CAMBRIDGE
International Education

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0627606773

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **February/March 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.

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1 **(a)** **(i)** Plant and animal cells both have cytoplasm.

Name **two** other cell structures found in both plant and animal cells.

1 .....

2 .....

[2]

(ii) Some cells store large glycogen molecules.

Name the small molecule that glycogen is made from.

..... [1]

(iii) Glycogen is a type of carbohydrate.

Circle **all** the chemical elements that make up carbohydrates.

carbon	**hydrogen**	**magnesium**
nitrogen	**oxygen**	**sulfur**

[1]

(b) Figure 1.1 is a diagram of a bacterial cell.

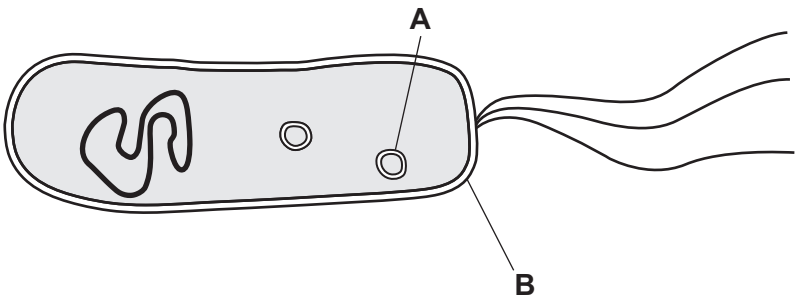

Figure 1.1

(i) Identify the part labelled **A** in Figure 1.1.

..... [1]

(ii) State the function of the part labelled **B** in Figure 1.1.

.....

..... [1]

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(c) (i) Many bacteria are pathogens.

Table 1.1 shows examples of different ways that pathogens are transmitted.

Place ticks (✓) in **all** the boxes which identify ways that pathogens are transmitted by **direct** contact.

Table 1.1

method of transmission	direct contact
air	
animals	
blood	
body fluids	
contaminated surfaces	
food	

[2]

(ii) State **two** body defences to prevent the **entry** of pathogens into the human body.

1 .....

.....

2 .....

.....

[2]

(iii) A person has a lower than average number of white blood cells.

This person is more likely to become ill when infected by a pathogen than a person with an average number of white blood cells.

Suggest **two** reasons why.

.....

.....

..... [2]

[Total: 12]

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2 (a) (i) Figure. 2.1 is a diagram of the human breathing system.

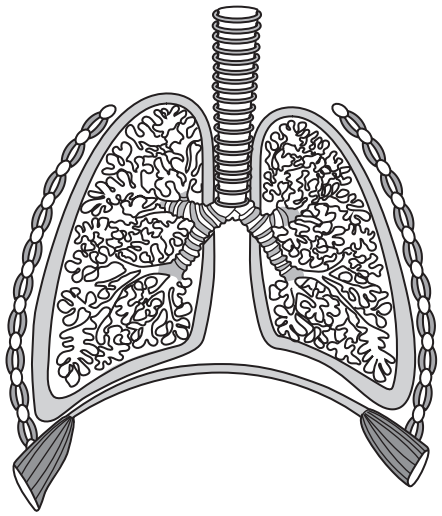

Figure. 2.1

On Figure. 2.1:

- draw a label line and the letter **T** to identify the trachea
- draw a label line and the letter **D** to identify the diaphragm.

[2]

(ii) Table 2.1 shows how the percentage of gases **X**, **Y** and **Z** changes in inspired air compared to expired air.

Table 2.1

gas	percentage in inspired air / %	percentage in expired air / %
X	0.04	4.00
Y	21.00	16.00
Z	variable	saturated

Identify which gas, **X**, **Y** or **Z** is oxygen.

..... [1]

(iii) Calculate the percentage increase in gas **X** in expired air compared to inspired air.

percentage increase = ...% [2]

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(b) (i) Cells use a gas from inspired air for aerobic respiration.

State the word equation for aerobic respiration.

..... + ... → ..... + ... [2]

(ii) Aerobic respiration releases energy.

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

1 .....

2 .....
[2]

(iii) Suggest how a lack of haemoglobin in red blood cells would affect aerobic respiration.

.....

..... [1]

[Total: 10]

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3 **(a)** Table 3.1 describes some terms used in genetics.

Choose words from the list to complete Table 3.1.

dominant **heterozygous** **homozygous** **inheritance**

phenotype **pure-breeding** **recessive**

Table 3.1

description	genetic term
The allele that is expressed if present in the genotype.	
The transmission of genetic information from generation to generation.	
Having two identical alleles of a particular gene.	
The observable features of an organism.	

[4]

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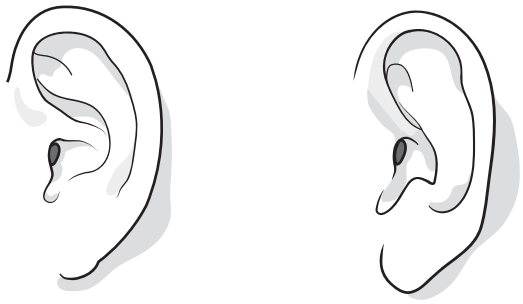
(b) Figure 3.1 shows two different earlobe shapes that humans have.



attached earlobe free earlobe

Figure 3.1

The allele for attached earlobes **(e)** is recessive to the allele for free earlobes **(E)**.

Two people with free earlobes have a child with attached earlobes.

The same two people are expecting a second child.

Complete the Punnett square to calculate the probability of the second child having **attached** earlobes.

		father's genotype	
		E	**e**
mother's genotype	.....	.....	.....
	.....	.....	.....

probability = ... [3]

(c) **(i)** New alleles may appear in a population.

Complete the sentence.

A new allele forms due to a genetic change called a ..... . [1]

(ii) Earlobe shape is an example of discontinuous variation.

Name **one** other example of discontinuous variation in humans.

..... [1]

[Total: 9]

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4 (a) (i) Complete the sentences about the nervous system of humans.

Choose words from the list.

chemical **electrical** **endocrine** **gland**

peripheral **receptor** **sensory** **spinal cord**

The central nervous system consists of the brain and ..... .

The three types of neurones in a reflex arc, are a ..... neurone, a relay neurone and a motor neurone.

The response to a stimulus is brought about by effectors such as muscles or a ..... .

Signals travel along neurones as ..... impulses.

[4]

(ii) Neurones form part of a reflex arc.

Figure 4.1 shows the three different types of neurones in a reflex arc.

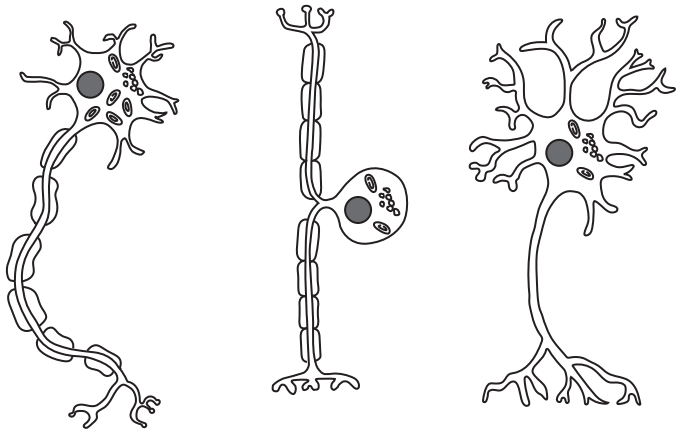

Figure 4.1

Identify the neurone in Figure 4.1 that is connected to a muscle.

..... [1]

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(b) Table 4.1 shows the number of neurones found in the brains of some different species.

Table 4.1

species	number of neurones in the brain
chimpanzee	28 000 000 000
gorilla	33 400 000 000
human	86 000 000 000
orangutan	32 600 000 000

Identify the species in Table 4.1 which has the lowest number of neurones in its brain.

..... [1]

(c) **(i)** The body secretes different hormones.

Name a hormone secreted by the:

ovary .....

pancreas .....

[2]

(ii) There are many different organs in the body which release hormones.

Figure 4.2 shows some organs of the human body that secrete hormones.

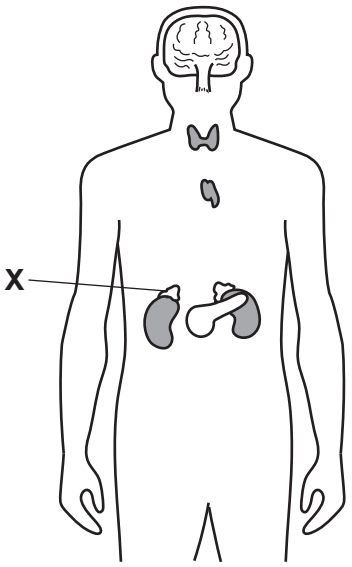


Figure 4.2

State **one** effect of the hormone secreted from the organ labelled **X** in Figure 4.2.

.....

..... [1]

[Total: 9]

5 **(a)** The list shows six molecules that contain carbon.

carbon dioxide

ethane

ethene

ethanol

methane

poly(ethene)

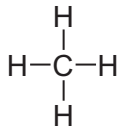
Use molecules from the list to answer the following questions.
Each molecule can be used once, more than once, or not at all.

Identify the molecule that:

(i) is the main constituent of natural gas

..... [1]

(ii) has the displayed formula



..... [1]

(iii) is **not** a hydrocarbon

..... [1]

(iv) is made from many smaller molecules called monomers

..... [1]

(v) has a carbon–carbon double bond (C=C).

..... [1]

(b) Carbon dioxide is produced when a carbonate reacts with an acid.

Balance the symbol equation for the reaction between magnesium carbonate and dilute hydrochloric acid.

$$MgCO_3 + ...HCl \rightarrow MgCl_2 + CO_2 + H_2O$$ [1]

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(c) Carbon dioxide is an acidic oxide.
Copper oxide is a basic oxide.

(i) Complete the sentence to explain why.

Metallic elements form ..... oxides and non-metallic elements

form ..... oxides.

[1]

(ii) Suggest the pH of the solution formed when carbon dioxide dissolves in water.

pH = ... [1]

(d) Table 5.1 shows some information about carbon and oxygen.

Use the Periodic Table on page 28 to complete Table 5.1.

Table 5.1

element	group in Periodic Table	number of protons in the nucleus	period number in Periodic Table
carbon		6	
oxygen	VI		2

[2]

[Total: 10]

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6 **(a)** Copper is a transition element.
Copper is a metal.

Tick (✓) the **two** correct statements about copper.

copper acts as a catalyst ☐

copper forms white compounds only ☐

copper has a low melting point ☐

copper is a good conductor of thermal energy ☐

copper is a poor conductor of electricity ☐

copper is not malleable ☐

[2]

(b) Brass is a mixture of copper and zinc.

(i) State the name given to a mixture of metals such as brass.

..... [1]

(ii) Identify which structure, **A**, **B**, **C** or **D**, in Figure 6.1 shows the arrangement of atoms in brass.

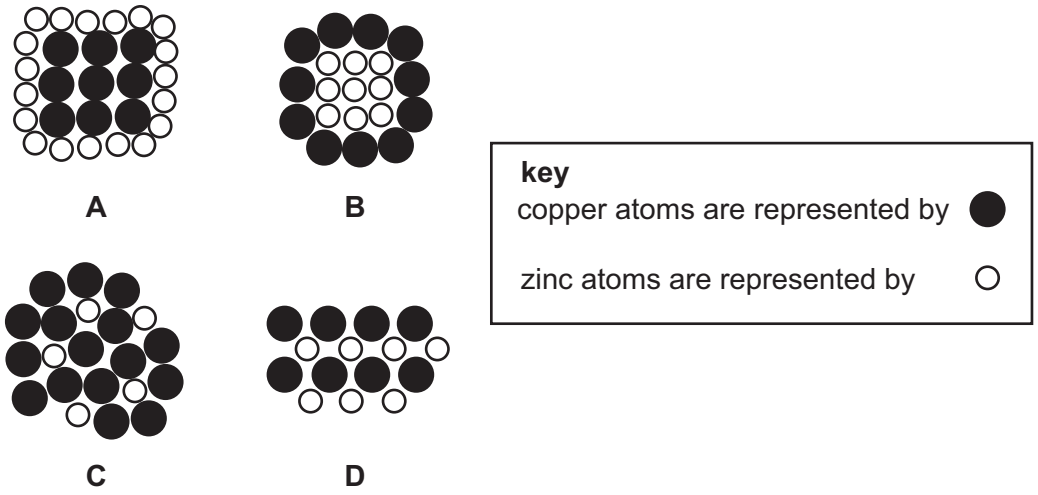

Figure 6.1

structure ..... [1]

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(c) An atom of copper is represented by $^{64}_{29}Cu$.

(i) State the mass number of this atom of copper.

..... [1]

(ii) Deduce the number of electrons in this atom of copper.

..... [1]

(iii) State the relative charge on an electron.

..... [1]

(d) A student adds dilute hydrochloric acid to three metals, copper, magnesium and iron.

Figure 6.2 shows the student's observations.

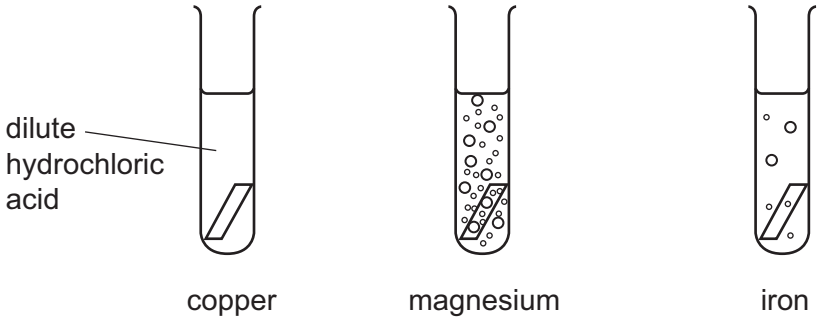

Figure 6.2

(i) Describe the reaction of copper with dilute hydrochloric acid.

..... [1]

(ii) When magnesium reacts with dilute hydrochloric acid, magnesium chloride and a gas are the products.

Write the word equation for this reaction.

..... + ... → ..... + ... [2]

(iii) Use your knowledge of the reactivity series to explain the student's observations for the reactions of magnesium and iron.

.....

.....

..... [1]

[Total: 11]

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7 **(a)** Sodium reacts with chlorine to produce sodium chloride.

(i) Explain why chlorine molecules are described as diatomic molecules.

.....

..... [1]

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

..... [1]

(b) Sodium chloride is a compound.
Sodium and chlorine are elements.

Explain the difference between an element and a compound.

element .....

.....

compound .....

.....
[2]

(c) When sodium reacts with chlorine, sodium ions are formed from sodium atoms and chloride ions are formed from chlorine atoms.
The electronic configuration of a sodium atom is 2,8,1.

State the electronic configuration of a sodium ion.

..... [1]

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(d) Figure 7.1 shows the apparatus used for the electrolysis of concentrated aqueous sodium chloride.

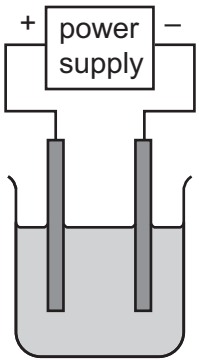

Figure 7.1

(i) On Figure 7.1, use a label line and the letter **E** to identify the electrolyte. [1]

(ii) On Figure 7.1, use a label line and the letter **C** to identify the cathode. [1]

(iii) Suggest a suitable material to make the cathode.

..... [1]

(iv) Identify the gases produced at the electrodes.

positive electrode

.....

negative electrode

.....

[2]

[Total: 10]

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8 **(a)** A student investigates the rate of reaction between equal sized pieces of calcium carbonate and excess dilute hydrochloric acid.
The student completes three experiments **A**, **B** and **C** using three different concentrations of dilute hydrochloric acid under the same temperature conditions.
The mass of calcium carbonate used in each experiment remains the same.

Figure 8.1 shows the apparatus used by the student.

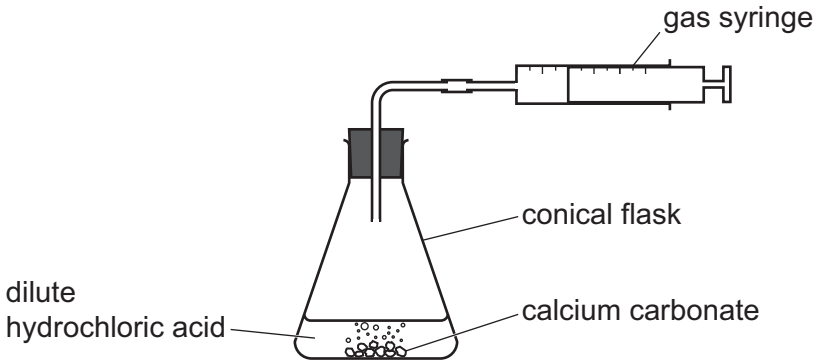

Figure 8.1

The volume of carbon dioxide gas that is produced is measured every 20 s during the reaction.

Figure 8.2 shows a graph of the results of the three experiments **A**, **B** and **C**.

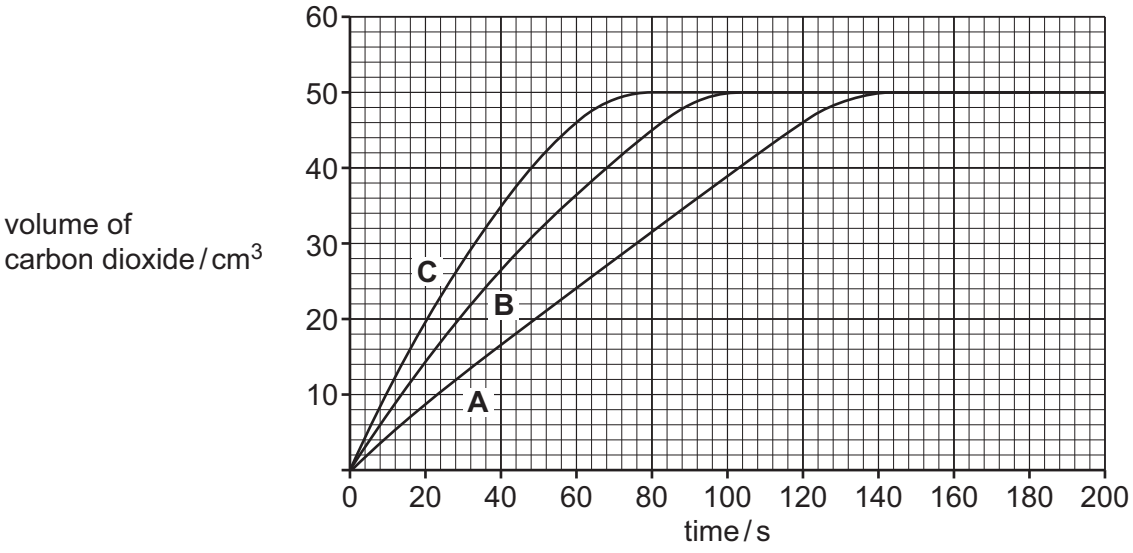

Figure 8.2

(i) Suggest one piece of apparatus that is not shown in Figure 8.1 which the student needs to investigate the rate of the reaction.

..... [1]

(ii) State the time taken for the reaction in experiment **B** to complete.

..... s [1]

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(iii) State the total volume of gas collected in experiment **A**.

..... cm^3 [1]

(iv) Identify the experiment, **A**, **B** or **C**, that uses the lowest concentration of acid.
Explain your answer.

experiment .....

explanation .....

.....

.....
[1]

(v) The student repeats experiment **C** using the same concentration of acid and the same mass of calcium carbonate.
In this experiment the student uses powdered calcium carbonate.

On Figure 8.2, draw a line to show the student's expected results. [2]

(b) Carbon dioxide gas is released during the reaction. Carbon dioxide is present in small quantities in clean dry air.

(i) Name the **two** gases which are present in clean dry air in the highest percentages.

1 .....

2 .....
[1]

(ii) Higher levels of carbon dioxide in the air lead to increased global warming and climate change.

State and explain one strategy to reduce the climate change.

strategy

.....

.....

explanation

.....

.....
[2]

[Total: 9]

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9 **(a)** There are eight planets in the Solar System.

Table 9.1 shows the names of some of the planets in order of distance from the Sun.

Table 9.1

increasing distance from the Sun ⟶

Mercury			Mars		Saturn		

(i) Complete Table 9.1 to show the names of the other planets in order of increasing distance from the Sun. [2]

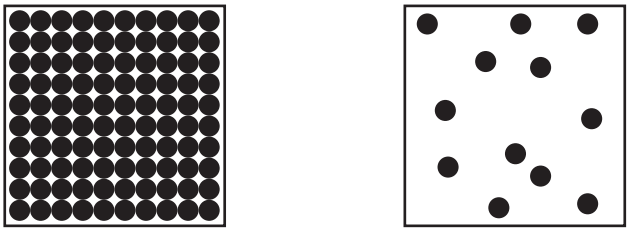
(ii) Explain why all the planets in the solar system orbit the Sun rather than another planet.

.....

..... [2]

(b) Earth is described as a solid rocky planet.
Jupiter is described as a gas giant.

Figure 9.1 shows the arrangement of atoms in a solid and in a gas.



solid gas

Figure 9.1

(i) Describe how the arrangement and motion of molecules in a gas differs from the arrangement and motion of the molecules in a solid.

.....

.....

.....

..... [2]

(ii) Complete the sentence about solids and gases.

The shape of a solid is ..... but the shape of a

gas is ..... .

[1]

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(c) Thermal energy is transferred from the Sun to the planets by radiation.

(i) Explain why this energy cannot be transferred by conduction or convection.

.....

.....

..... [1]

(ii) Identify the electromagnetic radiation that is involved in thermal energy transfer by radiation.

..... [1]

[Total: 9]

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10 (a) Figure 10.1 shows four forces acting on a submarine moving underwater.

The submarine is moving from right to left as shown.

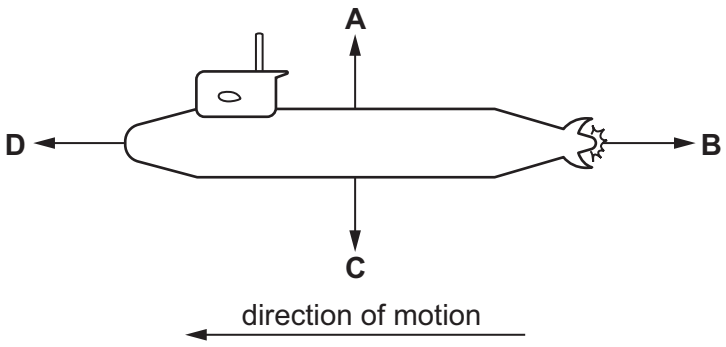

Figure 10.1

(i) State the name of force **C**.

..... [1]

(ii) Forces **B** and **D** have the same magnitude.

Describe the speed of the submarine.

.....

..... [1]

(iii) The submarine travels 35 km at a speed of 5 m / s.

Calculate the time taken, in seconds, to travel 35 km.

time = ... s [3]

(b) The submarine is powered by a nuclear reactor.

The nuclear reactor uses the isotope uranium-235.

(i) State the name of the process by which electrical energy is generated in a nuclear reactor.

..... [1]

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(ii) Ionising radiation is released inside the nuclear reactor.

Suggest why the nuclear reactor is surrounded by thick lead.

.....

..... [1]

(iii) The nucleus of a uranium atom consists of protons and neutrons.

State the charge on a proton and the charge on a neutron.

proton charge = ...

neutron charge = ...
[1]

(c) Submarines use ultrasound waves during underwater navigation.

Suggest a frequency in Hz of the ultrasound waves used.

frequency = ... Hz [1]

[Total: 9]

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11 **(a)** A torch (flashlight) contains a cell, a lamp and a switch connected in series.

(i) Draw the circuit diagram for the torch using electrical symbols.

[2]

(ii) The voltage across the lamp is measured using a voltmeter.

On the circuit drawn in **11(a)(i)** draw the voltmeter connected in the correct position. [2]

(iii) The voltage across the lamp is 3.0 V.
The current in the lamp is 0.25 A.

Calculate the resistance of the lamp.

resistance = ... Ω [2]

(b) Figure 11.1 shows a ray of light from the torch entering a glass block.

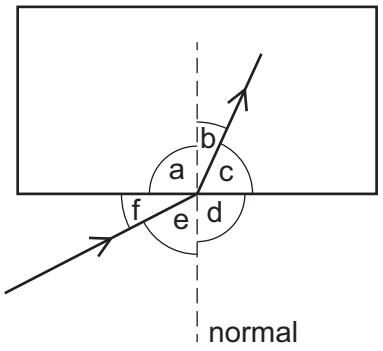

Figure 11.1

State the angle of incidence and the angle of refraction shown on Figure 11.1.

angle of incidence .....

angle of refraction .....

[1]

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(c) When a ray of light from the torch enters a glass prism, dispersion occurs, and the white light forms a visible spectrum.

Red and violet are two colours in the visible spectrum.

(i) Complete the list to show the five missing colours of the visible spectrum in the correct order.

red .... violet [1]

(ii) State which colour in the visible spectrum has the

longest wavelength .....

highest frequency ..... [1]

(iii) Red light has a wavelength of 7.0×10^{-7} m and travels at 3.0×10^{8} m/s.

Calculate the frequency of red light.

frequency = ... Hz [2]

[Total: 11]

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12 (a) Figure 12.1 shows a speed–time graph for a car moving in a straight line over a period of 50 seconds.

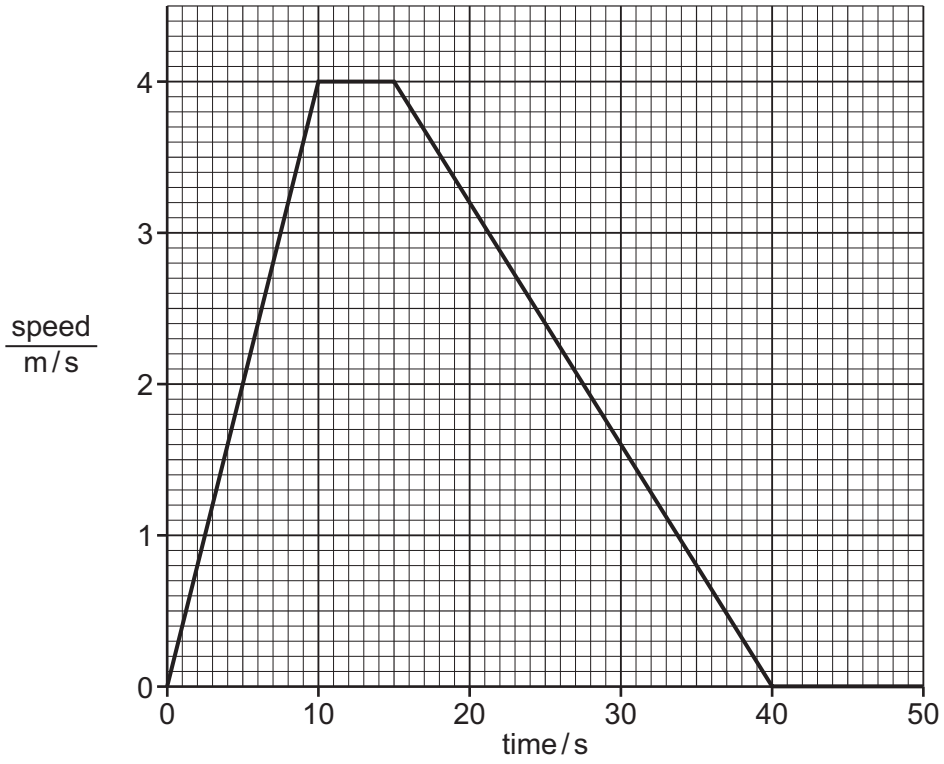

Figure 12.1

Complete the sentences using only these words or phrases.

accelerating **at rest** **decelerating** **moving at constant speed**

At time = 5 s the car is ..... .

At time = 12 s the car is ..... .

At time = 20 s the car is ..... .

At time = 45 s the car is ..... .

[2]

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(b) Figure 12.2 shows the energy flow diagram for the car powered by a petrol engine.

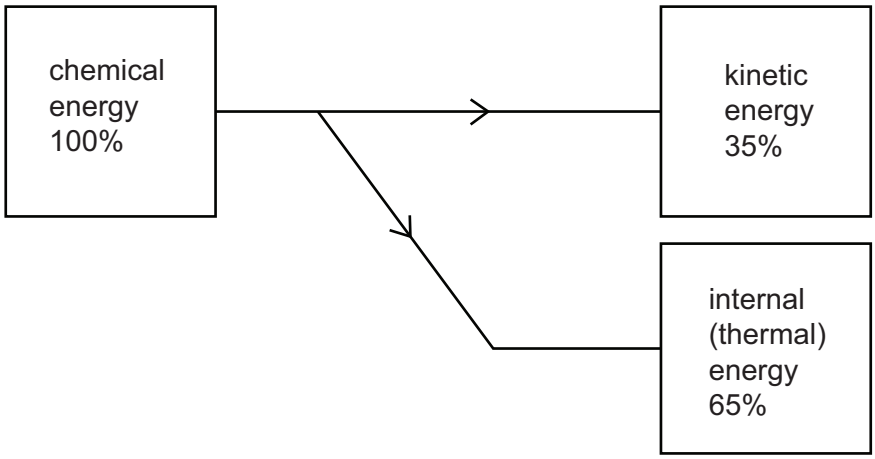

Figure 12.2

Using Figure 12.2 demonstrate the principle of conservation of energy.

.....

.....

..... [1]

(c) As the car travels along the road, electrostatic charges build up on the car due to friction.

State the name of the negatively charged particles that are transferred during the charging of a solid.

..... [1]

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(d) The car driver changes a wheel.

Figure 12.3 shows a wheel nut being loosened by a spanner of length 0.50 m.

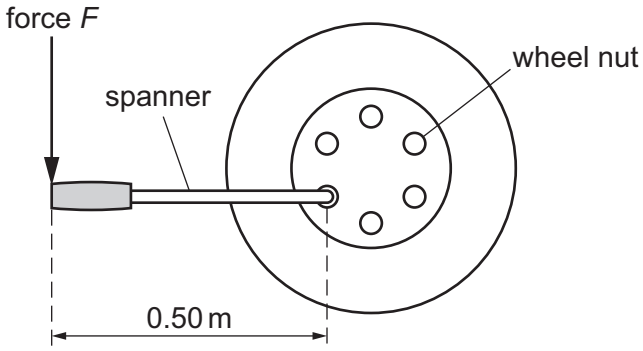

Figure 12.3

The driver knows that the moment of the force needed to loosen the wheel nut is 150 N m.

Calculate the force *F* that the driver needs to use.
State the unit of your answer.

force = ... unit ..... [3]

(e) The power of a car headlamp is 6.0 W when the potential difference across the headlamp is 12 V.

Calculate the current in the car headlamp.

current = ...A [2]

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(f) Powerful electromagnets are used at car scrapyards to separate iron from non-magnetic metals.

State two differences between an electromagnet and a permanent magnet.

difference 1

.....

.....

difference 2

.....

.....

[2]

[Total: 11]

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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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