Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4436106192

PHYSICAL SCIENCE **0652/31**

Paper 3 Theory (Core) **October/November 2022**

1 hour 15 minutes

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 80.
- 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 **24** pages. Any blank pages are indicated.

1 **(a)** A climber needs to know the diameter of a rope.

Fig. 1.1 shows a method for measuring the diameter of a rope.

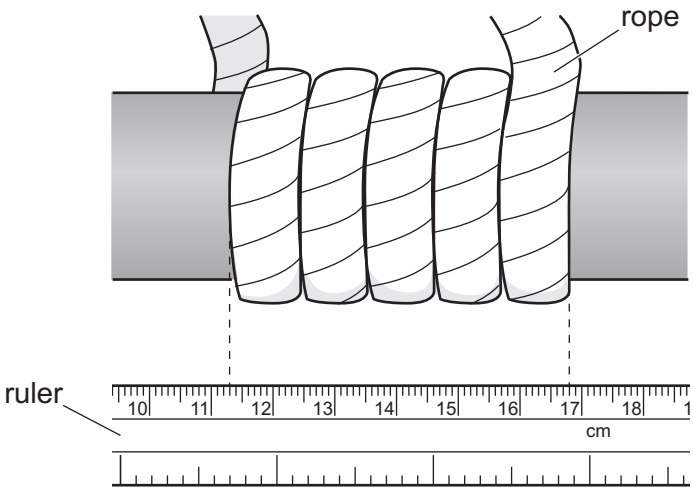

Fig. 1.1

Calculate the diameter of the rope.

Show your working.

diameter = ... cm [2]

(b) Fig. 1.2 shows the climber climbing a wall.

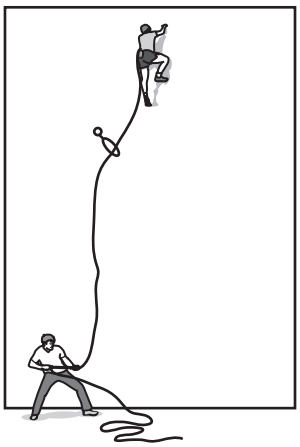

Fig. 1.2

(i) The mass of the climber is 70 kg.

Calculate the weight of the climber.

Use g = 10 N / kg.

weight = ... N [1]

(ii) The climber slips and falls. He comes to rest and is held in a stationary position by the rope, as shown in Fig. 1.3.

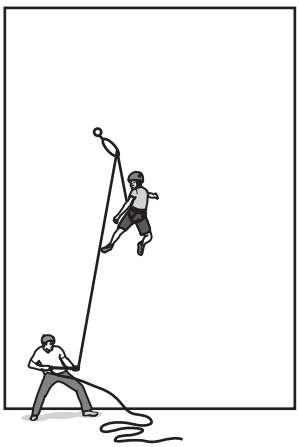

Fig. 1.3

State how we know that the resultant force on the climber in Fig. 1.3 is zero.

.....

..... [1]

(iii) State the size and direction of the force exerted by the rope on the climber.

size of force ..... N

direction of force .....

[1]

[Total: 5]

2 Fluorine is an element in the Periodic Table.

(a) Use the Periodic Table on page 24 and words from the box to complete these sentences.

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

one	**two**	**three**	**four**	**five**
six	**seven**	**eight**	**nine**	**ten**

Fluorine is an element in Group ..... of the Periodic Table.

An atom of fluorine has ..... electrons in its outer shell.

Fluorine has an atomic number of ..... .

A fluoride ion has a negative charge of ..... .

[4]

(b) Fluorine reacts with potassium to form a salt.

Suggest the name of this salt.

..... [1]

[Total: 5]

3 Car tyres contain air under pressure.

Fig. 3.1 shows two tyres, **A** and **B**, supporting the same weight of car.

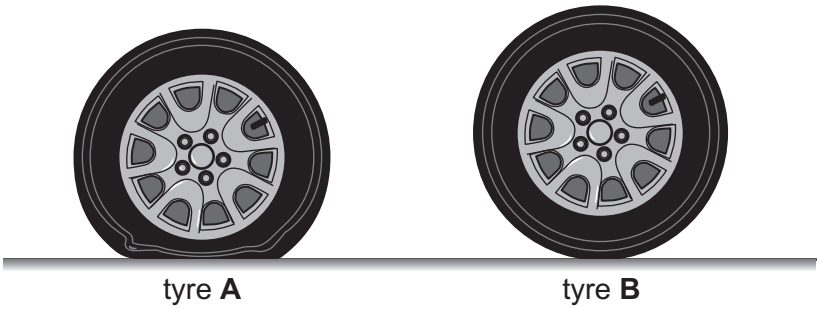

Fig. 3.1

Tyre **A** contains less air than tyre **B**.

(a) Use the words pressure, area and force to explain why the tyres have a different shape.

.....

.....

..... [2]

(b) A wheel on the car is changed.

A jack is used to raise the car up, as shown in Fig. 3.2.

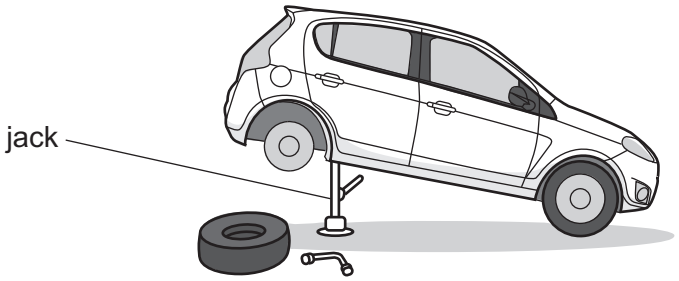

Fig. 3.2

Complete the sentence by using words from the box.

Use each word once, more than once or not at all.

elastic	**force**	**joule**	**potential**	**power**	**work**

As the car is lifted, ... is done on the car by the jack and the car gains ..... energy. [2]

(c) Fig. 3.3 shows a spanner used to undo a wheel nut.

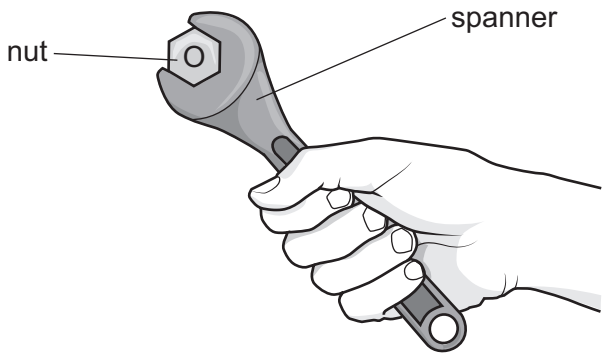

Fig. 3.3

(i) A force applied by the hand produces a moment.

State what is meant by the term moment of a force.

.....

..... [1]

(ii) A large moment is needed to undo the nut.

State **two** ways of increasing the moment.

1 .....

2 .....
[2]

[Total: 7]

4 Fermentation is used to make ethanol.

A gas is also produced.

(a) A chemical test shows that this gas is carbon dioxide.

State the chemical used in the test and the result of a positive test.

chemical .....

result .....

.....

[2]

(b) Ethanol is used as a fuel.

(i) State the **two** products formed when ethanol is burnt in excess oxygen.

1 .....

2 .....

[2]

(ii) State **one other** use of ethanol.

..... [1]

(c) Some fuels are compounds of carbon and hydrogen only.

State the general name for these compounds.

..... [1]

(d) An organic compound contains two carbon atoms and four hydrogen atoms.

(i) Draw the structure of the compound.

[1]

(ii) State the name of this compound.

..... [1]

[Total: 8]

5 Fig. 5.1 shows apparatus used to react excess zinc with hydrochloric acid.

The mass of the flask and its contents is measured at regular intervals and the mass lost is recorded.

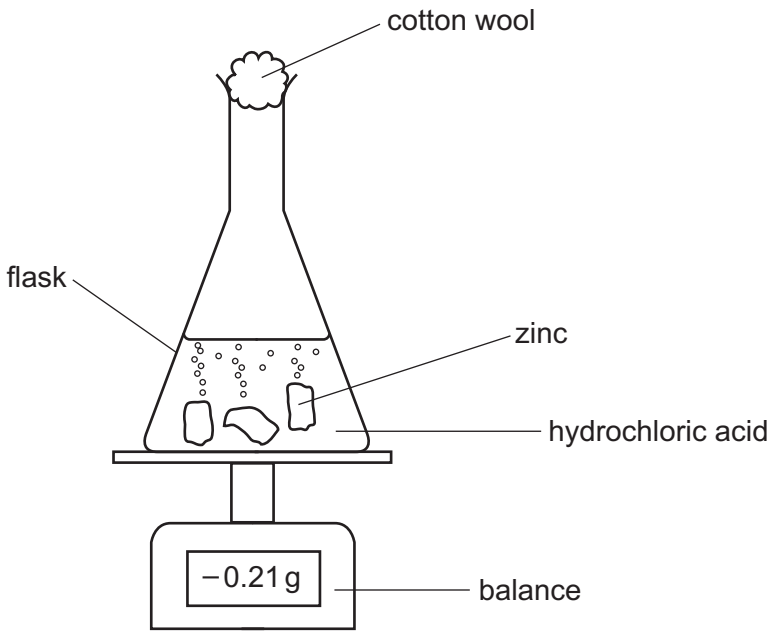

Fig. 5.1

(a) (i) Complete the word equation for this reaction.

zinc + hydrochloric acid → [ ] + [ ] [2]

(ii) Suggest **two** ways of increasing the rate of this reaction.

1 .....

2 .....
[2]

(b) The graph in Fig. 5.2 shows the mass lost from the flask and its contents over time.

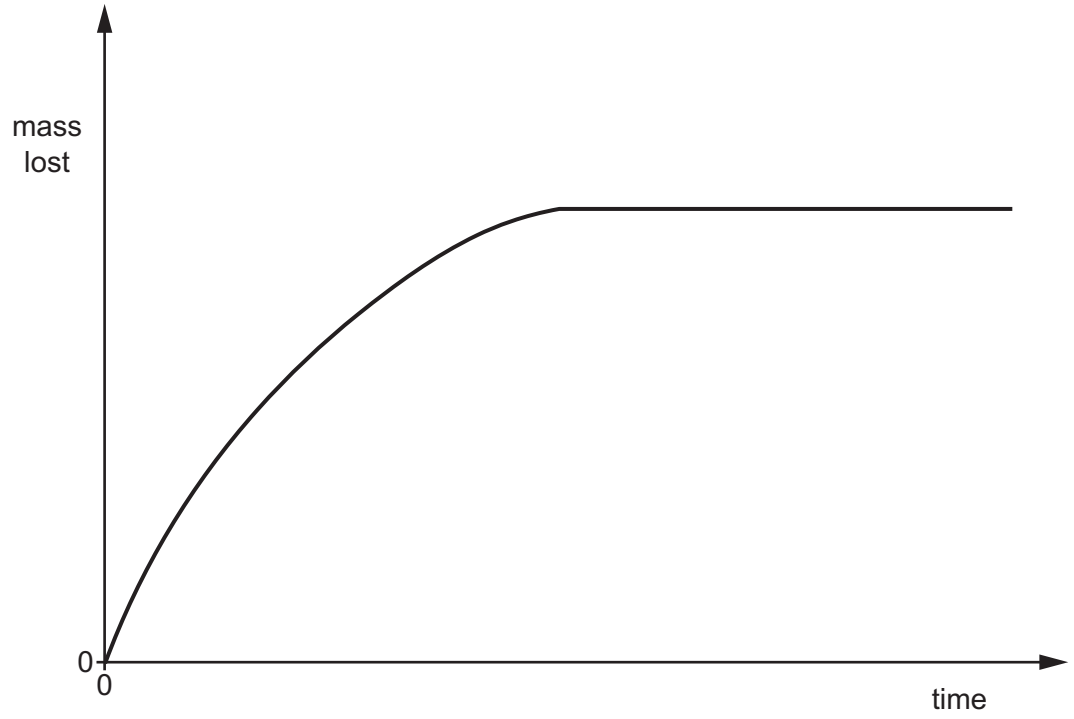

Fig. 5.2

(i) Suggest why the mass lost eventually stops increasing.

..... [1]

(ii) The experiment is repeated using half the volume of hydrochloric acid of the same concentration.

On the axes of Fig. 5.2, sketch the curve that is produced. [2]

(c) Zinc is mixed with copper to make an alloy.

State the name of this alloy.

..... [1]

[Total: 8]

[Turn over

6 A farmer uses a tape attached between two poles to scare birds, as shown in Fig. 6.1.

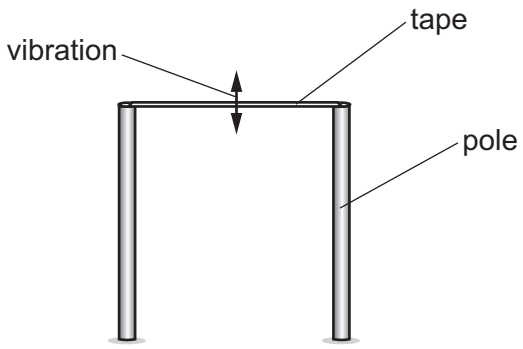

Fig. 6.1

The wind causes the tape to vibrate and make a noise.

(a) Describe how the tape produces a sound wave in the air.

.....

..... [1]

(b) Describe how the eardrum detects the sound wave.

.....

..... [1]

(c) State the lowest frequency of sound audible to the human ear.

lowest frequency = ... Hz [1]

(d) Sound waves change speed when they travel from warm air to cold air. This results in a change in direction of the sound wave.

State the name of this process.

..... [1]

[Total: 4]

7 Table 7.1 gives information about some atomic particles.

(a) Complete Table 7.1 to show the missing information.

Table 7.1

particle	position in atom	relative charge	relative mass
proton	in nucleus	.....	1
electron	outside nucleus	.....	.....
.....	in nucleus	0	.....

[5]

(b) An atom of sodium, Na, has 11 electrons.

Complete the diagram in Fig. 7.1 to show the number of electrons in each shell.

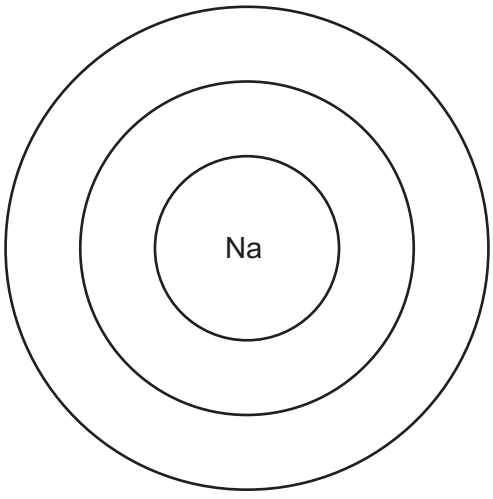

Fig. 7.1

[1]

[Total: 6]

8 Fig. 8.1 shows the design of an energy-saving kettle.

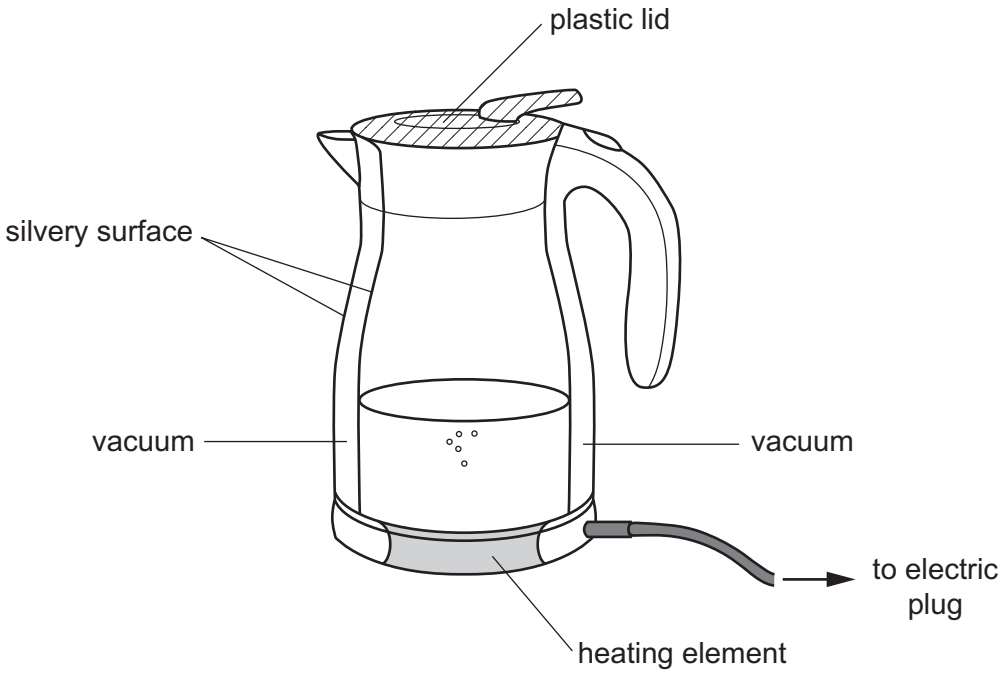

Fig. 8.1

(a) (i) The kettle is filled with water and is heated until the water starts to boil.

State the temperature at which water boils.

temperature = ... °C [1]

(ii) A lid is put on the kettle to reduce the thermal energy lost to the surroundings.

State the type of thermal energy transfer that this reduces.

..... [1]

(b) The kettle is filled with 500 cm^3 of water at 20 °C and switched on.

With the lid on, the water starts to boil after 4 minutes.

With the lid off, the water starts to boil after 6 minutes.

Explain how this information shows that putting the lid on makes the kettle more efficient.

.....

.....

.....

..... [2]

(c) There is a vacuum between the walls of the kettle, as shown in Fig. 8.1.

State the type of thermal energy process that occurs through the vacuum.

..... [1]

(d) Suggest **one** way in which this type of kettle helps to reduce electricity bills.

.....

..... [1]

[Total: 6]

9 Fig. 9.1 shows an experiment to demonstrate the force on a current carrying wire in a magnetic field.

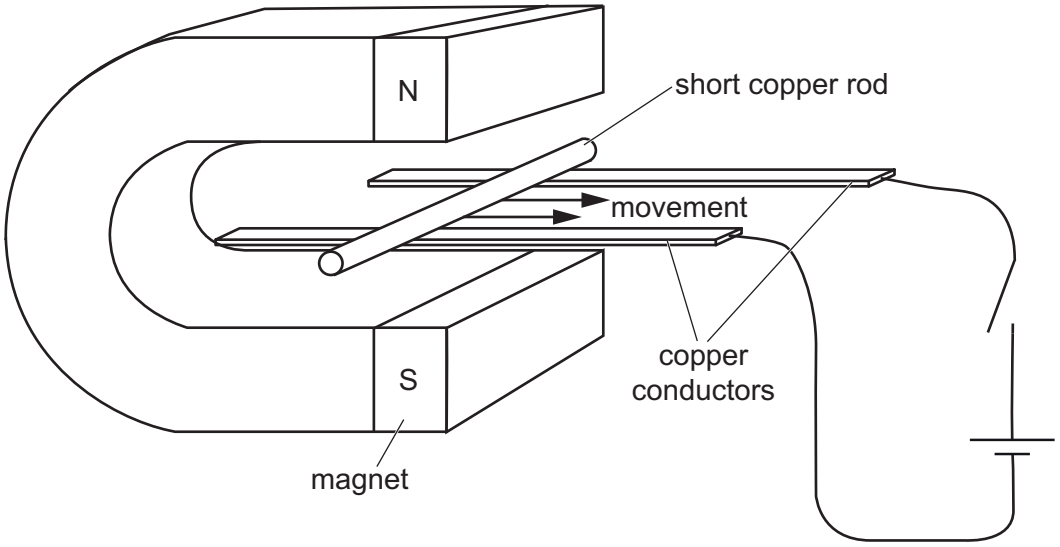

Fig. 9.1

The switch is closed and the copper rod moves to the right. The switch is then opened.

(a) State what happens to the copper rod when the switch is **opened**.

..... [1]

(b) Tick **two** boxes which describe changes to the experiment that cause the rod to move more quickly when the switch is **closed**.

decrease the voltage	☐
increase the current	☐
reverse the direction of the current	☐
use a light plastic rod	☐
use a stronger magnet	☐

[2]

(c) The magnet is rearranged as shown in Fig. 9.2.

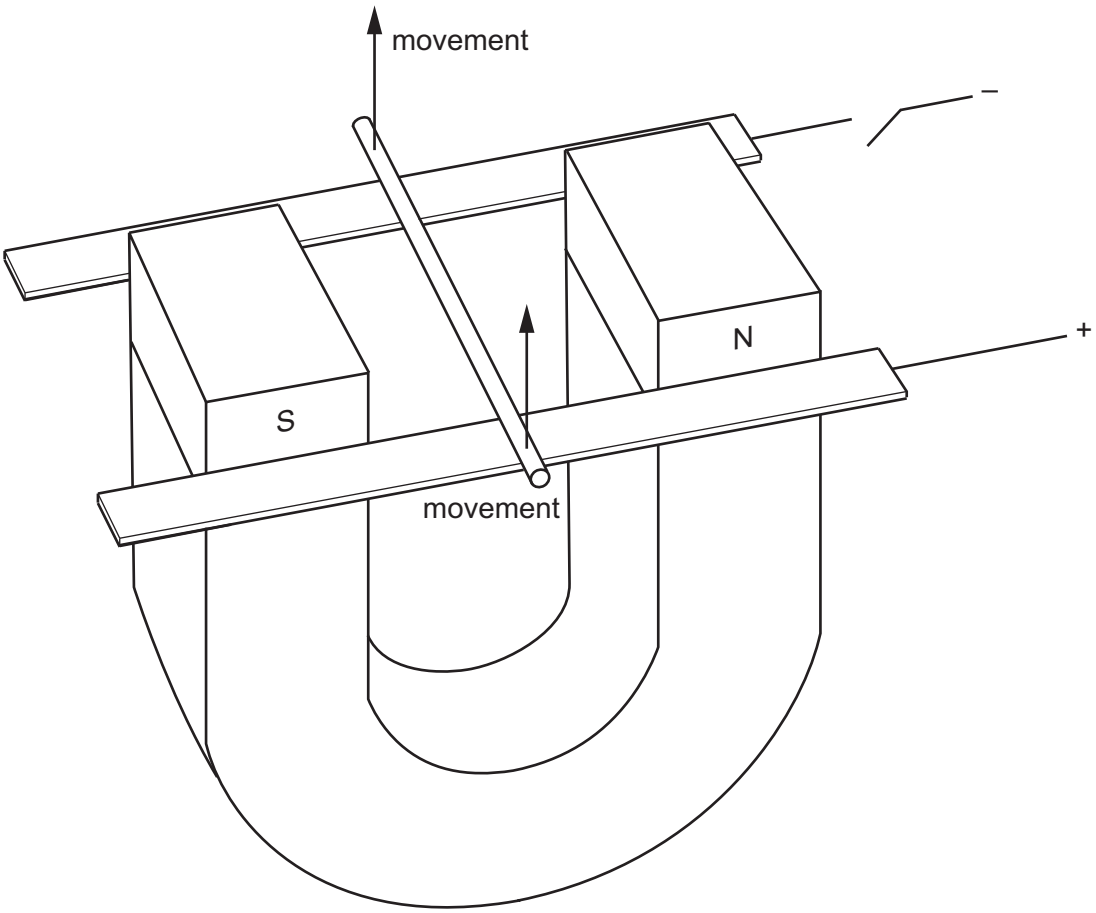

Fig. 9.2

The switch is closed and the rod moves upwards.

Explain why the rod falls back down again.

.....

.....

.....

..... [2]

[Total: 5]

10 Hydrogen chloride, HCl, is a covalent compound of hydrogen and chlorine.

(a) **(i)** Draw a dot-and-cross diagram to show the arrangement of the outer electrons in a molecule of hydrogen chloride.

[2]

(ii) State the name of a covalent compound containing hydrogen and oxygen.

..... [1]

(b) Chlorine forms an ionic compound with sodium, sodium chloride.

(i) Complete the sentence to describe the volatility of hydrogen chloride compared to sodium chloride.

Hydrogen chloride is ..... volatile than sodium chloride. [1]

(ii) Complete the equation for the reaction between chlorine and sodium.

..... Na + Cl_2 → ……..…… [2]

[Total: 6]

11 Fig. 11.1 shows the apparatus used for the electrolysis of dilute sulfuric acid.

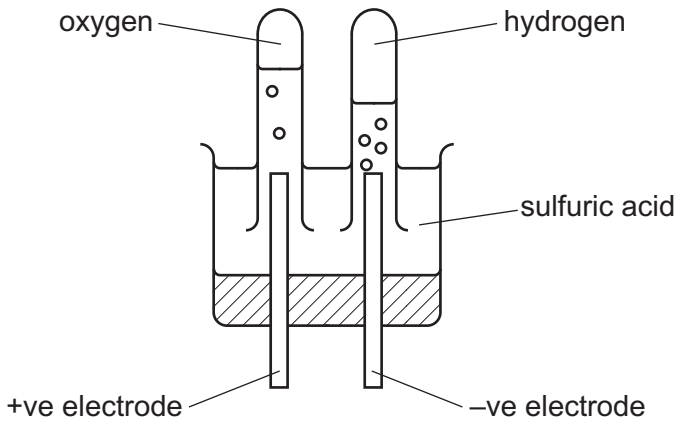

Fig. 11.1

(a) (i) Suggest a suitable material to use for the electrodes.

Give **two** reasons for your choice.

material .....

reason 1 .....

reason 2 .....

[3]

(ii) State the names of the two electrodes.

positive electrode .....

negative electrode .....

[2]

(b) During the electrolysis the pH number of the dilute sulfuric acid does **not** change.

(i) State the pH number of dilute sulfuric acid.

..... [1]

(ii) Suggest the type of substance that can be added to sulfuric acid to increase the pH number of the acid.

..... [1]

[Total: 7]

12 A detector is used to measure the level of background radiation. The count per minute is measured five times.

The results are shown in Table 12.1.

Table 12.1

	test 1	test 2	test 3	test 4	test 5
count per minute	15	11	9	12	13

(a) (i) Suggest why the counts per minute vary.

..... [1]

(ii) Calculate the average background count per minute.

average background count = ... per minute [1]

(b) The detector is now used to measure the level of radiation from a radioactive source.

The average background count is subtracted from each reading.

This gives the corrected count per minute, as shown in Table 12.2.

Table 12.2

time / minutes	corrected count per minute
0	256
5	180
10	130
15	90
20	65
25	50

(i) Explain why the average background count is subtracted from each reading.

.....

..... [1]

(ii) The corrected count rate at the start of the experiment is 256 counts per minute.

Circle the number that shows the corrected count rate when **one** half-life has passed.

0 **64** **128** **256** **512** [1]

(iii) Use the information in Table 12.2 to estimate the half-life of the radioactive sample.

half-life = ... minutes [1]

(c) The detector is 20 cm away from the source.

State **one** type of radioactive emission that **cannot** reach the detector through 20 cm of air.

..... [1]

[Total: 6]

13 Fig. 13.1 shows part of the electromagnetic spectrum.

	visible light	

Fig. 13.1

(a) State the names of the electromagnetic radiation found on either side of visible light. Write your answers in the boxes. [2]

(b) All types of electromagnetic radiation leaving the Sun take the same time of 8 minutes to reach the Earth.

Explain why.

.....

..... [1]

(c) The converging lens in a telescope is used to produce a real image of the Sun on a piece of white card used as a screen, as shown in Fig. 13.2.

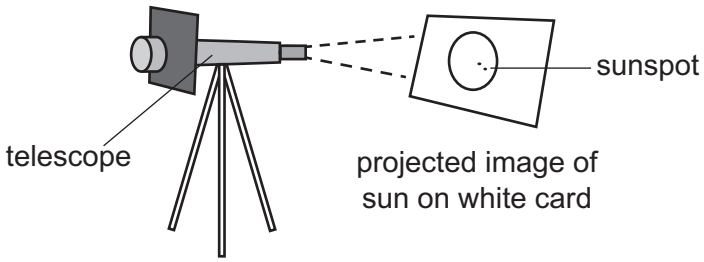

Fig. 13.2 (not to scale)

The image shows a darker region, called a sunspot.

(i) Complete Fig. 13.3 to show how the light from the sunspot passes through the telescope lens to form a real image on the screen. [2]

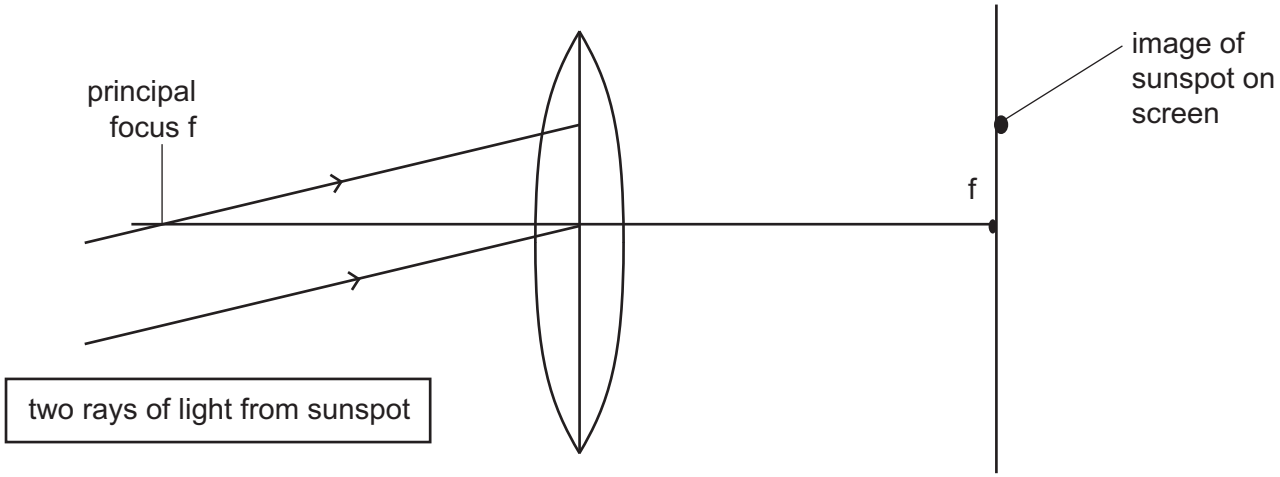

Fig. 13.3

(ii) Circle the words or phrases in the box that correctly complete the sentence.

diminished	**enlarged**	**inverted**	**same size**	**upright**

The real image of the Sun in Fig. 13.3 is ..... and ..... . [2]

[Total: 7]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).