Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3520448561

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **May/June 2020**

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 **32** pages. Blank pages are indicated.

1 **(a)** A student investigates the conditions that affect germination of seeds.

Each test-tube has different conditions, as shown in Fig. 1.1.

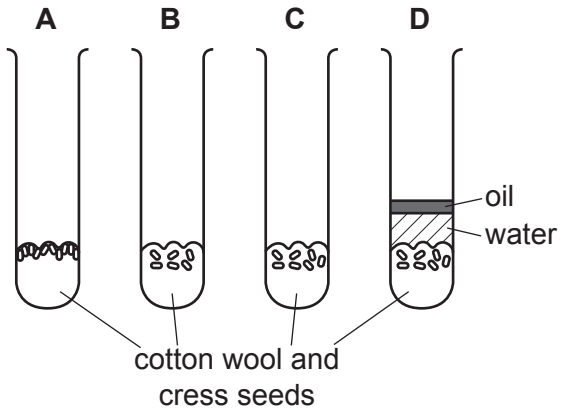


Fig. 1.1

Table 1.1 summarises these conditions.

Table 1.1

test-tube	temperature / °C	condition of cotton wool
A	20	damp
B	5	damp
C	20	dry
D	20	damp

Only the seeds in test-tube **A** germinate.

(i) State **one** conclusion about the conditions needed for germination shown by test-tubes:

A and **B** .....

.....

A and **C**. .....

.....
[2]

(ii) Suggest why the seeds in test-tube **D** did not germinate.

.....

..... [1]

(iii) Ten cress seeds were used in test-tube **A**. Only eight seeds germinated.

Calculate the percentage of seeds that germinated.

..... % [1]

(b) Seedlings of cress plants were grown in a Petri dish.

A lamp was placed next to the Petri dish, as shown in Fig. 1.2.

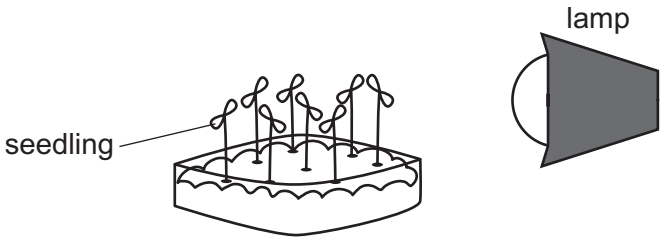


Fig. 1.2

(i) Draw an arrow on Fig. 1.2 to predict the direction of continued growth of the seedlings. [1]

(ii) State the name of the growth response to light in plants.

..... [1]

(c) Cress plants reproduce by sexual reproduction, which involves gametes.

(i) Use words or phrases from the list to complete the definition of the term *sexual reproduction*.

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

cell walls **chromosomes** **fetus**

nuclei **sex** **zygote**

Sexual reproduction is a process involving the fusion of the .....

of two gametes (..... cells) to form a .....

and the production of offspring that are genetically different from each other. [3]

(ii) State the function of the ovary in a plant.

.....

..... [1]

(iii) State the name of the **male** gamete in **humans**.

..... [1]

[Total: 11]

2 Calcium is in Group II of the Periodic Table.

(a) (i) An atom of calcium has a proton number (atomic number) of 20 and a nucleon number (mass number) of 40.

For this calcium atom state:

the number of **neutrons** it contains .....

its electronic structure. ..... [2]

(ii) Explain why atoms are electrically neutral.

Use ideas about protons and electrons.

.....

.....

.....

.....

..... [3]

(iii) State where the neutrons are in an atom.

..... [1]

(b) The main compound in limestone is calcium carbonate, $CaCO_3$.

(i) State the number of different elements in calcium carbonate.

..... [1]

(ii) Complete the word equation for the reaction between calcium carbonate and dilute hydrochloric acid.

calcium carbonate	+	hydrochloric acid	→		+		+	

[2]

(iii) Rainwater is slightly acidic.

The acid in rainwater reacts very slowly with limestone rocks.

Suggest two reasons for the very slow rate of reaction between rainwater and limestone rocks.

1 .....

.....

2 .....

.....

[2]

[Total: 11]

3 **(a)** Fig. 3.1 shows a distance-time graph of a girl's journey to school.

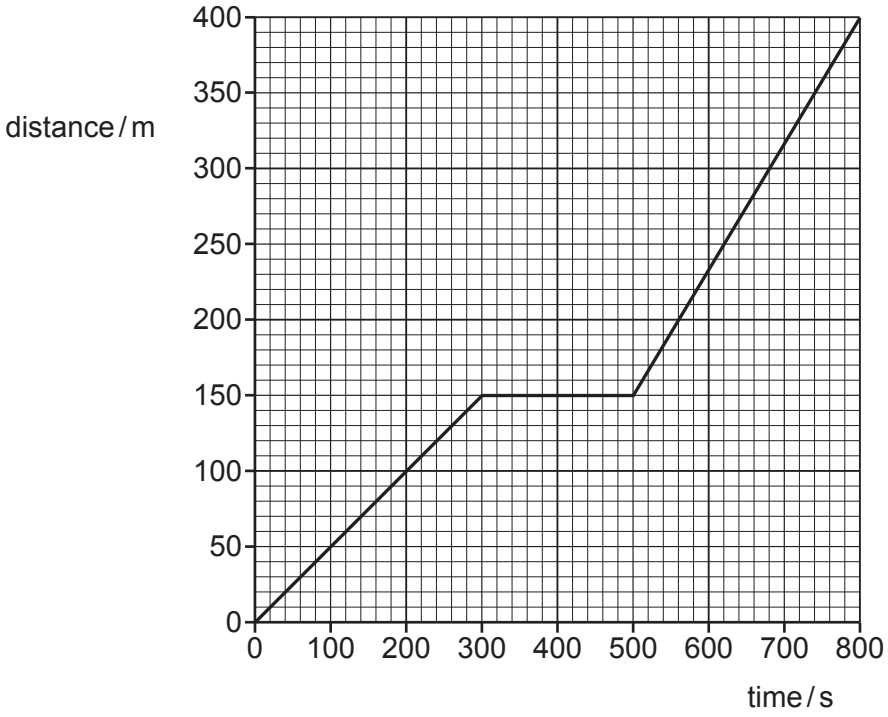


Fig. 3.1

(i) Write the letter **X** on part of the graph where the girl is walking fastest. [1]

(ii) Write the letter **Y** on part of the graph where the girl is not moving for a period of time. [1]

(iii) The girl walks a total distance of 400 m in 800 s.

Calculate her average speed.

average speed = ... m / s [2]

(b) At school, the girl places a brick onto a board with a rough surface, and raises one end of the board until the brick moves.

Fig. 3.2 shows the angle of the board when the brick starts to move.

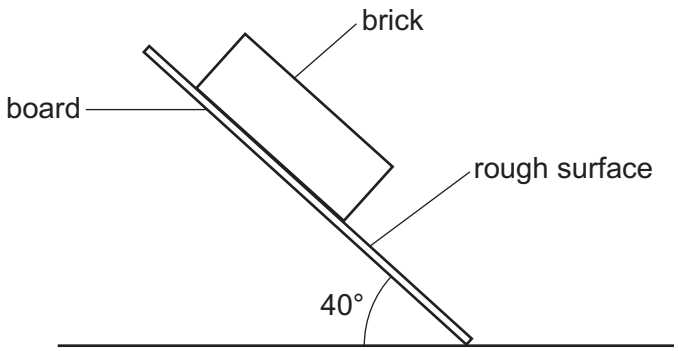


Fig. 3.2

(i) Name the force that prevents the brick from moving before the board is raised to 40°.

..... [1]

(ii) Suggest how the motion of the brick would be different if a board with a **smooth** surface was used.

.....

..... [1]

(iii) State the type of energy that decreases as the brick moves down the board.

..... [1]

(c) The girl then clamps a ruler to the side of a table as shown in Fig. 3.3.

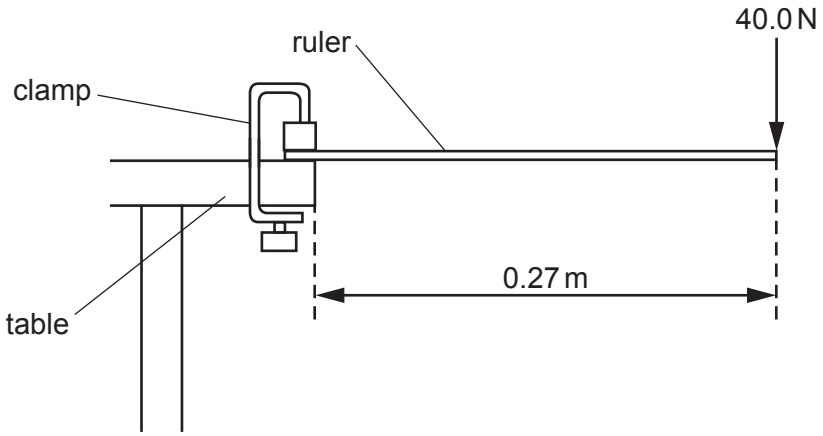


Fig. 3.3

She applies a force of 40.0 N to the end of the ruler which is 0.27 m from the edge of the table.

Calculate the moment of the force about the edge of the table.

moment = ... N m [2]

[Total: 9]

4 **(a)** Huntington's disease is an inherited disease which damages neurones in the brain.

The disease usually develops between the ages of 30–50.

- The allele for developing Huntington's disease is dominant, **H**.
- The allele for **not** developing Huntington's disease is recessive, **h**.

Fig. 4.1 shows the probability of the offspring of **cross 1** developing Huntington's disease.

cross 1 **hh × hh**

	h	h
h	hh	hh
h	hh	hh

probability of offspring developing Huntington's disease:

= 0%

cross 2 **Hh × hh**

	H	h
h	.....	.....
h	.....	.....

probability of offspring developing Huntington's disease:

= .....

Fig. 4.1

(i) Complete Fig. 4.1 to show the probability of the offspring of **cross 2** developing Huntington's disease. [2]

(ii) Name the type of breeding **cross 1** represents.

..... [1]

(iii) Use the example of the inheritance of Huntington's disease to state the heterozygous genotype.

..... [1]

(b) Alleles are versions of genes.

Genes are lengths of DNA that code for a protein.

(i) Circle the **four** elements that are in a protein.

carbon **calcium** **hydrogen** **oxygen**

nitrogen **water** **potassium**

[1]

(ii) Describe how to test a substance for protein.

Include the positive result.

.....

.....

..... [2]

(iii) The boxes on the left show large molecules.

The boxes on the right show small molecules.

Draw **four** lines to link each large molecule with the small molecules they are made from.

large molecules	small molecules
fats and oils	amino acids
glycogen	fatty acids and glycerol
protein	glucose
starch	

[3]

[Total: 10]

5 Fig. 5.1 is a pie chart showing the percentages of some of the elements in the Earth's crust.

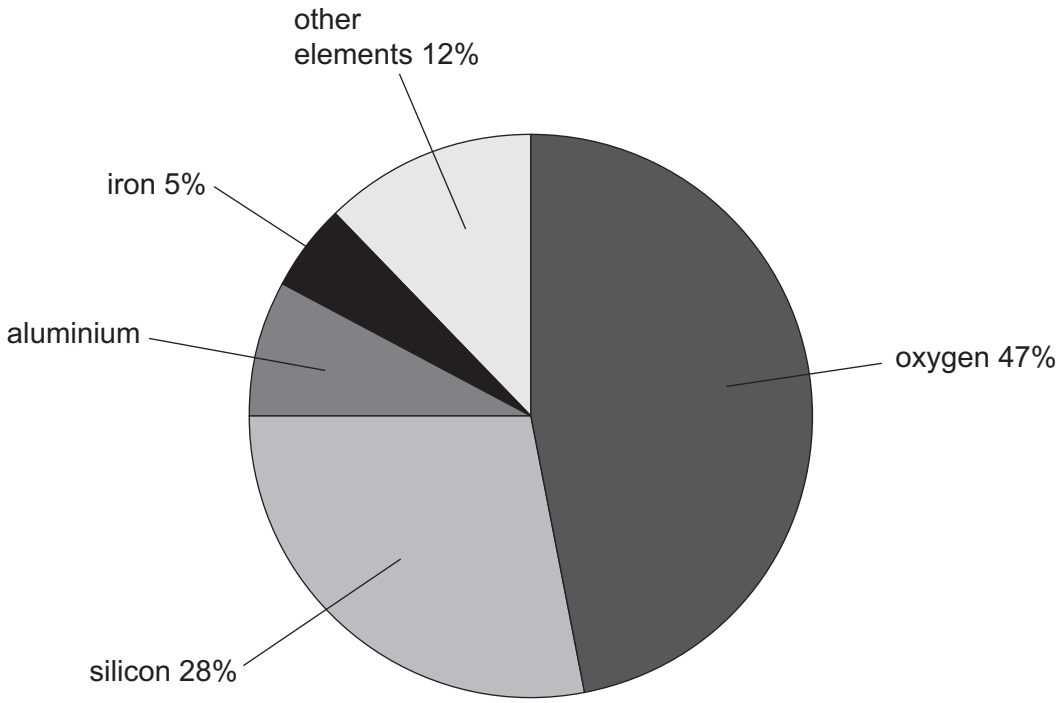


Fig. 5.1

(a) (i) Calculate the percentage of aluminium in the Earth's crust.

percentage of aluminium = ... % [1]

(ii) State the name of the ore from which aluminium is extracted.

..... [1]

(iii) State the name of the method used to extract aluminium from its ore.

..... [1]

(b) Aluminium in the form of a very thin sheet is known as aluminium foil.

Fig. 5.2 shows aluminium foil being made.

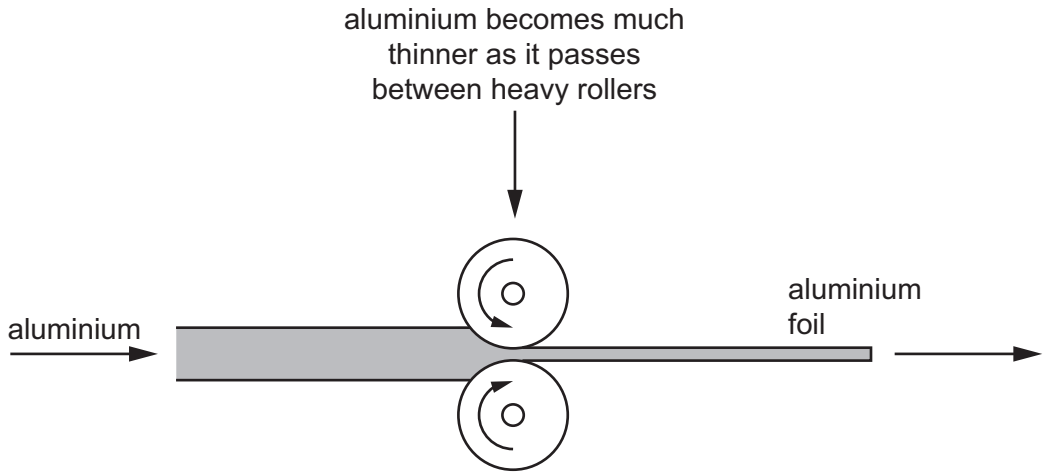


Fig. 5.2

(i) State and describe the **physical** property of aluminium that allows foil to be made in this way.

physical property .....

description .....

.....

.....

[2]

(ii) Aluminium foil is used to make food containers.

State the **chemical** property of aluminium that makes it suitable for this use.

..... [1]

(c) Alloys containing aluminium are used to make aircraft parts.

(i) State the meaning of the word *alloy*.

.....

..... [1]

(ii) Aircraft parts are made of aluminium alloys rather than pure aluminium.
Suggest why.

Use ideas about physical properties.

.....

..... [1]

(d) Mild steel is an alloy containing iron.

Mild steel is used to make car bodies.

Car bodies are painted to prevent rusting.

Explain in detail why painting car bodies prevents rusting.

.....

.....

.....

..... [3]

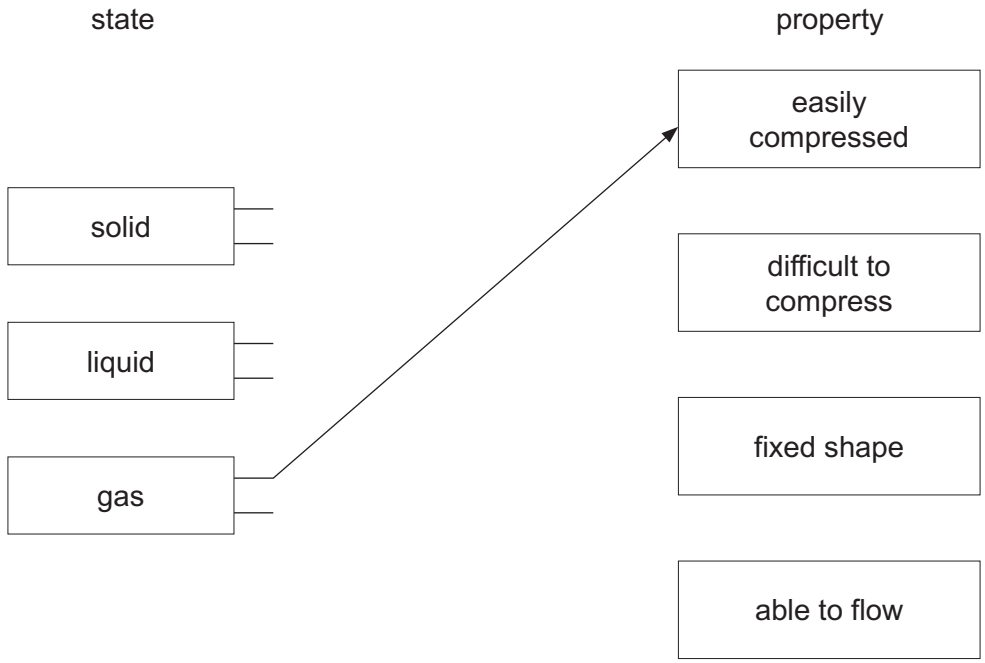
[Total: 11]

6 **(a)** Solids, liquids and gases have different properties.

Draw **two** lines from each state of matter to link to **two** correct properties of matter.

You may draw lines to each property of matter once, more than once or not at all.

One line has been drawn for you.



[3]

(b) When a liquid is heated, it expands.

(i) Describe how the structure of a liquid-in-glass thermometer is designed to make use of this property.

.....

.....

.....

..... [2]

(ii) When a liquid is heated to a high enough temperature, it starts to boil.

State the meaning of the term *boiling point*.

.....

..... [1]

(c) Some materials conduct thermal energy well, and other materials are better thermal insulators.

Complete Table 6.1 by placing a tick (✓) in the correct column for each material.

Table 6.1

material	thermal conductor	thermal insulator
aluminium		
copper		
plastic		
steel		
wool		

[2]

(d) State the name of the process that transfers thermal energy from the Sun through the vacuum of space.

..... [1]

(e) **(i)** Complete the sentence to describe sound waves.

Sound waves transfer ..... without transferring matter. [1]

(ii) State the approximate range of audible frequencies for a healthy human ear.

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

(iii) The pitch and loudness of a sound wave are increased.

State how the amplitude and the frequency of the sound wave changes.

amplitude .....

frequency .....
[1]

[Total: 12]

7 Fig. 7.1 shows a food chain.

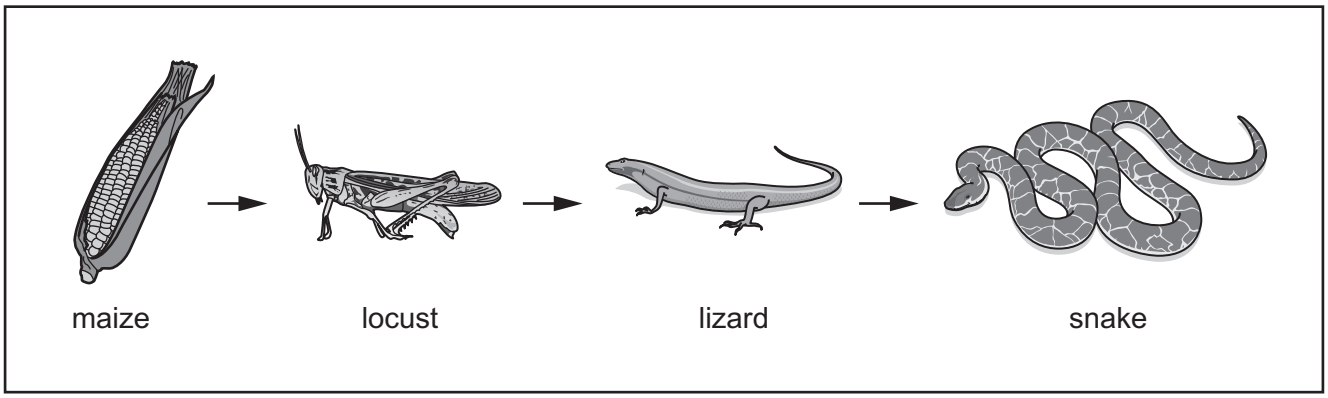


Fig. 7.1

(a) Table 7.1 shows some of the terms that can be used to describe the organisms in the food chain in Fig. 7.1.

Complete Table 7.1 by placing ticks (✓) to identify the terms that can be used to describe each organism in this food chain.

Table 7.1

	maize	locust	lizard	snake
producer				
consumer				
carnivore				

[3]

(b) The Sun is the principal source of energy input to biological systems.

Describe how energy from the Sun is used to make organic nutrients.

.....

.....

.....

.....

..... [3]

(c) Corn snakes are a type of snake often kept as pets.

Selective breeding has resulted in bright red-coloured corn snakes.

The sentences below describe the process of selective breeding of bright red corn snakes.

The sentences are **not** in the correct order.

Use numbers **1**–**5** to show the correct order.

The third sentence has been identified.

Their offspring are observed and bright red snakes identified.	3
This process is repeated over many generations.	
The two bright red corn snakes are bred together.	
Two bright red corn snakes are selected.	
The bright red offspring are bred.	

[2]

[Total: 8]

8 Water is a compound of the elements hydrogen and oxygen.

(a) (i) State **one** metallic element that reacts very quickly with water releasing hydrogen gas.

..... [1]

(ii) The reaction in **(a)(i)** produces an aqueous solution that has a pH greater than seven.

Explain why.

..... [1]

(b) (i) Fig. 8.1 shows what happens when a student tests a gas to check that it is hydrogen.

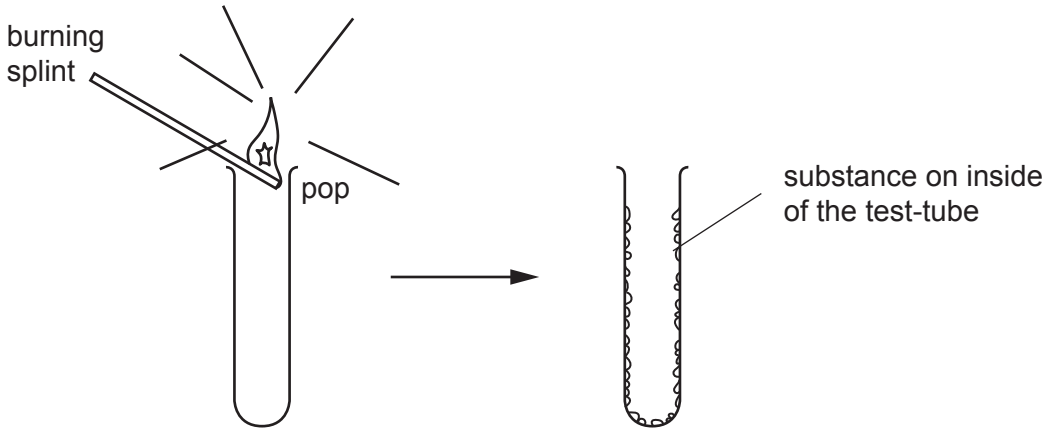


Fig. 8.1

Describe a chemical test the student uses to show that the substance in the test-tube is water.

test .....

result .....
[2]

(ii) Balance the equation for the combustion of hydrogen.

$$\text{.....}H_2 + O_2 \rightarrow \text{.....}H_2O$$

[1]

(c) Fig. 8.2 is a dot-and-cross diagram of a water molecule.

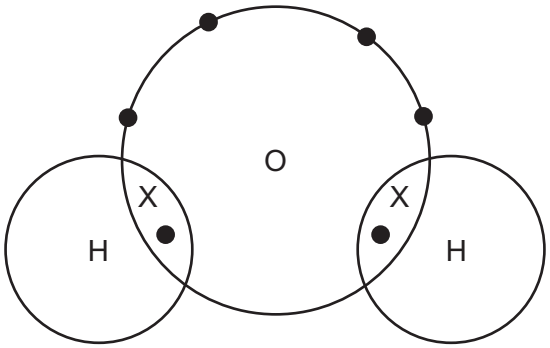


Fig. 8.2

State the type of chemical bonding in a water molecule.

..... [1]

(d) A student places an aqueous solution of sodium chloride into the apparatus shown in Fig. 8.3.

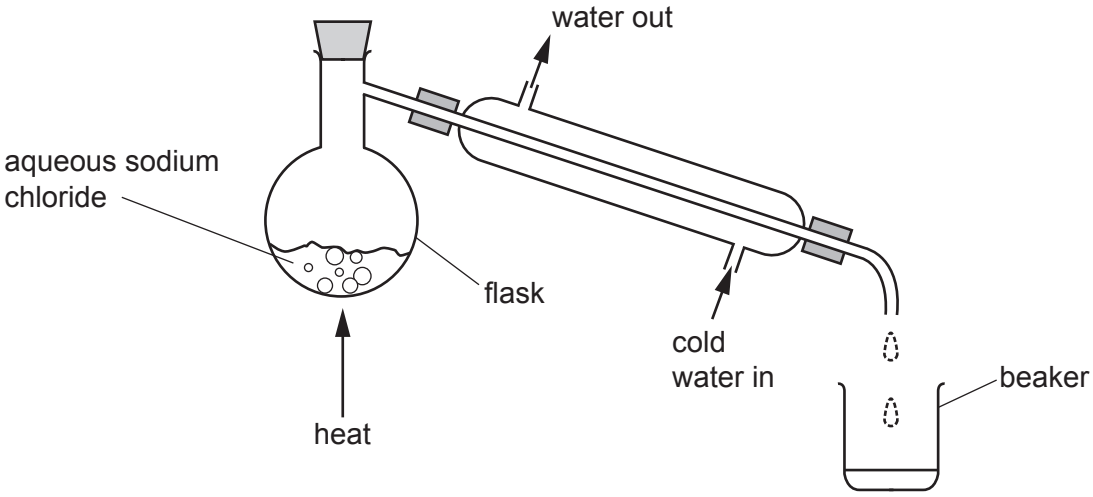


Fig. 8.3

Water collects in the beaker.

Solid sodium chloride remains in the flask.

(i) State the method of separation shown in Fig. 8.3.

..... [1]

(ii) Explain why water and sodium chloride can be separated using this method.

Use ideas about the **types** of chemical bond in these compounds.

.....

.....

.....

.....

..... [2]

[Total: 9]

9 **(a)** Fig. 9.1 shows visible light rays passing through a thin converging lens onto a screen.

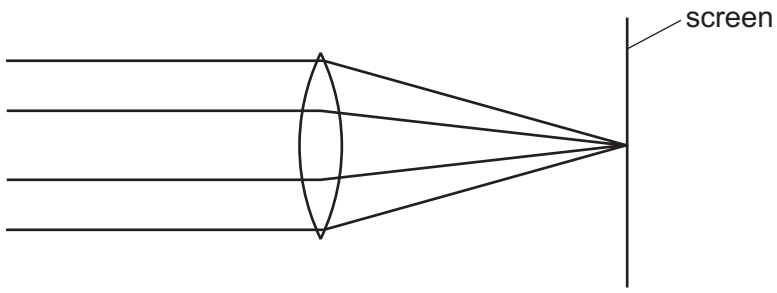


Fig. 9.1

(i) On Fig. 9.1, show the focal length of the thin converging lens using a doubled-headed arrow (⟷). [1]

(ii) On Fig. 9.1 label the position of the principal focus of the lens with the letter **F**. [1]

(iii) Write **visible light** in the correct position in the electromagnetic spectrum in Fig. 9.2.

	X-rays	ultraviolet				radio waves

[1]

Fig. 9.2

(iv) X-rays are used to look at bones in the human body.

Describe a safety precaution that is taken when using X-rays.

.....

..... [1]

(b) **(i)** X-rays are an example of *ionising radiation*.

State two other examples of ionising radiation.

1 .....

2 .....

[2]

(ii) State **one** effect of ionising radiation on living things.

..... [1]

(c) A sample of radioactive material is tested in a hospital laboratory.

A detector records the radioactive emissions from the sample.

The sample is moved away from the detector.

Explain why there is still some radiation detected by the radiation detector.

Suggest a source of this radiation.

explanation .....

.....

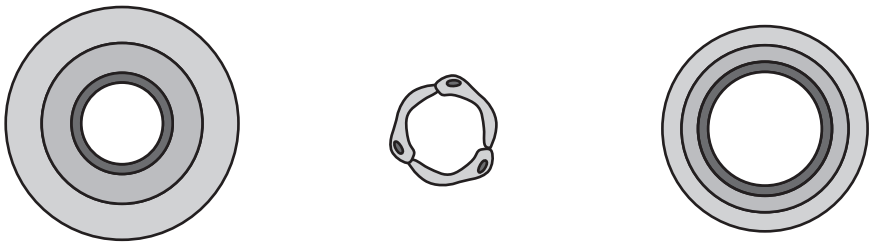
source .....

[2]

[Total: 9]

10 (a) Fig. 10.1 shows simplified cross-sections of three different types of blood vessel.

The artery has been identified.



artery ....

Fig. 10.1

Complete Fig. 10.1 to identify the other two types of blood vessel. [2]

(b) Table 10.1 shows three organs of the body.

The table also shows some of the blood vessels that transport blood to and from these organs.

Table 10.1

organ	name of blood vessel transporting blood to the organ	name of blood vessel transporting blood away from the organ
heart	vena cava	.....
lungs	pulmonary artery	.....
kidney	.....	.....

Complete Table 10.1 to show the main blood vessels to and from these organs. [3]

(c) Fig. 10.2 shows a description that a student has written about the circulatory system.

> The circulatory system is a system of airways with a pump and valves to ensure two-way flow of blood.

Fig. 10.2

Circle the **two** incorrect words in the description. [2]

(d) Plants have specialist tissues for transporting substances.

Fig. 10.3 is a simplified cross-section of a plant stem.

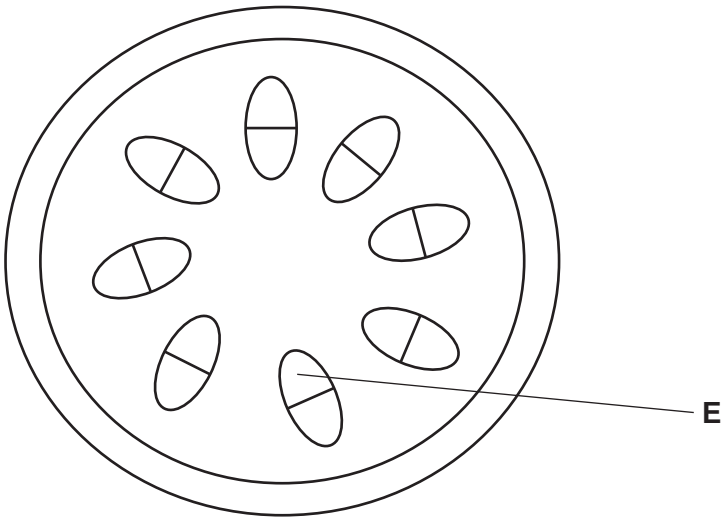


Fig. 10.3

(i) Identify the tissue labelled **E** in Fig. 10.3.

..... [1]

(ii) Name the plant tissue responsible for transporting dissolved sugars.

..... [1]

(iii) Describe where water enters **and** exits a plant.

enters .....

.....

exits .....

.....

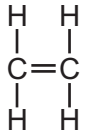
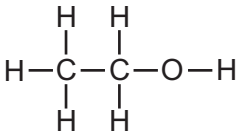
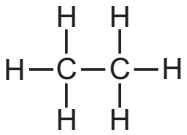
[2]

[Total: 11]

11 Ethane, ethene and ethanol are carbon compounds.

(a) Complete Table 11.1.

Table 11.1

molecular structure	name of carbon compound
	.....
	.....
	.....

[2]

(b) Fig. 11.1 is a diagram of an industrial process to make ethanol.

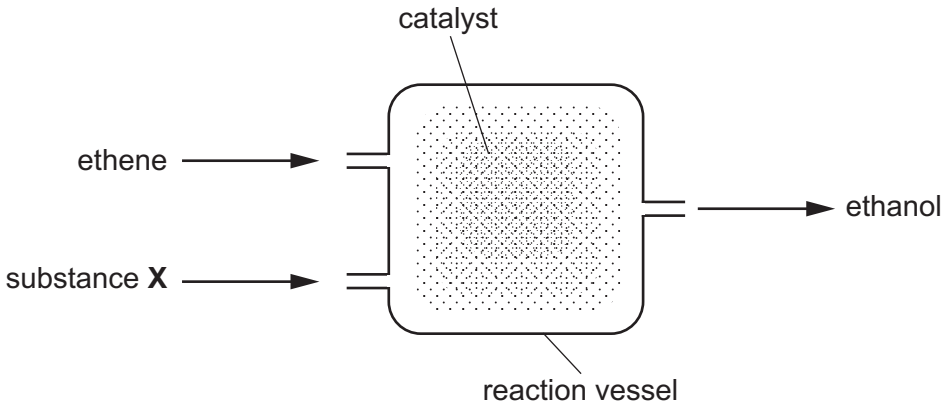


Fig. 11.1

(i) Identify substance **X**.

..... [1]

(ii) Suggest why a catalyst is needed in the reaction vessel.

.....

..... [1]

(c) Fig. 11.2 shows apparatus and materials a student uses to make ethanol in a school laboratory.

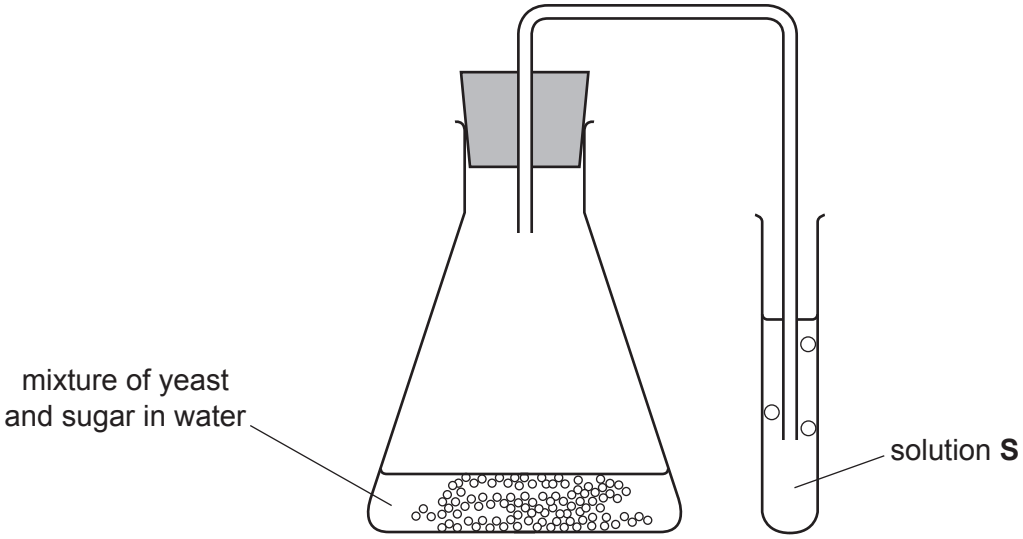


Fig. 11.2

(i) State the name of this process.

..... [1]

(ii) The student observes a gas bubbling into solution **S**.

Solution **S** becomes milky.

Identify the gas and solution **S**.

gas .....

solution **S** .....
[2]

(d) Fig. 11.3 shows apparatus the student uses to measure the change in mass when ethanol burns in air.

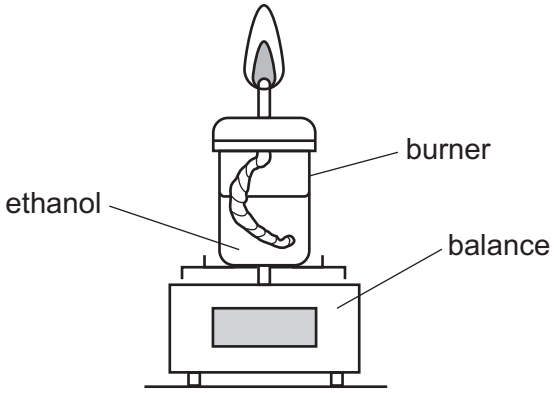


Fig. 11.3

The mass of the burner and ethanol decreases during the experiment.

Suggest why.

.....

.....

.....

.....

..... [3]

[Total: 10]

12 (a) Fig. 12.1 shows an electric circuit.

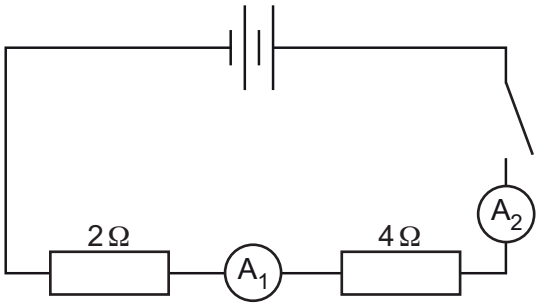


Fig. 12.1

(i) With the switch closed, ammeter A_1 shows a reading of 0.5 A.

State the reading on ammeter A_2.

..... A [1]

(ii) A boy measures the potential difference across a resistor in the circuit.

Name the instrument the boy uses to measure the potential difference.

..... [1]

(b) Fig. 12.2 shows a circuit with two resistors in parallel.

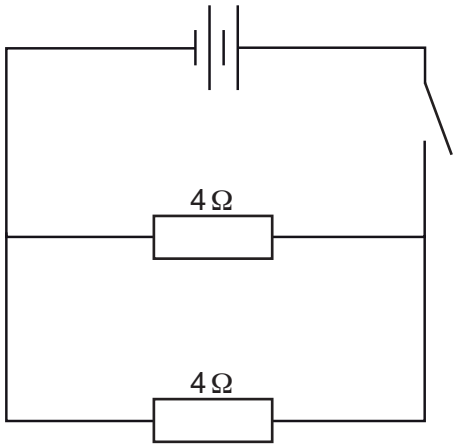


Fig. 12.2

Identify, from the list, the most likely value of the combined resistance of the resistors in parallel.

Explain your answer.

2 Ω **4 Ω** **8 Ω** **16 Ω**

value ..... Ω

explanation .....

.....

[2]

(c) Complete the sentences using the words in the list.

You can use each word once, more than once or not at all.

current **potential difference** **e.m.f.** **resistance**

The flow of charge in a circuit is called the ..... .

..... is a measure of the difficulty for a charge to flow in an electrical circuit. [2]

(d) One of the wires in the circuit was investigated to see the pattern of the magnetic field around it.

On Fig. 12.3 draw the expected pattern and direction of the magnetic field on the square piece of card.

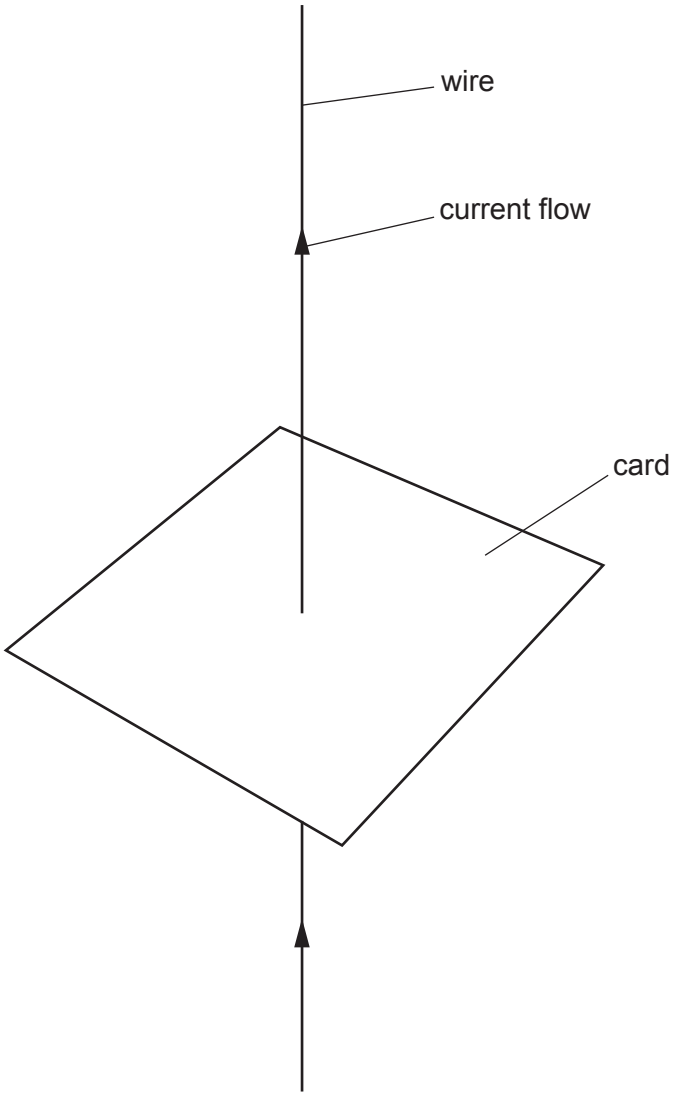


Fig. 12.3

[3]

[Total: 9]

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.).