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International Education

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CANDIDATE NAME

CENTRE NUMBER

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0766533697

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **May/June 2026**

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. Do **not** use correction fluid or tape.
- 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

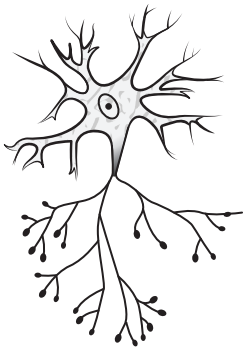
- The total mark for this paper is 120.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

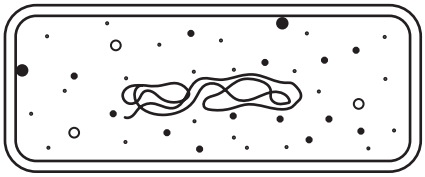
This document has **28** pages. Any blank pages are indicated.

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1 Figure 1.1 shows two different types of cell.

not to scale





neurone cell bacterial cell

Figure 1.1

(a) Identify **three** differences between the structure of the neurone cell and the structure of the bacterial cell shown in Figure 1.1.

1 .....

2 .....

3 .....

[3]

(b) Name the type of neurone shown in Figure 1.1.

..... [1]

(c) Complete the sentence about neurones.

Neurones are cells specialised to conduct ..... impulses. [1]

(d) Some bacteria cause disease.

Circle the name given to disease-causing organisms.

antibiotic **decomposer** **enzyme** **pathogen** [1]

DO NOT WRITE IN THIS MARGIN

(e) The human body defends itself against disease-causing organisms.

Describe **two** of the body's defences against disease-causing organisms.

1 .....

2 .....

[2]

(f) Bacteria and humans are both living organisms.

Complete Table 1.1 to name each of the characteristics of living organisms described.

One has been done for you.

Table 1.1

description	name
ability to detect and respond to changes in environment	sensitivity
removal of waste products and substances in excess	
taking in of materials for energy, growth and development	

[2]

[Total: 10]

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2 **(a)** A student investigates the effect of exercise on breathing rate.

The student:

- counts their number of breaths for 1 minute before exercise
- exercises vigorously for 4 minutes
- counts their number of breaths per minute every minute during the exercise
- continues counting their number of breaths per minute for 2 minutes after the exercise finishes.

(i) The line on Figure 2.1 shows the breathing rate of the student before exercise.

Sketch a line to complete the graph showing how the student's breathing rate will change during the investigation.

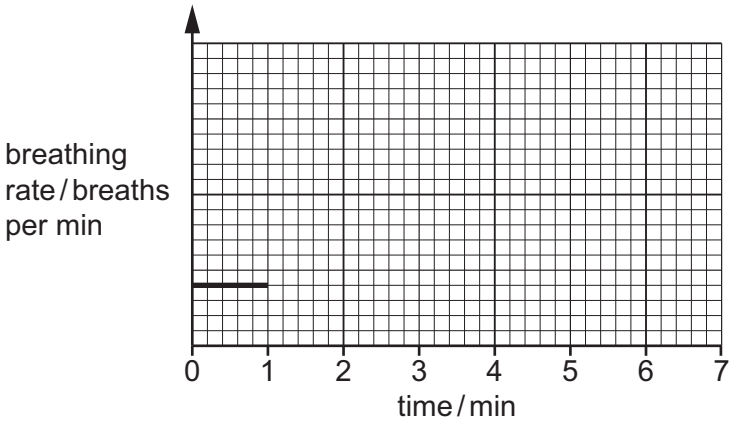


Figure 2.1

[2]

(ii) The student also investigates the effect of exercise on depth of breathing.

The student finds that the volume of air breathed in with each breath at rest is 0.5 dm^3.

During exercise, this increases to 3.0 dm^3.

Calculate the percentage increase in the volume breathed in during exercise.

percentage increase = ... % [2]

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(b) In another investigation, the student uses the equipment shown in Figure 2.2.

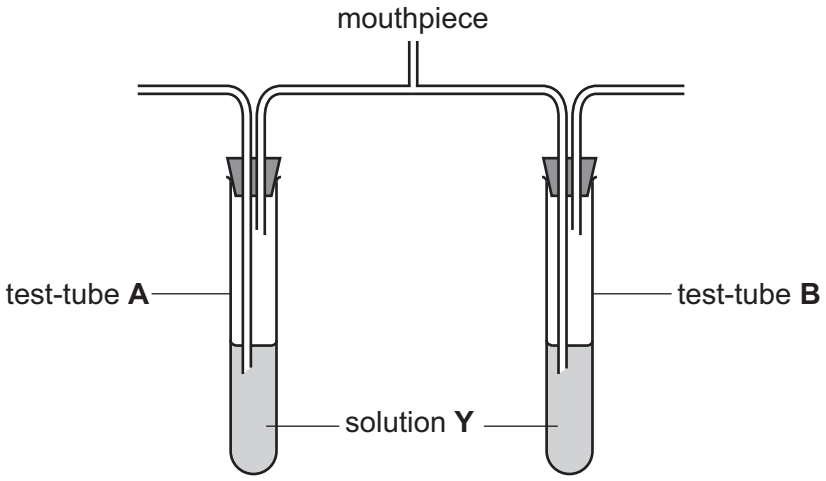


Figure 2.2

The student breathes in and out through the mouthpiece.

Solution **Y** turns milky in test-tube **B only**.

(i) State the name of solution **Y**.

..... [1]

(ii) Explain why solution **Y** turns milky in test-tube **B only**.

.....

.....

..... [2]

(c) During exercise, the body needs energy for muscle contraction.

(i) Name the process that releases energy for muscle contraction.

..... [1]

(ii) State **one** other use of energy in living organisms.

..... [1]

[Total: 9]

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3 Figure 3.1 shows an insect-pollinated flower.

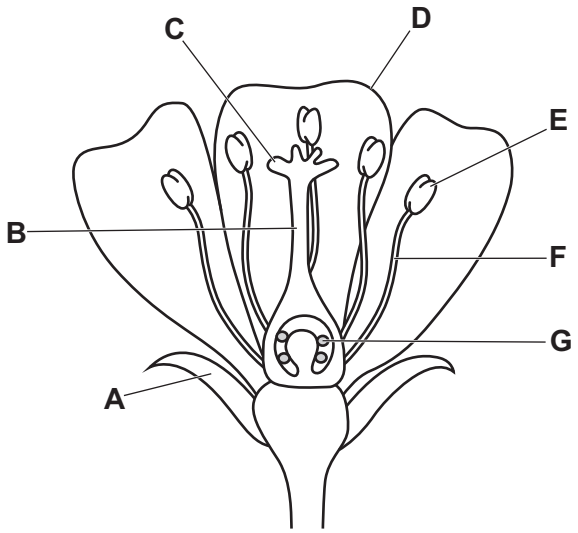


Figure 3.1

(a) (i) Using letters **A**–**G** from Figure 3.1, identify:

a filament .....

a style .....

a sepal. .....
[3]

(ii) State **two** ways that insect-pollinated flowers are adapted for pollination.

1 .....

.....

2 .....

.....
[2]

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(b) Draw **one** straight line from each word to its definition.

word	definition
	contains female gamete
fertilisation	contains pollen
ovule	male gamete
pollination	fusion of nuclei of male and female gamete
	transfer of male gamete from anther to stigma

[3]

(c) Plants need water for photosynthesis.

Describe how water for photosynthesis is transported from the soil to the leaf.

Include ideas about:

- the names of the cells water passes through
- the process by which water moves from cell to cell.

.....

.....

.....

.....

..... [3]

[Total: 11]

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4 Figure 4.1 shows a photograph of a Sumatran tiger.



Figure 4.1

The Sumatran tiger is the top predator in its food chain.

The Sumatran tiger catches and eats animals called deer.

(a) Place ticks (✓) to show **all** the words which describe the Sumatran tiger.

producer ☐

consumer ☐

herbivore ☐

carnivore ☐

decomposer ☐

[1]

(b) The Sumatran tiger is also part of a food web.

Describe what is meant by a food web.

.....

..... [1]

(c) The Sumatran tiger is critically endangered.

There are fewer than 400 surviving.

(i) One reason they are endangered is the destruction of their habitats.

Suggest **two** other reasons why the Sumatran tiger is endangered.

1 .....

2 .....

[2]

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(ii) The habitat of the Sumatran tiger is destroyed by deforestation.

State **two** undesirable effects of deforestation apart from its effect on the tigers.

1 .....

2 .....

[2]

(iii) The forest is often cut down and replaced with oil palm trees.

Palm oil is used in cooking and the production of food, soap and cleaning products.

Place a tick (✓) in **one** box to identify this reason for habitat destruction.

area used for crop production	☐
area used for livestock production	☐
building houses on the land	☐
pollution of habitat	☐

[1]

(d) The thin stripes on the fur of the Sumatran tiger are an adaptation.

They allow the tiger to be camouflaged in their habitat of trees.

Complete the sentences to describe how the Sumatran tiger developed these thin stripes.

Within the population of tigers, there is genetic ..... .

Those tigers with the adaptation of ..... survived.

They reproduced and passed on the ..... for the adaptation to the next generation.

This process continued for many generations and is called natural selection.

[3]

[Total: 10]

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5 **(a)** Draw **one** line from each chemistry word to its description.

chemistry word	description
anhydrous	a chemical reaction involving simultaneous oxidation and reduction
argon	a noble gas
carbon	this element forms 21% of clean dry air
oxygen	a substance that contains no water
redox	diamond and graphite contain atoms of this element

[4]

(b) A student investigates the rate of reaction between calcium carbonate and dilute hydrochloric acid.

The student does four experiments, **A**, **B**, **C** and **D**.

The student uses the same mass of powdered calcium carbonate and the same volume of acid in each experiment.

Table 5.1 shows the temperature and the concentration of acid used in each experiment.

Table 5.1

experiment	temperature of acid / °C	concentration of acid / g / dm^3
A	20	36.5
B	50	36.5
C	20	73.0
D	50	73.0

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(i) Predict which experiment, **A**, **B**, **C** or **D**, has the slowest rate of reaction.

Explain your answer using information from Table 5.1.

experiment .....

explanation .....

.....

.....

[2]

(ii) Suggest the pH of the dilute hydrochloric acid used.

pH = ... [1]

(iii) The student uses universal indicator to determine the pH of the dilute hydrochloric acid.

Suggest the colour of the universal indicator after it has been added to the acid.

..... [1]

(iv) Suggest why the student **cannot** use methyl orange indicator to determine the pH of the dilute hydrochloric acid.

.....

..... [1]

(v) Calcium carbonate reacts with dilute hydrochloric acid to produce a gas.

State the name of this gas.

..... [1]

[Total: 10]

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6 **(a)** The molecular formula of ethanol is C_2H_5OH.

(i) Determine the total number of atoms shown in this formula.

number of atoms = ... [1]

(ii) Complete Figure 6.1 to show the displayed formula of ethanol.

C – C

Figure 6.1

[2]

(iii) State the type of chemical bonding between the carbon, hydrogen and oxygen atoms in a molecule of ethanol.

..... [1]

(iv) Calculate the relative molecular mass, M_r, of ethanol.

[A_r: C, 12; H, 1; O, 16]

relative molecular mass M_r = ... [2]

(b) Ethanol is a liquid at room temperature.

Describe the motion and separation of the particles in a liquid.

motion .....

.....

separation .....

.....

[2]

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(c) Explain why ethanol is **not** a hydrocarbon.

.....

..... [1]

(d) Ethanol is used as a fuel.

State **one** other use for ethanol.

.....

..... [1]

(e) Complete the word equation for the complete combustion of ethanol.

ethanol + ... → ..... + ... [2]

[Total: 12]

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7 Copper, iron, magnesium and zinc are metals.

(a) State **two** general physical properties of metals.

1 .....

2 .....

[2]

(b) Table 7.1 shows observations made when copper, iron, magnesium and zinc are added to dilute hydrochloric acid.

Table 7.1

metal	observations
copper	no bubbles
iron	bubbles form very slowly
magnesium	bubbles form very quickly
zinc	bubbles form quickly

List the four metals in order of their reactivity.

most reactive

.....

.....

.....

.....



least reactive

[1]

(c) Balance the symbol equation for the reaction between magnesium and dilute hydrochloric acid.

$$Mg + ...HCl \rightarrow MgCl_2 + H_2$$ [1]

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(d) Brass and stainless steel are alloys.

(i) State the **two** main metals always used to make brass.

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

(ii) Explain why stainless steel rather than iron is used to make cutlery.

.....

..... [1]

(e) Copper(II) sulfate has the formula $CuSO_4$.

(i) State the number of different elements found in $CuSO_4$.

number of elements = ... [1]

(ii) State the oxidation number of the copper ion in copper(II) sulfate.

oxidation number = ... [1]

[Total: 8]

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8 **(a)** The electronic configuration of chlorine is 2,8,7.

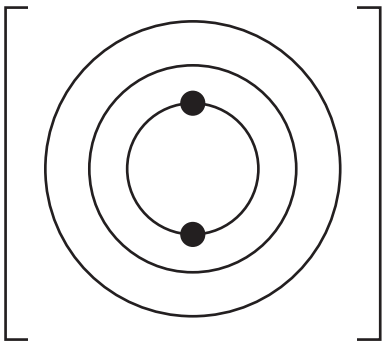
Describe the relationship between the group number of an element and the number of outer-shell electrons in an atom of that element.

.....

..... [1]

(b) Complete Figure 8.1 to show the dot-and-cross diagram of a chloride ion.

Include the charge on the ion.



.....

Figure 8.1

[2]

(c) Describe the chemical test used to identify chloride ions.

State the observation for a positive result.

test .....

observation .....

.....

[2]

(d) Sodium chloride is a solid ionic compound.

Describe **two** properties of solid ionic compounds.

1 .....

2 .....

[2]

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(e) A concentrated aqueous solution of sodium chloride is electrolysed.

(i) Complete the sentence to describe the process of electrolysis.

Electrolysis is the ..... of an ionic compound, when

..... or in aqueous solution, by the passage of an electric current.
[2]

(ii) In this electrolysis, hydrogen and chlorine gas are released.

State the name of the electrode where each is released.

hydrogen is released at the .....

chlorine is released at the .....
[1]

[Total: 10]

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9 **(a)** Electricity is used to boil water in a kettle.

(i) State the boiling temperature of pure water at standard atmospheric pressure.

boiling temperature = ... °C [1]

(ii) Boiling is one of the processes by which a substance changes state.

State the name of the process that occurs when a:

solid changes into a liquid .....

gas changes into a liquid. .....
[2]

(b) Figure 9.1 shows the kettle with a heating element near the bottom of the kettle.

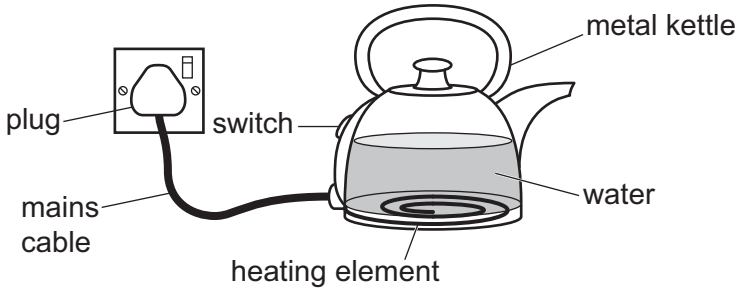


Figure 9.1

Explain why the heating element is placed near the bottom of the kettle.

Use ideas about thermal energy transfer in your answer.

.....

.....

..... [2]

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(c) The kettle has a power rating of 2.8 kW.

The kettle is switched on for 120 s.

(i) Calculate the energy transferred.

energy = ... J [3]

(ii) The current passing through the kettle is 11 A.

Suggest a suitable value for the fuse that protects the kettle.

Choose from the list.

3 A 5 A 10 A 13 A 30 A

Explain your answer.

fuse ..... A

explanation .....

.....

[2]

(iii) Explain how the fuse protects the kettle from a large current.

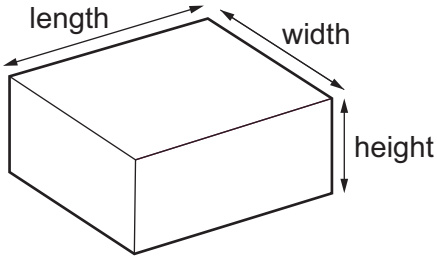
.....

..... [2]

[Total: 12]

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10 Figure 10.1 shows a block of aluminium.



not to scale

Figure 10.1

(a) Table 10.1 shows information about the block of aluminium.

Table 10.1

mass / g	64.8
length / cm	4.0
width / cm	3.0
height / cm	2.0

Calculate the density of aluminium.

density = ... g / cm^3 [3]

(b) The block of aluminium is polished and used as a mirror.

Figure 10.2 shows a ray of light incident on the aluminium mirror.

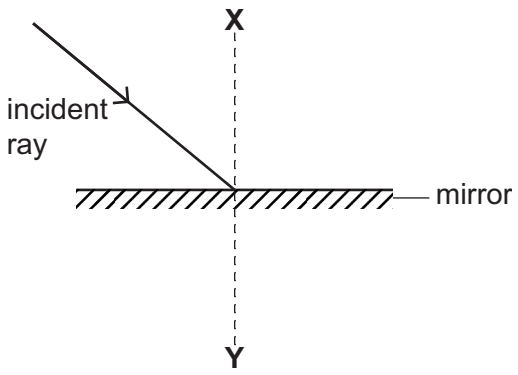


Figure 10.2

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(i) On Figure 10.2, draw the reflected ray. [1]

(ii) State the name of the line **XY**.

..... [1]

(iii) On Figure 10.2, label the angle of incidence ***i*** and the angle of reflection ***r***. [1]

(c) The isotope aluminium-28 decays by β-emission.

(i) Describe the change in the nucleus of an aluminium-28 atom that occurs during β-emission.

.....

.....

..... [2]

(ii) The isotope aluminium-28 has a half-life of 135 seconds.

A sample of aluminium-28 has a mass of 0.10 g.

Calculate the mass of aluminium-28 remaining after 540 seconds.

mass = ... g [2]

[Total: 10]

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11 (a) Figure 11.1 shows a gardener pushing a wheelbarrow full of soil along a straight path at constant speed.

Four forces acting on the wheelbarrow, **A**, **B**, **C** and **D**, are shown.

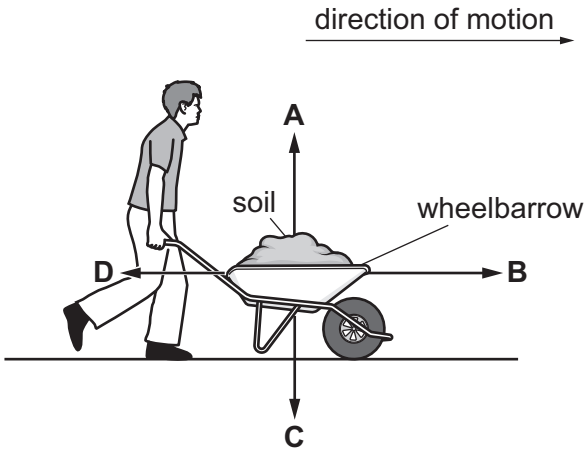


Figure 11.1

(i) State the letter, **A**, **B**, **C** or **D**, that is the weight of the wheelbarrow and soil.

..... [1]

(ii) State the letter, **A**, **B**, **C** or **D**, that is the air resistance frictional force.

..... [1]

(iii) State the magnitude of the resultant horizontal force.

Explain your answer.

resultant force = ... N

explanation .....

.....

[2]

(iv) The gardener pushes the wheelbarrow for a distance of 40 m using a horizontal force of 150 N.

Calculate the work done by the gardener on the wheelbarrow.

work done = ... J [2]

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(b) Figure 11.2 shows an empty wheelbarrow resting on the ground.

A vertical force of 25 N is needed to just lift the rear of the wheelbarrow off the ground.

This force is applied 0.70 m from the pivot.

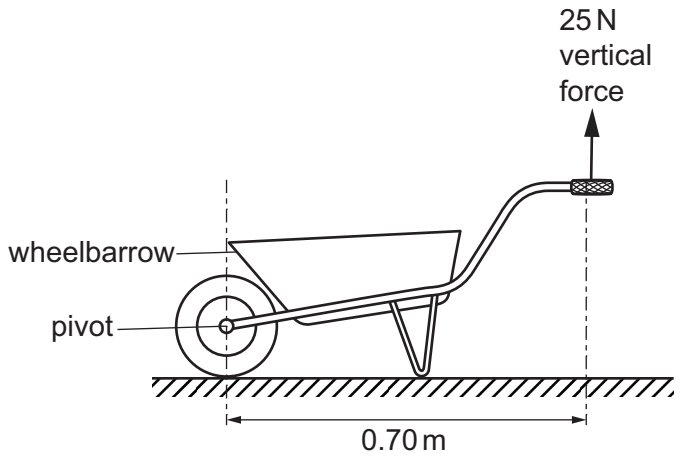


Figure 11.2

Calculate the moment of the 25 N force about the pivot.

State the units of your answer.

moment = ... units ..... [3]

[Total: 9]

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12 **(a)** A car is parked outside on a sunny day.

The Sun radiates most of its energy in three regions of the electromagnetic spectrum.

State these **three** electromagnetic radiations.

1 .....

2 .....

3 .....

[2]

(b) Figure 12.1 shows a speed–time graph for part of a journey made by the car.

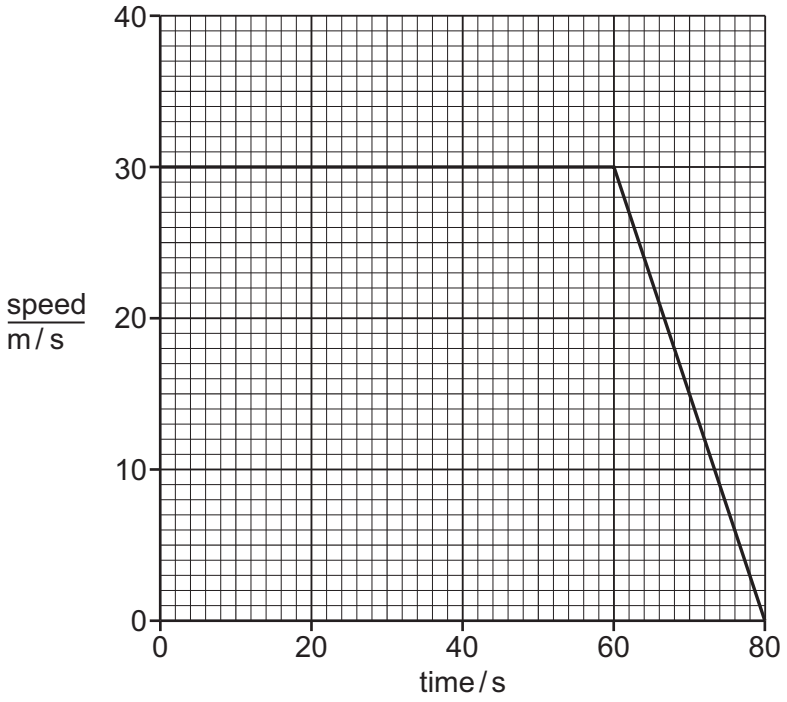


Figure 12.1

(i) Label, with the letter **A**, a point on the graph when the car is decelerating. [1]

(ii) Calculate the distance travelled by the car during the first 60 s of the journey.

distance = ... m [2]

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(c) During the journey, the car becomes charged with static electricity by friction.

State the name of the charged particles that are transferred during this process.

..... [1]

(d) The car has two identical headlamps.

The lamps are connected in parallel across a 12 V battery.

The resistance of each lamp is 4.0 Ω.

(i) Calculate the current in each lamp when lit.

current = ... A [2]

(ii) Suggest **one** reason why the lamps are connected in parallel and **not** in series.

.....

..... [1]

[Total: 9]

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The Periodic Table of Elements

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 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.).

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