Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

1623068538

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **October/November 2021**

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.

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.

DC (RW/SW) 211585/3

[Turn over

1 **(a)** Fig. 1.1 is a diagram of a single-celled organism called a euglena.

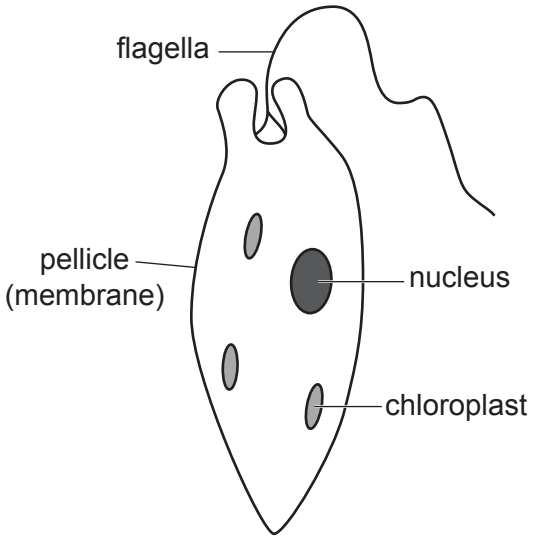

Fig. 1.1

(i) Table 1.1 shows some of the cell components of animal, euglena and plant cells.

Complete Table 1.1 by placing ticks (✓) to show the correct cell components of each type of cell.

Use the information in Fig. 1.1 and your knowledge to answer the question.

Table 1.1

type of cell	cell component			
	cell wall	**chloroplast**	**nucleus**	**vacuole**
animal				
euglena				
plant				

[3]

(ii) State evidence from Fig. 1.1 for and against euglena being a plant cell.

evidence for .....

.....

evidence against .....

.....

[2]

(b) State the function of the nucleus.

.....

..... [1]

(c) The length of a palisade cell is 0.08 mm.

The length of a red blood cell is 0.007 mm.

Calculate how many times bigger a palisade cell is than a red blood cell.

Give your answer to the nearest whole number.

..... [2]

(d) Fig. 1.2 shows a type of nerve cell (neurone).

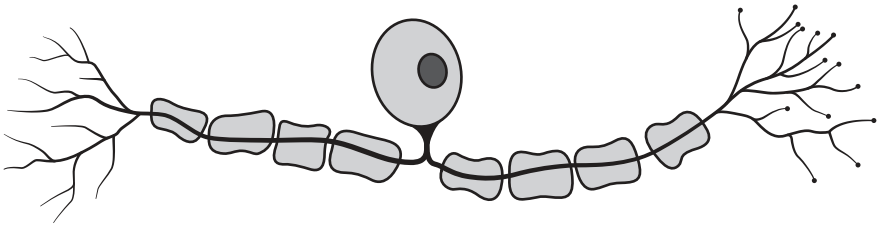

Fig. 1.2

(i) Name the type of neurone shown in Fig. 1.2.

..... [1]

(ii) The type of neurone shown in Fig. 1.2 can be 1.5 m in length.

Suggest why these cells need to be very long.

.....

.....

..... [1]

[Total: 10]

2 **(a)** Table 2.1 shows the melting points and reactivity with water of three Group I metals.

Table 2.1

element	melting point / °C	reactivity with water
lithium	181	.....
sodium	98	forms bubbles of gas rapidly
potassium	.....	forms bubbles of gas very rapidly

Complete Table 2.1 to predict

- the melting point of potassium
- the reactivity of lithium with water. [2]

(b) Name the gas made when a Group I metal reacts with water.

..... [1]

(c) When sodium reacts with chlorine, an orange flame is seen and the sodium melts.

Sodium chloride is formed.

(i) State if the reaction is exothermic or endothermic.

Explain your answer.

reaction is .....

explanation .....

..... [1]

(ii) Sodium chloride contains chloride ions.

Describe a test for chloride ions and the positive result.

test .....

result ..... [2]

(iii) State the type of bonding present in sodium chloride.

Explain your answer.

type of bonding .....

explanation .....

..... [2]

(d) Concentrated aqueous sodium chloride is electrolysed.

State the products at the electrodes.

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

(e) A student separates a mixture of sand and aqueous sodium chloride.

(i) State the method of separation used to separate the sand from the aqueous sodium chloride.

..... [1]

(ii) Describe how solid sodium chloride can be obtained from aqueous sodium chloride.

.....

..... [1]

[Total: 12]

3 **(a)** An astronomer on Earth is able to see the Moon even though the Moon does not emit visible light.

State one property of visible light that enables observation of the Moon.

.....

..... [1]

(b) Visible light is part of the electromagnetic spectrum.

Place visible light in the correct place in the incomplete electromagnetic spectrum in Fig. 3.1.

	X-rays	**ultraviolet**			**microwaves**	

Fig. 3.1

[1]

(c) **(i)** Light rays from the Moon travel at 3×10^5 km/s to reach the astronomer on Earth.

The distance travelled is 400 000 km.

Calculate the time taken for the light rays to travel from the Moon to the Earth.

time = ... s [2]

(ii) Explain why sound waves are unable to travel from the Moon to the Earth.

.....

..... [1]

(d) The astronomer uses lenses in a telescope to look at the Moon.

Fig. 3.2 shows rays of light passing through a lens.

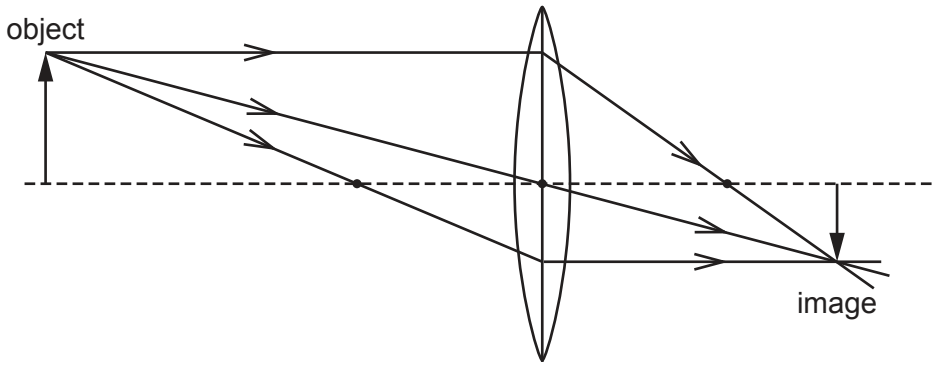

Fig. 3.2

(i) On Fig. 3.2 label the focal length of the lens with a double headed arrow (↔). [1]

(ii) On Fig. 3.2 label the principal focus of the lens with the letter **F**. [1]

(e) An astronaut on the Moon is exposed to ionising background radiation.

(i) State **one** effect of ionising radiation on the human body.

.....

..... [1]

(ii) Suggest one source of background radiation on the Moon.

.....

..... [1]

[Total: 9]

4 Fig. 4.1 is a diagram of a cross-section through skin tissue.

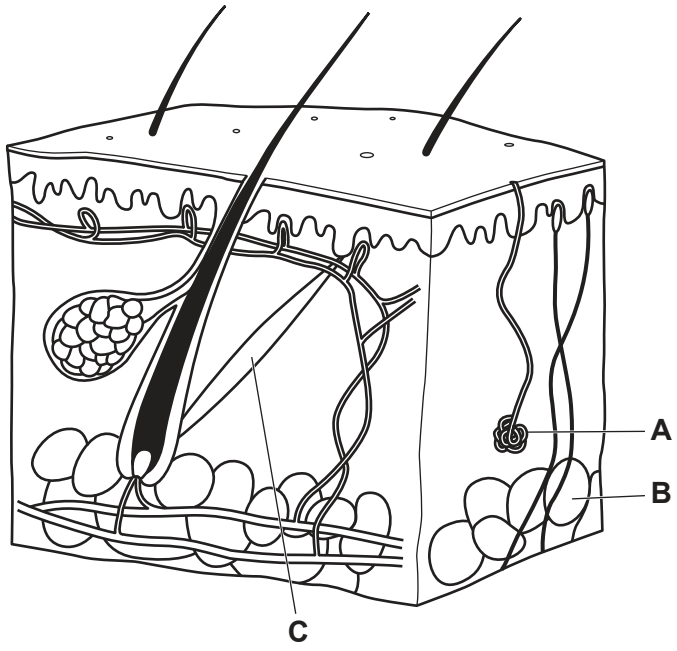

Fig. 4.1

(a) Identify the parts labelled **A**, **B** and **C** in Fig. 4.1.

A .....

B .....

C .....

[3]

(b) Complete the sentences to describe how the body responds in cold conditions using words from the list.

Each word may be used once, more than once or not at all.

blood **energy** **muscles** **skin**

When the internal body temperature decreases, the brain detects the low temperature of the ..... .

To increase the body temperature ..... contract and relax rapidly. This is called shivering.

This increases the rate of respiration which releases ..... in the form of heat.

[3]

(c) The boxes on the left show some sentence beginnings.

The boxes on the right show some sentence endings.

Draw **one** line to link one box on the left to one box on the right to show the correct definition of *homeostasis*.

Homeostasis is the detection of a changing	external environment.
Homeostasis is the detection of a constant	external temperature.
Homeostasis is the maintenance of a changing	internal environment.
Homeostasis is the maintenance of a constant	internal processes.

[2]

[Total: 8]

5 **(a)** **(i)** State the percentage of oxygen and of nitrogen in a sample of clean air.

oxygen .....%

nitrogen .....% [2]

(ii) A sample of air collected near a busy road contains carbon monoxide.

Carbon monoxide is made by car engines.

Describe how carbon monoxide is made by car engines.

.....

.....

.....

..... [3]

(iii) State one harmful effect of carbon monoxide on the health of a human.

.....

..... [1]

(b) The atmosphere contains small quantities of sulfur dioxide.

Sulfur dioxide causes acid rain.

(i) Suggest a pH for acid rain.

..... [1]

(ii) Suggest one adverse effect of acid rain on buildings.

.....

..... [1]

(iii) Sulfur dioxide is made when sulfur is burned in oxygen.

This reaction is called an oxidation reaction.

State the meaning of the term *oxidation*.

.....

..... [1]

[Total: 9]

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6 **(a)** Fig. 6.1 shows an electric heater containing two heating elements.

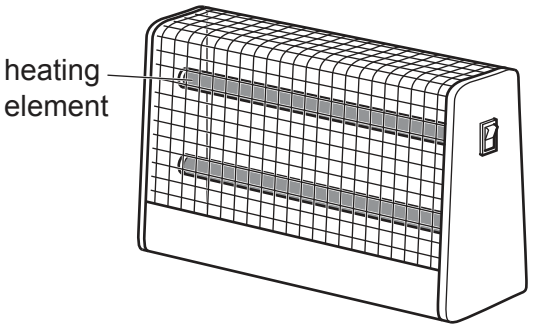


Fig. 6.1

(i) The two heating elements are connected in series.

Each heating element has a resistance of 8 Ω.

Calculate the combined resistance of the two heating elements.

resistance = ... Ω [1]

(ii) A different heater has the two heating elements connected in parallel.

State which value could be the combined resistance of the two heating elements connected in parallel.

Explain your answer.

4 Ω **8 Ω** **16 Ω** **32 Ω**

combined resistance in parallel = ... Ω

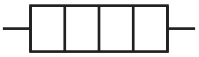
explanation .....

.....

..... [2]

(iii) Complete the circuit diagram for the two heating elements (resistors) connected in parallel to an a.c. power supply.
The circuit should contain one switch to operate both heating elements.

The symbol for a heating element is 



[2]

(b) Fig. 6.2 shows the heater on a wall in a room.

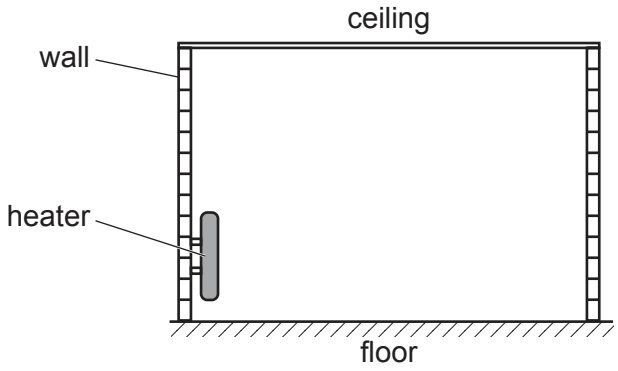


Fig. 6.2

When the heater is switched on, the air around the heater is warmed.

(i) On Fig. 6.2 draw **four** arrows to show how the warm air circulates around the room. [2]

(ii) Name the process which circulates the warm air.

..... [1]

(c) A man walks on the floor in the room.

As he walks he gains a negative charge.

Describe how the man gains this charge.
Use ideas about charged particles in your answer.

.....

.....

.....

..... [3]

[Total: 11]

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7 **(a)** State the word equation for photosynthesis.

..... [2]

(b) Fig. 7.1 is a diagram of a cross-section of a leaf.

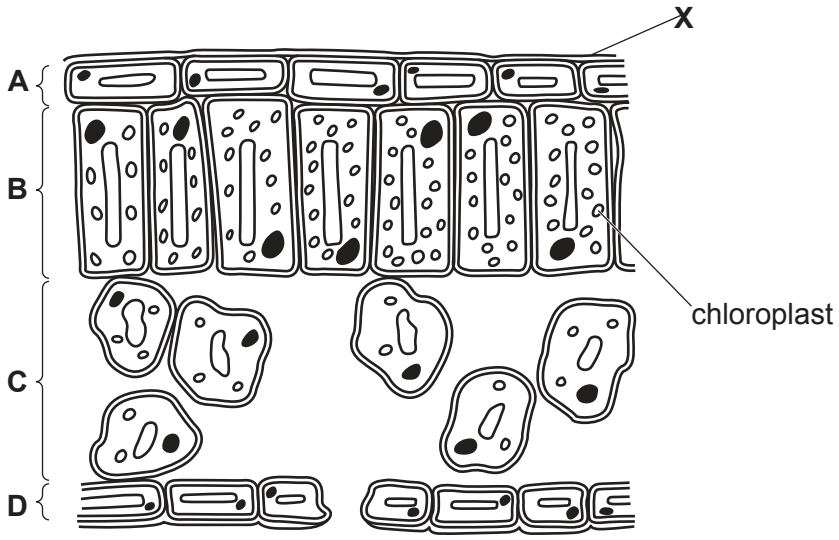

Fig. 7.1

(i) Identify the area in Fig. 7.1, **A**, **B**, **C** or **D**, where most photosynthesis takes place.

Give **one** reason for your answer using evidence from Fig. 7.1.

area .....

reason .....

.....

[2]

(ii) On Fig. 7.1, draw **one** arrow to show the pathway of water during transpiration. [2]

(iii) State the name of part **X** shown in Fig. 7.1.

..... [1]

(c) A group of pea plants is grown with standard fertiliser and another group is grown with fertiliser containing additional magnesium.

The height of the plants is measured and an average calculated.

Table 7.1 shows the results.

Table 7.1

group of pea plant	average height of plant / cm
standard fertiliser	27.4
fertiliser with additional magnesium	33.0

Carbohydrates are needed for plant growth.

Explain the results shown in Table 7.1.

Include ideas about carbohydrates and photosynthesis in your answer.

.....

.....

.....

.....

..... [3]

(d) Fertilisers contain nitrate ions.

Describe the importance of nitrate ions to plants.

.....

..... [1]

[Total: 11]

8 **(a)** An atom of aluminium has a proton number of 13 and nucleon number of 27.

(i) State what is meant by the term *nucleon number*.

.....

..... [1]

(ii) Describe the electronic structure of an atom of aluminium.

You may wish to draw a diagram to help your answer.

.....

..... [2]

(b) Aluminium is extracted from its ore by electrolysis.

(i) Name one ore from which aluminium is extracted.

..... [1]

(ii) Electrolysis results in a chemical change.

Explain what is meant by a *chemical change*.

.....

..... [1]

(c) Aluminium alloys are used in aircraft parts.

(i) State what is meant by the term *alloy*.

.....

..... [1]

(ii) State why aluminium alloys are used in aircraft parts.

.....

..... [1]

(iii) State why aluminium is used in the form of alloys rather than as pure aluminium.

.....

..... [1]

(iv) Describe and explain **one** other use of aluminium.

use .....

explanation ..... [2]

[Total: 10]

9 **(a)** Choose words from the list below to complete the sentences that describe the energy changes occurring when a wind turbine is used.

Each word may be used once, more than once or not at all.

electrical kinetic light potential thermal sound

The kinetic energy of the wind is transferred to the ..... energy of the moving rotor blades of the wind turbine.

The useful output energy from the wind turbine is ..... energy.

The wind turbine makes sound energy which is unwanted. Another unwanted form of energy made by wind turbines is ..... energy.

[2]

(b) State **one** advantage of using wind rather than coal to generate electricity.

.....

..... [1]

(c) **(i)** One disadvantage of wind turbines is they give out very low frequency sound waves.

State what is meant by *the frequency of a wave*.

.....

..... [1]

(ii) The frequency of the sound waves produced is very low.

A healthy human ear can only just hear this sound.

Suggest a value for this frequency.

..... Hz [1]

(d) Magnets are used in the generators of wind turbines.

Fig. 9.1 shows a bar magnet.

Fig. 9.1

On Fig. 9.1, draw the pattern and direction of the magnetic field lines around the magnet. [2]

(e) Another method of generating electricity is to use nuclear fission in a nuclear power station.

During nuclear fission, α-particles, β-particles and γ-rays may be released from atoms.

(i) Complete Table 9.1 to show the properties of α-particles, β-particles and γ-rays.

Table 9.1

radiation	ionising ability	nature	penetrating ability
α-particle	high	helium nucleus	
β-particle	medium		medium
γ-ray		electromagnetic wave	

[3]

(ii) Describe what happens to the nucleus of an atom during nuclear fission.

.....

..... [1]

[Total: 11]

10 **(a)** A student writes a definition of an enzyme.

The definition is **not** correct.

'Enzymes are fats that function as chemical catalysts.'

Circle the **two** words in the student's definition that are **not** correct. [2]

(b) Enzymes are used to break down large molecules into smaller molecules.

Table 10.1 shows some large molecules and the smaller molecules they are made from.

Complete Table 10.1.

Table 10.1

large molecules	smaller molecules
1. starch 2.	glucose
.....	amino acids
fats	1. fatty acids 2. .....

[3]

(c) List the three chemical elements that make up fats.

1 .....

2 .....

3 .....

[1]

(d) Fig. 10.1 is a graph showing the enzyme activity at different temperatures of four different enzymes, **A**, **B**, **C** and **D**.

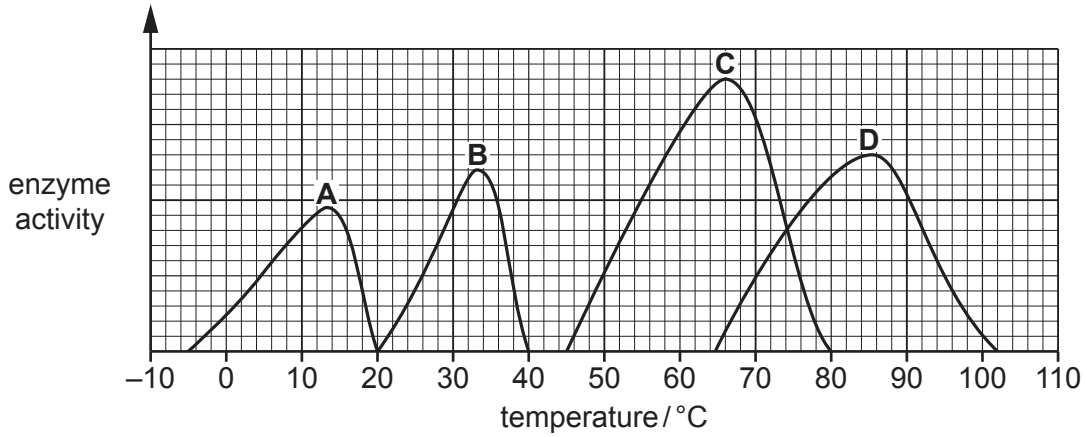

Fig. 10.1

Table 10.2 shows average temperatures in different environments.

Table 10.2

type of environment	average temperature / °C
hot springs	50
arctic sea	–2
hydrothermal vent region	95
deep sea	2
volcano sediment	75

(i) Describe the effect of temperature on the enzyme activity of enzyme **B**.

Use data to support your answer.

.....

.....

.....

..... [2]

(ii) Use Fig. 10.1 and Table 10.2 to identify the enzyme, **A**, **B**, **C** or **D**, found in bacteria that can survive in:

hydrothermal vent regions .....

arctic seas .....

the same environment as enzyme **C** .....

[3]

[Total: 11]

11 **(a)** Methane is a greenhouse gas.

Name one other greenhouse gas.

..... [1]

(b) Methane is completely combusted in oxygen. Carbon dioxide and water are made.

Balance the symbol equation for this reaction.

$$CH_4 + \text{.....}O_2 \rightarrow CO_2 + \text{.....}H_2O$$

[2]

(c) Complete Fig. 11.1 to show the structural formula of methane.

C – H

Fig. 11.1

[1]

(d) Methane is the **main constituent** of a fossil fuel.

(i) Name this fossil fuel.

..... [1]

(ii) Name one **other** fossil fuel.

..... [1]

(e) Methane is an alkane. Ethene is an alkene.

(i) State the difference in structure between an alkane and an alkene.

.....

..... [1]

(ii) A student uses a chemical reagent to show the difference between an alkane and an alkene.

Tick (✓) the correct box to show the chemical reagent used.

aqueous bromine	☐
limewater	☐
litmus	☐
universal indicator	☐

[1]

(f) Ethene, C_2H_4, reacts with steam to produce ethanol, C_2H_5OH.

Ethene is a hydrocarbon.
Explain why ethanol is **not** a hydrocarbon.

.....

..... [1]

[Total: 9]

12 **(a)** Fig. 12.1 shows the horizontal forces acting on a motorcyclist and his motorcycle.

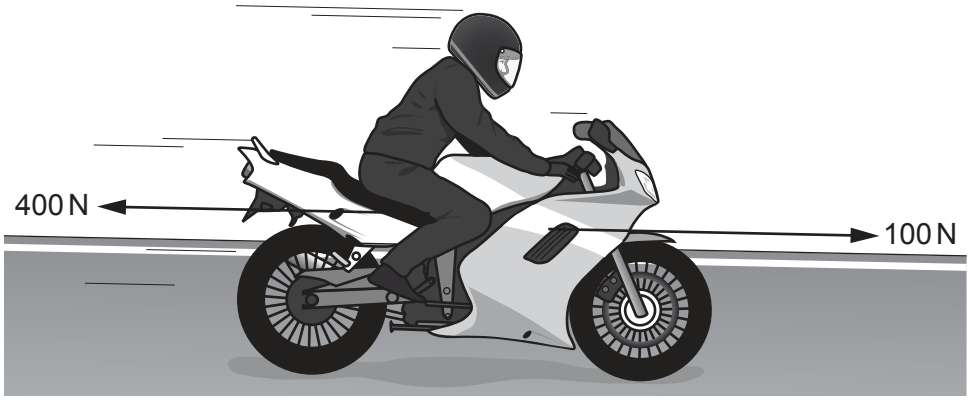

Fig. 12.1

(i) Calculate the resultant horizontal force acting on the motorcyclist and motorcycle.

force ..... N [1]

(ii) Describe how this resultant force changes the speed of the motorcycle.

..... [1]

(b) Fig. 12.2 shows a speed-time graph for the motorcycle's journey over 80 s.

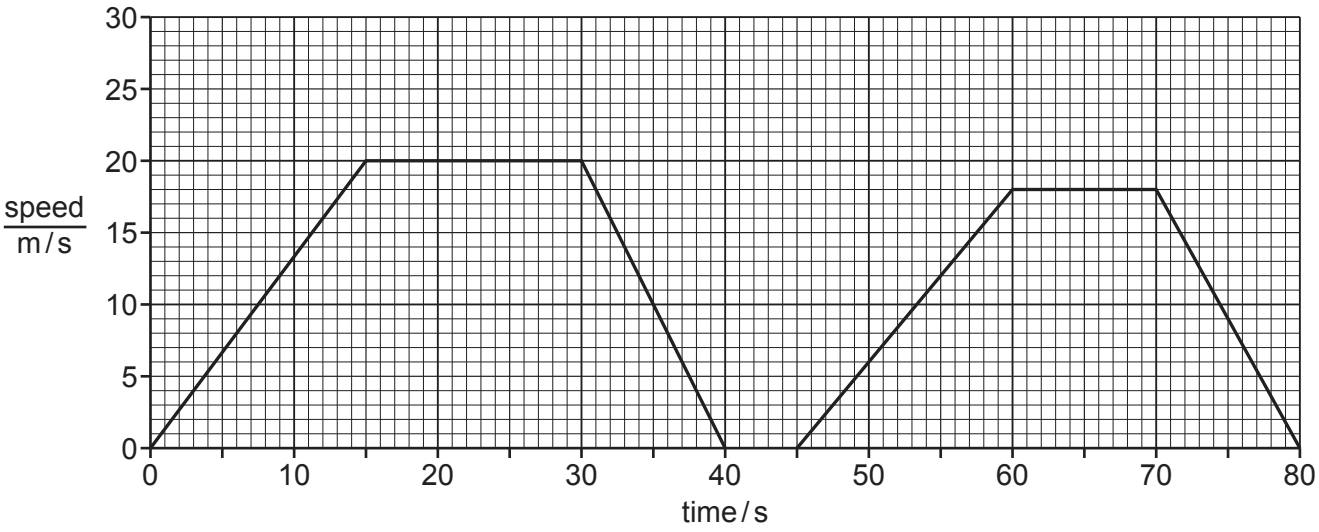

Fig. 12.2

(i) State a time when the motorcycle is not moving.

..... s [1]

(ii) On Fig. 12.2 label with the letter **C** a point when the motorcycle is moving at a constant speed. [1]

(iii) On Fig. 12.2 label with the letter **S** a point when the speed of the motorcycle is increasing. [1]

(c) The motorcycle produces a loud sound with a high frequency when moving.

Describe the pitch and amplitude of the sound waves produced.

pitch .....

amplitude .....
[2]

(d) As the motorcycle moves along the road, the temperature of the air in the tyres increases.

Explain why the pressure of the air in the tyres increases.

.....

.....

.....

..... [2]

[Total: 9]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group

I	II											III	IV	V	VI	VII	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 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* 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 T*l* 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 F*l* flerovium –		116 Lv livermorium –		

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.).