UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

1991743325

COMBINED SCIENCE **0653/33**

Paper 3 (Extended) **October/November 2012**

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, 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 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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **23** printed pages and **1** blank page.

1 Flowers are organs in which sexual reproduction takes place.

(a) Sexual reproduction can be defined as:

"the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring."

(i) Explain the meaning of the term *diploid*.

....

.... [1]

(ii) State the scientific term for the fusion of two nuclei. .... [1]

(b) Fig. 1.1 shows a section through a flower.

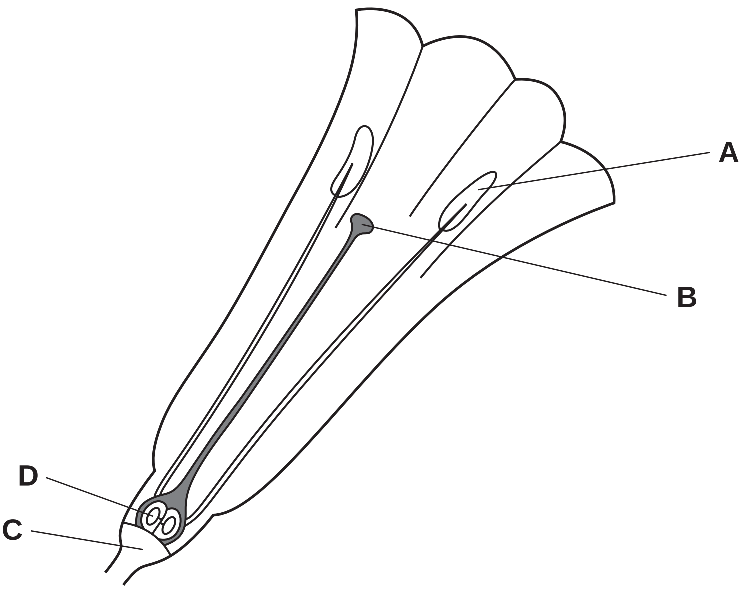

Fig. 1.1

(i) State the **letter** of the part in which

the male gametes are produced, ...

a zygote is produced. .... [2]

For Examiner's Use

(ii) Explain how the structure of the flower in Fig. 1.1 indicates that it is pollinated by insects.

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.... [3]

(c) After pollination, seeds are produced. A student set up an experiment to investigate the conditions needed for the germination of lettuce seeds.

He placed five lettuce seeds on cotton wool in each of five test-tubes. Fig. 1.2 shows the conditions present in each tube.

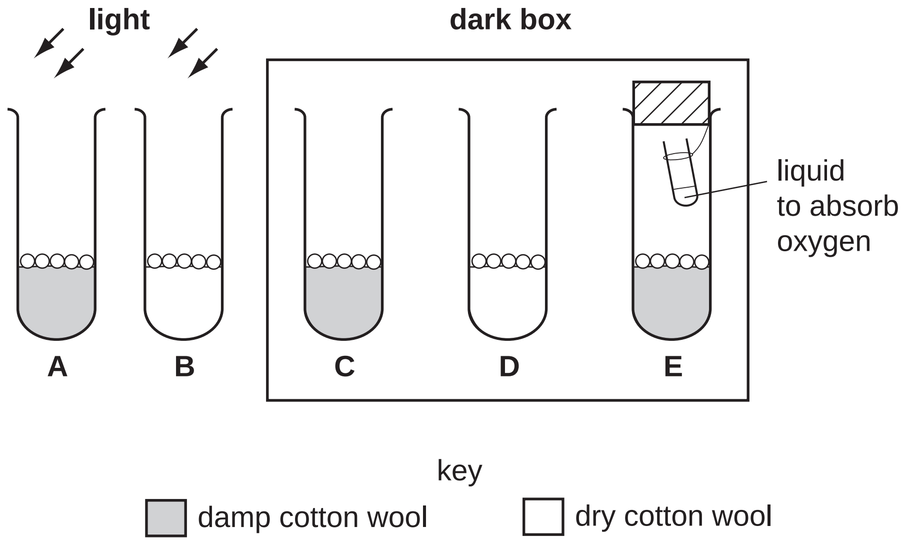


Fig. 1.2

Table 1.1 shows his results.

Table 1.1

tube	number of seeds that germinated
A	5
B	0
C	5
D	0
E	0

What conclusions can the student make from these results?

....

....

....

.... [3]

Please turn over for Question 2.

2 Fig. 2.1 represents what happens when calcium carbonate, an **insoluble** ionic … added to water.

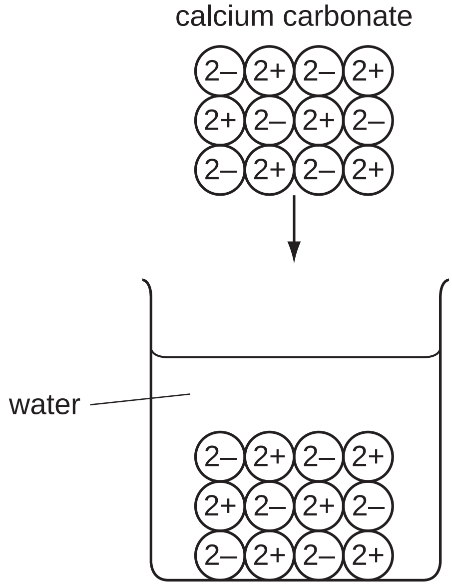


Fig. 2.1

(a) Sodium chloride is a **soluble** ionic salt.

On Fig. 2.2, sketch how the ions from sodium chloride are arranged after it is added to water.

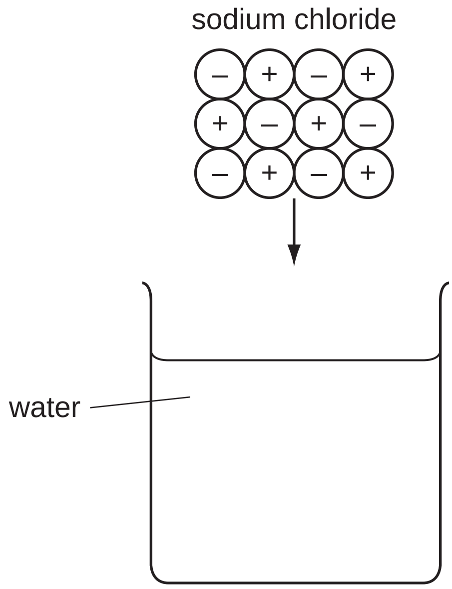


Fig. 2.2

[2]

(b) Explain, in terms of relative numbers of protons and electrons, why calcium ion[s have] an electrical charge of 2+, but sodium ions have a charge of 1+.

....

....

....

....

.... [3]

(c) The formula of a sodium ion is Na^{+}. The formula of a carbonate ion is CO_3^{2-}.

Use this information to deduce the chemical formula of sodium carbonate.

Show how you arrived at your answer.

....

.... [2]

3 Fig. 3.1 shows two speed / time graphs for a car.

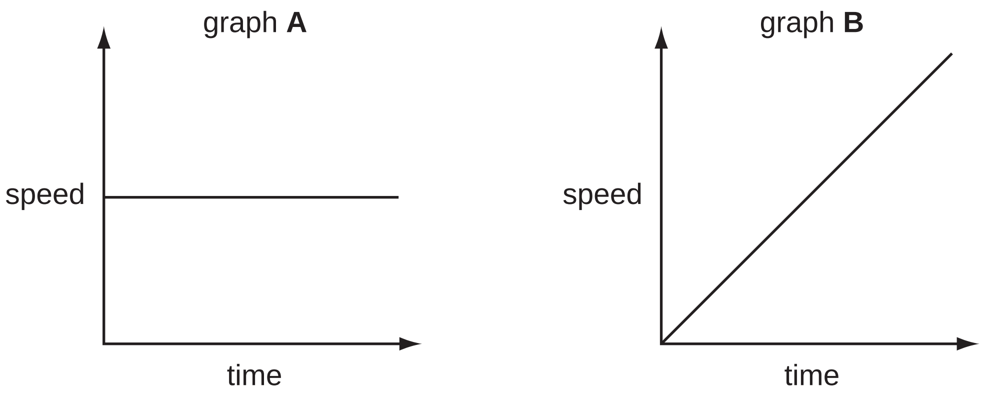


Fig. 3.1

(a) Describe the motion of the car in

graph **A**, ...

graph **B**. .... [1]

(b) The car travels at 20 m / s for 90 seconds.

The total force driving the car forward is 1000 N.

(i) Calculate the work done by this force during this 90 second journey.

State the formulae that you use and show your working.

formulae used

working

.... [3]

(ii) Calculate the useful power output of the engine during this time.

State the formula that you use and show your working.

formula used

working

.... [2]

(c) The car accelerates from 0 to 33 m / s in 11 seconds.

Calculate the acceleration of the car during the 11 seconds.

Show your working.

.... [2]

4 Bats use echo location to detect objects around them. To do this, they emit ultrasound.

(a) **(i)** Ultrasound is sound that has a frequency too high for a human to hear.

Suggest a frequency for the ultrasound emitted by bats. .... [1]

(ii) Underline the word or words that correctly describe an ultrasound wave.

electromagnetic **longitudinal** **transverse** [1]

(b) Most bats drink by flying close to the surface of a pond and taking mouthfuls of water from it.

Researchers thought that bats may be able to tell where water is present because the water has a much smoother surface than the surrounding ground. They put several thirsty bats into a closed room. They placed sheets of two rough materials and two smooth materials on the floor.

rough materials	**smooth materials**
metal grid	metal sheet
tree bark	smooth wood

The researchers counted the number of times the bats tried to drink from the surface of each material. Their results are shown in Fig. 4.1.

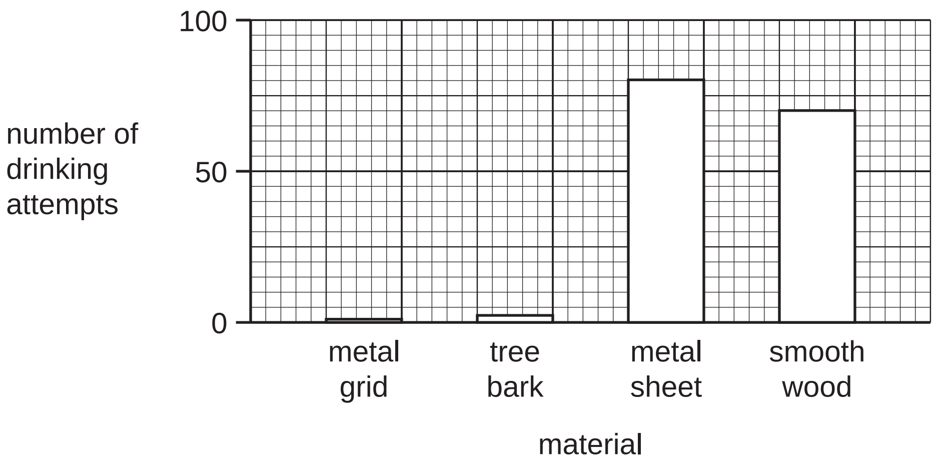


Fig. 4.1

(i) Compare the results for the rough materials and the smooth materials.

....

....

.... [2]

For Examiner's Use

(ii) The ultrasound waves reflect from surfaces and are detected by receptors on the bat's head.

Fig. 4.2 shows how ultrasound waves are reflected from a rough surface and from a smooth surface. The arrows show the direction in which the sound waves travel.

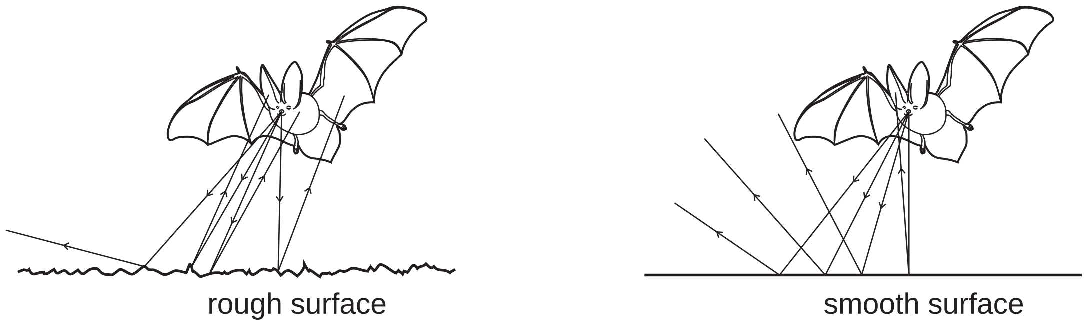


Fig. 4.2

Use the information in Fig. 4.1 and Fig. 4.2 to suggest how bats detect a water surface.

....

....

....

.... [2]

(c) The droppings of bats are used as a fertiliser in many parts of the world. They contain large quantities of nitrate and phosphate, which plants need for healthy growth.

However, if more fertiliser is added to the soil than the crop plants can absorb, some of the fertiliser may wash into rivers when it rains.

Explain how this can cause fish to die.

....

....

....

....

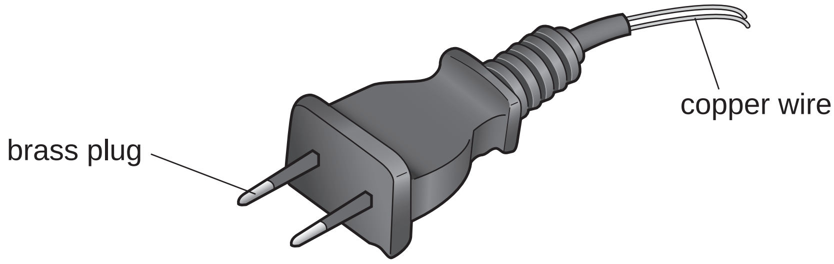
.... [3]

For Examiner's Use

5 Metallic copper is a very important material that has been extracted from compounds for thousands of years.

(a) Copper is used to make electrical wires.

Copper wires are connected to the mains electrical supply using brass plugs. Brass is an alloy of copper and zinc, and is a much less malleable material than pure copper.



Draw a simple diagram of the atoms in brass, and use it to help you explain why brass is less malleable than pure copper.

....

....

....

.... [3]

(b) One of the processes used in the extraction of copper involves heating copper(I) sulfide, Cu_2S, in air. One of the reactions that occurs is between copper(I) sulfide and oxygen. This reaction produces copper and sulfur dioxide, SO_2.

Construct a balanced symbolic equation for this reaction.

.... [1]

(c) Small metallic objects can be covered with a thin layer of copper metal (copper p... using electrolysis.

Fig. 5.1 shows the apparatus a student used to cover a steel spoon with copper.

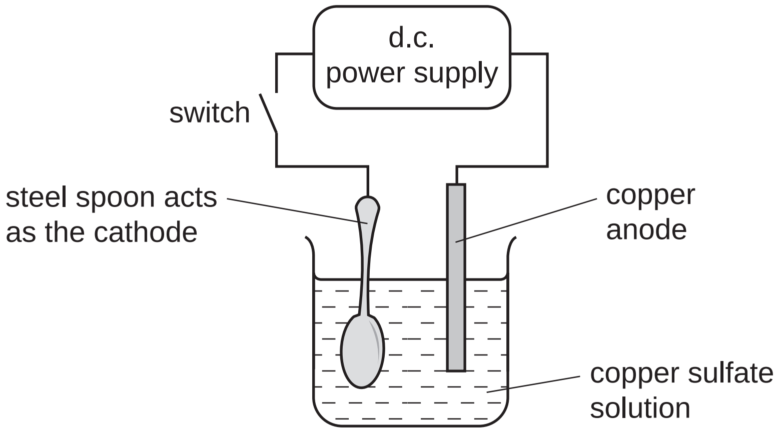


Fig. 5.1

In this process, aqueous copper ions, Cu^{2+}, move from the electrolyte and are converted into atoms of metallic copper on the surface of the steel spoon.

(i) Explain why the steel spoon must be made the cathode in this process.

....

....

.... [2]

(ii) Describe, in terms of ions, electrons and atoms, what happens at the surface of the spoon that results in the building up of a layer of metallic copper.

....

....

....

....

.... [3]

6 Fig. 6.1 shows a washing machine.

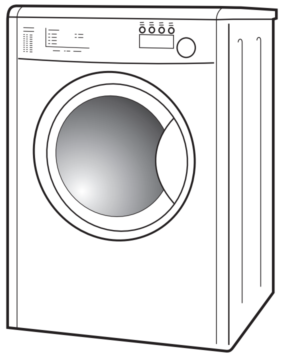


Fig. 6.1

(a) Complete the sentence below using **two** of the words in the list.

heat **kinetic** **light** **potential** **sound**

A washing machine is designed to transform electrical energy into ....

energy and .... energy. [2]

(b) (i) Some of the water inside the washing machine evaporates.

Explain the process of evaporation in terms of particles.

....

....

....

.... [2]

(ii) Explain why evaporation has a cooling effect.

....

.... [1]

(iii) The water inside the washing machine is heated by an electric heater.

Describe how heat energy is able to pass through the metal parts of the heater.

....

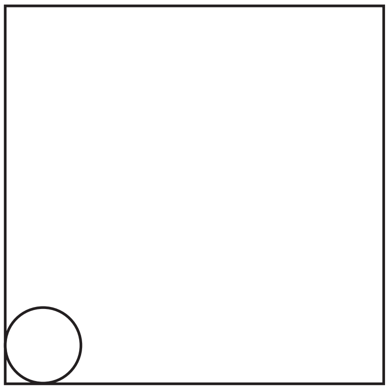
....

.... [2]

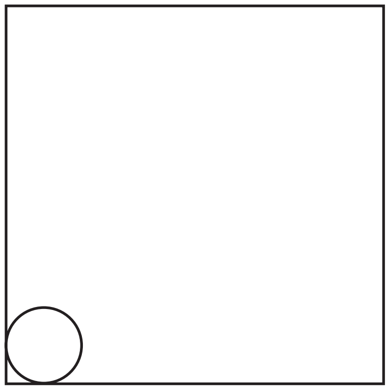
For
iner's

(c) The casing of the washing machine is a solid. The water used in it is a liquid.

Complete the diagrams below to show the arrangement of particles in a solid and in liquid.



solid



liquid

[2]

(d) Before buying a washing machine, a person may research several types to find out which washing machine has the greatest energy efficiency.

Explain the meaning of the term *efficiency*.

....

.... [1]

7 **(a)** Fig. 7.1 shows two human teeth.

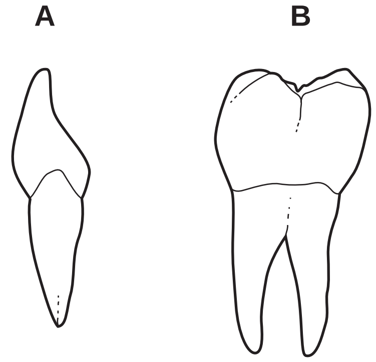


Fig. 7.1

(i) Name the **two** types of teeth shown in Fig. 7.1.

tooth **A** ....

tooth **B** .... [2]

(ii) Explain how tooth **B** helps to digest a food such as bread.

....

....

.... [2]

(b) Bread contains starch. Starch molecules are very large, and must be broken down into smaller sugar molecules before they can be absorbed. This is done by enzymes.

(i) Name **one** part of the alimentary canal in which starch is broken down.

.... [1]

(ii) Name the part of the alimentary canal where the sugar molecules are absorbed into the blood.

.... [1]

(c) Fig. 7.2 shows how pH affects the activity of the enzyme that breaks down starch in the human alimentary canal.

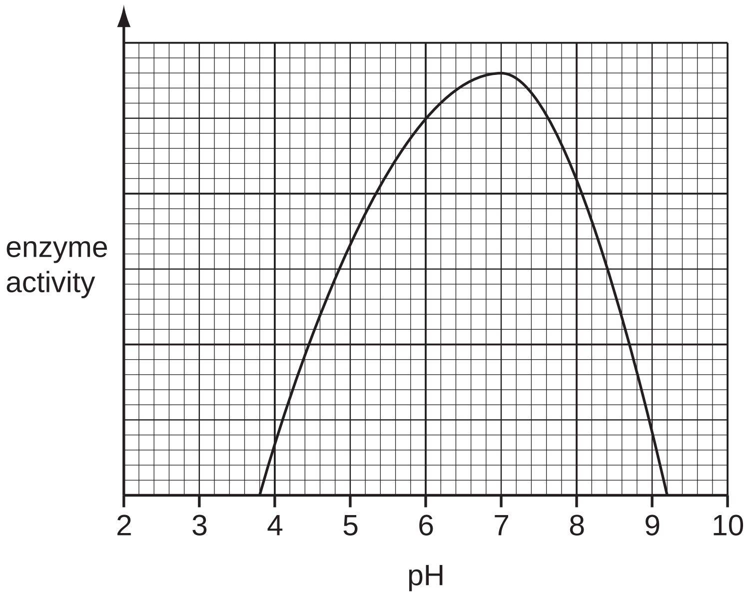


Fig. 7.2

Explain the reasons for the differences in activity of the enzyme at pH 5 and pH 7.

....

....

....

....

.... [3]

8 Carbon occurs naturally as an element and also in a very large number of compounds.

(a) (i) The most common atom of carbon has a proton number of 6 and a nucleon number of 12.

Draw a diagram of **one** atom of this isotope of carbon. Label the positions and numbers of the protons, neutrons and electrons.

[2]

(ii) Fig. 8.1 shows diagrams of particles in some substances. In these diagrams, different circles are used to represent different types of atoms.

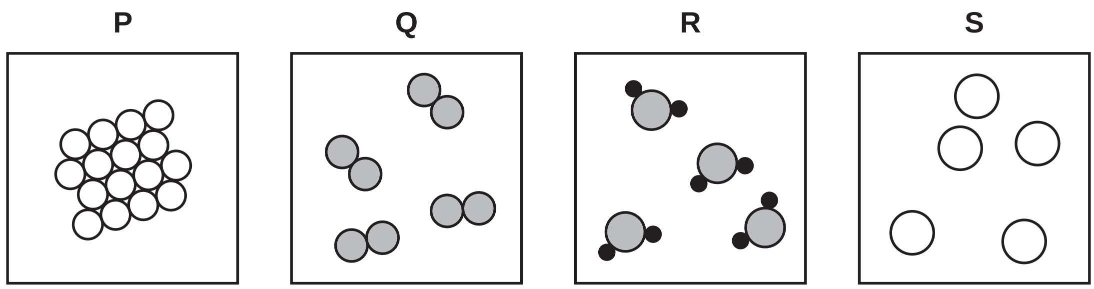


Fig. 8.1

Explain which of the diagrams, **P**, **Q**, **R** and **S**, represent elements and which represent compounds.

diagram(s) representing elements ....

explanation ....

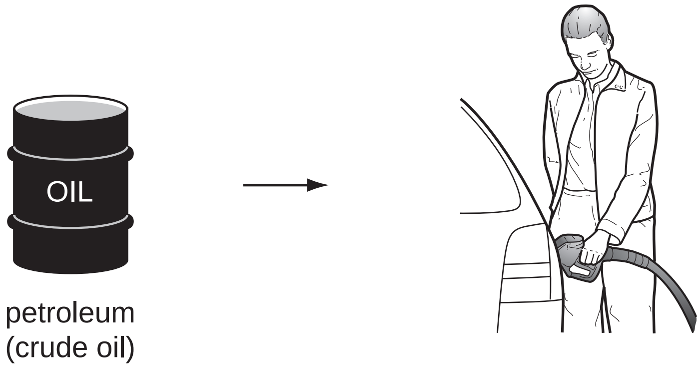
....

diagram(s) representing compounds ....

explanation ....

.... [4]

(b) Petroleum (crude oil) is the raw material from which gasoline (car fuel) is obtained.



(i) The extraction of gasoline from petroleum includes the process of fractional distillation.

Explain whether fractional distillation involves physical or chemical changes.

main type of change ....

explanation ....

.... [1]

(ii) Fig. 8.2 shows a simplified diagram of industrial fractional distillation.

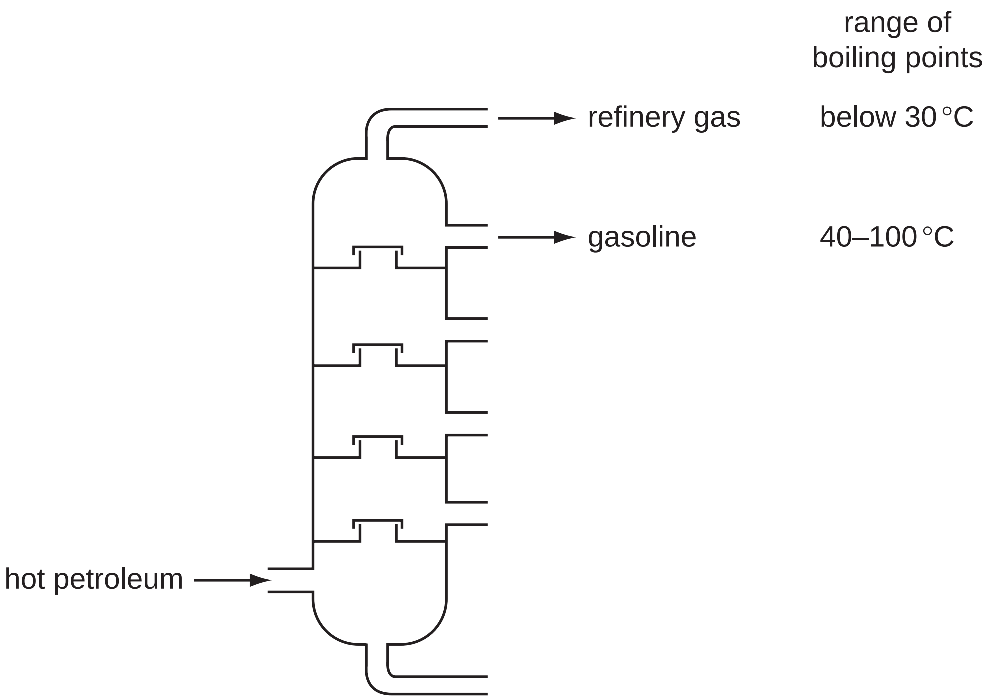


Fig. 8.2

Explain, in terms of molecules, why gasoline boils at a higher temperature than refinery gas.

....

....

.... [2]

(c) Some car manufacturers are researching the use of alternative fuels to replace gasoline.

One possible alternative fuel is hydrogen gas, H_2, which is oxidised in the car's engine.

Explain why air pollution caused by car engines would be greatly reduced if hydrogen could be used as the fuel instead of gasoline.

....

....

....

....

.... [3]

For Examiner's Use

9 **(a)** Fig. 9.1 shows an electrical circuit for a torch (flashlight).

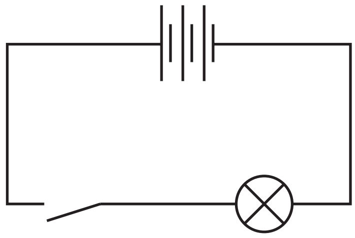


Fig. 9.1

(i) How many cells are fitted in the torch? .... [1]

(ii) A voltmeter is used to check the voltage across the light bulb.

Draw the symbol for the voltmeter in the correct position on the circuit. [1]

(iii) The current passing through the light bulb was 0.3 A when the voltage across it was 6 V.

Calculate the resistance of the light bulb.

Show your working and state the formula that you use.

formula used

working

.... [2]

(b) A single ray of light from a torch is shone onto a mirror as shown in Fig. 9.2.

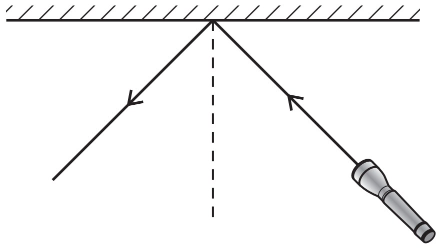


Fig. 9.2

(i) On Fig. 9.2, label the angle of incidence and angle of reflection. [1]

(ii) The angle of incidence = 45°.

Write down the value of the angle of reflection. .... [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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

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

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

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.).