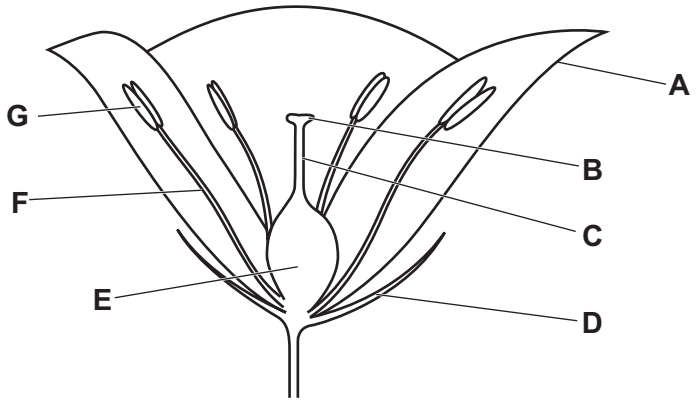


Fig. 4.2

Using letters **A**–**G** in Fig. 4.2, identify the part:

that produces the female gametes .....

that produces the pollen grains .....

where pollination takes place. .....

[3]

(c) Flowers produce seeds.

State the **three** conditions needed for germination of seeds.

1 .....

2 .....

3 .....

[3]

[Total: 9]

5 **(a)** The formulae of six gases found in the air are shown.

CO	**CO_2**	**He**
H_2O	**N_2**	**O_2**

Using these formulae:

(i) State the formula for a monatomic gas.

..... [1]

(ii) State the formula for a toxic gas.

..... [1]

(iii) State the formula for the gas that makes up 78% of clean dry air.

..... [1]

(iv) State the formula for an element.

..... [1]

(v) State the formulae for the **two** substances that are needed to cause iron to rust.

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

(b) Hydrogen chloride is a gas.

Complete the dot-and-cross diagram in Fig. 5.1 to show the electron arrangement in a molecule of hydrogen chloride.

Draw outer shell electrons only.

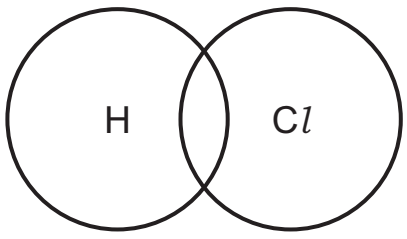


Fig. 5.1

[2]

(c) Hydrogen chloride dissolves in water to make dilute hydrochloric acid.

Describe the effect of dilute hydrochloric acid on blue litmus indicator.

..... [1]

(d) State the names of the **two** gaseous elements used in a fuel cell to produce electricity.

1 .....

2 .....

[2]

[Total: 11]

6 **(a)** Ethane, C_2H_6, is an alkane.

Ethene, C_2H_4, is an alkene.

Complete the sentences to explain why alkanes are described as saturated and alkenes are described as unsaturated.

Alkanes are saturated because they contain only ..... carbon–carbon covalent bonds.

Alkenes are unsaturated because they contain a ..... covalent bond. [1]

(b) Draw the displayed formula of ethane, C_2H_6.

[2]

(c) Determine the relative molecular mass, M_r, of ethane, C_2H_6.

[A_r: C, 12; H, 1]

relative molecular mass, M_r = ... [2]

(d) When ethane is completely combusted in oxygen, the two products are carbon dioxide gas and water vapour.

(i) A chemical test for water is the use of anhydrous cobalt(II) chloride.

State the colour change observed for a positive test.

from ..... to ..... [2]

(ii) The boiling point of a sample of water is 102 °C at standard atmospheric pressure.

Explain how this shows that the sample of water is impure.

.....

.....

..... [2]

(iii) Higher levels of carbon dioxide in the atmosphere cause climate change.

State and explain one strategy which will reduce the effects of climate change.

strategy

.....

.....

explanation

.....

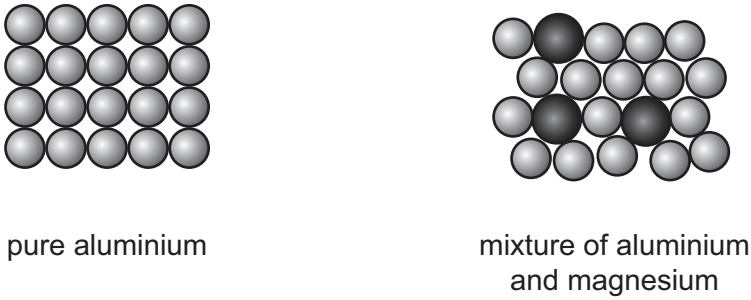
.....

.....

[2]

[Total: 11]

7 **(a)** Fig. 7.1 shows the arrangement of atoms in pure aluminium metal and in a mixture of aluminium and magnesium.



pure aluminium

mixture of aluminium and magnesium

Fig. 7.1

(i) State the name used to describe a mixture of metals.

..... [1]

(ii) Calculate the percentage of magnesium atoms in the mixture of metals shown in Fig. 7.1.

percentage of magnesium atoms = ...% [2]

(b) The metals in the list are extracted from their ores.

copper

iron

magnesium

potassium

sodium

Identify one metal from the list that is **not** able to be extracted from its ore by heating with carbon.

Explain your answer.

metal .....

explanation .....

.....

[2]

(c) A student investigates the reaction, if any, of four metals **W**, **X**, **Y** and **Z** with dilute hydrochloric acid.

The student places pieces of the different metals into separate test-tubes containing dilute hydrochloric acid.

Bubbles of gas are observed as shown in Fig. 7.2.

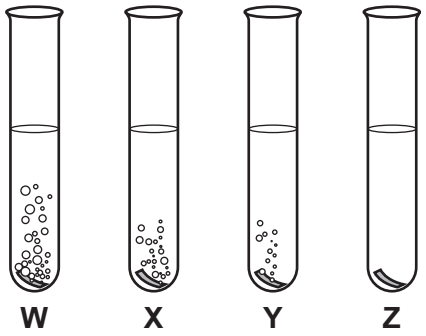


Fig. 7.2

The four metals are copper, iron, magnesium and zinc.

Use the information in Fig. 7.2 and your knowledge of the reactivity series to identify the metals **W**, **X**, **Y** and **Z**.

metal **W** .....

metal **X** .....

metal **Y** .....

metal **Z** .....

[2]

(d) The symbol equation for one of the reactions observed in Fig. 7.2 is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(i) Complete the word equation for this reaction.

..... + hydrochloric acid → ..... + ...

[2]

(ii) State what (aq) means in the symbol equation.

.....

..... [1]

[Total: 10]

8 **(a)** Sodium reacts with chlorine to make sodium chloride.

(i) Fig. 8.1 shows the formation of a sodium ion from a sodium atom.

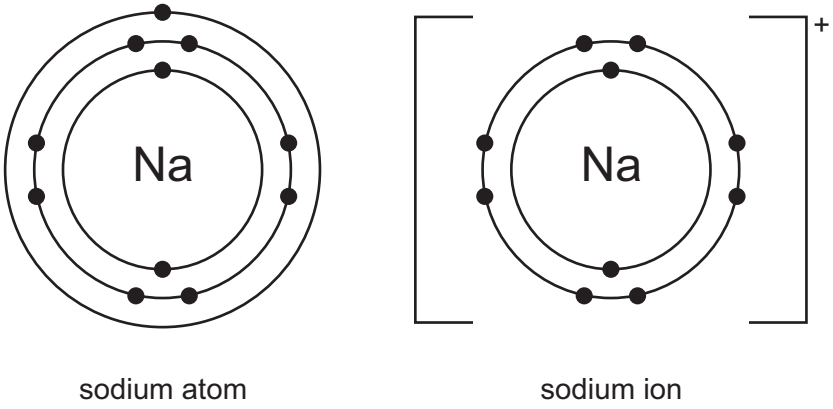


Fig. 8.1

Complete Fig. 8.2 to show the formation of a chloride ion from a chlorine atom.

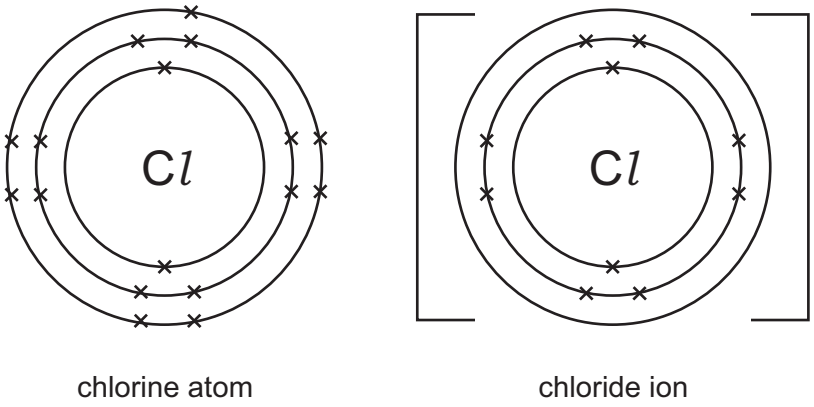


Fig. 8.2

[2]

(ii) Select three properties from the list that are properties of a solid ionic compound.

Place ticks (✓) in the **three** boxes next to the correct properties.

generally soluble in water	☐
good electrical conductivity	☐
high melting point	☐
low melting point	☐
poor electrical conductivity	☐

[2]

(b) Chlorine is a halogen in Group VII of the Periodic Table.

State the colour and physical state of chlorine at room temperature and pressure (r.t.p.).

colour .....

physical state .....

[2]

(c) Sodium chloride is also made by the neutralisation of an acid with an alkali.

State the name of a suitable acid and the name of a suitable alkali for this reaction.

acid .....

alkali .....

[2]

[Total: 8]

9 A house has an electric doorbell.

(a) (i) Draw a circuit diagram to show a doorbell connected in series with a switch and a battery.

Use the circuit symbol ,  , for the doorbell.

[2]

(ii) The battery has four 1.5 V cells in series.

When the bell rings the current in the bell is 3.0 A.

Calculate the resistance of the bell.

resistance = ... Ω [3]

(b) The house is fitted with a household fire (smoke) alarm.

The smoke detector in the alarm contains a radioactive isotope of americium-241 which emits α-particles.

(i) State the composition of an α-particle.

.....

..... [1]

(ii) Americium-241 has a half-life of 430 years.

Suggest why the long half-life of americium-241 is important for use in a smoke detector.

..... [1]

(iii) Americium-241 has the nuclide notation $^{241}_{95}\text{Am}$.

State the number of neutrons in the nucleus of an atom of americium-241.

..... [1]

[Total: 8]

10 Fig. 10.1 shows an electric kettle with a heating element.

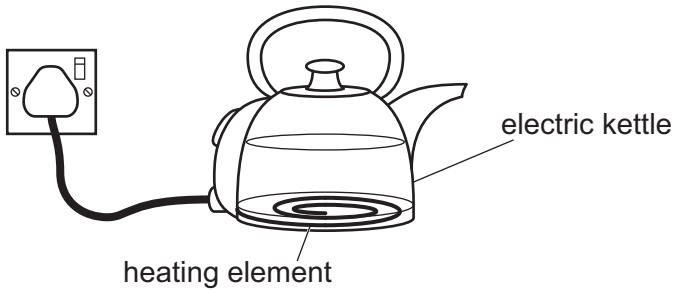


Fig. 10.1

(a) The heating element heats the water at the bottom of the kettle.

Thermal energy is then transferred to all the water in the kettle.

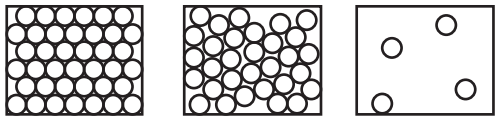
State the name of this important method of energy transfer in liquids.

..... [1]

(b) The water in the kettle is heated. The water boils and changes into steam.

Water is a liquid and steam is a gas.

Fig. 10.2 shows diagrams of the arrangements of particles in a gas, liquid and solid.



A **B** **C**

Fig. 10.2

Identify the diagrams for a gas and for a liquid.

gas is diagram .....

liquid is diagram .....

[1]

(c) The kettle is connected to a 240 V supply.

Power is supplied to the kettle at 3000 W.

(i) Calculate the current in the kettle.

current = ...A [2]

(ii) The kettle is used for 10 minutes.

Show that the energy used is 0.50 kW h.

[3]

(iii) 1 kW h costs $0.50.

Calculate the cost of the energy used in **(ii)**.

cost = $ ..... [1]

(d) Fig. 10.3 shows an electrical hazard for a person using the kettle.

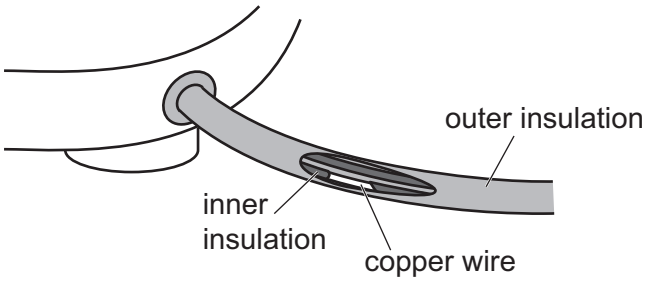


Fig. 10.3

State the electrical hazard shown and explain why it is dangerous.

hazard

.....

.....

explanation

.....

.....

[2]

[Total: 10]

11 (a) A student runs 100 m.

The running track is divided into five 20 m sections.

The student is timed over each 20 m section.

Table 11.1 shows the results.

Table 11.1

section	time taken / s
0 m–20 m	3.7
20 m–40 m	3.1
40 m–60 m	2.6
60 m–80 m	2.6
80 m–100 m	3.0

(i) Use Table 11.1 to calculate the average speed of the student over the 100 m run.

average speed = ... m / s [3]

(ii) The average power output of the student over the final section is 600 W.

Calculate the work done by the student in 3.0 s.

State the unit of your answer.

work done = ... unit ..... [3]

(b) (i) After the run the student starts sweating and the student's body cools down.

State the process responsible for this cooling down by sweating.

..... [1]

(ii) The student wears a black T-shirt in the Sun and becomes too hot.

Another student wears a white T-shirt in the Sun and does **not** become as hot.

Explain why.

.....

.....

..... [1]

(iii) The Sun consists mostly of two elements.

State the name of **one** of these elements.

..... [1]

(iv) Most of the energy emitted by the Sun is from three regions of the electromagnetic spectrum.

Name these **three** regions.

1 .....

2 .....

3 .....

[2]

[Total: 11]

12 **(a)** Fig. 12.1 shows four forces, **A**, **B**, **C** and **D**, acting on a car moving along a level road.

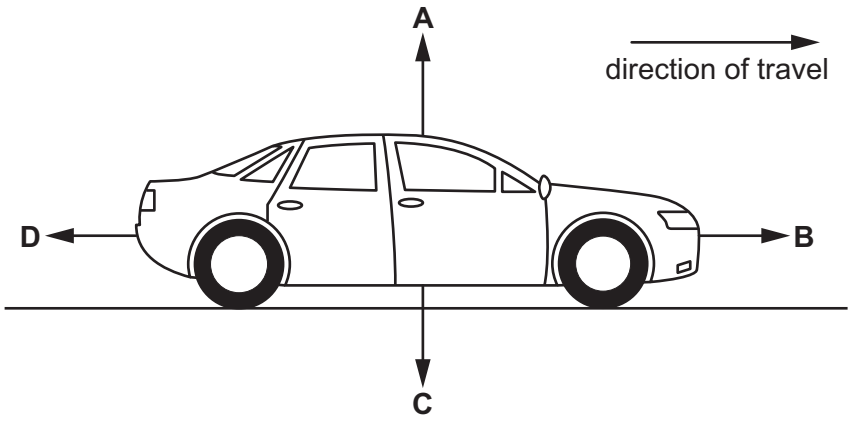


Fig. 12.1

(i) State which force, **A**, **B**, **C** or **D**, is partly caused by air resistance.

..... [1]

(ii) One of the forces shown on Fig. 12.1 is the weight of the car.

Explain why the definition of weight below is incorrect.

weight is a measure of the quantity of matter in an object

.....

..... [1]

(iii) The car is moving at constant speed.

Force **D** is 2000 N.

State the value of force **B**.

Explain your answer.

force **B** = ... N

explanation .....

.....

[1]

(b) As the car slows down the sound of the engine becomes quieter and the frequency of the sound waves decreases.

(i) State what happens to the amplitude of the sound waves.

..... [1]

(ii) State what happens to the pitch of the sound.

..... [1]

(c) The car has two identical headlamps **P** and **Q**, connected in a parallel circuit.

Fig. 12.2 shows the circuit diagram.

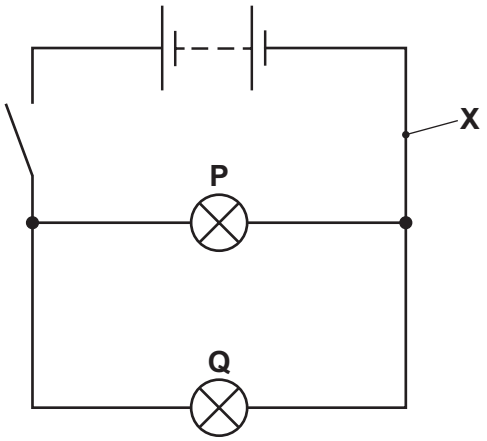


Fig. 12.2

(i) State the name of the component in the circuit that causes a current to flow in the circuit.

..... [1]

(ii) The current in each lamp is 4 A.

State the current at point **X** in the circuit. Choose from the values below.

0 A **2 A** **4 A** **8 A**

Explain your answer.

current at **X** = ... A

explanation .....

.....

[2]

(iii) State **one** reason why the headlamps in the car are connected in parallel rather than in series.

.....

..... [1]

(d) The driver uses a plane mirror in the car to see an image of a bus behind the car.

Describe the characteristics of the image of the bus compared with the bus.

.....

.....

..... [2]

[Total: 11]

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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.).