Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8567565760

CO-ORDINATED SCIENCES **0654/21**

Paper 2 (Core) **May/June 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 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 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 **31** printed pages and **1** blank page.

CAMBRIDGE International Examinations

1 (a) (i) Complete the following sentences about chemical bonding choosing words from the list below.

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

electrons	**ions**	**lost**	**molecules**
neutralised	**nucleons**	**shared**	**transferred**

Compounds may contain covalent or ionic bonds.

When a covalent bond forms, electrons are ..... between atoms.

When an ionic bond forms, ... are .....

between atoms. [2]

(ii) Predict the type of chemical bonding in the compound carbon dioxide.

Give a reason for your answer.

type of bonding .....

reason .....

..... [1]

(b) Fig. 1.1 shows two methods, **A** and **B** that may be used to fill a test-tube with carbon dioxide. Both sets of apparatus are at room temperature.

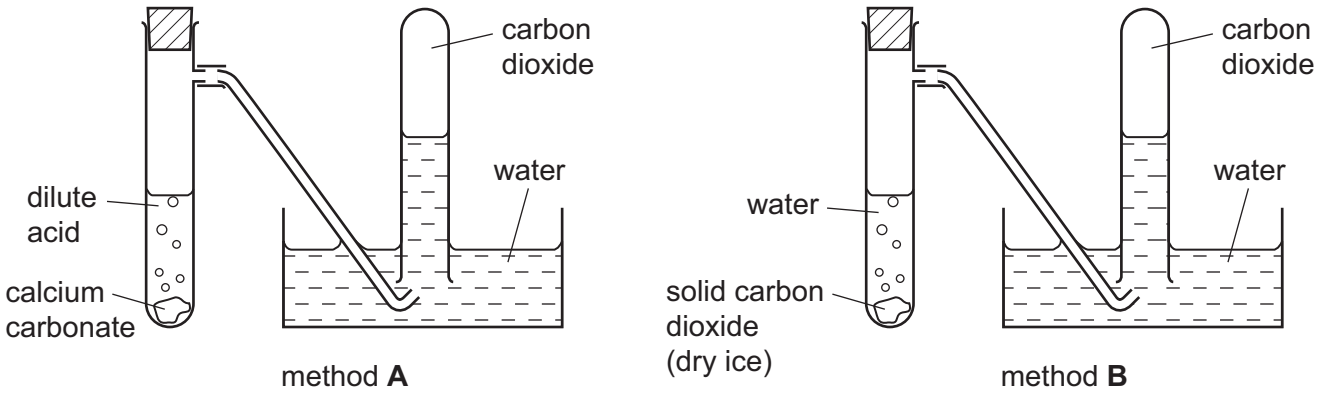


Fig. 1.1

(i) Describe a chemical test for carbon dioxide.

test .....

result ..... [2]

(ii) Method **A** produces carbon dioxide by a chemical change.
Method **B** produces carbon dioxide by a physical change.

Explain why these statements are correct.

method **A** chemical change

explanation .....

.....

method **B** physical change

explanation .....

.....

[2]

(c) Fig. 1.2 shows an experiment a student carried out to compare the reactivity of three metals, magnesium, iron and copper.

The pieces of metal she used were the same size. She added them to identical samples of dilute hydrochloric acid in three test-tubes, **P**, **Q** and **R**.

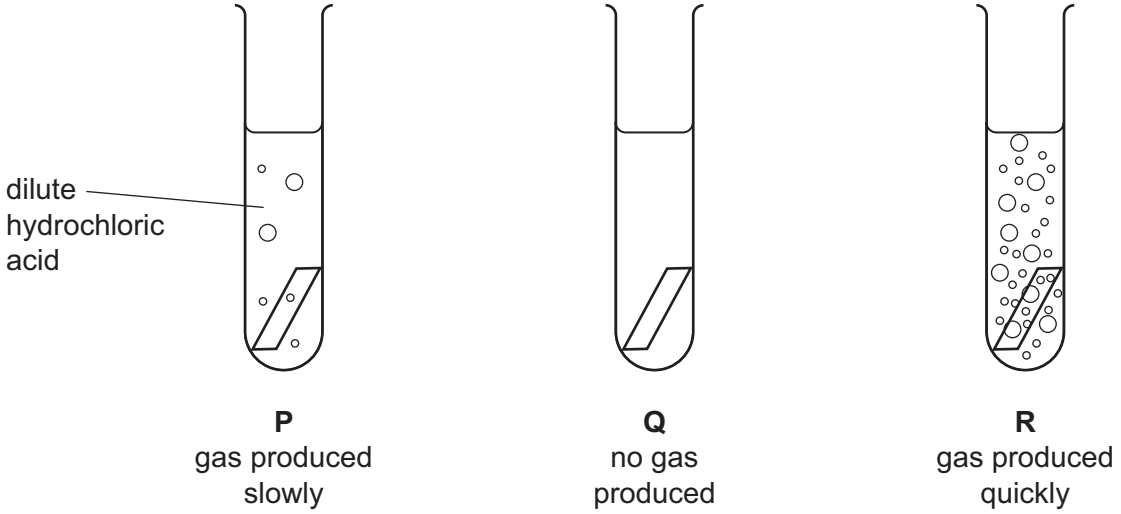


Fig. 1.2

(i) Name the gas that was given off in test-tubes **P** and **R**.

..... [1]

(ii) State the metal contained in each of the test-tubes.

tube **P** contained .....

tube **Q** contained .....

tube **R** contained ..... [1]

(iii) Explain your answer to **(ii)**.

.....

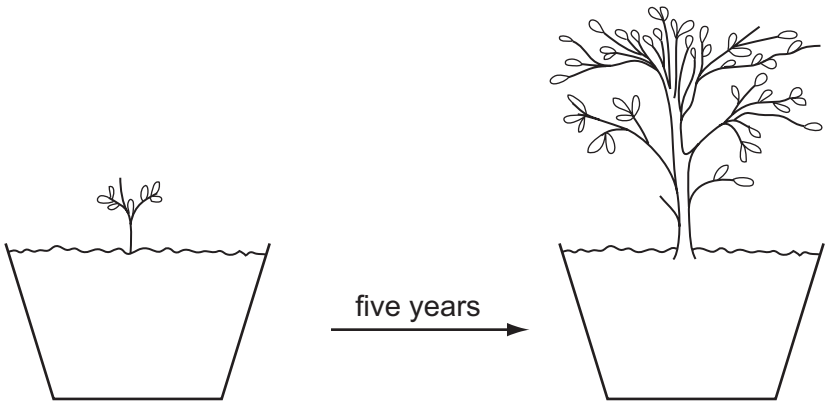
.....

..... [2]

Please turn over for Question 2.

2 In the seventeenth century, it was believed that plants obtained all their food from the soil. A scientist called Jan van Helmont did an experiment to investigate this.

He weighed a young willow tree, and then planted it in a large tub containing a weighed amount of dry soil. He added water to the soil, and kept the tree for five years, watering it regularly. After five years, the tree had grown.



After the five years, he weighed the tree again, and he also dried and reweighed the soil in the tub. Table 2.1 shows his results.

Table 2.1

	mass of tree / kg	mass of dry soil / kg
at the start	2.5	250.0
after five years	76.5	249.9

(a) (i) Name the process by which plants manufacture carbohydrates from raw materials.

..... [1]

(ii) Write the **word** equation for this process.

..... [2]

(b) (i) Describe how the mass of the soil changed over the five years of the experiment.

..... [1]

(ii) Suggest an explanation for this result.

.....

..... [1]

(c) Van Helmont thought that the growth of his tree was entirely due to the water that he had added. This conclusion was only partly correct.

(i) Explain in what way the conclusion was correct.

.....

[1]

(ii) State which other part of the environment contributed to the mass of the tree.

.....

[1]

(d) Since van Helmont decided that the tree only needed water to grow, he might have tried another experiment, growing the tree in a bucket of water, with no soil.

Explain why, if van Helmont had tried this experiment, the tree would not have grown well.

.....

.....

[1]

3 Fig. 3.1 shows information about two trucks, **X** and **Y**, coming to rest under the action of the same braking force.

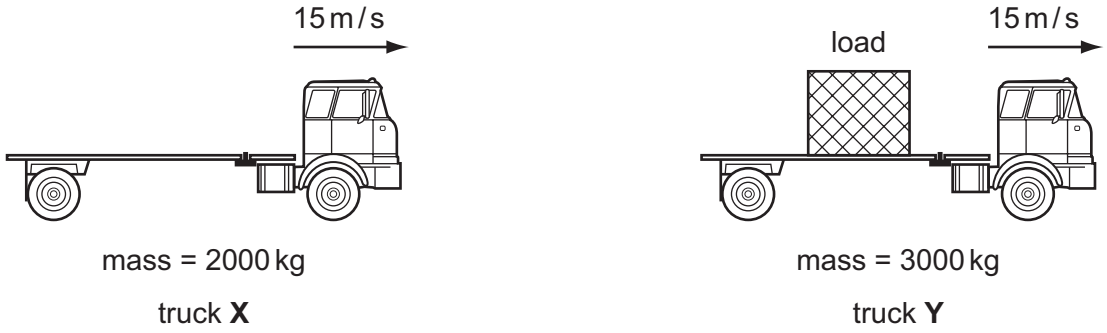


Fig. 3.1

The mass of truck **X** is 2000 kg and the mass of truck **Y** and its load is 3000 kg.

Fig. 3.2 shows the speed / time graph for the two trucks.

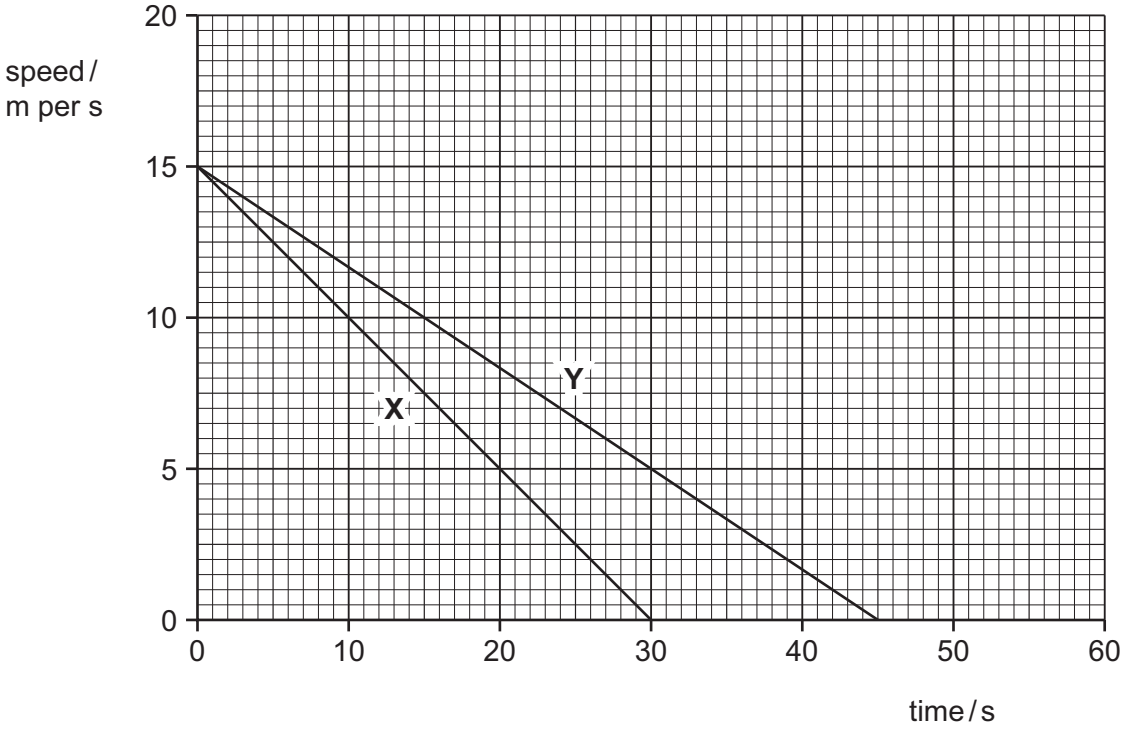


Fig. 3.2

(a) (i) After how many seconds did truck **X** stop?

..... seconds [1]

(ii) What was the maximum speed of truck **Y**?

..... m / s [1]

(iii) Explain how Fig. 3.2 shows that truck **X** has the greater deceleration.

.....

.....

..... [1]

(b) The load truck **Y** is carrying, is a large metal block. The block is shown in Fig. 3.3.

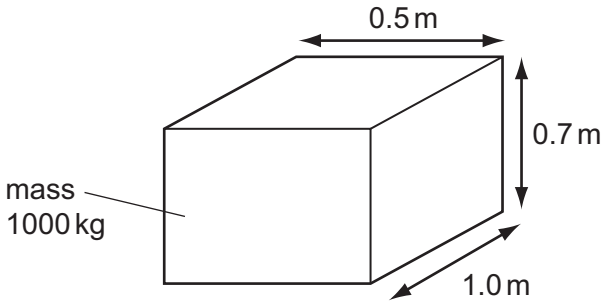


Fig. 3.3

(i) Calculate the volume of the block.

volume = ... m^3 [1]

(ii) The mass of the block is 1000 kg.

Calculate the density of the block.

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

formula

working

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

(c) The metal block is going to a factory to be melted down into a liquid. The melting point of the metal is 660 °C.

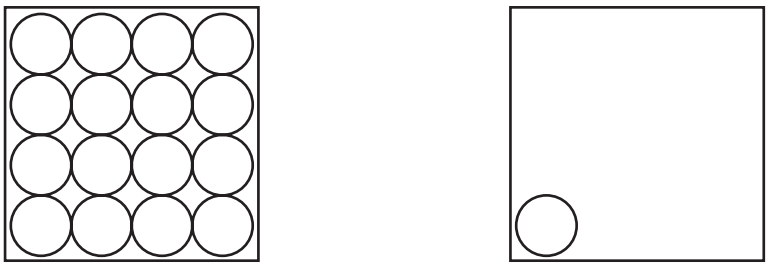
(i) State the meaning of the term *melting point*.

.....

..... [1]

(ii) Complete Fig. 3.4 to show the arrangement of particles in a liquid.

The diagram for a solid has been done for you.



solid liquid

Fig. 3.4

[2]

Please turn over for Question 4.

4 Fuels react with oxygen in combustion reactions. During these reactions, heat energy is released.

(a) (i) Name and state a use for **one** gaseous fuel and **one** liquid fuel.

gaseous fuel

name .....

use .....

liquid fuel

name .....

use .....

[4]

(ii) State the word used to describe chemical reactions that release heat energy.

..... [1]

(b) When some fuels are burned, the mixture of combustion products contains sulfur dioxide and oxides of nitrogen.

State **two** harmful effects of these gases in the environment.

1 .....

.....

2 .....

..... [2]

(c) Coal is a solid fuel that contains a large amount of the element carbon.

Large pieces of coal burn slowly. Coal in the form of a fine powder (coal dust) burns very quickly.

(i) Name a gas that is formed when the carbon in coal is oxidised.

..... [1]

(ii) Explain why coal dust burns more quickly than large pieces of coal.

.....

..... [1]

(iii) Coal mines contain electrical machinery which may cause sparks.

Suggest and explain reason why coal dust in the air inside a coal mine could be very dangerous.

.....

.....

..... [2]

5 **(a)** Fig. 5.1 shows a copper wire placed between the poles of a strong magnet.

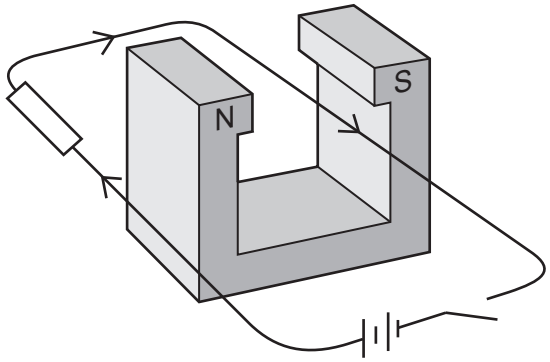


Fig. 5.1

(i) Describe what a student observes when the switch is closed.

.....

..... [1]

(ii) Describe the change in the observation in **(i)** if the current is in the opposite direction.

.....

..... [1]

(iii) Suggest the change in the observation of **(i)** if there is a larger current in the wire.

.....

..... [1]

(b) **(i)** Explain why a balloon rubbed with a woollen cloth gains a negative electric charge.

.....

.....

..... [2]

Fig. 5.2 shows two similarly charged balloons, suspended close together.

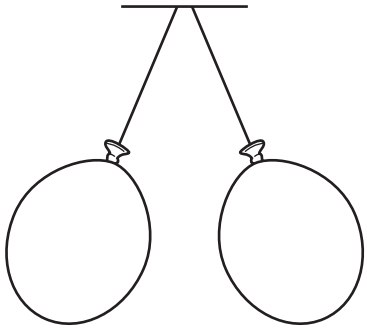


Fig. 5.2

(ii) Explain why the two balloons move apart.

.....

..... [1]

(c) In a domestic lighting circuit, lamps are connected in parallel.

Explain why the lamps are not connected in series.

.....

.....

..... [2]

(d) Describe how a fuse protects a worker using an electric drill.

.....

.....

..... [2]

6 Fig 6.1 shows part of a food web in African grassland (savannah).

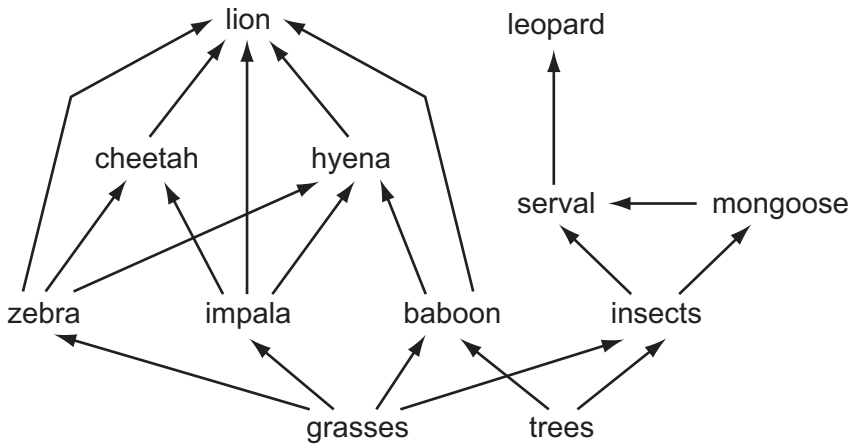


Fig. 6.1

(a) Explain what the arrows in the food web represent.

.....

.....

[1]

(b) Use the information in Fig. 6.1 to write down a food chain containing four organisms.

..... → ..... → serval → ..... [3]

(c) From Fig. 6.1, write down the name of

(i) a herbivore, ... [1]

(ii) a producer. ..... [1]

(d) Explain how grasses and trees get their food.

.....

.....

.....

.....

[2]

(e) The numbers of impala greatly decreased.

(i) A scientist predicted that this would cause the numbers of zebras to increase.

Explain why this **increase** could happen.

.....

..... [1]

(ii) Another scientist disagreed, and predicted that the numbers of zebras would decrease.

Explain why this **decrease** could happen.

.....

..... [1]

7 **(a)** Fig. 7.1 shows a chlorine atom that has a nucleon number (mass number) of 35.

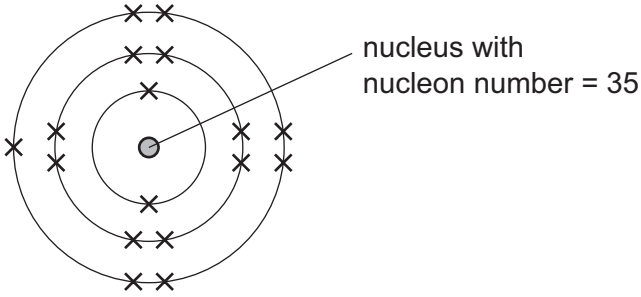


Fig. 7.1

Complete Table 7.1 to show the names and numbers of the particles found in the nucleus of this atom.

Table 7.1

name of particle	number in the nucleus
proton	

[2]

(b) **(i)** Explain why chlorine is added to water that will be used for drinking.

.....

.....

..... [2]

(ii) Complete the **word** chemical equation for the reaction that occurs when chlorine is mixed with sodium iodide solution.

chlorine	+	sodium iodide	→		+	

[2]

(c) Fig. 7.2 shows a diagram of apparatus that can be used to produce chlorine.

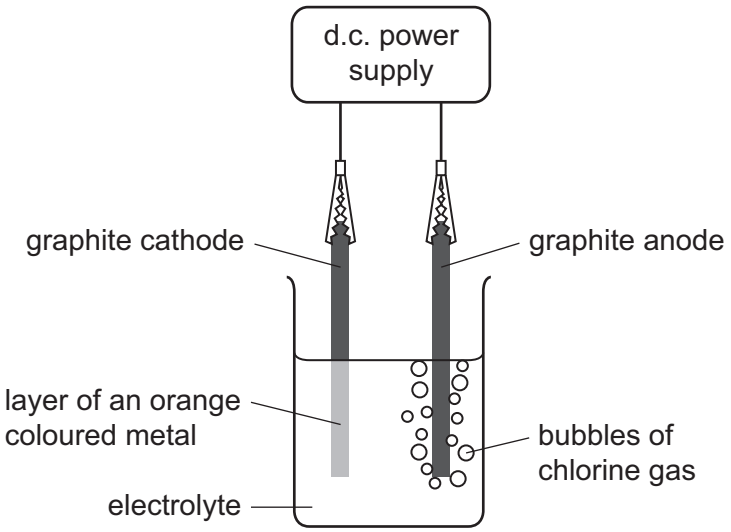


Fig. 7.2

(i) State the name of the process shown in Fig. 7.2.

.....[1]

(ii) Suggest the name of the ionic compound that has been used to make the electrolyte.

.....[1]

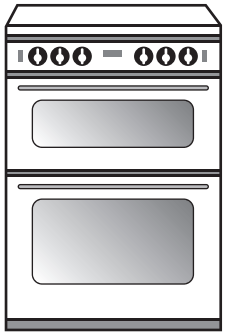
(iii) Use the evidence shown in Fig. 7.2 to explain your answer to **(ii)**.

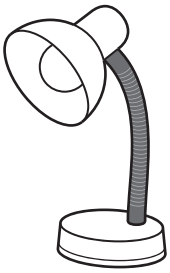
.....

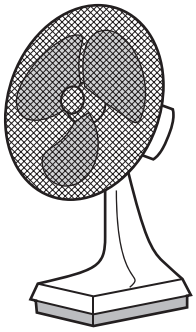
.....[1]

8 **(a)** Electrical appliances transform electrical energy into other forms of energy.

Complete the sentences below by writing down the **useful** form of energy produced in each case.







(i) In an electric cooker, electrical energy is changed into ..... energy. [1]

(ii) In an electric lamp, electrical energy is changed into ..... energy. [1]

(iii) In an electric fan, electrical energy is changed into ..... energy. [1]

(b) Fossil fuels store chemical energy, which is transformed into thermal energy when the fuel is burned.

Describe how this thermal energy is used to produce electricity.

.....

.....

.....

..... [3]

(c) In some power stations highly radioactive isotopes are formed when energy is released.

Workers at these power stations are monitored to check their exposure to radiation.

(i) State **one** way in which a worker's exposure to radiation can be monitored.

.....

..... [1]

(ii) Suggest **one** way in which the people, working with radioactive isotopes, can minimise their exposure to radiation.

.....

..... [1]

(iii) State **one** effect of ionising radiation on the human body.

.....

..... [1]

(d) Gamma radiation may be emitted from radioactive isotopes.

Gamma radiation is part of the electromagnetic spectrum.

State the part of the electromagnetic spectrum which is used for

terrestrial television communications, ...

mobile telephone (cell phone) communications.

.....

[2]

9 **(a)** State the function of the uterus in the female reproductive system.

.....

[1]

(b) Fig. 9.1 shows changes in the thickness of the lining of a woman's uterus over a period of 35 days.

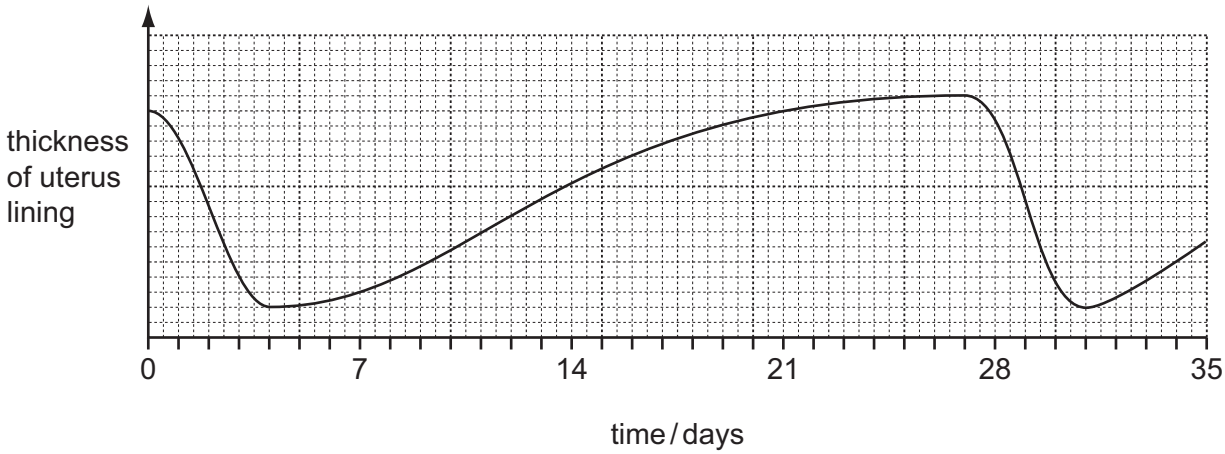


Fig. 9.1

(i) State the days when menstruation is occurring during the 35 day period.

between day ..... and day .....

and between day ..... and day ..... [2]

(ii) Suggest on what day ovulation is most likely to occur.

..... [1]

(iii) Explain why it is important for the uterus lining to become thicker.

.....

..... [1]

(c) Hormones control the thickness of the lining of the uterus.

Name the part of the reproductive system that produces these hormones.

..... [1]

(d) (i) Explain what is meant by *fertilisation*.

.....

..... [1]

(ii) If an egg is fertilised, the uterus lining remains thick.

Draw a line on Fig. 9.1 to show this. [2]

(iii) Explain why, after fertilisation, it is important for the uterus lining to remain thick.

.....

..... [1]

10 (a) Complete Table 10.1 to compare the properties of light and sound waves.

Write **yes** or **no** in each box in Table 10.1 to compare the properties of light waves and sound waves.

Table 10.1

property	light	sound
can be reflected		
can travel through a vacuum		
is a transverse wave		
is part of the electromagnetic spectrum		

[4]

(b) Ultrasound waves are sound waves with a very high frequency. These waves cannot be heard by humans.

(i) State the approximate range of frequencies audible to humans.

From ..... Hz to ..... Hz. [2]

(ii) Suggest a possible frequency for the ultrasound waves.

..... Hz [1]

(iii) Devices which emit ultrasound waves can be used to keep small animals such as cats away from gardens. The ultrasound waves take 0.05 s to travel 16.5 m from the device to a cat.

Calculate the speed of the ultrasound waves.

State the formula that you use and show your working.

formula

working

..... m / s [2]

11 Fig. 11.1 shows some of the regions of the alimentary canal in a human.

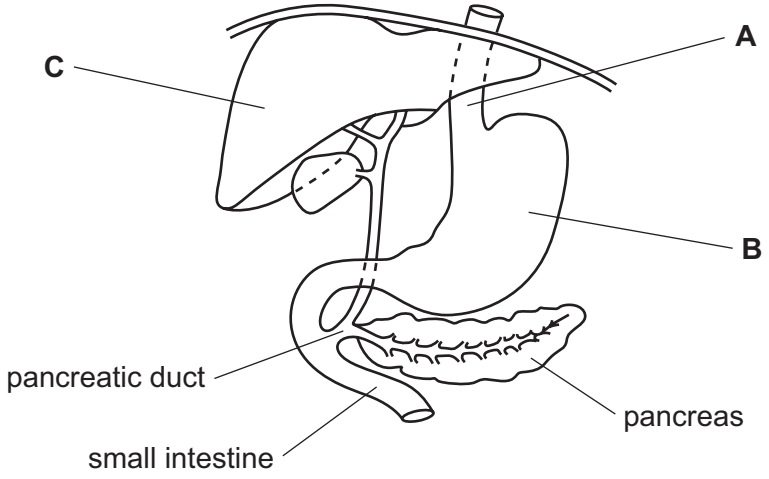


Fig. 11.1

(a) Name the structures labelled **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(b) State **one** function of the pancreas.

.....

..... [1]

(c) In people with cystic fibrosis, the pancreatic duct may become blocked.

Suggest and explain what the effect of this would be.

.....

.....

..... [2]

(d) (i) With reference to the alimentary canal, define the term *absorption*.

.....

.....

..... [2]

(ii) Name the parts of the alimentary canal in which there is the most absorption of

sugars, ...

water. ..... [2]

(iii) Explain how assimilation differs from absorption.

.....

.....

..... [2]

Please turn over for Question 12.

12 (a) The elements are often described as being either metals or non-metals.

(i) Describe **two** differences in the **physical** properties of a typical metal and a typical non-metal.

1 .....

.....

2 .....

..... [2]

(ii) The element calcium is in Group II of the Periodic Table as shown on page 32.

Predict whether calcium is a metallic or non-metallic element. Give a reason for your answer.

prediction .....

.....

reason .....

..... [1]

(iii) Identify the name or symbol of the noble (inert) gas that is in the same period of the Periodic Table as calcium.

..... [1]

(b) Oxides are compounds of oxygen with other elements.

A student made four mixtures, **W**, **X**, **Y** and **Z**, by shaking four oxides in water. He measured the pH values of the mixtures, and his results are shown in Table 12.1.

Table 12.1

mixture	pH
W	3
X	2
Y	12
Z	7

State and explain which mixture

(i) was the most acidic,

mixture .....

explanation .....

..... [1]

(ii) had been made using the oxide of a metallic element.

mixture .....

explanation .....

..... [1]

(c) Rust is a type of iron oxide.

Fig. 12.1 shows three test-tubes, **1**, **2**, and **3**, that were set up to investigate substances that react with an iron nail to form rust.

In each test-tube an iron nail was in contact with a liquid and a gas.

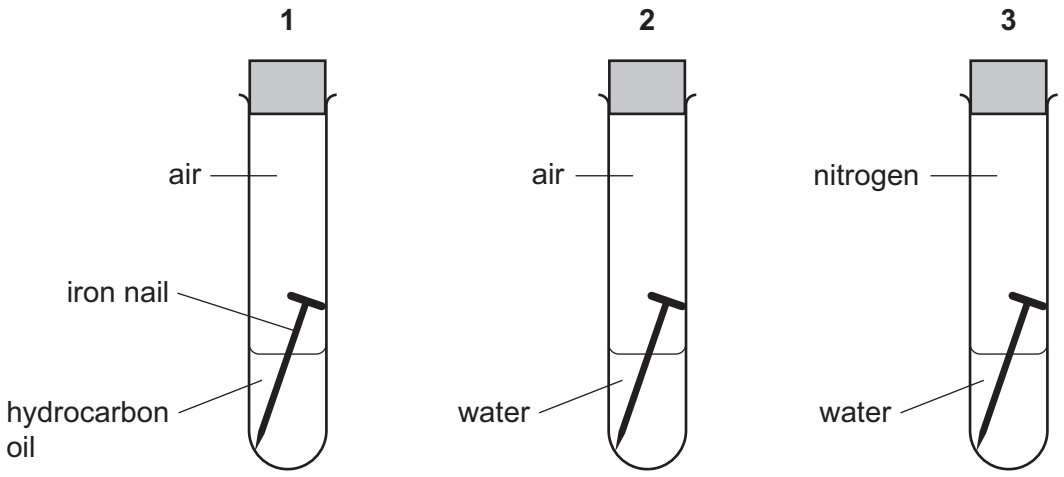


Fig. 12.1

The test-tubes and their contents were left for a week and then observed.

For each test-tube predict whether or not rust forms on the iron nail. Explain your prediction briefly in each case.

test-tube **1**

prediction .....

explanation .....

.....

test-tube **2**

prediction .....

explanation .....

.....

test-tube **3**

prediction .....

explanation .....

.....

[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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

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

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**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	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

Key

a **X** b

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

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