Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

5099704626

COMBINED SCIENCE **0653/43**

Paper 4 (Extended) **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **21** printed pages and **3** blank pages.

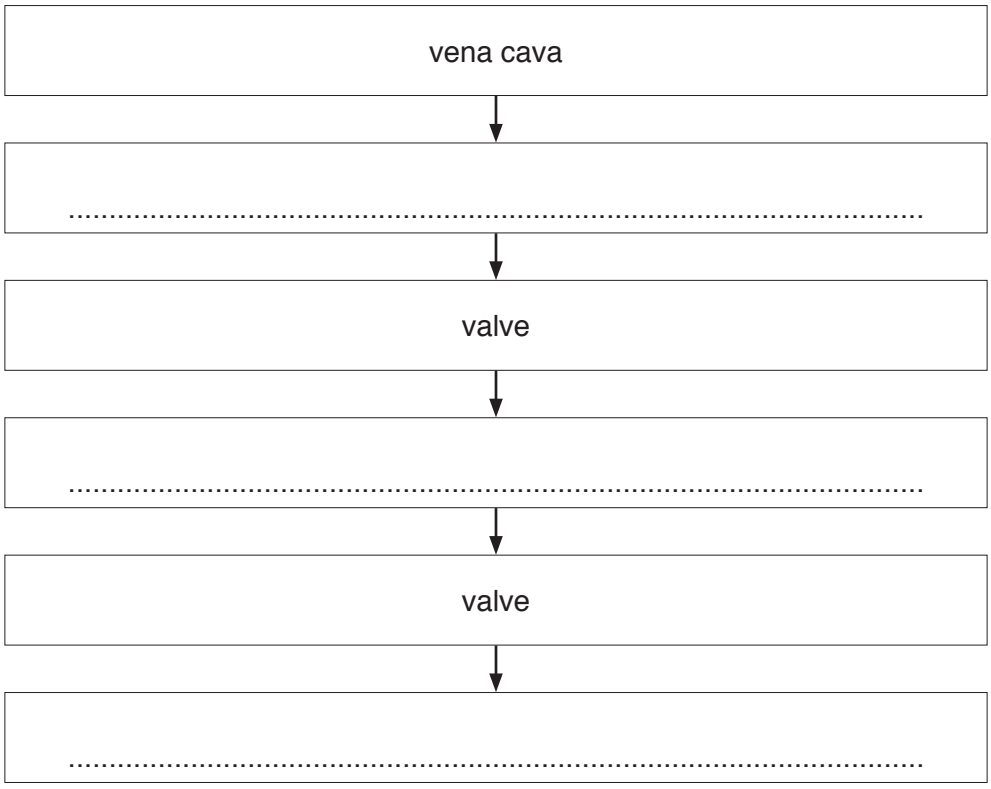
CAMBRIDGE International Examinations

1 **(a)** Use the following words or phrases to complete the flow chart about the structures the blood passes through on **one side of the heart** during the cardiac cycle.

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

aorta **left atrium** **left ventricle** **pulmonary artery**

right atrium **right ventricle** **valve**



[3]

(b) **(i)** Explain why the human circulation system is described as a *double circulation*.

.....

.....[1]

(ii) Explain why the blood leaving the left side of the heart has a higher pressure than blood leaving the right side of the heart.

Higher pressure is needed in the blood on the left side of the heart because .....

.....

.....

Lower pressure is needed in the blood on the right side of the heart because .....

.....

.....

[2]

(c) During exercise the heart rate and breathing rate both increase.

(i) Explain why the heart rate increases during exercise.

.....

.....

.....[2]

(ii) Explain why the breathing rate increases during exercise.

.....

.....[1]

(d) Smoking tobacco can have harmful effects on the gas exchange system and the body.

Choose **two** of the following components of tobacco smoke and describe **one** harmful effect of each component.

carbon monoxide **nicotine** **tar**

component .....

effect .....

.....

component .....

effect .....

.....

[2]

2 **(a)** The arrangements of particles in four substances are shown in Fig. 2.1.

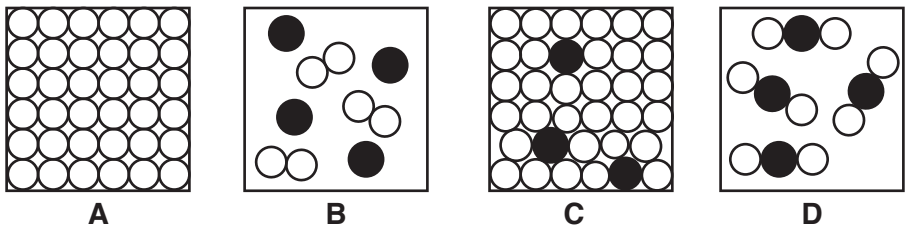


Fig. 2.1

Use letters **A**, **B**, **C** and **D** to identify

a pure substance, ...

a mixture, ...

an alloy, ...

a compound. .....

[2]

(b) A student adds pieces of calcium to dilute hydrochloric acid. A vigorous reaction is observed.

(i) Complete the balanced equation to show this reaction.

Include state symbols in the equation.

Ca(s) + 2 HC*l*(.....) → ..... (.....) + ... (.....)

[2]

(ii) The student repeats the reaction using a solution of hydrochloric acid that has a lower concentration.

State the effect of this change on the rate of the reaction.

Explain this effect using ideas about colliding particles in your answer.

effect on rate .....

explanation .....

.....

.....

[2]

(iii) State a simple chemical test that shows the presence of chloride ions in dilute hydrochloric acid.

test .....

result .....

[2]

(c) A salt contains iron(III) ions, Fe^{3+}, and sulfide ions, S^{2-}.

Determine the formula of this salt.

formula ..... [1]

3 Fig. 3.1 shows a toy car powered by batteries.

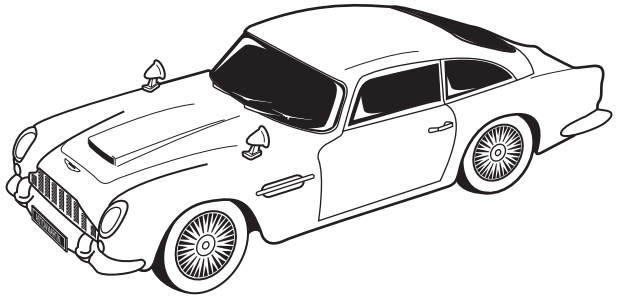


Fig. 3.1

Fig. 3.2 shows part of the circuit diagram for a circuit in the toy car, including the two headlamps which can be switched on when needed.

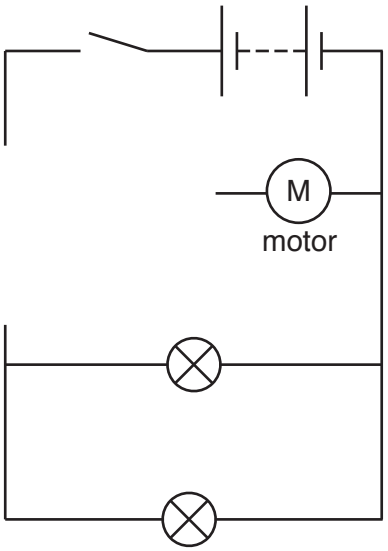


Fig. 3.2

(a) The car is driven by an electric motor which must be able to operate whenever the switch shown in Fig. 3.2 is on.

The speed of the electric motor is controlled by a variable resistor.

The two headlamps are only switched on when needed, so a separate switch controls both headlamps.

On Fig. 3.2, using the correct symbols, complete the circuit diagram by adding

- a variable resistor that controls the electric motor.
- the switch that controls both headlamps.
- any wires needed to complete the circuit connections.

[2]

(b) The resistance of the variable resistor is decreased in order to speed up the motor.

Suggest why decreasing the resistance will speed up the motor.

.....

.....[1]

(c) Complete the sentences below by writing the correct phrase in each space.

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

by an ammeter **by an insulator** **in parallel** **in series**

less than **more than** **the same as**

The electric motor and the headlamps are connected ..... .

When the car is travelling by day, the headlamps are switched off. The current through the motor is then ..... the current through the battery.

When the car is travelling at night, the headlamps are switched on. The combined resistance of the motor and headlamps is ..... the resistance of the motor before the headlamps are switched on. [3]

(d) The toy car travels at 5.0 km / h for 10 min before the battery runs out.

Calculate the distance travelled by the car during this 10 minute period.

Show your working.

distance = ... km [2]

[Turn over

4 Fig. 4.1 shows a diagram of the alimentary canal. The main areas where digestion takes place are labelled.

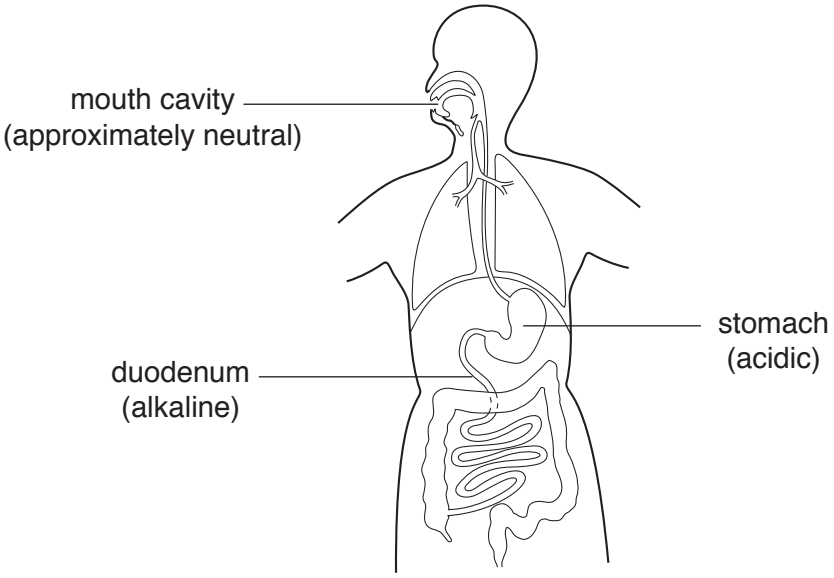


Fig. 4.1

(a) On Fig. 4.1 use a label line and the letter **A** to show where absorption of digested food occurs. [1]

(b) A student is investigating human digestive enzymes.

He has three test-tubes, **1**, **2** and **3**, containing protein solution at different pH values. He then adds the same enzyme to all three test-tubes and keeps them at 35 °C.

The protein solution is cloudy at the start of the experiment. If the protein in the solution is broken down the solution becomes clear and colourless.

The results are shown in Fig. 4.2.

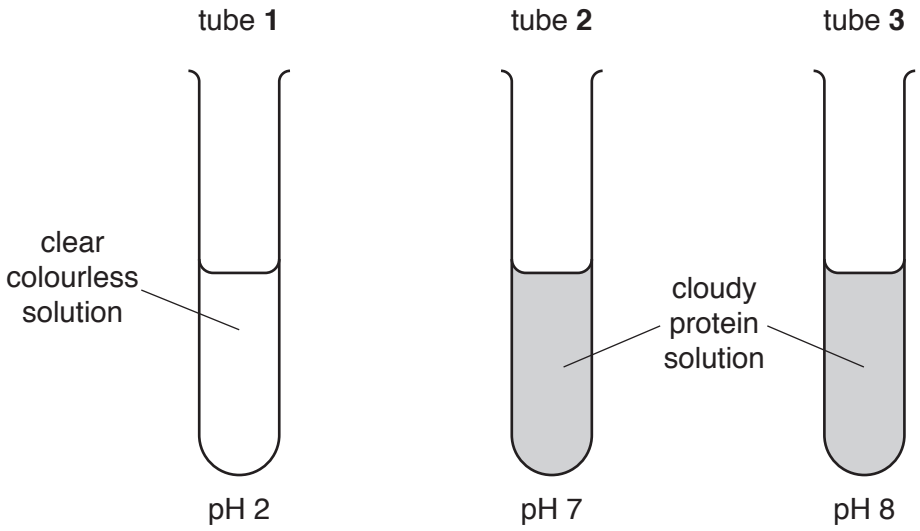


Fig. 4.2

(i) Use the information in Fig. 4.1 to identify the likely source of the digestive enzyme that produces the result in tube **1** in Fig. 4.2.

Explain your answer.

source of enzyme .....

explanation .....

.....

.....

.....

[3]

(ii) Explain why a temperature of 60 °C is **not** suitable for this experiment.

.....

.....

.....[2]

(iii) Explain why the change that takes place in tube **1** is an example of chemical digestion.

.....

.....

.....[2]

[Turn over

5 Fractional distillation of petroleum produces fractions containing different compounds.

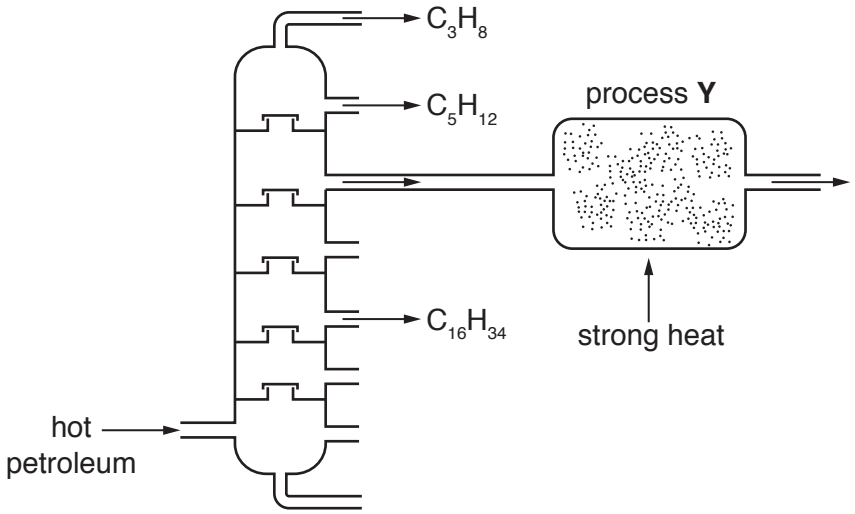


Fig. 5.1

(a) The formulae of three compounds contained in three fractions are shown in Fig. 5.1.

Describe the trend in the boiling points of these three compounds, from C_3H_8 to $C_{16}H_{34}$.

Explain this trend in terms of the sizes of the molecules and the forces between the molecules.

trend .....

explanation .....

.....

.....

[3]

(b) Process **Y**, shown in Fig. 5.1, changes the molecules in one fraction.

The molecular structure of a hydrocarbon produced in process **Y** is shown in Fig. 5.2.

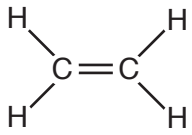


Fig. 5.2

(i) Name process **Y**.

.....[1]

(ii) Name the hydrocarbon shown in Fig. 5.2.

.....[1]

(iii) Name this **type** of hydrocarbon.

.....[1]

(iv) State the colour change that is seen when this hydrocarbon is added to bromine water.

from ..... to ..... [1]

(c) The combustion of a fossil fuel is an exothermic reaction.

Explain why this is an exothermic reaction.

Use ideas about temperature change and energy transformation in your answer.

.....

.....

.....[2]

[Turn over

6 Fig. 6.1a shows an insulated bag used to carry frozen food from the shop to home.

Fig. 6.1b shows the structure of the walls of the bag.

Fig. 6.1a

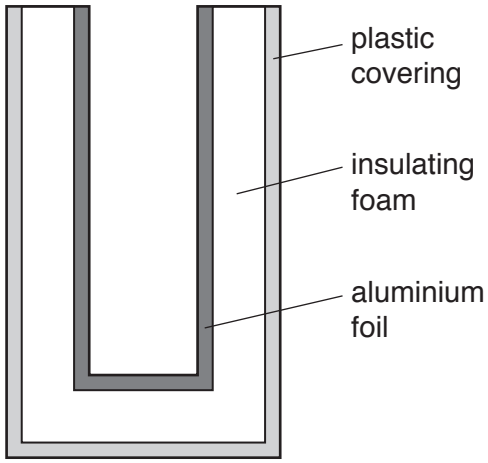


Fig. 6.1b (not to scale)

(a) The insulating foam is designed to reduce thermal energy transfer through the bag. It has many small pockets of trapped gas which reduce conduction of thermal energy.

(i) Describe how thermal energy is transferred through solids by conduction.

.....

.....

.....[1]

(ii) Suggest why the trapped gas is less able to transfer thermal energy by conduction.

.....

.....[1]

(b) The aluminium foil also helps to reduce thermal energy transfer.

Name the method of thermal energy transfer reduced by the use of aluminium foil.

.....[1]

(c) The food is transferred from the insulated bag into a refrigerator.

The refrigerator has an electric motor with a power input of 80 W when connected to a 240 V mains supply.

(i) Calculate the current through the electric motor.

State the formula you use and show your working.

formula

working

current = ... A [2]

(ii) Calculate the energy used by the refrigerator when the motor runs for one hour.

State the formula you use and show your working.

formula

working

energy = ... J [2]

7 Fig. 7.1 shows some processes occurring in a forest.

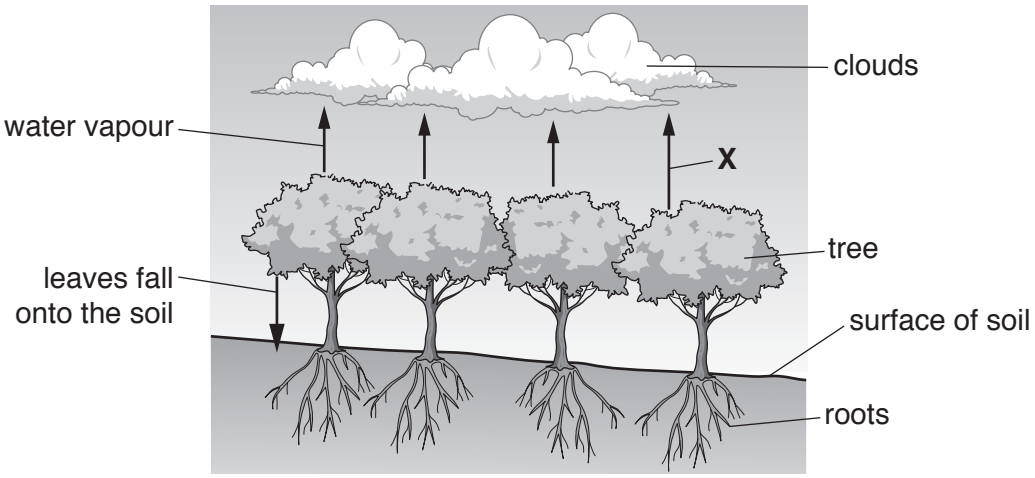


Fig. 7.1

(a) Name the process labelled **X**.

.....[1]

(b) The leaves of the trees contain nutrients in the form of minerals. When the leaves die they fall onto the soil. Organisms in the soil can make the minerals available to the trees again.

Name the type of organisms that make the minerals available. Explain your answer.

type of organism .....

explanation .....

.....

.....

[2]

(c) The trees in the forest shown in Fig. 7.1 are cut down.

Predict and explain the effect of clearing the trees on the amount of rain falling on the forest.

.....

.....[1]

(d) A storm occurs higher up the hill and water comes flowing down the hill.

Suggest how the soil in the cleared area will be affected by water from heavy rainfall flowing down the hill.

Explain your answer.

.....

.....

.....[2]

(e) The concentration of gases in the atmosphere changes immediately after the trees are cleared.

Describe and explain how the concentrations of the following gases change.

carbon dioxide .....

.....

oxygen .....

.....
[2]

8 **(a)** **(i)** The atomic number of oxygen is 8.

Complete Fig. 8.1 to show the electronic structure of an oxygen atom.

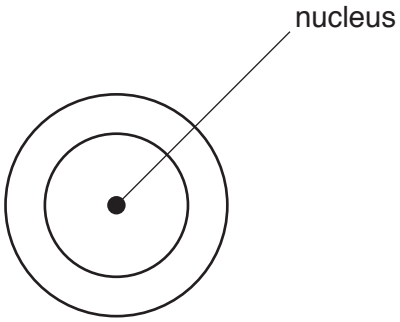


Fig. 8.1

[1]

(ii) Complete the dot-and-cross diagram of a molecule of water.

Show all the outer shell electrons.

H O H

[2]

(b) Element **Z** has two electrons in its outer shell.

Z is not the symbol for this element.

(i) Predict the group number of element **Z** in the Periodic Table.

..... [1]

(ii) An atom of element **Z** forms an ion.

State the charge of this ion.

Explain how this ion forms.

charge .....

explanation .....

.....

.....

[2]

(c) Potassium, copper and iron are extracted by different methods.

Complete Table 8.1 to show the order of reactivity of these three metals.

State the method of extraction of each metal from its ore.

Table 8.1

order of reactivity	metal	method of extraction
most reactive ↓ least reactive		

[3]

9 Fig. 9.1 shows four forces, **P**, **Q**, **R** and **S**, acting on a submarine travelling underwater. The submarine is moving to the right at constant speed.

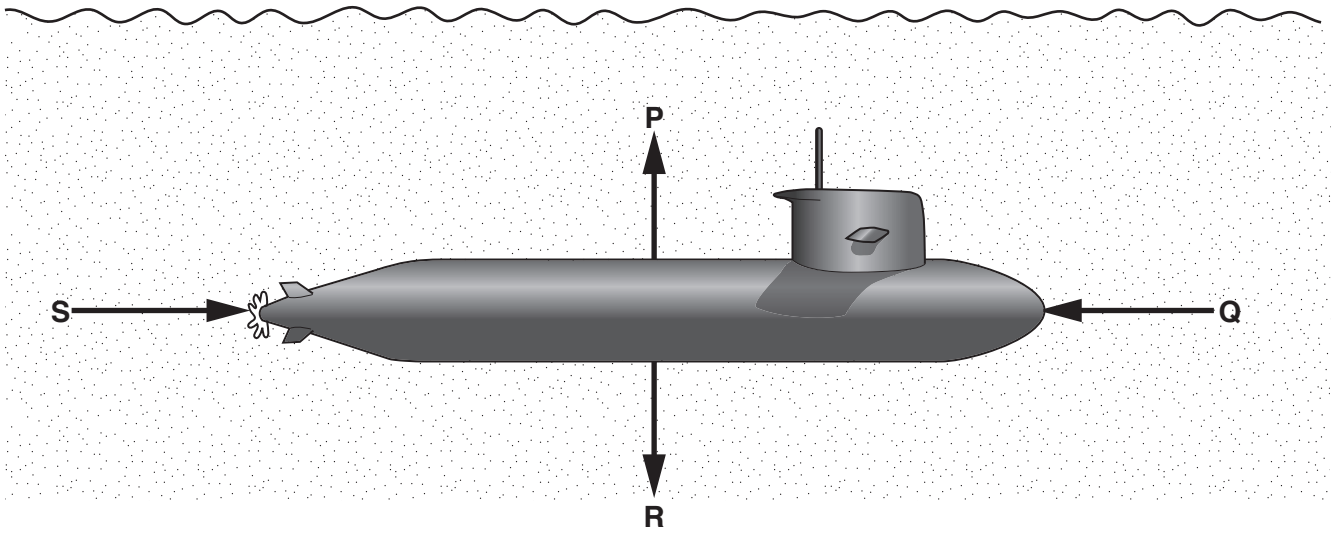


Fig. 9.1

The submarine has a mass of 3 000 000 kg.

(a) (i) Name force **Q**.

.....[1]

(ii) The submarine is travelling at constant speed at a constant depth.

State how the magnitude of force **Q** compares to the magnitude of force **S**.

.....[1]

(iii) Calculate the value of force **R**.

g = 10 N/kg

State the formula you use and show your working.

formula

working

force **R** = ... N [2]

(b) The captain orders the crew to bring the submarine to the sea surface from a depth of 50 m.

The crew change force **P** so that there is a net upward force of 100 000 N.

Calculate the work done by this upward force to bring the submarine to the surface.

State the formula you use and show your working.

formula

working

work done = ... J [2]

(c) **(i)** On the surface of the sea the captain is able to use a radio to send a message to his base.

The radio sends a signal at a frequency of 120 MHz.

Calculate the wavelength of the radio waves used.

Speed of electromagnetic waves = 3×10^8 m/s.

State the formula you use and show your working.

formula

working

wavelength = ... m [2]

(ii) Fig. 9.2 shows an incomplete electromagnetic spectrum. On Fig. 9.2 add radio waves in their correct place.

gamma rays			visible light		microwaves	

Fig. 9.2

[1]

(iii) Radio waves do not travel through sea water. But when submerged, submarines can receive sound signals from sound sources placed on the sea floor.

Sound is transmitted through water in the same way that it is transmitted through air.

Suggest how sound waves are transmitted through water. You should say how water molecules are involved, and you may wish to draw a diagram as part of your answer.

.....

.....

.....[2]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).