Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

5161772719

CO-ORDINATED SCIENCES **0654/32**

Paper 3 (Extended) **October/November 2014**

2 hours

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 soft pencil for any diagrams, graphs, tables or rough working.
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 32.

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 **29** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

1 Fig. 1.1 shows an astronaut in a rocket about to take off for the Moon.

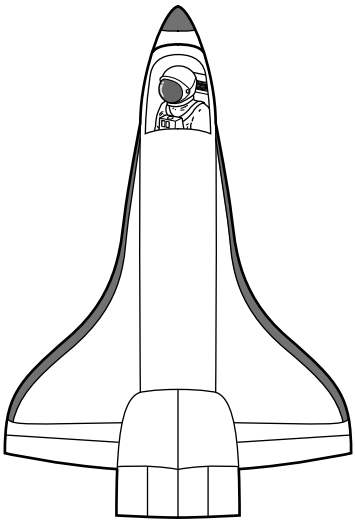


Fig. 1.1

(a) The mass of the astronaut and his spacesuit on the Earth is 100 kg.

The weight of the astronaut and his spacesuit on Earth is 1000 N.

The Moon has a smaller gravitational field than the Earth.

(i) Suggest the mass and weight of the astronaut and his spacesuit on the Moon.

- mass on the Moon .....kg
- weight on the Moon .....N [1]

(ii) Explain your answers to **(i)**.

explanation for mass .....

.....

.....

explanation for weight.....

.....

.....

[2]

(b) The weight of the rocket on take-off is 20 000 000 N.

When the rocket blasts off from the Earth's surface, it experiences a thrust force of 25 000 000 N.

Explain why the thrust force must be greater than the weight of the rocket.

.....

.....[1]

(c) At one stage on the journey the rocket is travelling at 36 000 km / hr which is equivalent to 10 000 m / s.

At this stage the total mass of the rocket is 1 500 000 kg.

Calculate the kinetic energy of the rocket in kJ.

State the formula that you use and show your working.

formula used

working

kinetic energy = ... kJ [4]

(d) During the journey from the Earth to the Moon, the astronaut communicates with Earth using radiowaves.

Explain why it is not possible to use sound waves for communication.

.....

.....[1]

(e) Once the rocket has left the Earth's atmosphere, the astronaut is exposed to increasing amounts of ionising radiation.

Explain the meaning of the term *ionising radiation*.

.....

.....[2]

2 Fig. 2.1 shows a fetus in the uterus.

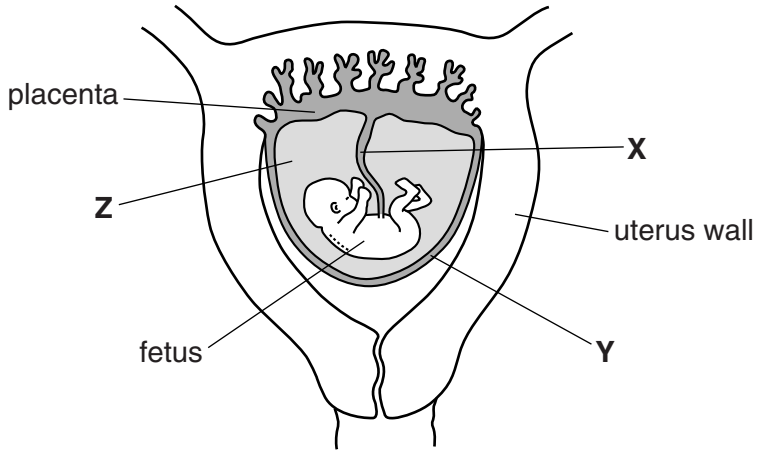


Fig. 2.1

(a) Name the structures labelled **X** and **Y**.

X .....

Y .....
[2]

(b) Describe the function of the fluid at **Z**.

.....

.....

.....[2]

(c) Suggest **three** ways in which the composition of the fetus's blood changes as it passes through the placenta.

1.....

2.....

3.....
[3]

(d) If a pregnant woman smokes, this may reduce the amount of oxygen available to her unborn baby (fetus).

Name the main component of tobacco smoke that causes this, and explain how it has this effect.

component .....

explanation of its effect

.....

.....

.....[3]

3 **(a)** **(i)** State the chemical symbols of the elements that form the **first** period of the Periodic Table.

.....[1]

(ii) State the **name** of the least reactive element in the **second** period.

.....[1]

(iii) State a period in the Periodic Table that contains transition metals.

.....[1]

(b) Fig. 3.1 shows the relative sizes of atoms and ions of the first three members of Group I.

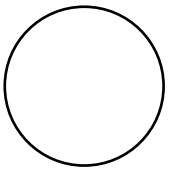
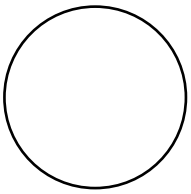
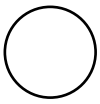
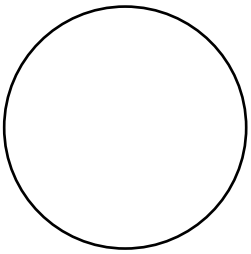
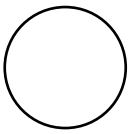
element	atoms	ions
lithium		
sodium		
potassium		

Fig. 3.1

(i) A lithium atom has a proton number of 3 and a nucleon number of 7.

Draw a diagram of this lithium atom. On your diagram, show the positions and numbers of the protons, neutrons and electrons.

[3]

(ii) Suggest why the size of the **atoms** change as shown in Fig. 3.1.

.....

.....[1]

(iii) Suggest why the ion of each element in Fig. 3.1 is smaller than its atom.

.....

.....[1]

(iv) The reactivity of the elements in Group I increases down the group.

Suggest, in terms of ion formation, why atoms with greater size in Group I are more reactive.

.....

.....

.....[2]

[Turn over

4 **(a)** In an experiment, amylase was added to a starch suspension in a test-tube at 35 °C. The amylase digested the starch.

Fig. 4.1 shows how the amount of starch remaining in the test-tube changed over the next eight minutes.

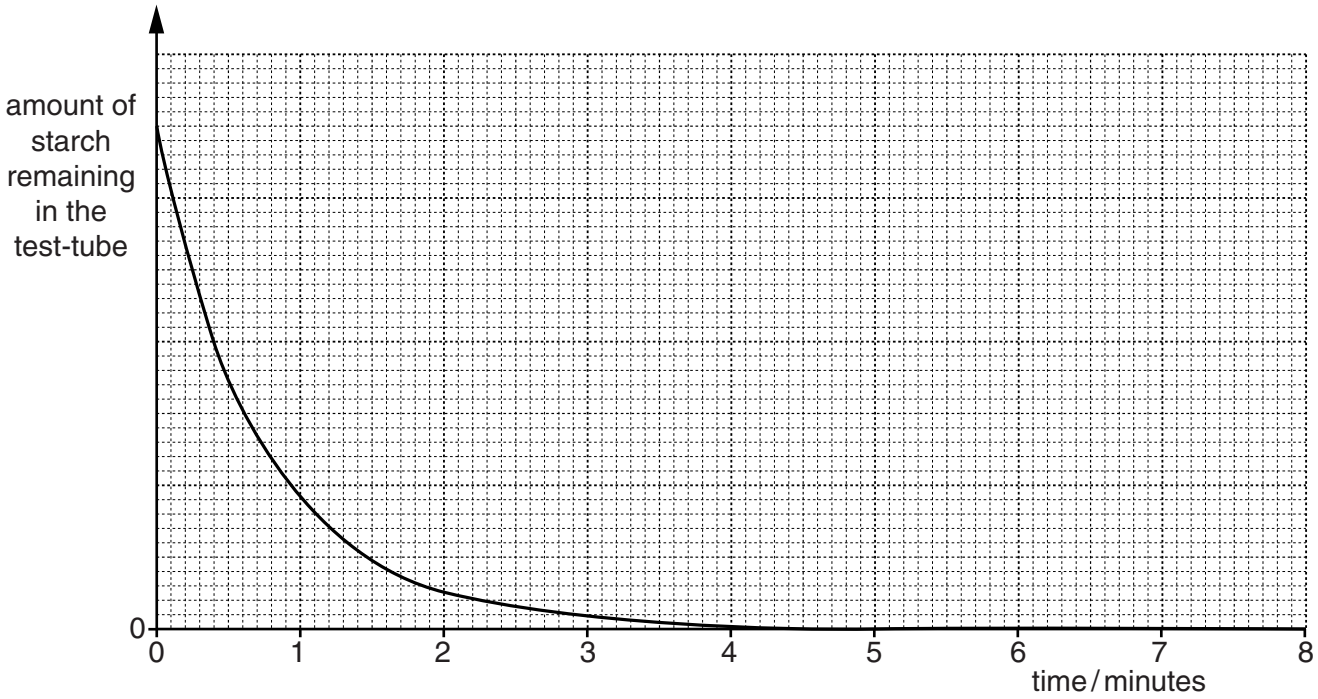


Fig. 4.1

(i) State the time at which the rate of digestion is fastest.

.....[1]

(ii) Suggest why the rate of digestion is fastest at this time.

.....

.....[1]

(iii) On Fig. 4.1, sketch a graph to show the result that would be expected if the experiment is repeated at 25 °C. [2]

(iv) Explain the reason for the difference between the rates of digestion at 25 °C and at 35 °C.

.....

.....

.....[2]

(b) Fig. 4.2 shows the structure of a villus in the small intestine.

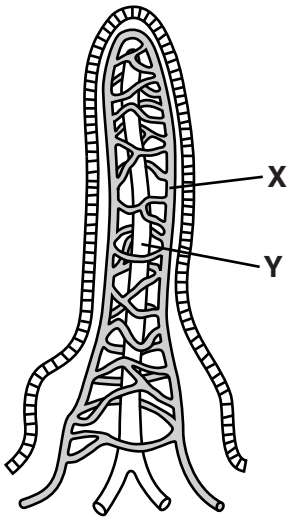


Fig. 4.2

(i) Name the structures labelled **X** and **Y**.

X .....

Y .....
[2]

(ii) Explain the significance of the shape of the villi for the absorption of food molecules in the small intestine.

.....

.....[1]

(iii) Explain why chemical digestion is necessary for food to be absorbed.

.....

.....[1]

5 **(a)** In industry, elements are extracted from compounds.

The chemical formulae of five compounds are shown.

Al_2O_3

$CuFeS_2$

Fe_2O_3

$NaCl$

SnO

Choose a compound from the list to match each description.

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

- This compound is electrolysed to obtain aluminium. .....
- This compound is reduced by carbon monoxide to obtain iron. .....
- This compound is electrolysed to obtain chlorine. .....
- This compound can be processed to obtain copper. .....

[2]

(b) Lead metal can be extracted from lead oxide, PbO, by heating a mixture of lead oxide powder and graphite powder.

Fig. 5.1 shows laboratory apparatus that can be used for this reaction.

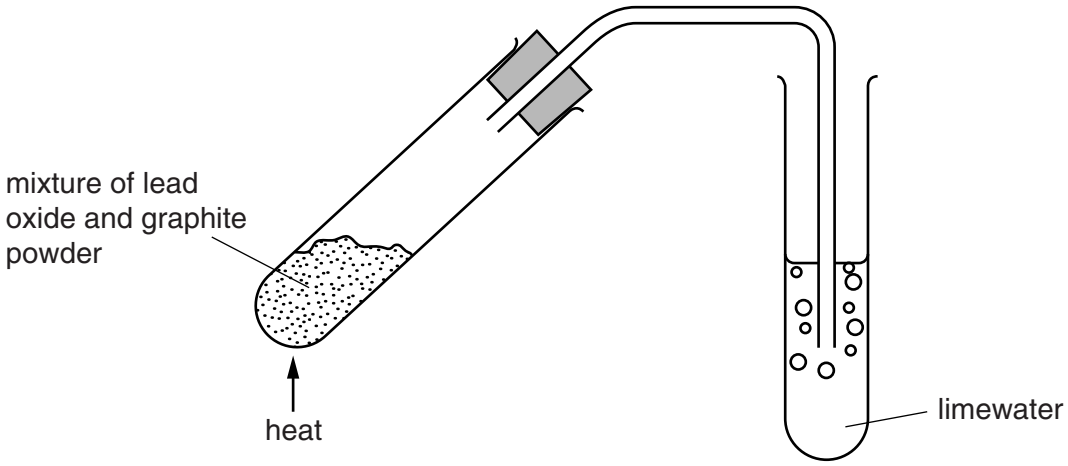


Fig. 5.1

During the reaction, lead oxide is reduced and a gas is given off that reacts with limewater turning it cloudy.

(i) Use the information above to construct a balanced symbol equation for the reaction between lead oxide and graphite.

.....[3]

(ii) In the reaction shown in Fig. 5.1 lead **ions** are converted into lead **atoms**.

Use the idea of electron transfer to explain why lead ions are said to be **reduced**.

.....

.....[1]

(c) Metallic lead may also be produced by electrolysis involving molten lead bromide.

Fig. 5.2 shows laboratory apparatus being used for this electrolysis.

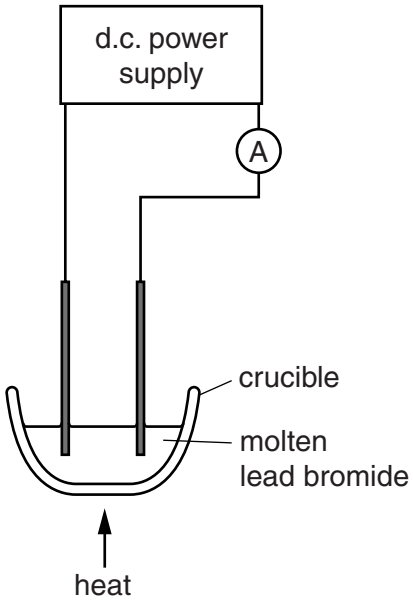


Fig. 5.2

Predict and explain what happens to the reading of the ammeter if the heat source is removed from the molten electrolyte.

.....

.....

.....

.....

.....[3]

6 **(a)** Fig. 6.1 shows a boy in a swimming pool watching water waves being made by a machine.

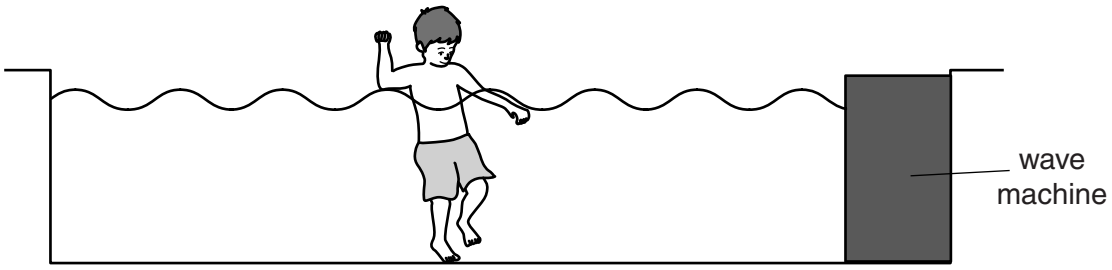


Fig. 6.1

Every 10 seconds, three waves go past the boy. The waves are 0.8 m apart.

Calculate the speed of the water waves.

State the formula that you use and show your working.

formula

working

speed of water waves = ... m/s [3]

(b) When the boy places his head in the water, he hears the noise from the wave machine.

(i) Describe in terms of particles how the sound waves travel through the water to the boy's ears.

.....

.....

.....[2]

(ii) The speed of sound in air is 340 m/s. Suggest a value for the speed of sound in water.

Give a reason for your answer.

speed of sound in water ..... m/s

reason .....

.....[2]

(c) The water in the swimming pool is heated by the Sun.

(i) Some molecules of the water evaporate.

Explain the process of evaporation in terms of the movement of water molecules.

.....

.....

.....

.....

.....[3]

(ii) The mass of water in the pool is 200 000 kg. The specific heating capacity of water is 4200 J/(kg °C).

Calculate the thermal energy required to raise the temperature of the water in the pool by 5 °C.

State the formula that you use and show your working.

Give your answer in MJ.

formula

working

thermal energy = ...MJ [3]

Please turn over for Question 7.

7 Petroleum (crude oil) is a mixture that contains thousands of different hydrocarbons.

(a) Table 7.1 contains descriptions of mixtures, compounds and elements.

Complete Table 7.1. Use the letters **M** for mixture, **C** for compound or **E** for element.

Table 7.1

description	**M**, **C** or **E**
contains different types of molecules	
all of the atoms have the same proton number	
molecules are all identical but each molecule contains more than one type of atom	
cannot be broken down into simpler substances	

[2]

(b) Fig. 7.1 shows the industrial apparatus used to obtain useful products from petroleum.

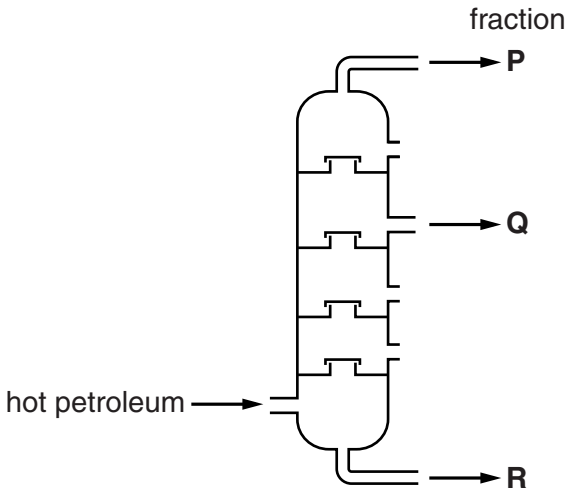


Fig. 7.1

(i) Suggest with reasons why fraction **P** is used as a fuel but fraction **R** is not.

.....

.....

.....[2]

(ii) Fraction **Q**, kerosene, is used to make the fuel used in jet aircraft engines. Kerosene is a mixture of hydrocarbons.

Fig. 7.2 shows a jet aircraft flying at a great height.

The jet engines burn kerosene which produces white vapour trails.

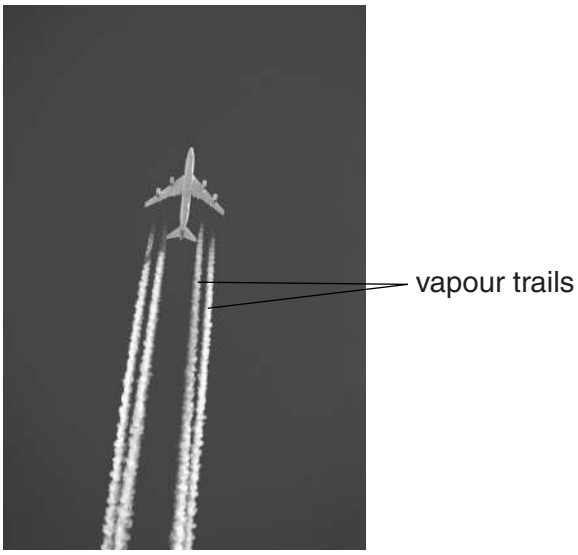


Fig. 7.2

Suggest **two** compounds that have a higher concentration in the vapour trails than in the surrounding air.

1 .....

2 ..... [2]

(iii) The air temperature outside the aircraft is –40 °C.

The vapour trails contain solid particles that reflect white light.

Suggest what these solid particles are made of and describe how they have formed.

.....

.....

.....[2]

(c) Methane, CH_4, is a member of the homologous series known as the alkanes.

(i) State the meaning of the term *homologous series*.

.....

.....[1]

(ii) Fig. 7.3 shows a graph of the boiling points in degrees Celsius of some alkanes.

The horizontal axis (x-axis) shows the number of carbon atoms in one molecule of the different alkanes.

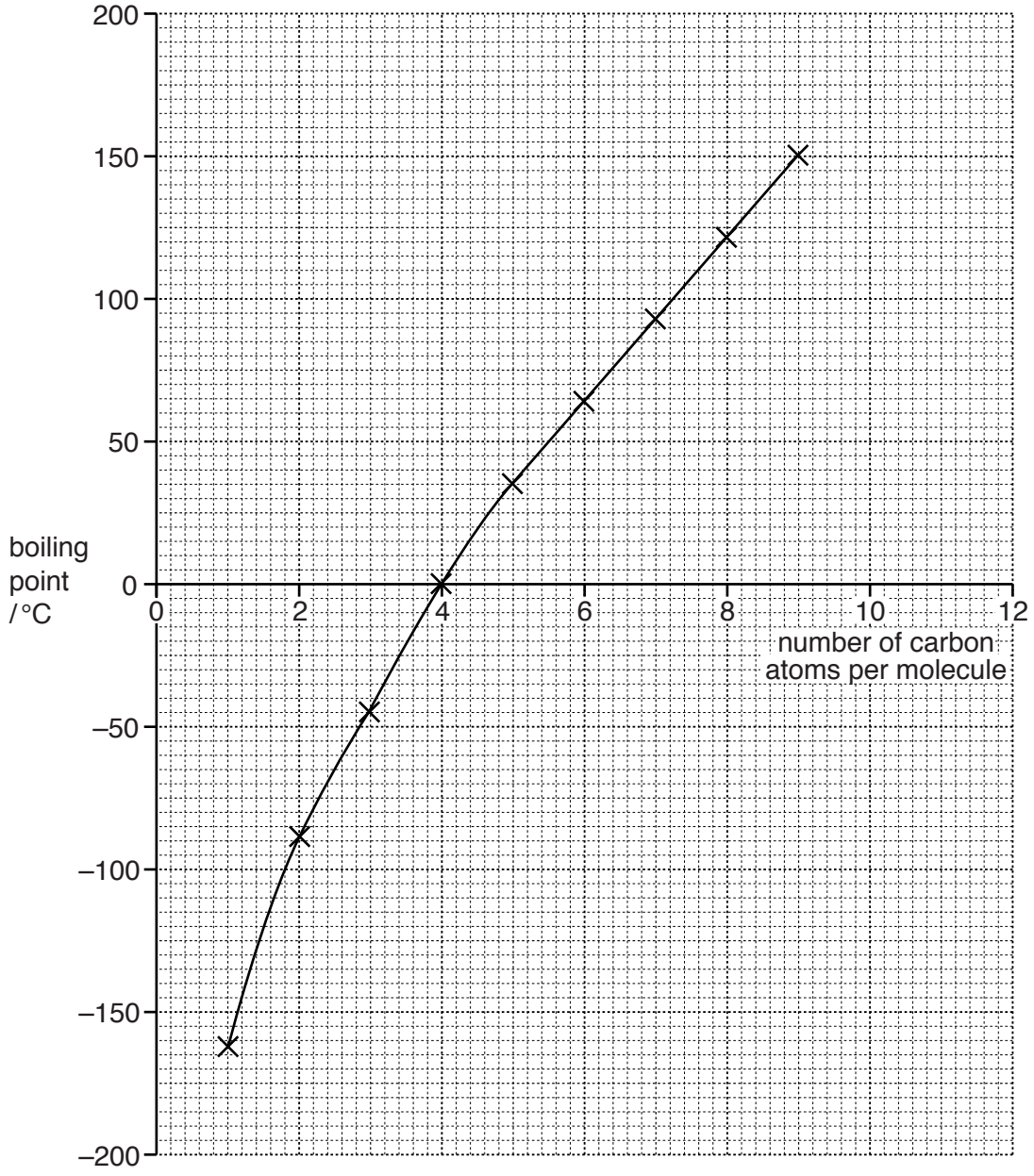


Fig. 7.3

Use the graph to estimate the boiling point of decane, $C_{10}H_{22}$, in degrees Celsius.

On Fig. 7.3, show how you obtained your answer.

.....°C [1]

(iii) State the trend shown in Fig. 7.3 and suggest a reason for this trend.

.....

.....

.....

.....[2]

8 **(a)** Acid rain can damage the environment.

Use the words or phrases from the list to complete the sentences about acid rain.

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

carbon dioxide **coal-fired** **fossil** **hydroelectric**

less **methane** **more** **nuclear** **sulfur dioxide**

Acid rain refers to any rainfall with a pH of ..... than 5.0.

One of the main causes of acid rain is emission of ..... from

..... power stations. The problem of acid rain can be reduced by

burning less ..... fuels. [4]

(b) Some freshwater animals are able to survive (tolerate) changes in the pH of the water in which they live. Table 8.1 shows the pH ranges that can be tolerated by some different types of animals living in the same lake.

Table 8.1

animal	lowest pH that the animal can tolerate	ideal pH range	highest pH that the animal can tolerate
crayfish	5.5	7.0 to 8.5	10.5
frog	4.0	6.0 to 8.0	10.0
mosquito larva	1.5	3.5 to 7.0	12.0
perch	3.5	4.0 to 7.5	9.5
trout	4.5	5.0 to 8.0	11.0

(i) State which of the animals listed in Table 8.1

is best able to tolerate strong alkaline conditions,

.....

survives best in strong acid conditions,

.....

is most likely to be harmed by acid rain.

.....

[3]

(ii) Use the information in Table 8.1 to suggest how a pH of 3.5 could be harmful to perch.

.....

.....[1]

(iii) Perch and trout compete for food. Use the information in Table 8.1 to suggest how a pH of 3.5 could be beneficial to perch.

.....

.....[1]

(c) When acid rain falls into a lake it can make the water acidic. Suggest how this can harm the cells of the fish in the lake.

.....

.....[1]

[Turn over

9 **(a)** An electric shower in a bathroom is rated at 11 kW. The mains voltage is 220 V.

(i) Calculate the current used by the shower.

State the formula that you use and show your working.

formula

working

current = ... A [2]

(ii) Calculate the resistance of the electric shower when in use.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

(b) Electricity can be generated by turning a coil of wire in a magnetic field.

Fig. 9.1 shows a simple generator.

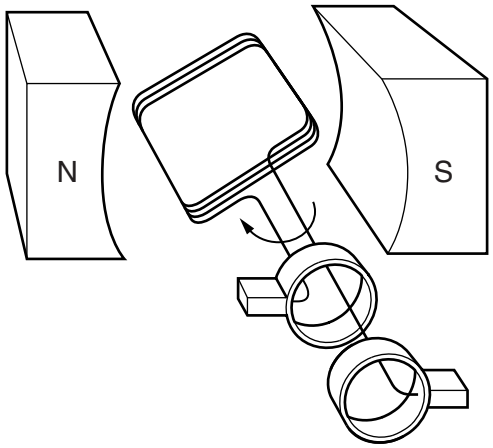
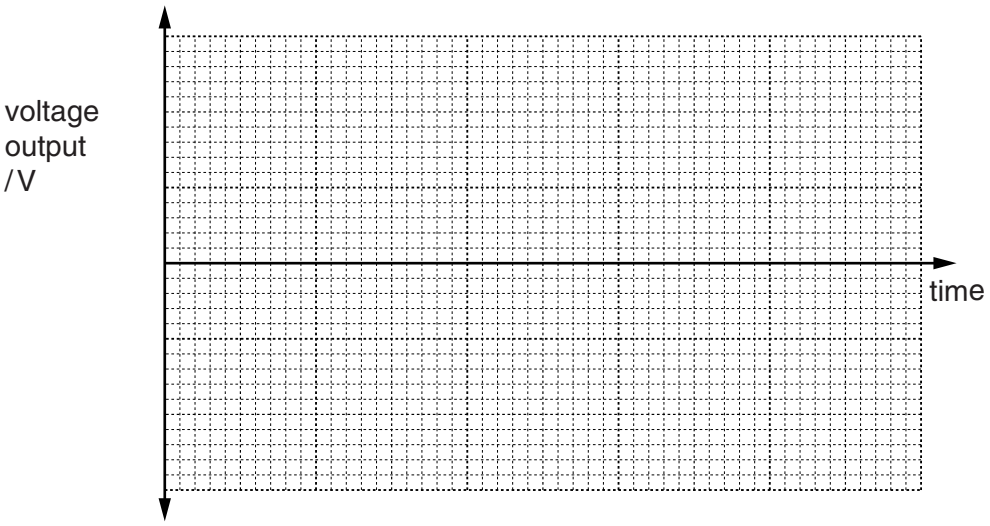


Fig. 9.1

(i) The voltage output is measured with a voltmeter.

On Fig. 9.1 complete the diagram to show how to connect a voltmeter to measure the voltage output. [1]

(ii) On the grid below, sketch a graph of voltage output against time for the generator, when the coil is being rotated at constant speed.



[2]

(iii) State **two** ways in which the size of the voltage output can be increased.

1 .....

2 .....

[2]

10 (a) Define the term *sensitivity*.

.....

.....

.....[2]

(b) Some seedlings are supported on their sides in a light-proof container and left for five days. Fig. 10.1 shows what happens.

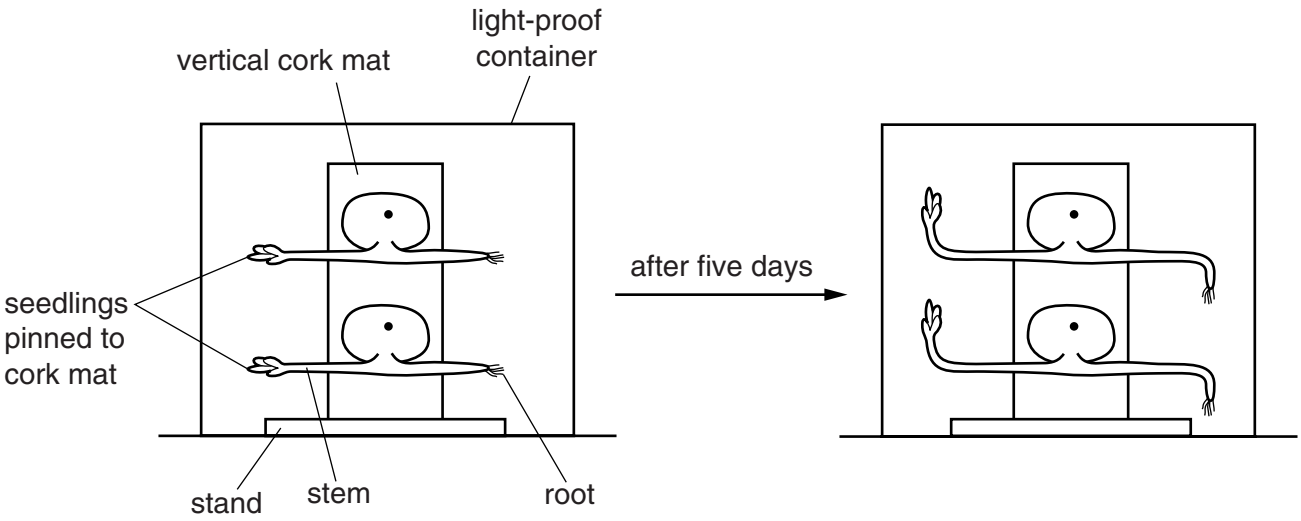


Fig. 10.1

(i) Name the response of the seedlings in Fig. 10.1.

.....[1]

(ii) With reference to Fig. 10.1, describe how the survival chances of a plant are increased by the type of response shown by

the roots,

.....

.....

.....[2]

the stems.

.....

.....

.....[2]

(iii) Explain the role of auxin in the responses of the roots and stems shown by these seedlings.

.....

.....

.....

.....[3]

11 **(a)** Complete the **word** chemical equations below for reactions involving dilute hydrochloric acid.

hydrochloric acid	+	magnesium	→	magnesium chloride	+			
hydrochloric acid	+	copper oxide	→		+	water		
hydrochloric acid	+	potassium carbonate	→		+	carbon dioxide	+	

[3]

(b) Fig. 11.1 shows apparatus a student uses to investigate the chemical reaction between **excess** dilute hydrochloric acid and calcium carbonate.

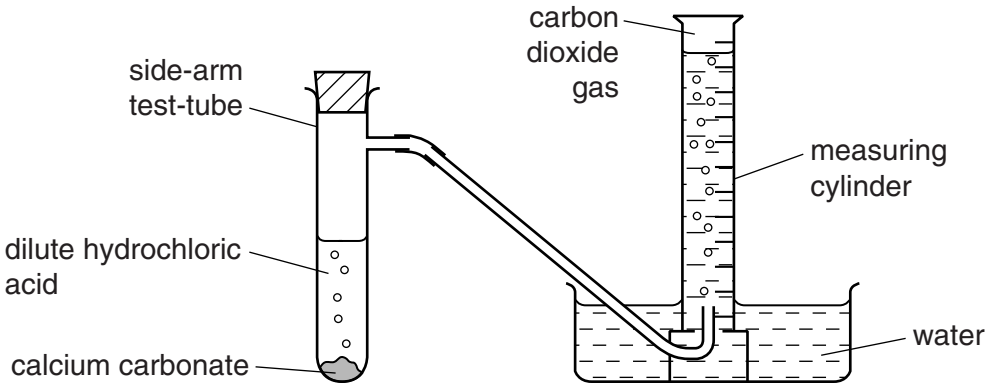


Fig. 11.1

When the student adds the reactants to the side-arm test-tube, carbon dioxide gas flows into the measuring cylinder.

The student records the volume of carbon dioxide in the measuring cylinder every 10 seconds for 90 seconds.

Her results are shown as a graph in Fig. 11.2.

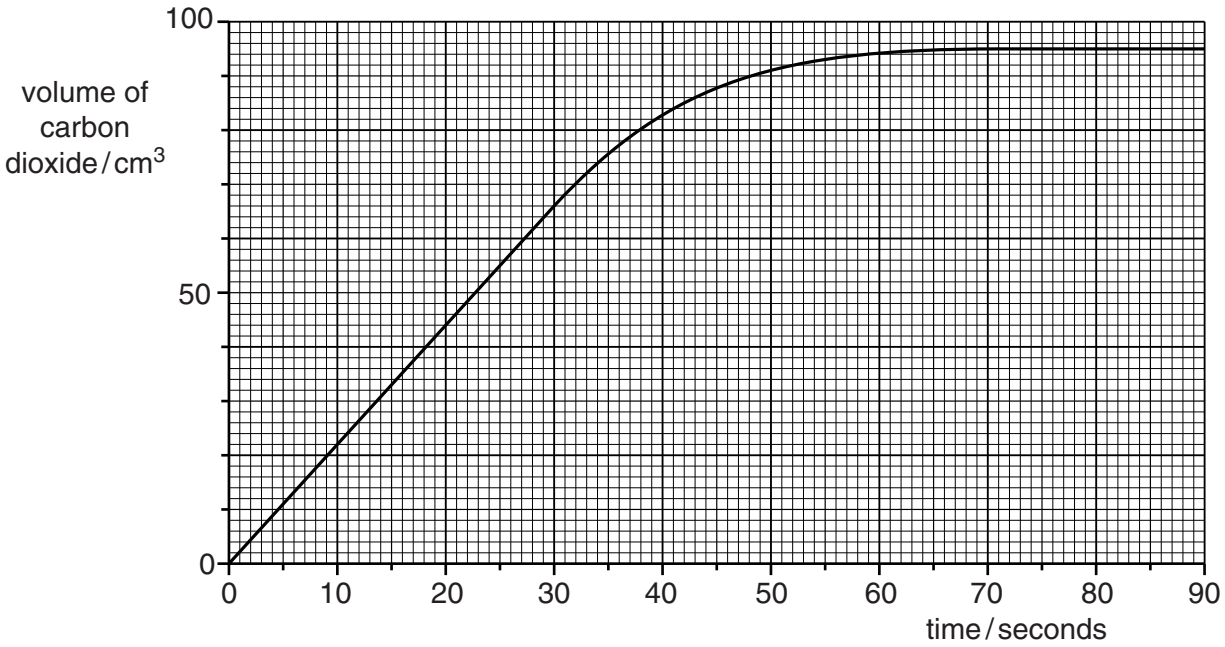


Fig. 11.2

(i) Use the graph to find the volume of carbon dioxide that was produced during the first 30 seconds of the experiment.

.....[1]

(ii) Describe and explain the shape of the graph during the last 50 seconds of the experiment.

.....

.....

.....[2]

(iii) Calculate the number of moles of carbon dioxide produced during the experiment.

The volume of one mole of carbon dioxide under the same conditions of temperature and pressure as those in the experiment is 24 dm^3.

Show your working.

number of moles = ...[3]

12 Fig. 12.1 shows the speed/time graph for a car being driven along a road for 120 seconds.

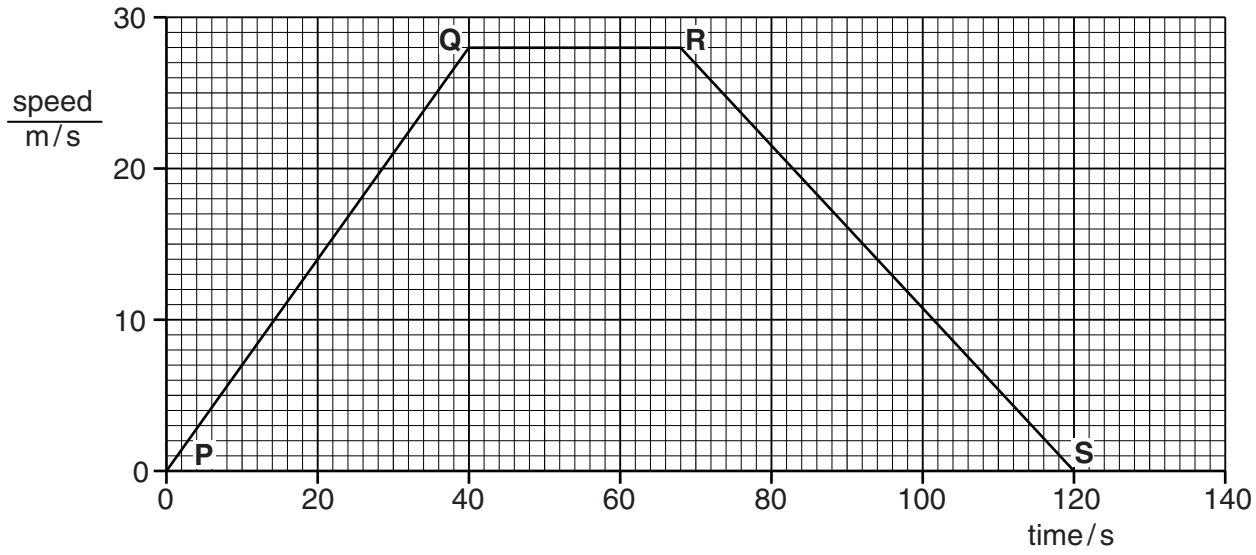


Fig. 12.1

(a) State a section of the graph which represents a constant speed.

.....[1]

(b) State a point on the graph at which the car is not moving.

.....[1]

(c) Calculate the acceleration of the car during the first 40 seconds.

Show your working.

acceleration = ... m/s^2 [2]

(d) Calculate the distance travelled by the car over the 120 second journey.

Show your working.

distance travelled = ...m [3]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0	
							1 H Hydrogen 1									4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

* 58–71 Lanthanoid series
† 90–103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = atomic (proton) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).