UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0201648935

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **May/June 2011**

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 a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 28.

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.

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1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

This document consists of **27** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

1 Fig. 1.1 shows layers of sedimentary rocks lying under the sea bed near a coast. The diagram is not drawn to scale.

Some of these rock layers are permeable and contain fossil fuels trapped inside them.

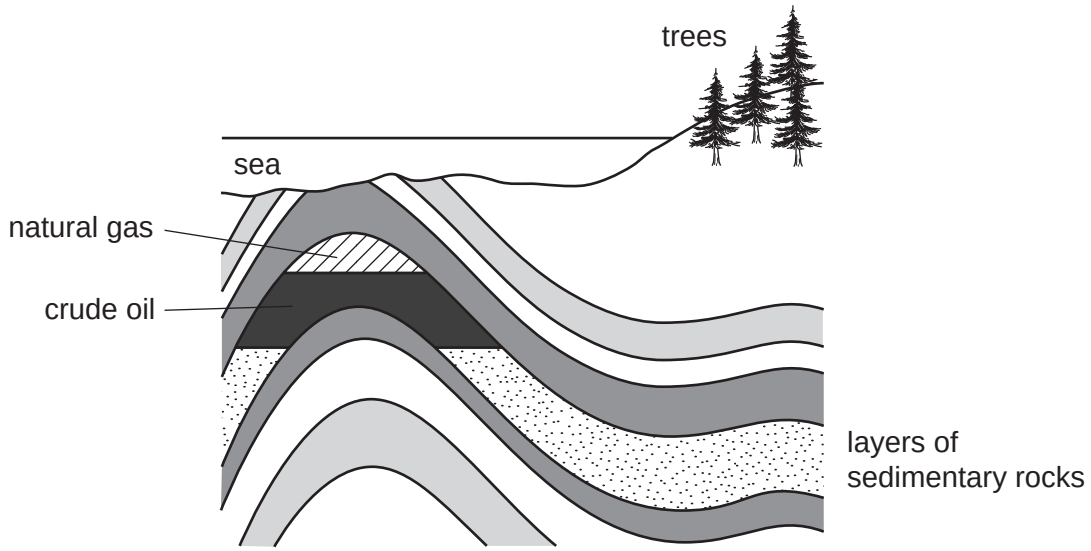

Fig. 1.1

(a) (i) Wood obtained from trees and compounds obtained from crude oil and natural gas can be used as fuels.

State **two** reasons why crude oil and natural gas are examples of *fossil fuels* but wood is not.

1 .....

.....

2 .....

..... [2]

(ii) Fossil fuels contain mainly hydrocarbons. Wood contains cellulose which is a carbohydrate.

Name an element which is combined in carbohydrate molecules but **not** in hydrocarbons.

..... [1]

(iii) Plants produce both glucose and cellulose.

Describe briefly how cellulose molecules are formed from glucose molecules.

.....

.....

..... [2]

(b) The molecular formulae of three hydrocarbon molecules are shown below.

C_6H_{14} C_3H_8 CH_4

Suggest and explain briefly which **one** of these formulae is of a hydrocarbon **least** likely to be found in natural gas.

formula .....

explanation .....

..... [1]

(c) In a car engine, the combustion of hydrocarbons produces a mixture of very hot waste (exhaust) gases.

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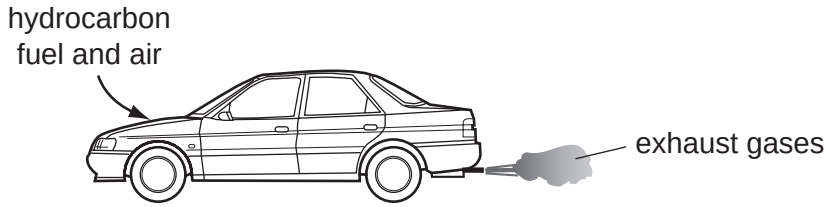
These gases are released from the car into the atmosphere, and some of them cause pollution because they are poisonous.



Some of the gases in a car's exhaust are listed in Table 1.1.

Table 1.1

substance in exhaust gases
carbon dioxide
carbon monoxide
nitrogen
nitrogen dioxide
oxygen
water vapour

(i) Write the names of gases chosen from Table 1.1 which match the following descriptions.

unreactive element which makes up most of the atmosphere

.....

condenses when cooled to form a colourless liquid compound

..... [2]

For Examiner's Use

(ii) Suggest how a sample of the exhaust gases from a car could be tested to show the presence of carbon dioxide.

.....

.....

..... [2]

(iii) **Two** of the gases in Table 1.1 are hazardous air pollutants because even small amounts can have harmful effects on humans who inhale them.

Name these hazardous air pollutants.

1 .....

2 ..... [2]

For Examiner's Use

2 **(a)** A builder does 8000 J of work in ten minutes.

Calculate the average power he produces.

State the formula that you use and show your working.

State the units in your answer.

formula used

working

..... [3]

(b) A brick falls from a crane on a building site. It hits the ground at a speed of 40 m / s. The air resistance on the brick can be ignored.

(i) The brick has a mass of 2 kg.

Calculate the kinetic energy of the brick as it hits the ground.

State the formula that you use and show your working.

formula used

working

..... J [2]

(ii) State the value for the potential energy of the brick before it fell from the crane.

Explain your answer.

potential energy ..... J

explanation .....

..... [2]

(c) Fig. 2.1 shows the structure of the walls of a house in a cold climate.

Heat can escape through the walls of the house. Explain how the structure of the wall in Fig. 2.1 reduces heat loss.

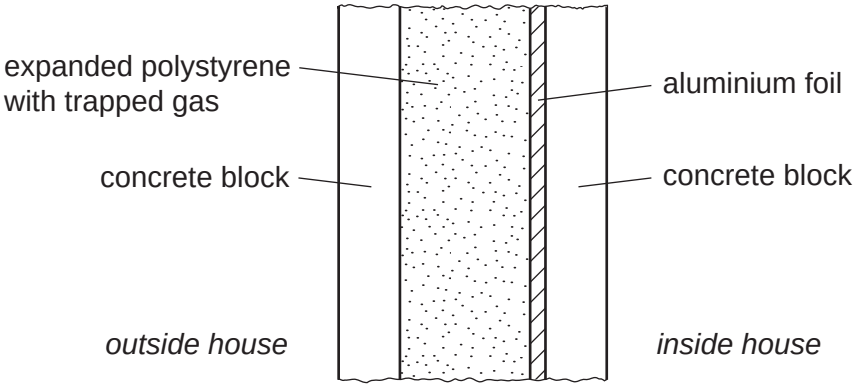


Fig. 2.1

.....

.....

.....

.....

.....

..... [3]

3 Fig. 3.1 shows some of the bones and muscles in the human arm.

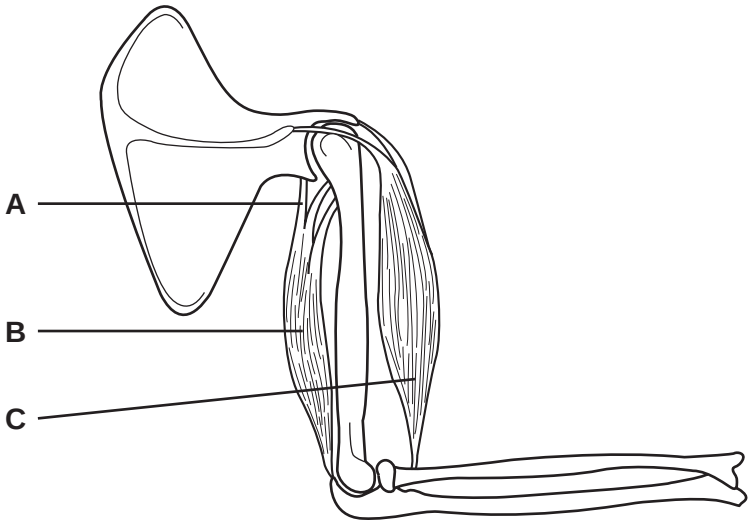


Fig. 3.1

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

B .....

C ..... [2]

(ii) State how each of these structures, shown in Fig. 3.1, helps to cause the arm to straighten.

structure **B** .....

structure **A** .....

structure **C** ..... [3]

For Examiner's Use

(b) Bone contains the mineral calcium phosphate.

A study was carried out in Brazil into the mineral content of the leg bones of school children between the ages of 10 and 19 years. The mineral content was measured as the mass of mineral per cm^3 of bone. Some of the results are shown in Fig. 3.2.

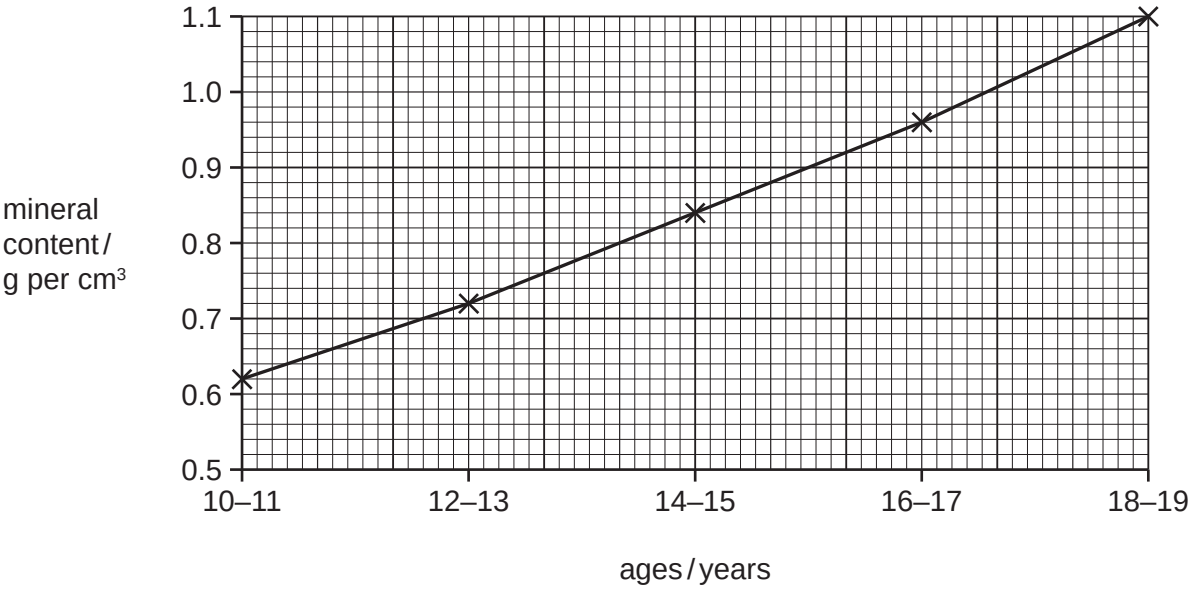


Fig. 3.2

(i) Describe how the mineral content of bone changes between the ages of 10 and 19 years.

.....

.....

..... [2]

(ii) Suggest why a teenager should have a diet containing plenty of dairy products such as milk and cheese.

.....

.....

..... [2]

(iii) Bone also contains a protein called collagen. Vitamin C is required to make collagen.

Name **one** food that contains large amounts of vitamin C.

..... [1]

(c) Some parts of the human skeleton are made of cartilage.

For Examiner's Use

(i) State **one** difference between the properties of bone and cartilage.

.....

..... [1]

(ii) State precisely where cartilage is found in the human arm shown in Fig. 3.1, and describe its function.

.....

.....

..... [2]

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Please turn over for Question 4.

4 **(a)** Fig. 4.1 shows a skier being pulled up a mountain slope by a cable (lift).

For Examiner's Use

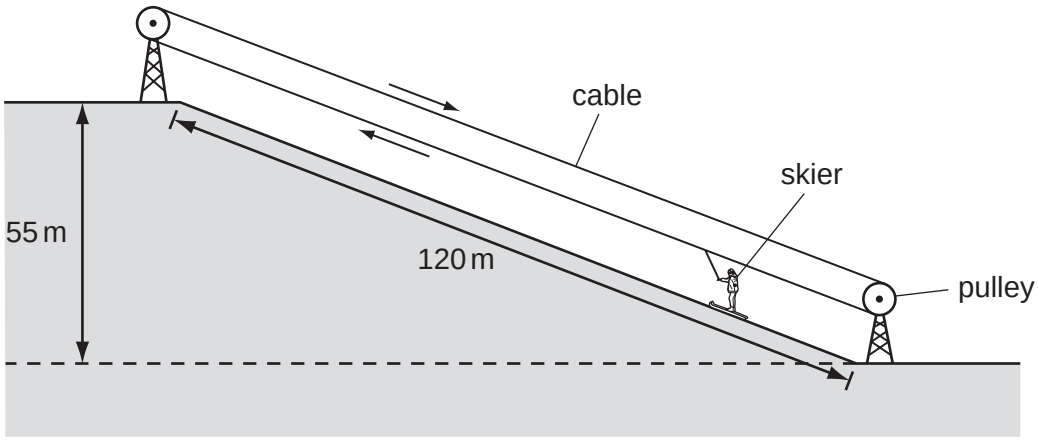


Fig. 4.1

The skier weighs 700 N. She travels 120 m along the slope and rises by a vertical height of 55 m.

Calculate the work done lifting the skier from the bottom to the top of the slope. You should ignore the work done against friction.

State the formula that you use and show your working.

formula used

working

..... J [2]

(b) Fig. 4.2 shows the speed-time graph for a skier competing in a race.

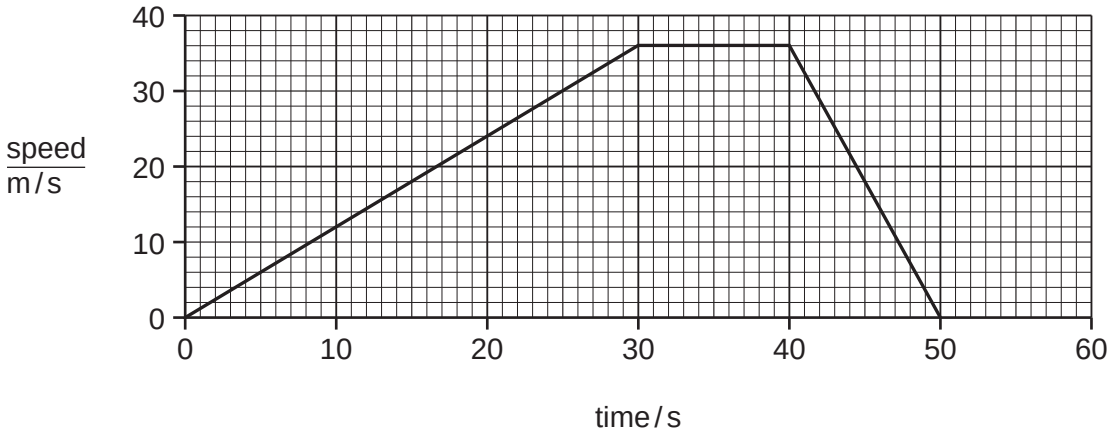


Fig. 4.2

(i) State the length of time the skier was moving.

.....[1]

(ii) Describe the motion of the skier between 30 and 40 seconds.

.....

.....[2]

(c) Skiers use a ski pole in each hand to help control their motion. The ski poles work best when they only go into the snow for a few centimetres.

Fig. 4.3 shows a skier using ski poles.

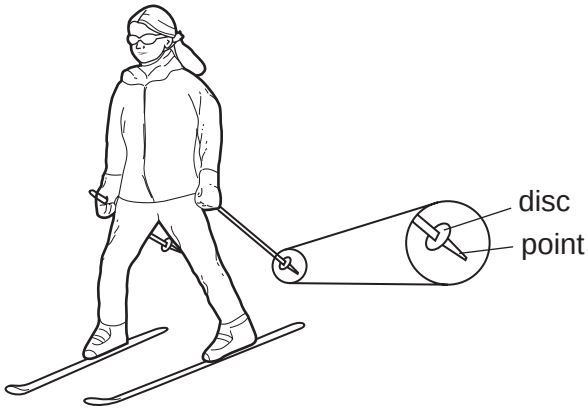


Fig 4.3

Explain, in terms of pressure, force and area, why the ski pole has a pointed end and a large disc a few centimetres above this.

.....

.....

..... [2]

(d) Explain why a skier keeps the lower surface of her skis smooth and well polished.

.....

..... [1]

5 Guanacos are relatives of camels and live in the Andes mountains in South America. They feed on grasses and other plants. They are hunted by pumas, and young guanacos may be killed by foxes.

Fig. 5.1 shows a guanaco.

Fig. 5.1

(a) (i) State **one** feature, visible on Fig. 5.1, that indicates that guanacos are mammals.

..... [1]

(ii) State **one** feature, visible on Fig. 5.1, that could help guanacos to avoid being killed by pumas.

..... [1]

(b) Guanacos can live at very high altitudes, above 4000 metres, where there is less oxygen in the air than at sea level.

(i) Describe how oxygen from the air enters the blood of a mammal, such as a guanaco.

.....

.....

..... [2]

[Turn over

(ii) The blood of a guanaco contains four times as many red blood cells per cm^3 as the blood of a human.

This helps the guanaco to adapt to its environment. Suggest an explanation for this.

.....

.....

..... [2]

(c) Guanacos are an endangered species. Their numbers have fallen because of loss of suitable habitat and because of hunting by humans. Several countries in South America have conservation programmes to try to increase the numbers of guanacos.

In one conservation programme, five male and five female guanacos were introduced into a suitable habitat of about 25 km^2. They were protected from humans.

Fig. 5.2 shows what happened to the guanaco population over the next few years.

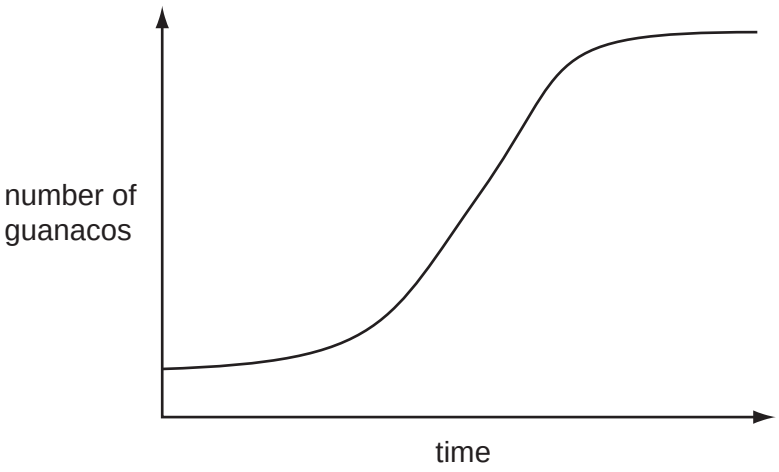


Fig. 5.2

(i) Explain why the guanaco population eventually stopped increasing.

.....

.....

.....

..... [2]

(ii) Suggest **two** reasons why it is important to conserve guanacos.

1 .....

.....

2 .....

..... [2]

For Examiner's Use

6 Lithium and its compounds have many important uses.

(a) (i) State the group number and period number of lithium in the Periodic Table.

group number .....

period number ..... [1]

(ii) Fig. 6.1 shows how pieces of lithium metal are stored.

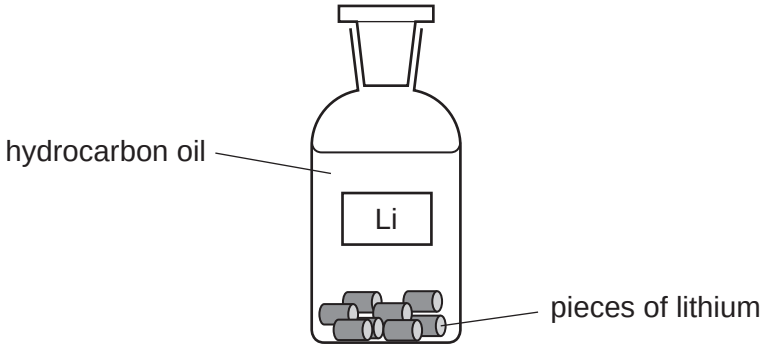


Fig. 6.1

State and explain why it is necessary to store lithium in this way.

.....

.....

..... [2]

(iii) Fig. 6.2 shows a student's attempt to draw the arrangement of all the electrons in a lithium atom.

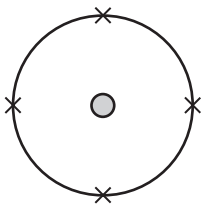


Fig. 6.2

State **two** mistakes that the student has made.

1 .....

.....

2 .....

..... [2]

For Examiner's Use

(b) Lithium is extracted from the salt lithium chloride by electrolysis.

Lithium chloride is first made by reacting lithium carbonate with an acid **A**.

(i) Suggest the name of acid **A**.

.....[1]

(ii) When acid **A** reacts with lithium carbonate a gas is given off.

Name this gas.

.....[1]

(iii) Complete the word equation below which describes the electrolysis of lithium chloride.

lithium chloride $\rightarrow$ lithium + ...[1]

(c) Lithium carbonate is widely used as a drug to treat some types of mental illness.

(i) State the general meaning of the term *drug*.

.....

.....[1]

(ii) It is very important that compounds for use as drugs are made to high standards of purity.

State **one** important reason for this requirement.

.....

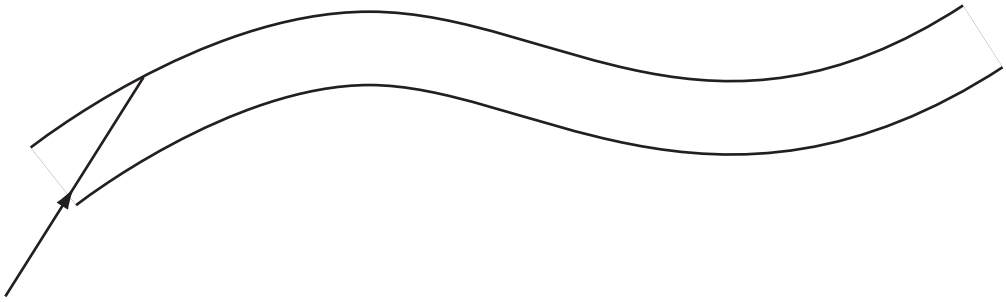
.....[1]

For Examiner's Use

7 **(a)** Optical fibres are used to see inside the human body. Light is sent along some of the fibres to enable doctors to see what is there.

Fig. 7.1 shows an optical fibre with a ray of light travelling down part of it.

Draw the path of the ray of light as it travels down the fibre.



[2]

Fig. 7.1

(b) A doctor wants to use a small torch to look down a patient's throat.

The torch does not work.

Fig. 7.2 shows the circuit diagram for the torch.

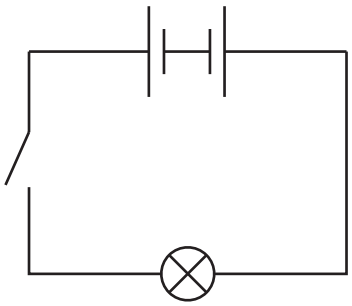


Fig. 7.2

Draw the correct circuit diagram to make the torch work.

[1]

(c) Human eyes are able to detect the three primary colours.

For Examiner's Use

(i) Name these colours.

1 .....

2 .....

3 ..... [1]

(ii) These three colours of light are electromagnetic waves. Apart from their colour, state **one** other way in which they differ from each other.

.....

..... [1]

For Examiner's Use

8 Many plants can reproduce sexually. The parts of a plant that carry out sexual reproduction are the flowers.

(a) Name the part of a flower that carries out each of the following functions.

(i) attracts insects to the flower ..... [1]

(ii) makes pollen ..... [1]

(iii) contains the female gametes ..... [1]

(b) Explain the differences between *pollination* and *fertilisation*.

.....

.....

.....

..... [2]

(c) The cells of a sunflower plant contain 34 chromosomes.

(i) How many chromosomes will there be in a male gamete of a sunflower?

..... [1]

(ii) State the part of a cell in which chromosomes are found.

..... [1]

(iii) Name the chemical that stores coded instructions in chromosomes.

..... [1]

(d) The cells in the petals of most flowers do not contain chlorophyll and cannot photosynthesise.

For Examiner's Use

(i) Suggest how the cells in flowers obtain sugars and other nutrients.

.....

.....

.....

..... [2]

(ii) Suggest **one** reason why cells in flowers need sugars.

..... [1]

9 A student investigated the reactivity of four metals **A**, **B**, **C** and **D**, by comparing the rate at which these metals reacted in dilute acid.

Fig. 9.1 shows what the student observed during the experiment.

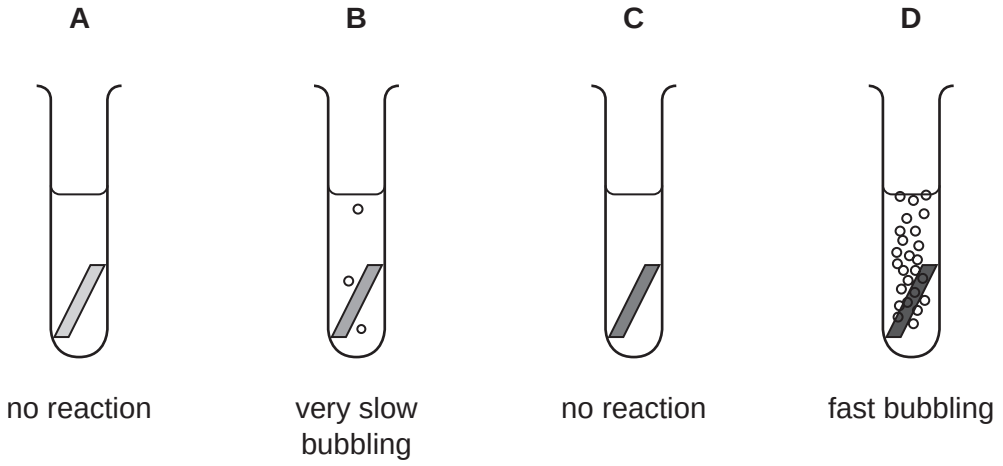


Fig. 9.1

(a) (i) State **three** variables (experimental conditions) that the student must keep the same if her assessment of the relative reactivity of the four metals is to be reliable.

1 .....

2 .....

3 ..... [3]

(ii) Predict and explain what would be observed if a lighted splint is held in the mouth of the test-tube in which metal **D** is reacting.

.....

.....

..... [2]

(iii) Explain briefly why the student's observations did **not** allow her to place all four metals into order based on their reactivity.

.....

..... [1]

For Examiner's Use

(b) The student was asked to use some larger pieces of metals **A** and **C** as electrodes in an electrochemical cell.

In addition to the electrodes and connecting wires, the student was given a voltmeter, a beaker and a bottle containing potassium nitrate solution (an electrolyte).

(i) Draw a diagram to show how the student should set up the apparatus and materials to produce an electrochemical cell.

[3]

(ii) The student successfully set up the electrochemical cell using metals **A** and **C** as electrodes. She measured the voltage of this cell.

She then replaced the electrode made of metal **A** by one made of metal **B**.

State and explain the effect, if any, that this had on the electrochemical cell.

.....

.....

..... [2]

[Turn over

For Examiner's Use

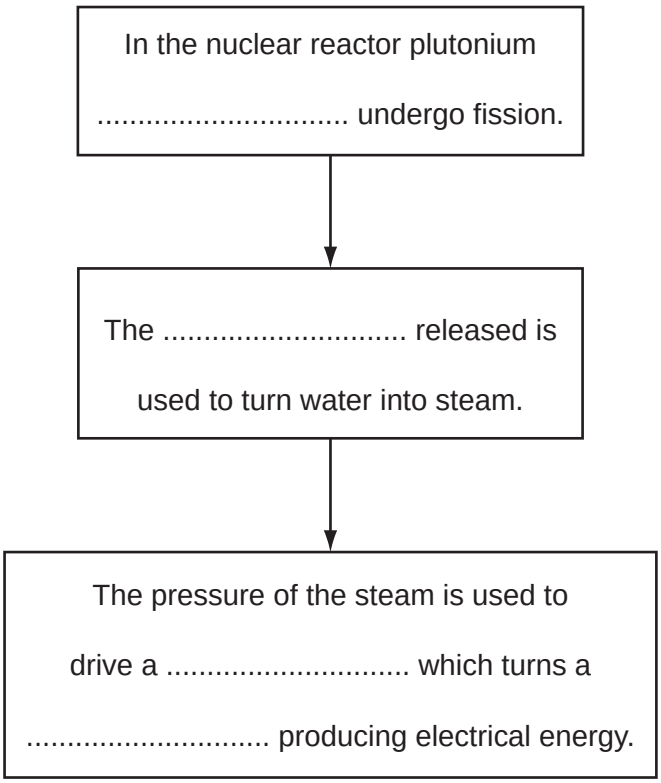
10 (a) Nuclear reactors in power stations released energy through nuclear fission.

(i) Plutonium is a fuel used in nuclear reactors. Another element used as nuclear fuel has the symbol U.

Name this element. ..... [1]

(ii) Using words from the list below, complete the flow chart to show the stages of generating electrical energy in a nuclear power station.

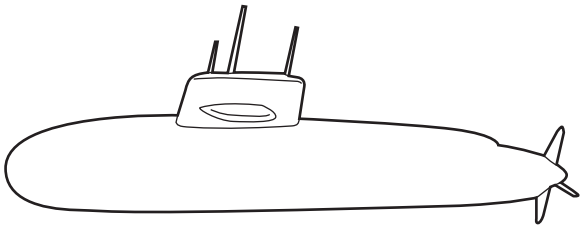
energy **generator** **nuclear** **nuclei** **turbine**



[3]

For Examiner's Use

(b) A nuclear reactor can also be used to power a submarine.



Radiation is released during nuclear fission. The reactor has to be shielded to protect the crew from this radiation.

(i) Suggest **one** material which could shield a nuclear reactor to stop radiation escaping.

..... [1]

(ii) Describe how exposure to ionising radiation can affect the human body.

.....

.....

..... [2]

(c) Waste from a nuclear reactor contains radioactive material with a half-life of 100 years.

A sample of this material gives a count rate of 3200 counts per minute.

(i) What instrument could be used to measure the count rate?

..... [1]

(ii) Calculate the time taken for the count rate to drop to 400 counts per minute.

Show your working.

..... years [2]

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.).