Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/22**

Paper 2 (Core) **October/November 2014**

1 hour 15 minutes

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 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 20.

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 **19** printed pages and **1** blank page.

CAMBRIDGE International Examinations

1 **(a)** Copper metal can be extracted from copper oxide by heating it with carbon.

The word equation for this reaction is shown below.

copper oxide + carbon → copper + carbon dioxide

Explain why this reaction could be described as a redox reaction.

.....

.....[2]

(b) Lead can be extracted from lead bromide by electrolysis.

Stage **1**. Lead bromide crystals are melted.
Stage **2**. The molten lead bromide is electrolysed.

Fig. 1.1 shows the apparatus that could be used for the electrolysis of molten lead bromide.

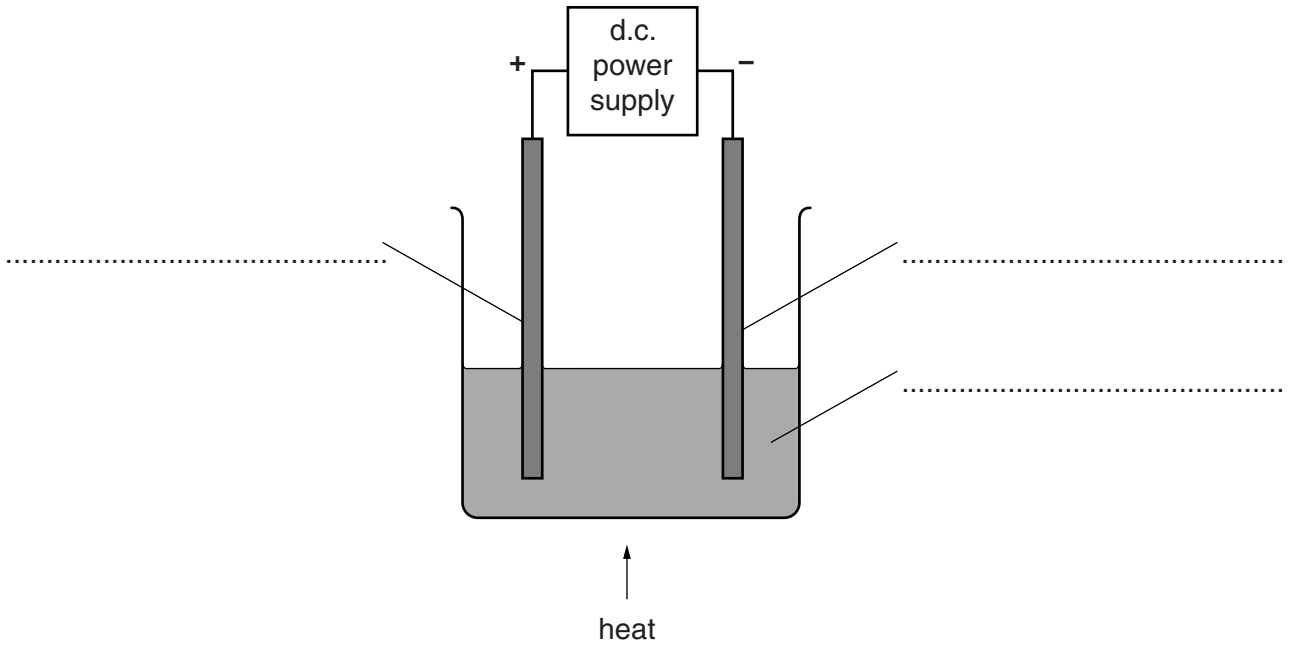


Fig. 1.1

(i) Use the following terms to complete the labelling of the diagram in Fig. 1.1.

anode **cathode** **electrolyte** [2]

(ii) Name and describe the appearance of the products that appear at or near

the **positive** electrode, ...

.....

the **negative** electrode. .....

.....[3]

2 Fig. 2.1 shows a special bicycle used to break the world speed record for a human-powered bicycle.

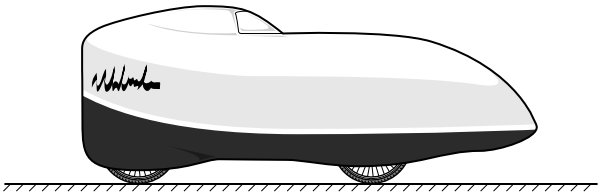


Fig. 2.1

On one run along a measured distance of 200 m, the rider's speed is 40 m/s.

(a) (i) Calculate the time taken by the rider over the measured distance of 200 m.

State the formula you use and show your working.

formula

working

time = ... s [2]

(ii) Calculate the rider's speed in kilometres per hour (km/h).

Show your working.

speed = ... km/h [2]

[Turn over

(b) After pedalling at constant speed for 200 m, the rider uses the brakes to stop the bicycle over the next 300 m.

On the axes below, sketch the shape of the speed / time graph for this motion.

[2]

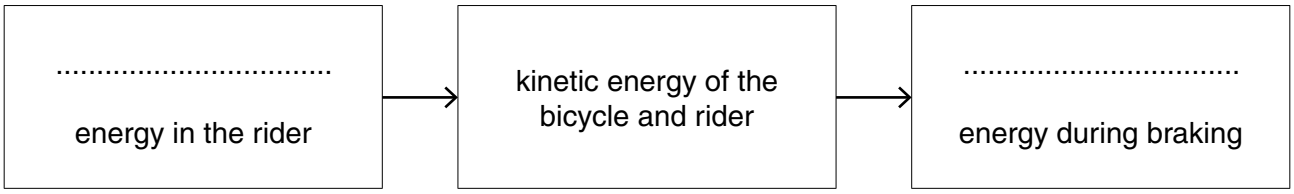
(c) While moving at a constant speed of 40 m / s, the bicycle is moved forward by a constant force of 400 N against the opposing forces.

(i) State the magnitude of the opposing forces. Give a reason for your answer.

.....

.....[1]

(ii) Complete the sequence of energy transfers that occurs during the run.



[2]

3 **(a)** Fig. 3.1 shows the human gas exchange system.

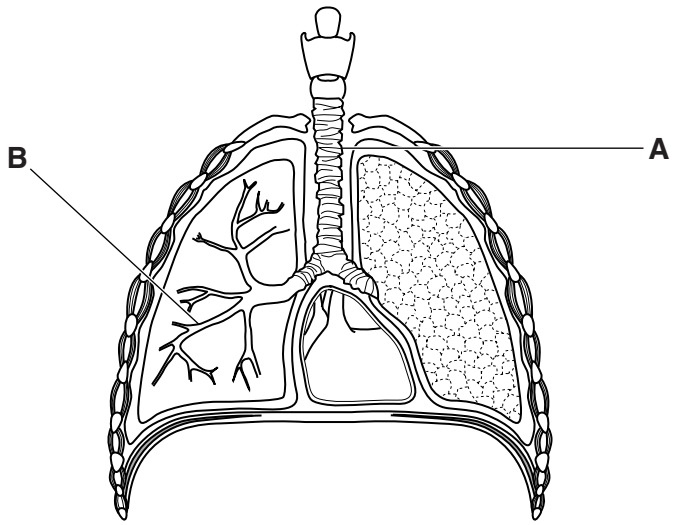


Fig. 3.1

Name structures **A** and **B**.

A .....

B ..... [2]

(b) A student investigates his breathing before and after exercise. He measures the number of breaths taken during one minute. He also measures the average volume of one breath during this minute.

His results are shown in Table 3.1.

Table 3.1

	number of breaths per minute	average volume of one breath / dm^3
at rest	20	0.5
immediately after exercise	35	1.6

Describe **two** ways in which the breathing of the athlete changes with exercise.

1.....

.....

2 .....

.....[2]

[Turn over

(c) The student uses the apparatus in Fig. 3.2 to compare inhaled and exhaled air. The inhaled air passes through the limewater in flask **P**. The exhaled air passes through the limewater in flask **Q**. The limewater changes to a milky colour when enough carbon dioxide passes through it.

The student breathes in and out of the apparatus until the limewater goes milky in one of the flasks. He times how long this takes.

The experiment is done twice, once before exercise and once after exercise.

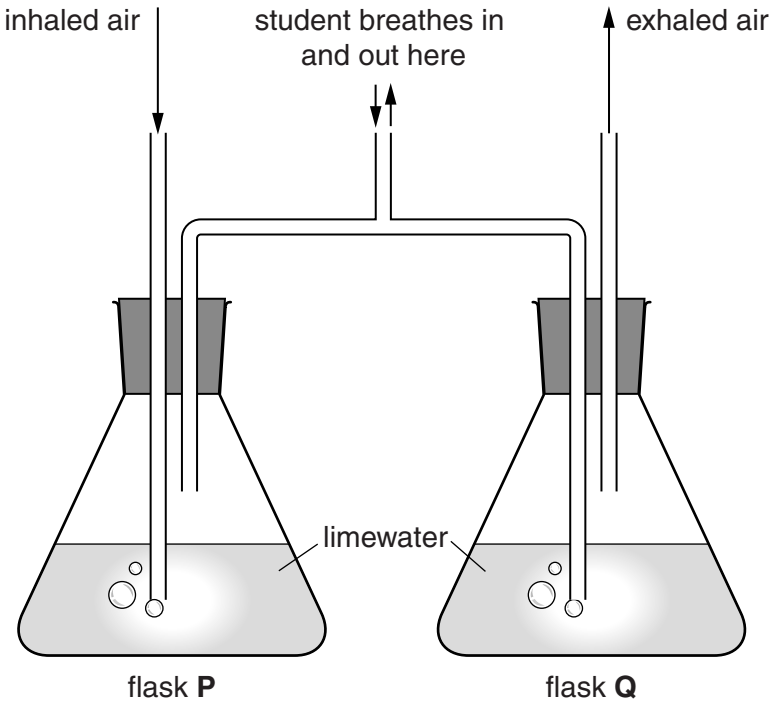


Fig. 3.2

Table 3.2 shows the results obtained.

Table 3.2

	observation of limewater in flask **P**	time taken for limewater to change in flask **Q**/s
before exercise	no change	20
immediately after exercise	no change	4

(i) Use the information in Table 3.2 to compare the carbon dioxide content of inhaled and exhaled air.

.....

.....[1]

(ii) Study the times taken for the limewater to turn milky in Table 3.2 before and after exercise.

Draw a conclusion from these results.

.....

.....

.....[2]

(iii) Suggest why there is no change observed in flask **P**.

.....

.....

.....[2]

4 Fig. 4.1 shows the circuit symbols for an electric bell and a push-switch.

electric bell push-switch

Fig. 4.1

(a) (i) Complete the circuit diagram in Fig. 4.2 for a circuit for a door-bell with a push-switch, powered by a battery with four cells, for the front door of a house.

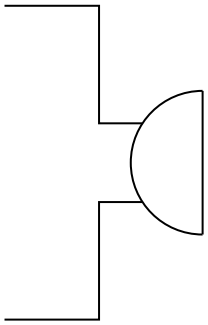


Fig. 4.2

[2]

(ii) Add a voltmeter to the completed circuit diagram in Fig. 4.2 to measure the voltage across the battery. [1]

(b) The ringing bell emits a sound of frequency 400 Hz.

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

.....

.....[1]

(ii) The house owner makes the sound of the bell louder by adding another cell to the battery, but the pitch of the sound from the bell remains unchanged.

State the effect this change has on the amplitude and frequency of the sound emitted.

effect on the amplitude .....

.....

effect on the frequency .....

.....[2]

(c) (i) The voltage provided by the battery is 6 V. When the bell is rung, a current of 2 A flows through the bell.

Use the formula

$$R = \frac{V}{I}$$

to calculate the resistance of the bell.

Show your working and state the unit of your answer.

working

resistance = ... unit ..... [2]

(ii) The house owner adds a second identical bell in the circuit in parallel to the first bell. When the switch is pushed, both bells ring.

Suggest the effect the second bell will have on the current taken from the battery when the bells are rung. Give a reason for your answer.

.....

.....

.....[2]

5 **(a)** An atom of carbon has a proton (atomic) number 6 and nucleon (mass) number 12.

(i) Complete Table 5.1 to show the structure of this carbon atom.

Table 5.1

	in nucleus	outside nucleus
number of protons		
number of neutrons		
number of electrons		

[2]

(ii) Explain why a carbon atom is electrically neutral.

.....

.....

.....[2]

(b) Methane is a carbon compound which is used as a fuel.

(i) Suggest a source of methane.

.....[1]

(ii) Write a **word** equation for the complete combustion of methane.

[ ] + [ ] ⟶ [ ] + [ ] [2]

(c) Fig. 5.1 shows the structure of a molecule of methane.

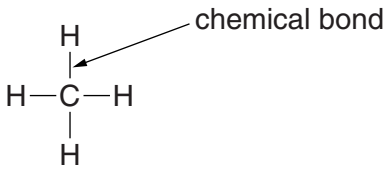


Fig. 5.1

(i) State the chemical formula of methane.

..... [1]

(ii) Name the type of chemical bond present in a methane molecule.

.....[1]

(iii) State the number of electrons found in the chemical bond shown in Fig. 5.1.

.....[1]

6 Fig. 6.1 shows a method that uses solar energy to purify drinking water. The method is used in hot desert countries.

The impure water is heated by the sun and distilled. The pure water is collected separately, while the impurities are left behind.

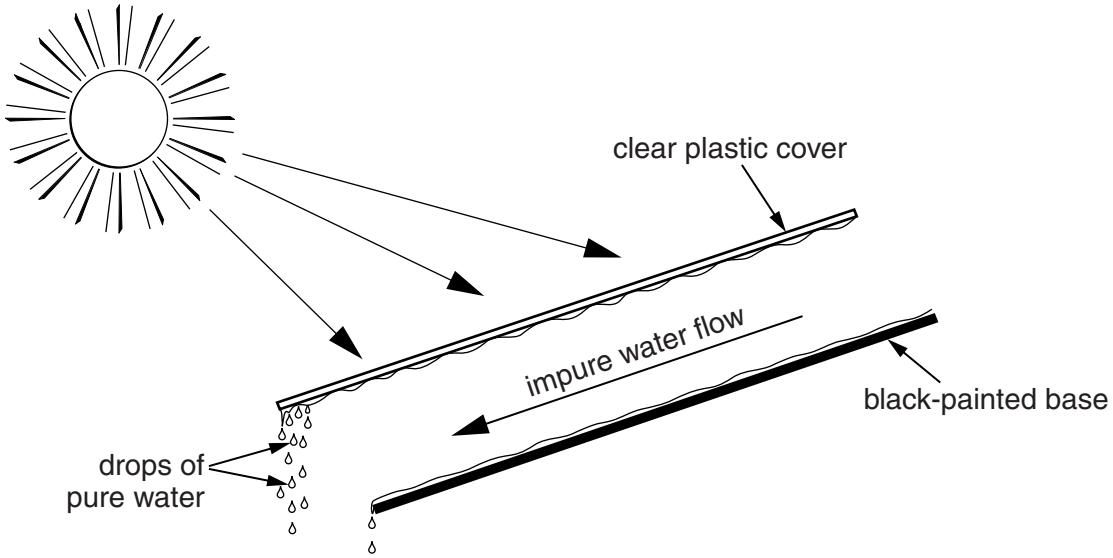


Fig. 6.1

(a) State the part of the Sun's electromagnetic spectrum that heats the water.

.....[1]

(b) Solar energy produces water vapour from the impure water.

Explain why water molecules are able to escape more easily from warm water than from cold water.

.....

.....

.....[2]

(c) Explain why thermal energy transfer from the Sun only occurs by radiation and not by conduction or convection.

.....

.....[1]

[Turn over

(d) Fig. 6.2 shows a ray of sunlight about to pass through the plastic cover.

Draw the path of the ray from the point where it enters the plastic to show what happens at the lower face of the plastic. Indicate the angles of incidence and refraction at the upper face.

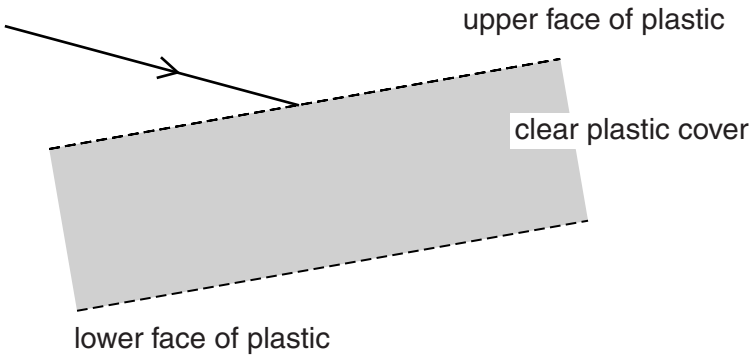


Fig. 6.2

[3]

7 **(a)** Fig. 7.1 shows what happens when a plant is placed near a window where bright light is coming from one side.

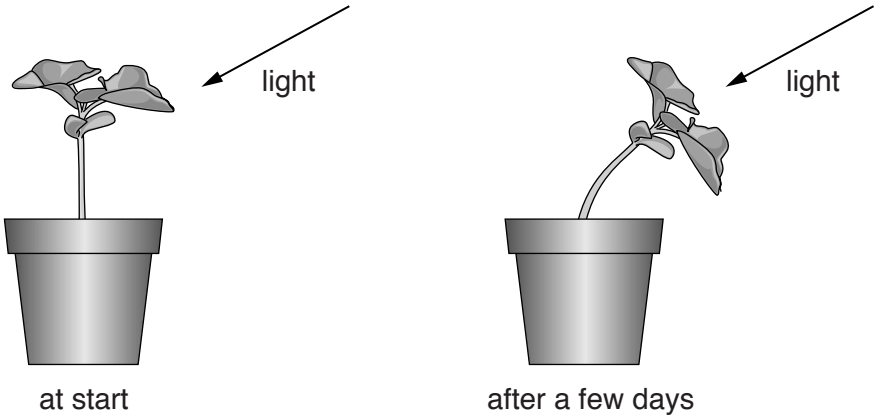


Fig. 7.1

(i) Name the response shown by the plant.

.....[1]

(ii) Explain why the response shown in Fig. 7.1 is an advantage to the plant.

.....

.....

.....[2]

(iii) Using the information in Fig. 7.1 name **two** characteristics of living things shown by this plant.

1 .....

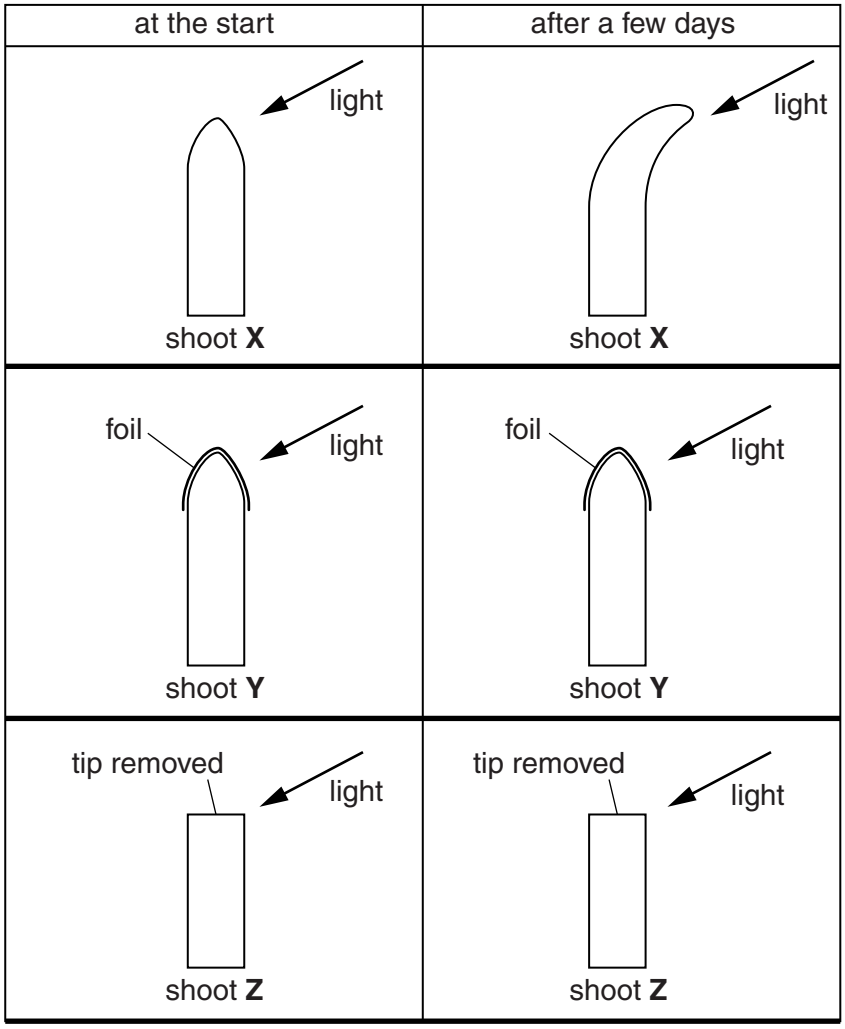
2 .....[2]

[Turn over

(b) A student carries out an experiment to find out more about plant responses. He uses simple shoots and light coming from one side.

The results are shown in Table. 7.2.

Table 7.2



(i) Describe the results shown in Table 7.2.

.....

.....

.....[2]

(ii) Suggest a possible conclusion about the control of plant responses in the shoots.

Explain your answer.

.....

.....

.....[2]

(c) Animals are able to respond to situations by secreting the hormone adrenaline.

Adrenaline is secreted into the blood when an athlete starts to run a race.

Suggest how this helps the athlete to run fast.

.....

.....

.....[2]

8 Some sulfur has become contaminated with a small amount of aluminium powder.

(a) A liquid is added to the mixture which dissolves the sulfur.

Fig. 8.1 shows how sulfur is separated from the mixture of aluminium and sulfur.

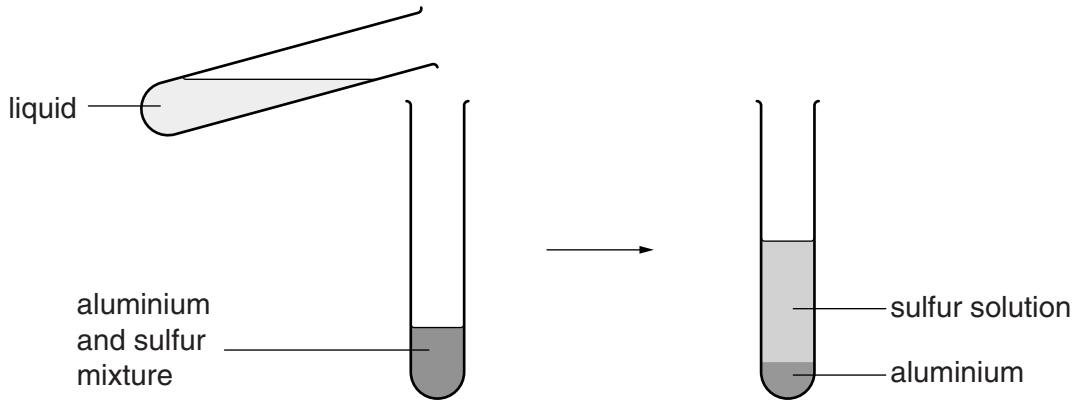


Fig. 8.1

Suggest how the processes of filtration and crystallisation could be used to obtain pure sulfur from the sulfur solution and aluminium.

You should draw diagrams to show your arrangement of apparatus.

.....

.....

.....

.....[3]

(b) Aluminium sulfide is a *compound* made by heating a *mixture* of aluminium and sulfur.
Aluminium sulfide is a compound of the *elements* aluminium and sulfur.

The left hand column in Fig. 8.2 gives four descriptions of materials.
The right hand column shows three different types of materials.

Draw a line from each description on the left hand side to the correct material on the right.

cannot be broken down into simpler substances	compound
contains different atoms chemically bonded together	element
contains more than one type of atom which are not bonded together	mixture
contains one type of atom	

Fig. 8.2

[4]

(c) **(i)** When aluminium and sulfur atoms react together, positive aluminium ions and negative sulfide ions are formed.

Describe, in terms of electrons, how these ions are formed from atoms.

.....

.....

.....[2]

(ii) Aluminium sulfide consists of two aluminium ions to every three sulfide ions.

State the chemical formula of aluminium sulfide.

.....[1]

[Turn over

9 Fig. 9.1 shows the reproductive system of a female.

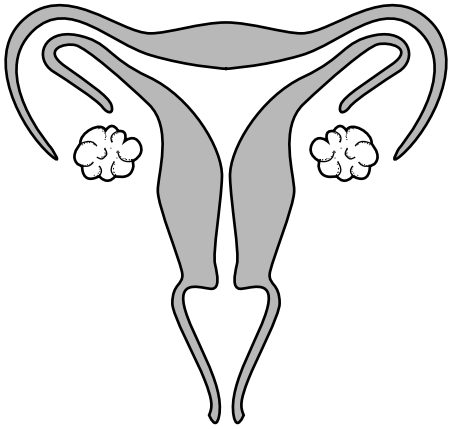


Fig. 9.1

(a) (i) On Fig. 9.1 use label lines to label the cervix and the vagina. [2]

(ii) On Fig. 9.1 use a label line and the letter **H** to show where haploid cells are found. [1]

(b) (i) State the area where fertilisation occurs.

.....[1]

(ii) The fertilised egg cell (the zygote) divides to form a ball of cells.

Describe where this ball of cells settles (implants) to continue development into a baby.

.....

.....[2]

(c) One way in which the human immunodeficiency virus (HIV) can be transmitted is through sexual intercourse.

State one other way in which HIV can be transmitted.

.....

.....[1]

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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 †															

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

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

Key

a **X** b	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.).