Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

5588521900

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **October/November 2015**

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 an HB 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 24.

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

CAMBRIDGE International Examinations

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1 Fig. 1.1 shows some cells. They are not drawn to scale.

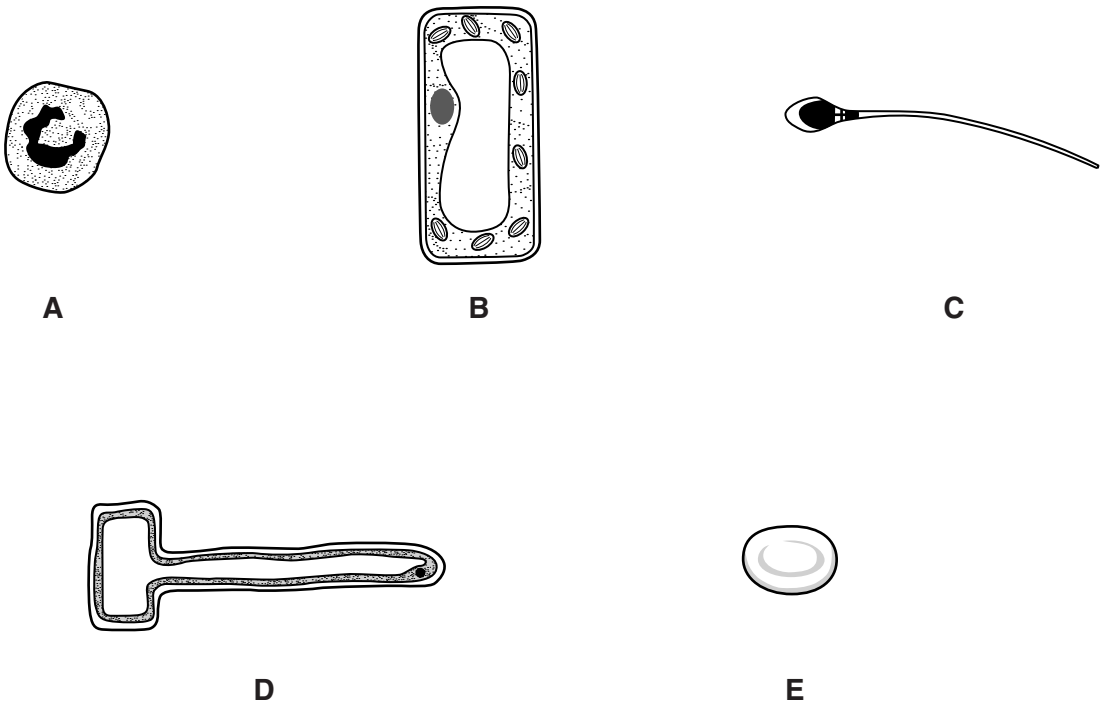


Fig. 1.1

(a) Write the letter or letters of the cell or cells

(i) that are plant cells,

.....[1]

(ii) with a haploid nucleus.

.....[1]

(b) On **one** plant cell in Fig. 1.1, use label lines and the correct names to label two parts of the cell that are present in plant cells but absent from animal cells. [2]

(c) A student uses the apparatus in Fig. 1.2 to compare the rates of transpiration of two shoots, shoot **1** and shoot **2**. The shoots are taken from the same tree. The stems of the shoots each have the same diameter and the same number of leaves.

However, one shoot has leaves of shape **X** and the other shoot has leaves of shape **Y**. This is shown in Fig. 1.2.

As each shoot transpires, the meniscus moves upwards in the capillary tubing.

For each shoot the student calculates the average distance the meniscus moves in one minute.

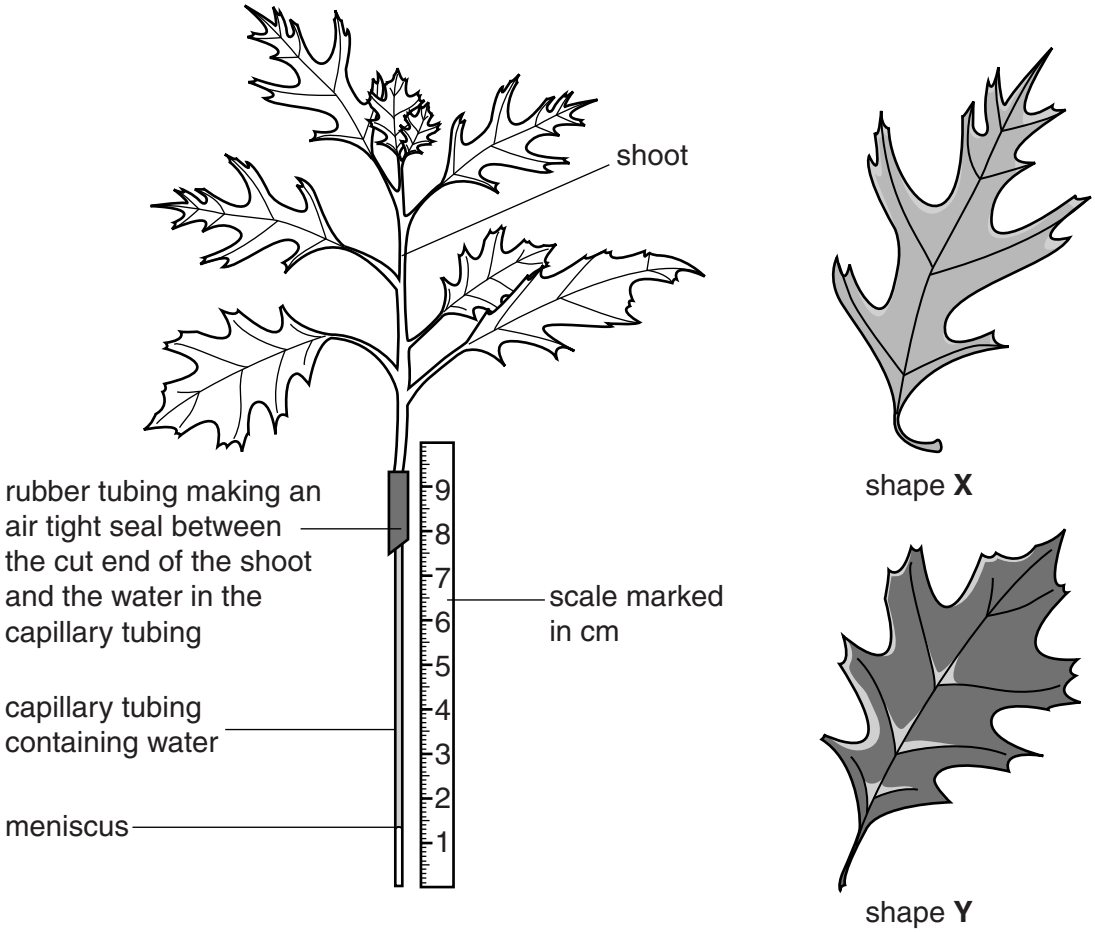


Fig. 1.2

results

Table 1.1

shoot	average distance moved by the meniscus in one minute / cm
1	5.8
2	4.6

(i) Use the results to state the letter of the shape of leaves on shoot **2**.

Explain your answer.

shape of leaf on shoot **2** = ...

explanation .....

.....

.....

.....[2]

(ii) If the same experiment is carried out under different environmental conditions the results obtained will be different from those shown in Table 1.1.

Explain why the average distance moved by the meniscus will change for both shoots when

the temperature increases,

.....

.....

.....

the humidity decreases.

.....

.....

.....

[2]

2 **(a)** Fig. 2.1 shows samples of some elements in Group VII of the Periodic Table at room temperature.

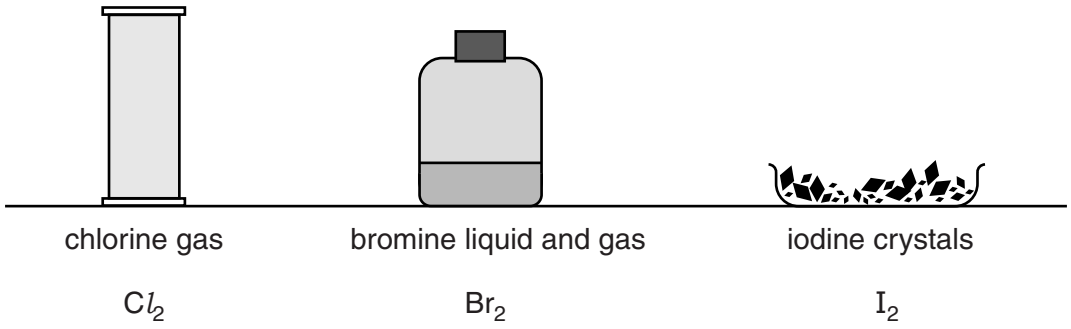


Fig. 2.1

Describe the trend in melting point down Group VII.

.....

.....[1]

(b) A piece of burning sodium is lowered into bromine gas.

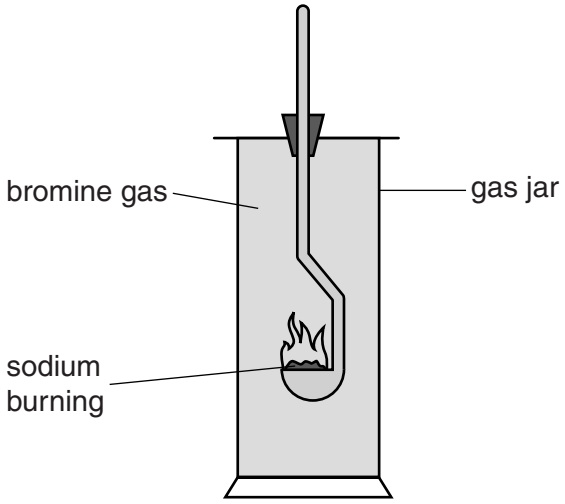
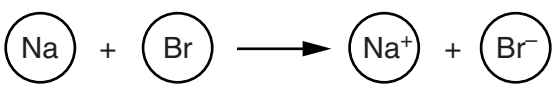


Fig. 2.2

The sodium and bromine react together to produce sodium bromide.

Sodium bromide is made of sodium ions and bromide ions.

The change from atoms to ions in this reaction can be represented as follows:



Explain how the ions are formed in terms of the movement of electrons.

.....

.....

.....[2]

(c) Fig. 2.3 shows what happens when a student adds colourless chlorine solution to colourless sodium bromide solution.

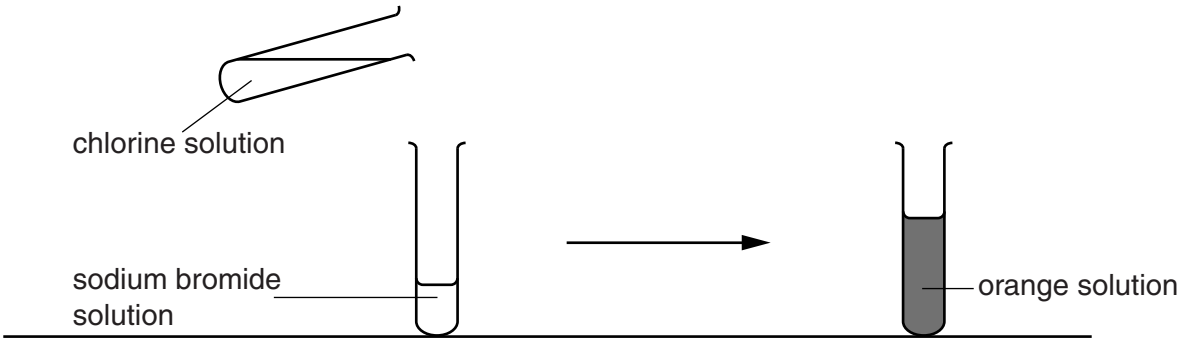


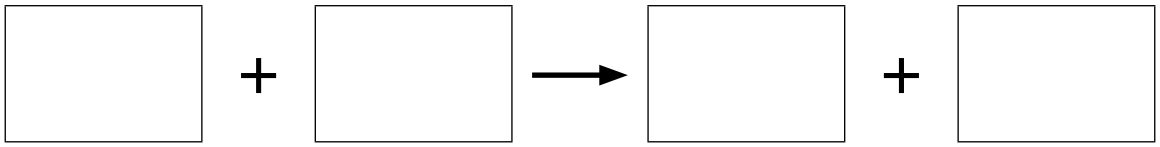
Fig. 2.3

The resulting mixture is orange.

(i) State the name of the substance formed which gives the final mixture this colour.

.....[1]

(ii) Write a word equation for the reaction that occurs.



[2]

(iii) The reactivity of the halogens decreases down the group.

most reactive chlorine

bromine

least reactive iodine

Explain why sodium bromide reacts with chlorine but does not react with iodine.

.....

.....

.....

.....[2]

3 Fig. 3.1 shows a man bungee jumping. He is attached to a long elastic rope as he jumps off a bridge.

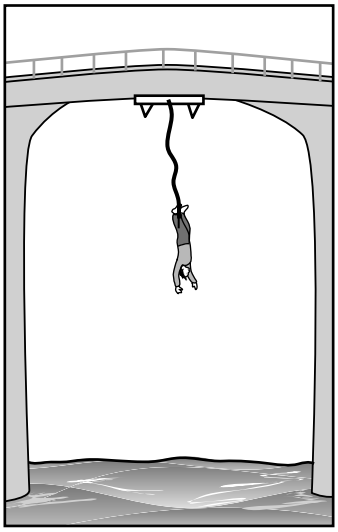


Fig. 3.1

Fig. 3.2 shows the jump at several stages from the time the man jumps off the bridge.

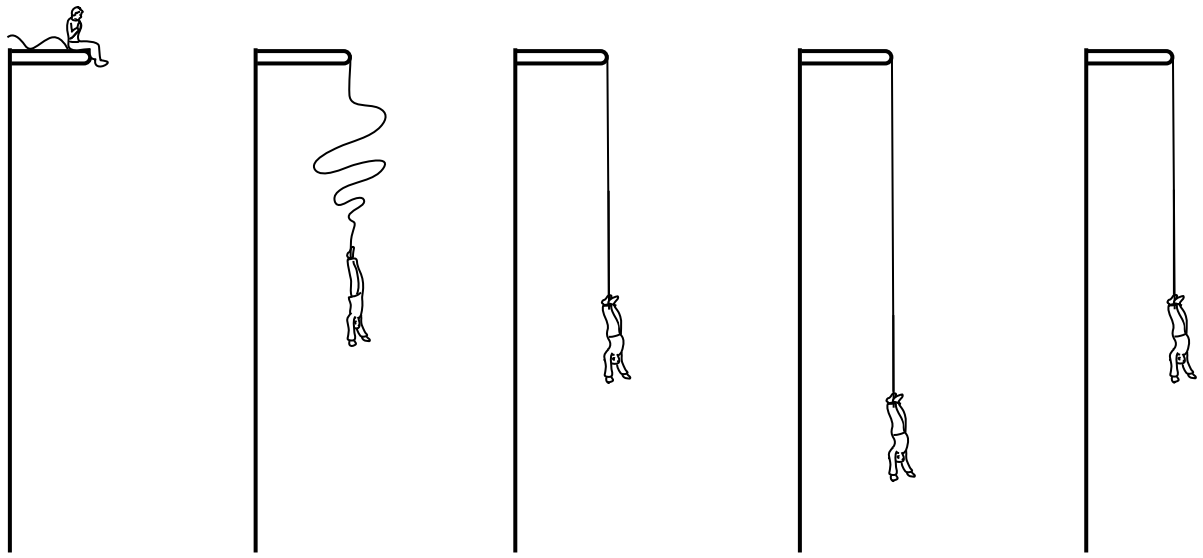


Fig. 3.2

(a) State the energy transformation occurring between stage 1 and stage 2.

from ..... energy to

..... energy. [1]

(b) (i) Identify the main force acting on the man just after he jumps off the bridge.

.....[1]

(ii) As the man falls, another force, air resistance, acts on the man to slow him down.
On Fig. 3.3, draw an arrow to show the direction in which air resistance is acting on the man.

Fig. 3.3

[1]

(iii) State the **name** of the unit in which force is measured.

..... [1]

(c) As the man falls, the rope begins to stretch.

On the axes below, sketch a speed/time graph to show how his speed changes as the rope stretches until he reaches the lowest point.

[2]

(d) The man then rises up again. He bounces up and down a few times before hanging from the rope at rest.

The unstretched length of the elastic rope is 25 m.

At the lowest point, the length of the rope is 40 m.

Estimate a value for the length of the rope when the man is hanging from the rope at rest.

Give a reason for your answer.

Length of rope: ..... m

Reason for your estimate: .....

.....

.....

.....[2]

(e) Before the jump, the temperature of the rope is 20 °C. The rope is now used for several jumps by different people. At the end of all of the jumps, the temperature of the rope is 25 °C.

Suggest where the energy has come from to heat the rope.

.....

.....[1]

Please turn over for Question 4.

4 **(a)** Fig. 4.1 shows the male reproductive system.

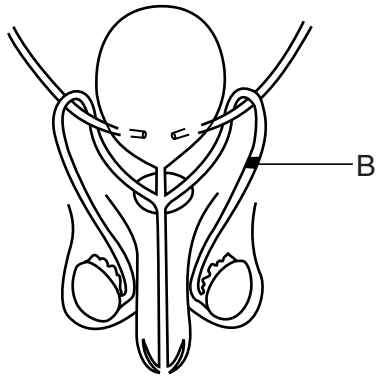


Fig. 4.1

(i) On Fig 4.1 use lines to label and name

the urethra,

the prostate gland. [2]

(ii) A man's reproductive system is found to have a blockage at the point marked with a **B**.

Predict whether this man would still be able to have children.

Explain your answer.

.....

.....

.....

.....

.....

.....[3]

(b) Fig. 4.2 shows how the thickness of the lining of a woman's uterus changes with time.

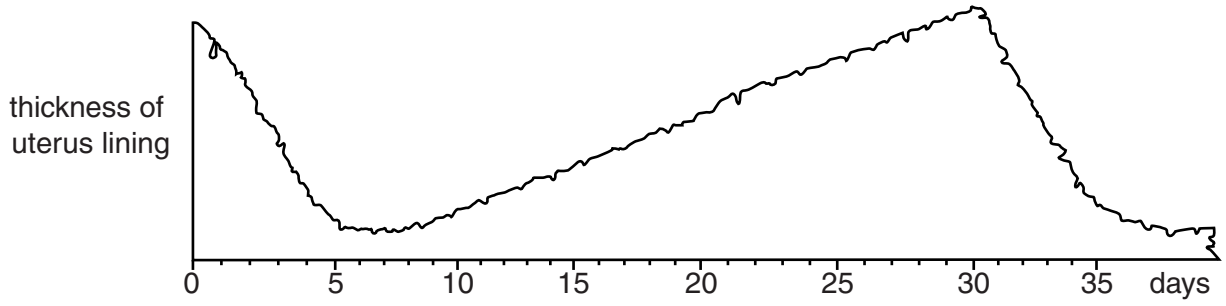


Fig. 4.2

(i) State the days during which menstruation is taking place. Explain your answer.

days .....

explanation .....

.....

.....[2]

(ii) Suggest on which day an egg cell is most likely to be fertilised.

.....[1]

(iii) At certain times of the menstrual cycle the lining of the uterus becomes thicker.

Describe what causes this to occur.

.....

.....[1]

(iv) Explain the importance of this thickened uterus lining.

.....

.....[1]

5 Methane is a hydrocarbon which is used as a fuel to heat homes.

(a) State one source of methane.

……..…… [1]

(b) Fig. 5.1 shows a demonstration of an explosion caused when methane burns.

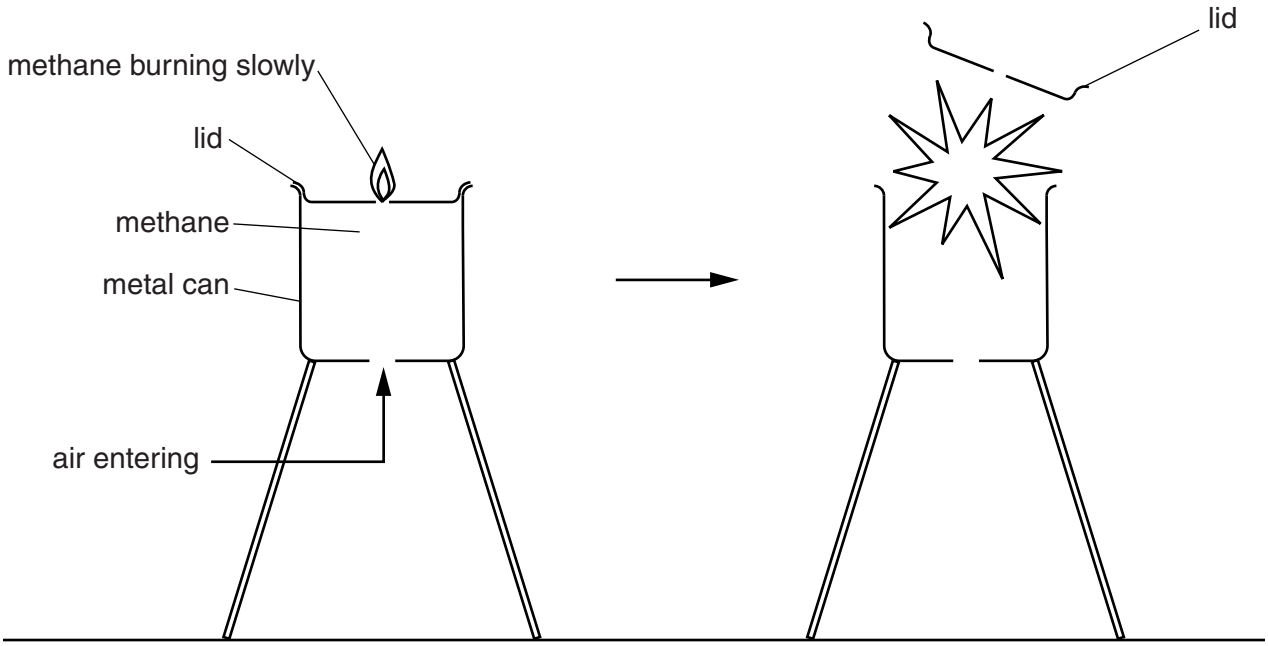


Fig. 5.1

- At first, methane escapes through the hole in the lid and burns slowly.
- As methane leaves the can, air enters through the hole in the base.
- When enough air has entered an explosion occurs.

(i) Table 5.1 compares the three main gases in the can just before and just after the explosion.

Table 5.1

gases present **just before** the explosion		gases present **just after** the explosion
methane	→	
oxygen	→	
nitrogen	→	

Complete Table 5.1 showing the main gases present just before and just after the explosion. [2]

(ii) The explosion occurs when the rate of combustion of methane suddenly increases. This causes a rapid increase in temperature of the gases in the can.

State the term used to describe a chemical reaction which causes an increase in temperature.

……..…… [1]

(c) Gasoline (petrol) is a mixture of hydrocarbons which includes a compound called nonane.

One nonane molecule contains 20 hydrogen atoms and 9 carbon atoms.

(i) State the chemical formula of a nonane molecule.

……..…… [1]

(ii) State the type of bonding between the carbon and hydrogen atoms in a nonane molecule. Explain your answer.

type of bonding ……..……

explanation .....

.....[2]

(d) Gasoline is obtained from petroleum (crude oil) by fractional distillation.

Fig. 5.2 summarises the process.

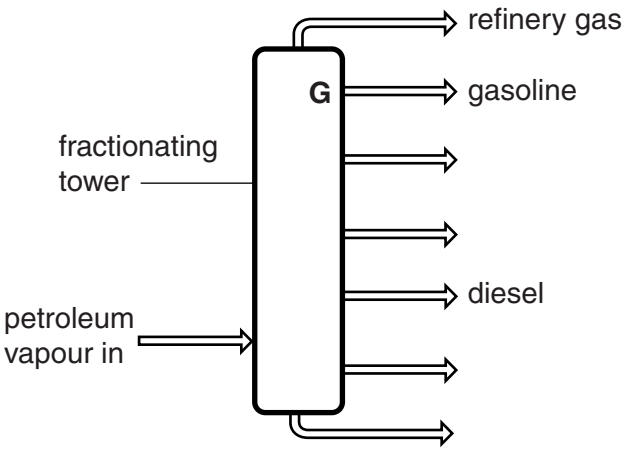


Fig. 5.2

The petroleum is vaporised before it enters the fractionating tower and rises.

The gasoline fraction separates from the mixture at point **G** in the tower.

(i) State what change happens to the gasoline vapour at point **G**.

……..…… [1]

(ii) Explain why gasoline and diesel separate at different points in the tower.

.....

.....[1]

6 **(a)** Fig. 6.1 shows a ray of light passing through a glass block.

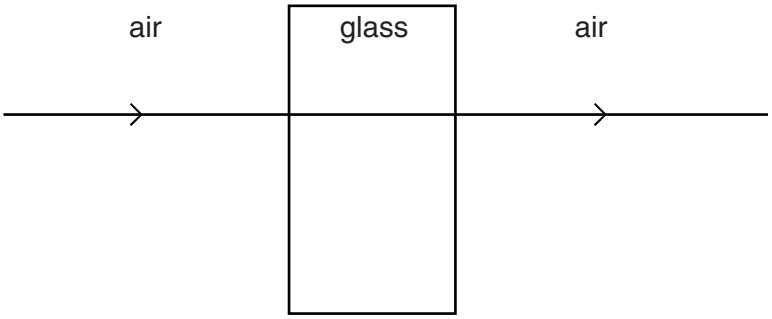


Fig. 6.1

Fig. 6.2 shows the block now turned at an angle to the ray of light.

On Fig. 6.2 draw the path of the ray of light as it enters and passes through the block, and out of the other side.

On your diagram, indicate clearly the angle of incidence *i* and the angle of refraction *r* as the ray passes into the block.

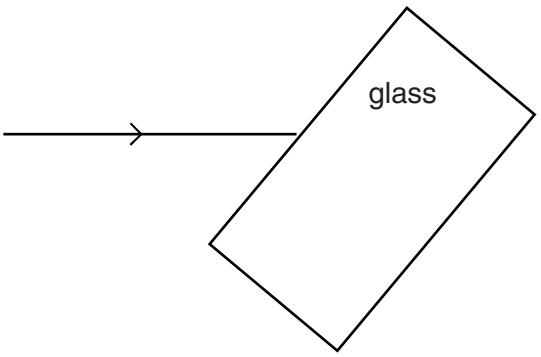


Fig. 6.2

[3]

(b) **(i)** Light is a form of electromagnetic radiation. Fig. 6.3 shows the electromagnetic spectrum.

gamma radiation	X-rays	ultra-violet	visible light	infra-red	microwaves	radio waves

Fig. 6.3

All electromagnetic radiations are refracted as they travel from one material to another.

The shorter the wavelength of an electromagnetic radiation, the more it is refracted.

From Fig. 6.3 state one form of electromagnetic radiation that is refracted more than light.

.....[1]

(ii) Electromagnetic radiation from the Sun warms the Earth.

State the form of electromagnetic radiation mainly responsible for this energy transfer from the Sun.

.....[1]

(c) (i) Fig. 6.4 shows a graph of a light wave. On Fig. 6.4, draw labelled arrows to indicate

1. one wavelength of this light wave,

2. the amplitude of this light wave.

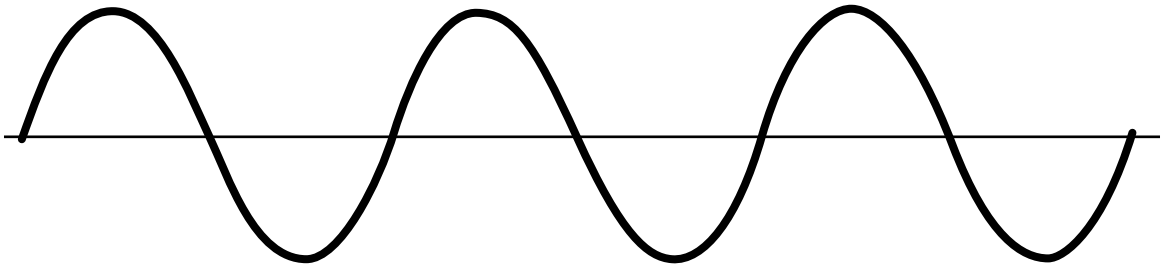


Fig. 6.4

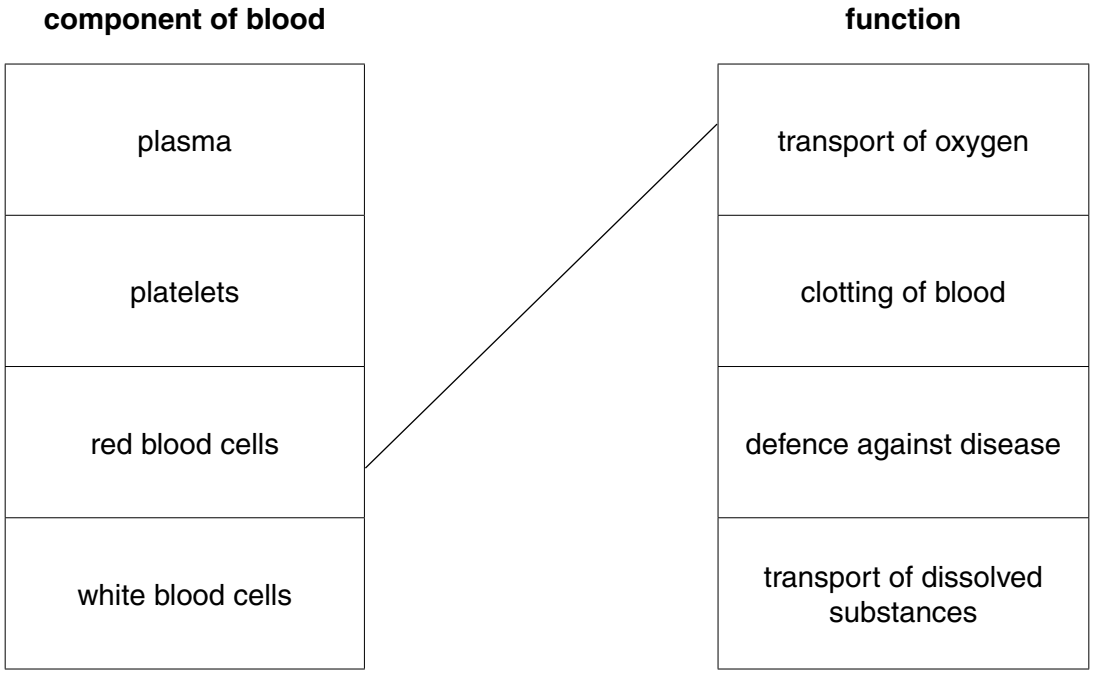
[2]

(ii) The amplitude of a light wave determines the brightness of the light.

State the property of sound determined by the amplitude of a sound wave.

.....[1]

7 **(a)** Use lines to connect the boxes on the left with the correct boxes on the right.
One line has been done for you.



[2]

(b) As blood travels through an organ, substances diffuse into and out of the blood to exchange materials with the cells.

Table 7.1 shows the relative concentrations of some substances in the blood and in the cells of a part of the body called the adrenal gland.

Table 7.1

substance	concentration of substance	
	in the blood	in the cells of the adrenal gland
oxygen	higher	lower
carbon dioxide	lower	higher
glucose	higher	lower
adrenaline	lower	higher

(i) The oxygen diffuses from the blood into the cells of the adrenal gland.

Explain why this happens.

.....

.....[1]

(ii) Describe what happens to the oxygen inside the cells.

.....

.....

.....

.....[2]

(iii) The adrenal gland releases the hormone adrenaline into the blood stream in certain situations. Describe one situation a human may be in that would cause an increase of adrenaline to be released from cells.

.....

.....[1]

(iv) State **two** effects of adrenaline on the body.

1 .....

2 .....[2]

8 A student investigates the speed of reaction between metals and a dilute acid.

He knows that adding dilute acid to iron wire produces hydrogen gas.

(a) Fig. 8.1 shows the apparatus the student uses to carry out the reaction.

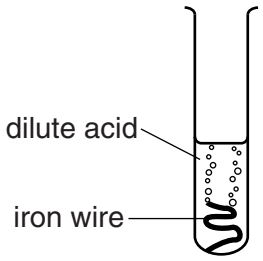


Fig. 8.1

The temperature of the acid is 20 °C.

(i) Describe the test for hydrogen gas.

test .....

result .....[2]

(ii) The rate of bubbling slows down and then stops. There is still some iron wire left in the test-tube.

Explain these observations.

.....

.....

.....[2]

(iii) The student thinks that the test-tube now contains a solution of iron chloride.

Describe a test and the result that shows that the solution contains chloride ions.

test .....

result .....[2]

(b) The student repeats the experiment using acid at a temperature of 40 °C.

Describe and explain the difference in what the student observes at this higher temperature.

.....

.....

.....

.....[2]

(c) Describe and explain what the student notices when he uses copper wire instead of iron.

.....

.....

.....

.....[2]

9 Fig. 9.1 shows a circuit used to investigate the resistance of pieces of wire. The pieces of resistance wire are connected to the circuit between **X** and **Y**.

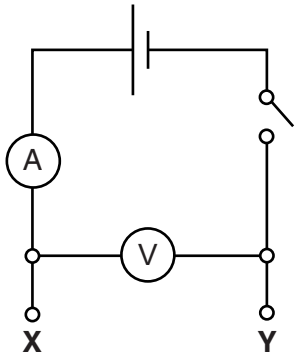


Fig. 9.1

A piece of resistance wire of length 100 cm is connected between **X** and **Y**.

The reading on the ammeter is 0.6 A.

The reading on the voltmeter is 1.2 V.

(a) (i) Complete the formula.

$$\text{resistance} = \frac{\qquad\qquad}{\text{current}}$$

[1]

(ii) The piece of resistance wire is cut in half. One length of 50 cm has half the resistance of the wire of 100 cm length.

The 50 cm wire is connected between **X** and **Y**.

Explain why the reading of the ammeter increases.

.....[1]

(iii) The second half of the resistance wire is connected in parallel with the first half between **X** and **Y**.

Predict the effect this has on the ammeter reading. Give a reason for your answer.

.....

.....

.....[2]

(iv) 100 cm of the resistance wire has a resistance of 2Ω.

Calculate the total resistance when four lengths of 100 cm each are connected in series.

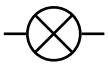
Show your working:

resistance = ...Ω [1]

(b) The names of some circuit components are given in the left hand column. Some circuit symbols are given in the right hand column.

Complete Table 9.1 to show the missing component name and symbols. One has been done for you.

Table 9.1

circuit component	symbol
direct current source	
fuse	
	
fixed resistor	

[2]

(c) Most of the stored chemical energy in the cell is changed to thermal energy in the wire. Some of this thermal energy is then transferred to the air surrounding the wire.

(i) Name the method of thermal energy transfer by the heated air to the surroundings.

.....[1]

(ii) Describe an experiment to show this method of thermal energy transfer. You may wish to draw a diagram.

.....

.....

.....

.....[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	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 **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.).