Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3150950449

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **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 **30** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

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

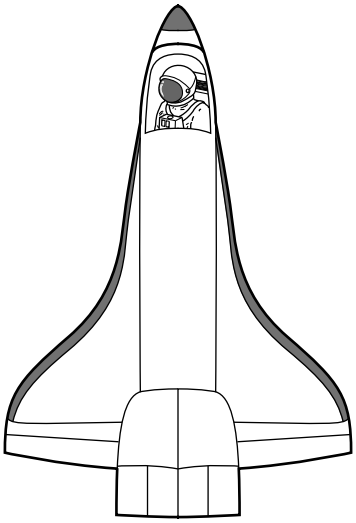


Fig. 1.1

(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.

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]

(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) While the rocket is travelling to the moon, there are many different energy changes.

Use the words in the list to complete the sentences below.

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

chemical electrical gravitational kinetic light sound thermal

As the rocket moves faster, it gains ..... energy.

As the rocket moves away from the Earth, it gains ..... potential energy.

The rocket fuel contains ..... energy which releases

..... energy when the fuel is burned. [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.

(i) Explain the meaning of the term *ionising radiation*.

.....

.....

.....[2]

(ii) Describe the effects of ionising radiation on the human body.

.....

.....

.....[2]

(f) Fig. 1.2 shows part of the electromagnetic spectrum. Radiowaves and γ-radiation are both part of the electromagnetic spectrum.

On Fig. 1.2, place radiowaves and γ-radiation in their correct places.

	X-rays		**visible light**		**microwaves**	

Fig. 1.2

[2]

2 Fig. 2.1 shows the female reproductive system.

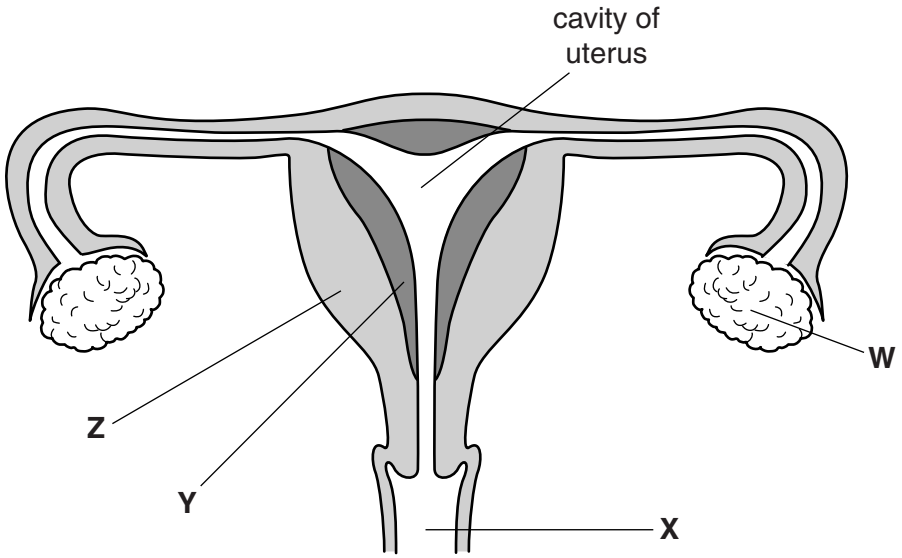


Fig. 2.1

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

W .....

X .....[2]

(b) In the uterus, the part labelled **Y** is rich in blood vessels and the part labelled **Z** is muscular. Describe the functions of these parts.

function of **Y**

.....

.....

function of **Z**

.....

.....[2]

(c) Outline the process of fertilisation.

.....

.....

.....

.....[3]

(d) If a pregnant woman is infected with HIV, her baby may also become infected.

Suggest **one** way in which a woman can reduce her chance of becoming infected with HIV.

.....

.....[1]

(e) Table 2.1 shows the percentage of babies that become infected with HIV as a result of their mother being infected with the virus.

Table 2.1

	percentage of babies infected with HIV	
	babies infected at birth	babies infected after 12 months
mothers infected with HIV and **not** receiving treatment	22%	31%
mothers infected with HIV and receiving treatment	4%	6%

(i) Explain how an HIV infected mother could pass the virus on to her baby at birth.

.....

.....[1]

(ii) If a pregnant woman is receiving treatment for her HIV infection, state what effect this has on the probability of her baby becoming infected with HIV.

.....

.....[1]

(iii) Table 2.1 shows that the babies are more likely to be infected with HIV after 12 months than at birth. Suggest why this is so.

.....

.....[1]

3 The elements from lithium, Li, to neon, Ne, form the second period of the Periodic Table.

(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 the atoms of the first three members of Group I.

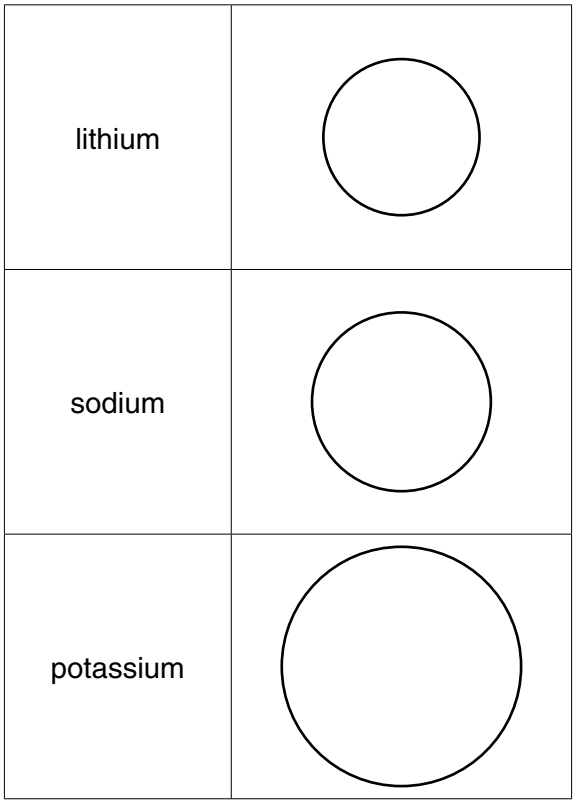


Fig. 3.1

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

State the names and numbers of each type of particle in the nucleus of this lithium atom.

.....

.....[3]

(ii) Suggest why the atoms increase in size from lithium to potassium.

.....

.....[1]

4 **(a)** Define the term *digestion*.

.....

.....

.....[2]

(b) Name the enzyme that digests starch in the alimentary canal.

.....[1]

(c) In an experiment, a starch digesting enzyme was added to a starch suspension in a test-tube at 35 °C.

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

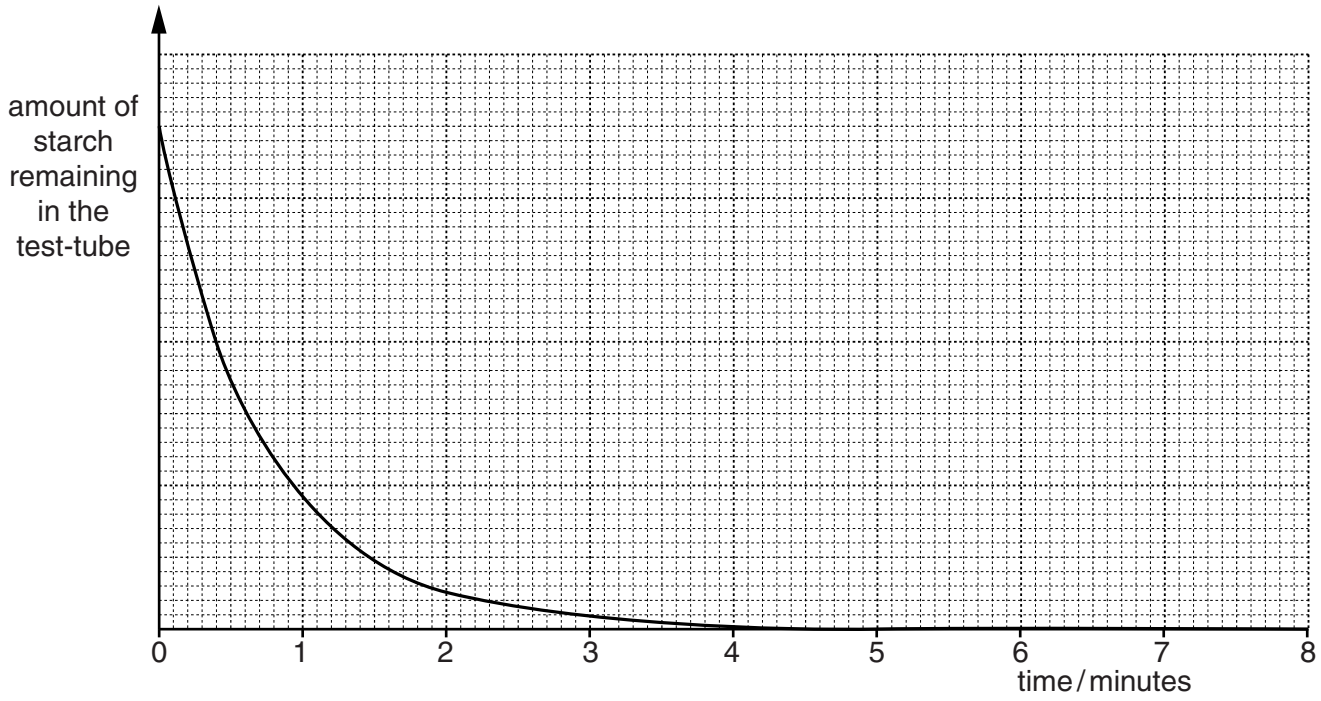


Fig. 4.1

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

.....[1]

(ii) Name the product of the digestion of starch in this test-tube.

.....[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]

(d) Explain why starch is digested by the body.

.....

.....[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 contains aluminium. .....
- This compound is iron oxide. .....
- This compound could be used to produce chlorine. ..... [2]

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

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

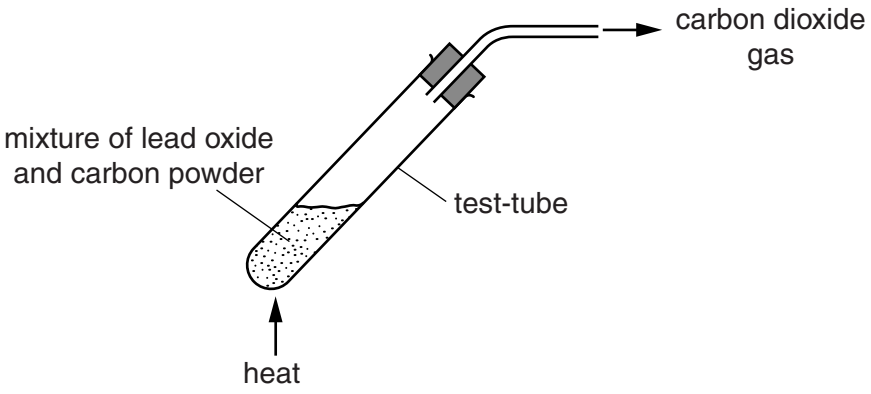
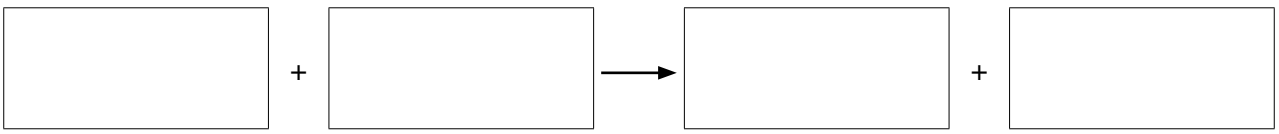


Fig. 5.1

During the reaction, lead metal forms at the bottom of the test-tube and carbon dioxide gas is given off.

(i) Suggest the **word** chemical equation for this reaction by completing the boxes below.



[1]

(ii) Suggest **one** simple test and the result that would show that the piece of lead has a physical property typical of metals.

test .....

result .....

.....[2]

(iii) In the reaction shown in Fig. 5.1 both reduction and oxidation take place.

State and explain which substance has been reduced.

name of substance that is reduced .....

explanation .....

.....[2]

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

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

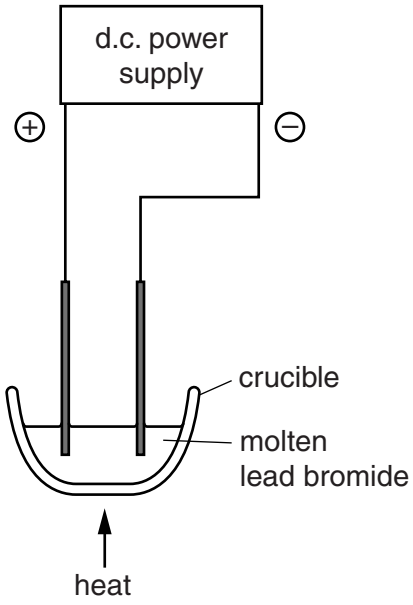


Fig. 5.2

(i) State the meaning of the term *cathode*.

.....[1]

(ii) Lead bromide is an ionic compound containing lead ions, Pb^{2+}, and bromide ions, Br^{-}. During electrolysis, these ions are converted into atoms.

State and explain which one of the ions gains electrons during electrolysis.

ion gaining electrons .....

explanation .....

.....

.....[2]

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

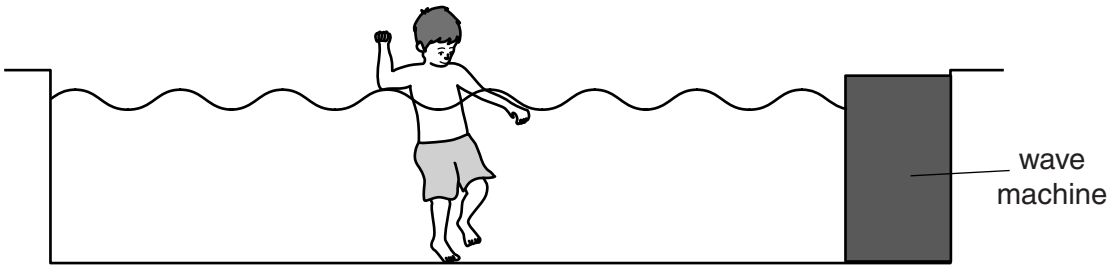


Fig. 6.1

(i) Every 10 seconds, three waves go past the boy.

Calculate the frequency of the waves.

frequency = ... Hz [1]

(ii) Water waves are examples of transverse waves.

Describe how a transverse wave is different from a longitudinal wave.

You may draw a labelled diagram if it helps your answer.

.....

.....

.....[2]

(iii) Give **one** example of a longitudinal wave.

.....[1]

(b) Fig. 6.2 shows a block of cork used by the boy to keep afloat.

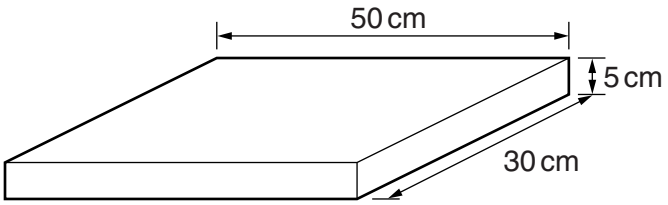


Fig. 6.2

(i) Calculate the volume of the block of cork.

volume = ...cm^3 [1]

(ii) The mass of the block of cork is 1875 g.

Calculate the density of the block of cork.

State the formula that you use, show your working and state the unit of your answer.

formula

working

density = ... unit .....[3]

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

(i) State the type of electromagnetic radiation which transfers the energy to heat the water.

.....[1]

(ii) Some molecules of water evaporate.

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

.....

.....

.....

.....[3]

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	

[3]

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

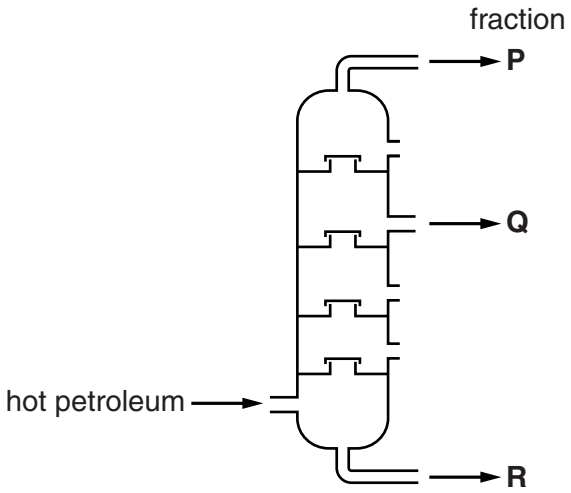


Fig. 7.1

(i) Suggest, in terms of their properties, **two** reasons why fraction **P** is used as a fuel but fraction **R** is not.

1 .....

.....

2 .....

.....[2]

(ii) Fraction **Q**, kerosene, is used to make the fuel used in jet aircraft engines.

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

The waste gases from the jet engines produce white vapour trails.

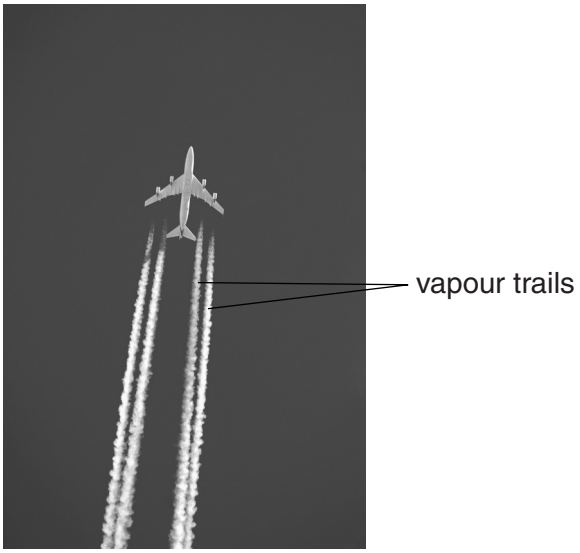


Fig. 7.2

Kerosene contains a large amount of the hydrocarbon heptane. Heptane undergoes complete combustion in the aircraft engines.

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) Heptane is a member of the family of hydrocarbons known as alkanes.

Fig. 7.3 shows a graph of the boiling points in degrees Celsius of four alkanes, **A**, **B**, **C** and **D**.

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

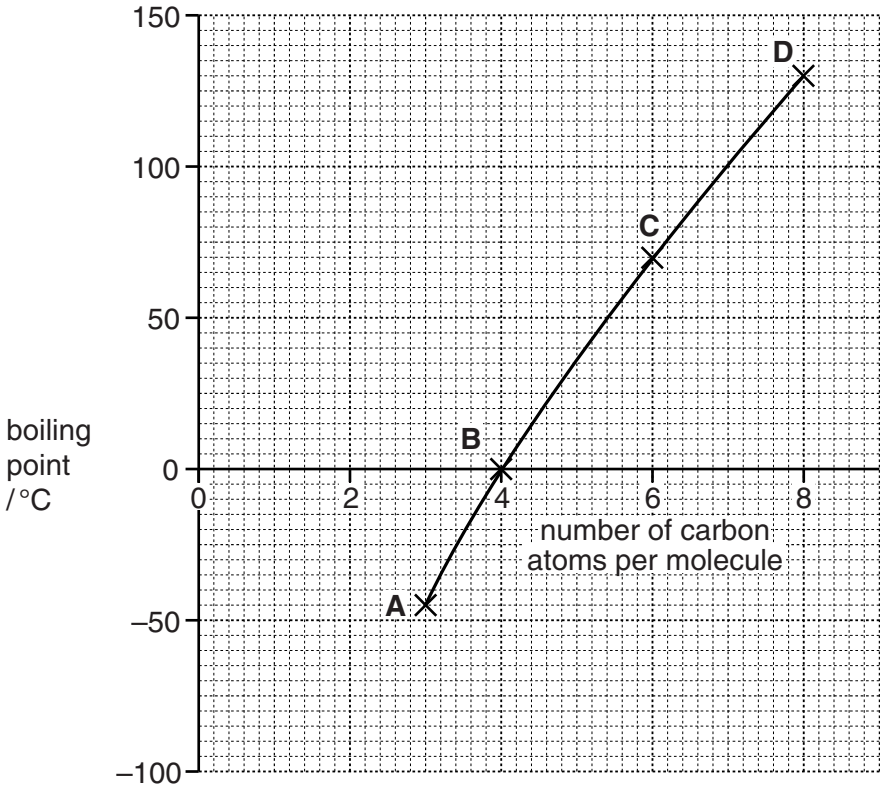


Fig. 7.3

(i) Describe the trend shown in the graph in Fig. 7.3.

.....

.....[1]

(ii) Use the graph to estimate the boiling point of heptane, C_7H_{16}, in degrees Celsius.

.....[1]

(iii) State and explain which of the four labelled alkanes, **A**, **B**, **C** and **D**, are gases at 20 °C.

.....

.....

.....[2]

Please turn over for Question 8.

8 **(a)** Large-scale removal of trees can damage the environment.

Use the words or phrases from the list to complete the sentences.

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

carbon dioxide **deforestation** **extinction** **methane**

pollution **soil** **sulfur dioxide** **temperature**

The large-scale removal of trees is called ..... and can harm the environment by causing a build up of ..... in the atmosphere.

This may lead to an increase in the ..... at the surface of the Earth.

Removal of trees in an area can cause loss of ..... and flooding. [4]

(b) The water in a river is polluted with sewage. Fig. 8.1 shows how the oxygen concentration of the water in the river changed as a result of this.

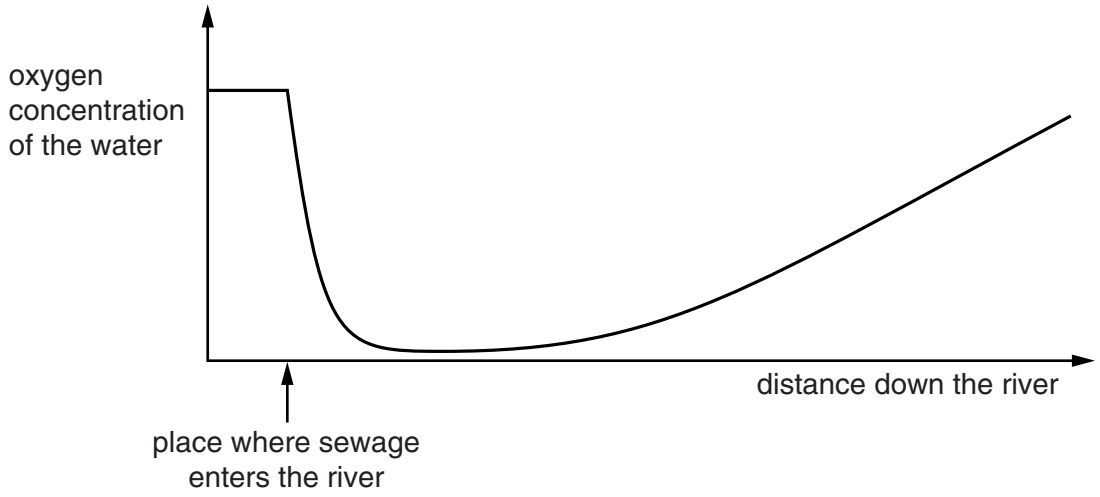


Fig. 8.1

(i) On Fig. 8.1, mark with the letter **X** the point at which you would expect the numbers of bacteria to be highest. [1]

(ii) Describe how the oxygen concentration of the water changes after the sewage enters the river.

.....

.....

.....[2]

(iii) After the sewage enters the river, explain what could cause the oxygen concentration of the water

to fall,

.....

.....

to rise.

.....

.....[2]

(iv) Explain why a low oxygen concentration could kill the fish in the river.

.....

.....[1]

9 **(a)** An electric shower is installed in a bathroom. A current of 50 A passes through the shower when the mains voltage is 220 V.

Calculate the resistance of the electric shower.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

(b) **(i)** A student investigates an electromagnet using the apparatus shown in Fig. 9.1.

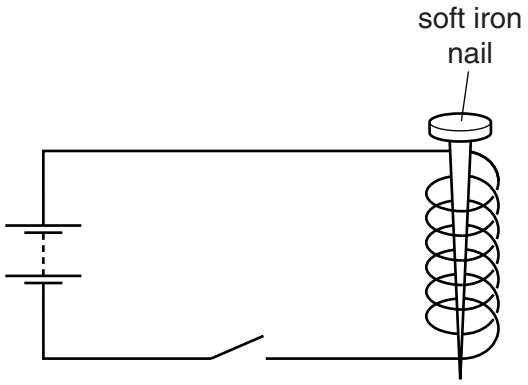


Fig. 9.1

When the switch is closed, the electromagnet can only pick up two paper clips in a chain, as shown in Fig. 9.2.

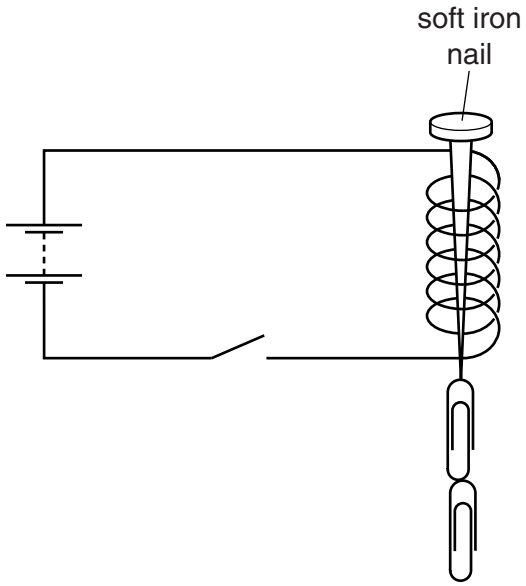


Fig. 9.2

Suggest **one** way of changing the circuit so that the electromagnet will pick up a longer chain of paper clips.

Give a reason for your answer.

.....

.....

.....[2]

(ii) Describe **one** use for an electromagnet which shows a difference between a permanent magnet and an electromagnet.

use .....

.....

difference .....

.....[2]

(iii) The voltage across the coil in Fig. 9.2 is 3 volts. On Fig. 9.2, using the correct circuit symbols, show how you would measure the voltage across the coil. [2]

10 Some seedlings are supported on their sides in a light proof container and left for five days.

Fig. 10.1 shows what happens.

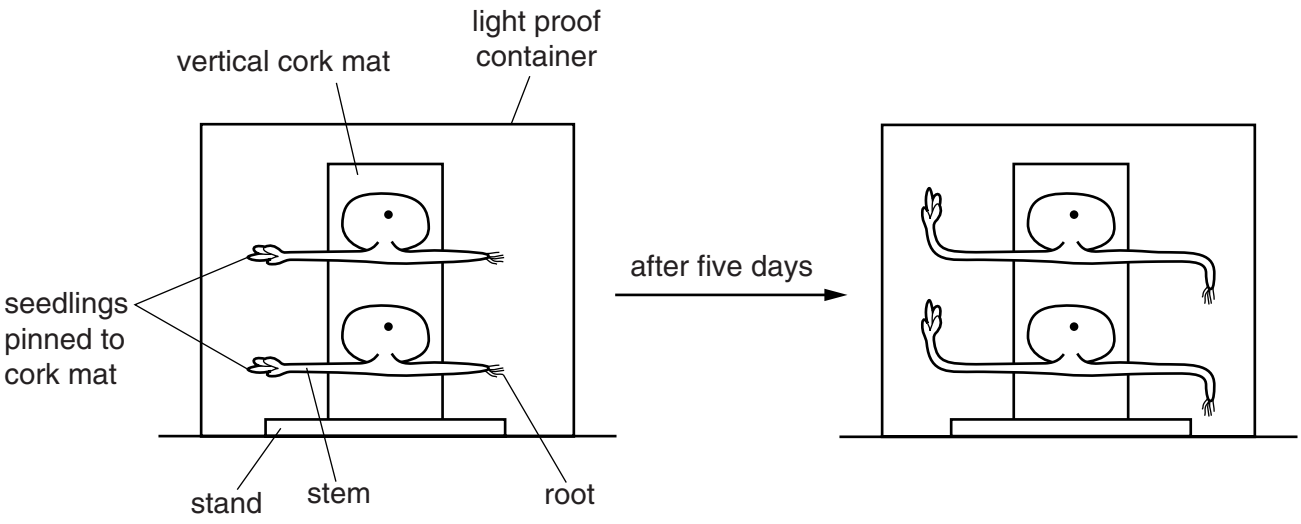


Fig. 10.1

(a) Name and describe the response of the seedlings shown in Fig. 10.1.

name of the response .....

description .....

.....

.....[3]

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

(i) the roots,

.....

.....

.....[2]

(ii) the stems.

.....

.....

.....[2]

(c) A different experiment which is similar to the one in Fig. 10.1 is set up. This has light coming in through a hole in one side of the container.

Suggest how the roots and stems of the seedlings will respond in this experiment.

.....

.....

.....[2]

(d) *Sensitivity* is the ability to respond to changes in the environment. It is one of the characteristics of living organisms.

Name **two** other characteristics of living organisms.

1.....

2.....[2]

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 used to investigate the chemical reaction between excess dilute hydrochloric acid and calcium carbonate.

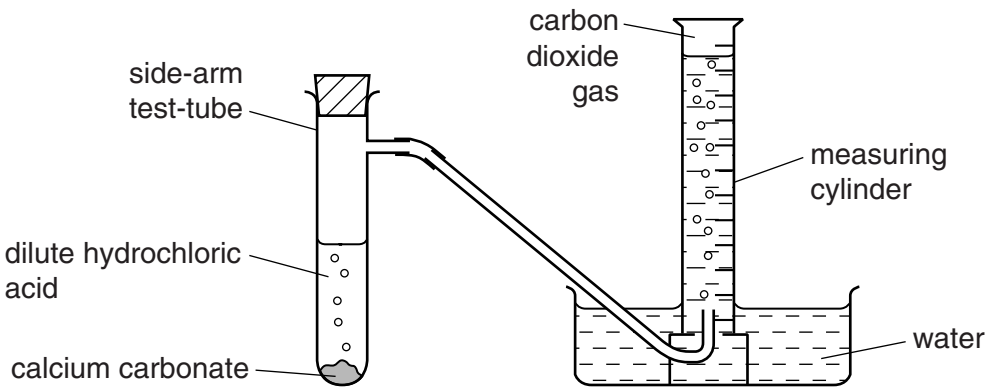


Fig. 11.1

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

The student records the time it takes for the measuring cylinder to fill with carbon dioxide.

(i) Describe a test and its result which would show that carbon dioxide was present in the measuring cylinder.

test .....

result .....

.....[2]

(ii) State **two** changes to the reaction conditions that would **decrease the time taken** for the measuring cylinder to fill with carbon dioxide.

1 .....

.....

2 .....

.....[2]

(c) (i) Suggest why calcium carbonate (agricultural lime) is sometimes spread onto soil used to grow crops.

.....

.....

.....

.....[2]

(ii) Calcium carbonate is used to make calcium oxide (quicklime).

Describe briefly what is done to produce calcium oxide from calcium carbonate.

.....

.....[1]

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

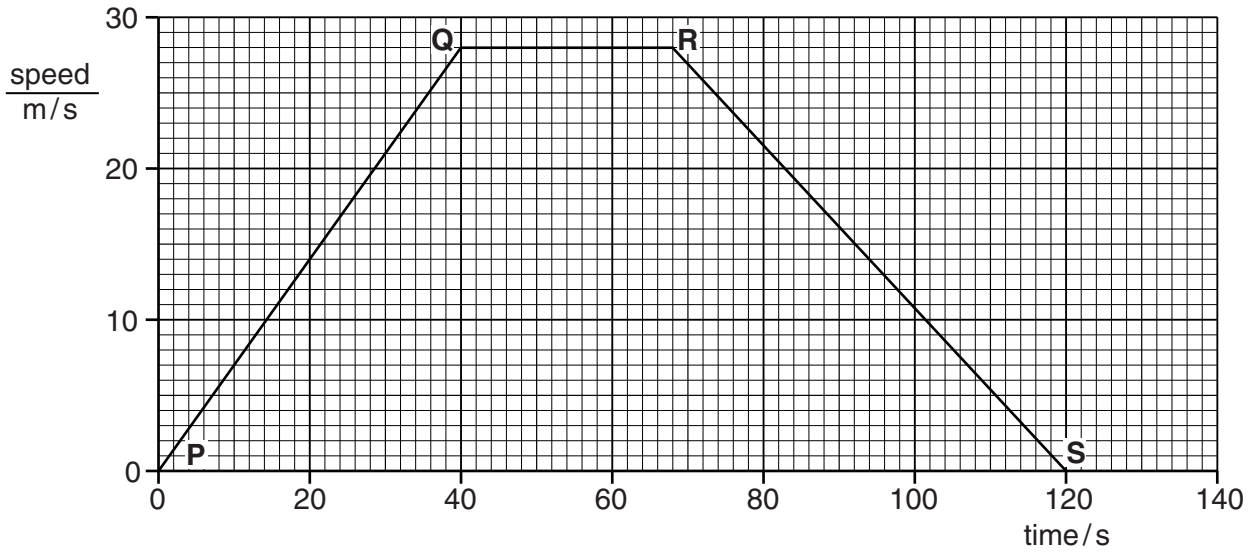


Fig. 12.1

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

.....[1]

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

.....[1]

(iii) Explain why the kinetic energy of the car is greater after 30 seconds than after 20 seconds.

.....

.....[1]

(b) Between **Q** and **R**, the car travels for 28 seconds at a speed of 28 m/s.

Calculate the distance that the car travels.

State the formula that you use and show your working.

formula

working

distance = ...m [2]

(c) Fig. 12.2 shows an electrical circuit in the car. The car battery is connected to three identical lamps and two switches.

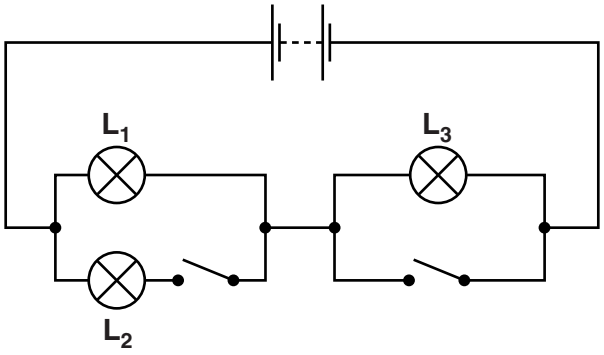


Fig. 12.2

(i) State which two lamps are connected in series when both switches are open,

lamp ..... and lamp ..... [1]

(ii) State which two lamps are connected in parallel when both switches are closed.

lamp ..... and lamp ..... [1]

BLANK PAGE

BLANK PAGE

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.).