UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

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.

For Examiner's Use

1 Flowers are organs in which sexual reproduction takes place.

1 (a) Sexual reproduction can be defined as: 0653/33/O/N/12

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

1 a (i) Explain the meaning of the term *diploid*. 0653/33/O/N/12

.....

..... [1]

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

0653/33/O/N/12

1 (b) Fig. 1.1 shows a section through a flower. 0653/33/O/N/12

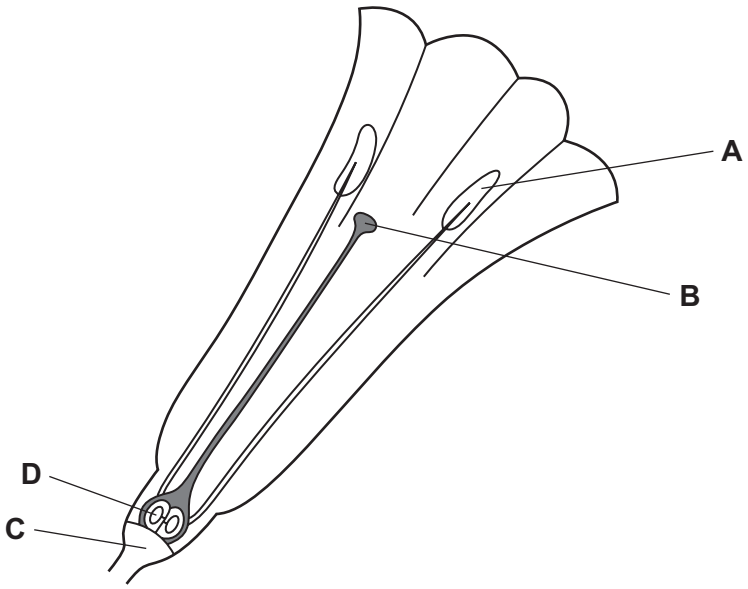

Fig. 1.1

1 b (i) State the **letter** of the part in which 0653/33/O/N/12

the male gametes are produced, ...

a zygote is produced. [2]

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

For Examiner's Use

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..... [3]

For Examiner's Use

1 **(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.

0653/33/O/N/12

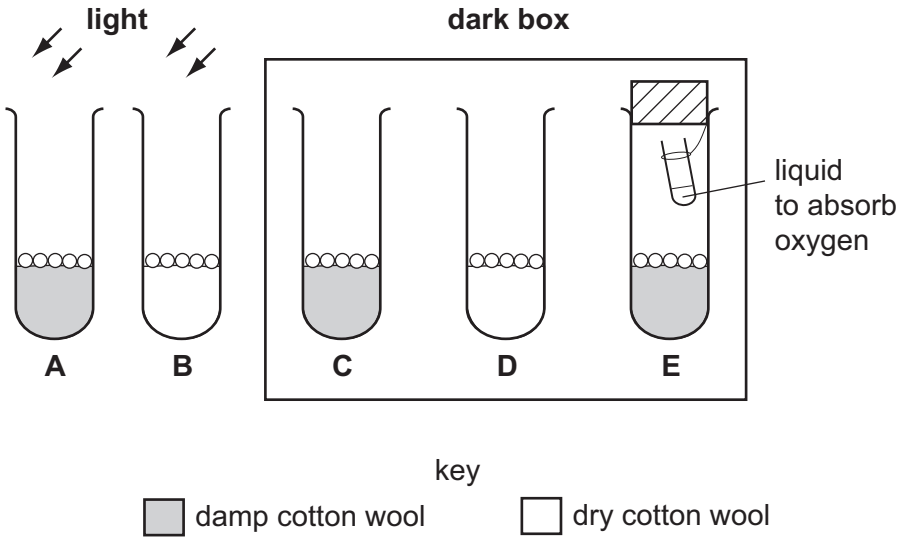

Fig. 1.2

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?

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..... [3]

Please turn over for Question 2.

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

0653/33/O/N/12

For Examiner's Use

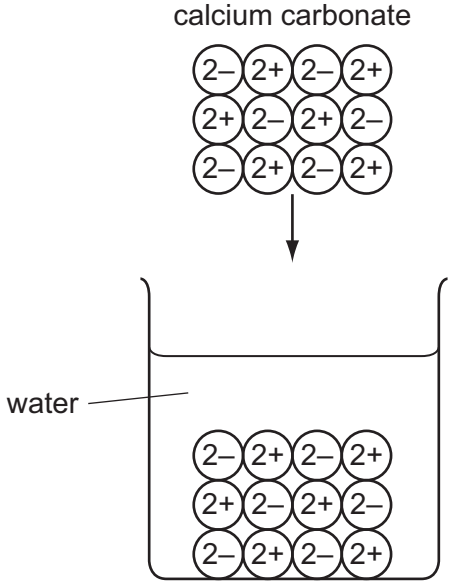

Fig. 2.1

2 (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.

0653/33/O/N/12

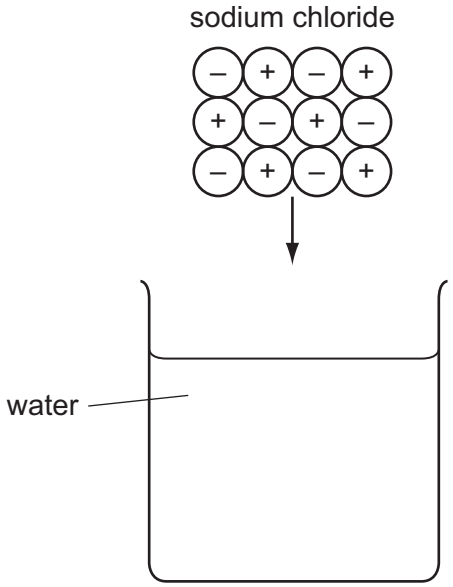

Fig. 2.2

[2]

For Examiner's Use

2 (b) Explain, in terms of relative numbers of protons and electrons, why calcium ions have an electrical charge of 2+, but sodium ions have a charge of 1+. 0653/33/O/N/12

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..... [3]

2 (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. 0653/33/O/N/12

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..... [2]

For Examiner's Use

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

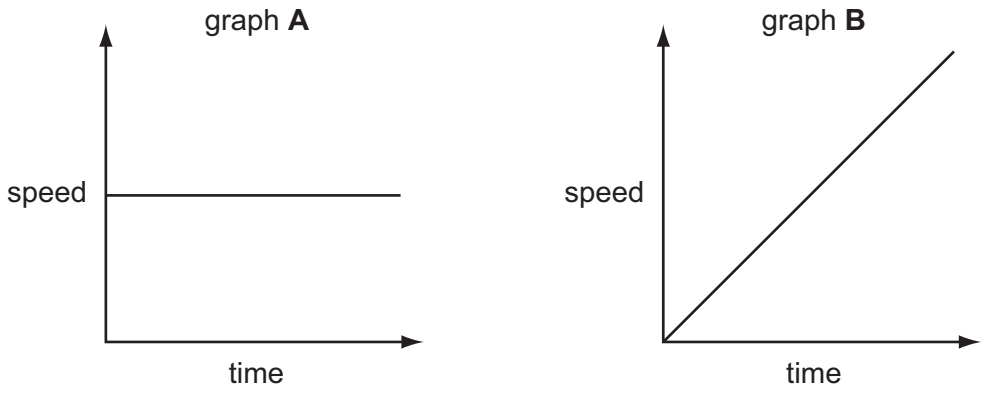

Fig. 3.1

3 (a) Describe the motion of the car in 0653/33/O/N/12

graph **A**, ...

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

3 (b) The car travels at 20 m / s for 90 seconds. 0653/33/O/N/12

The total force driving the car forward is 1000 N.

3 b (i) Calculate the work done by this force during this 90 second journey. 0653/33/O/N/12

State the formulae that you use and show your working.

formulae used

working

..... [3]

For Examiner's Use

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

State the formula that you use and show your working. 0653/33/O/N/12

formula used

working

..... [2]

3 (c) The car accelerates from 0 to 33 m / s in 11 seconds. 0653/33/O/N/12

Calculate the acceleration of the car during the 11 seconds.

Show your working.

..... [2]

For Examiner's Use

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

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

0653/33/O/N/12

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

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

0653/33/O/N/12

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

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

0653/33/O/N/12

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.

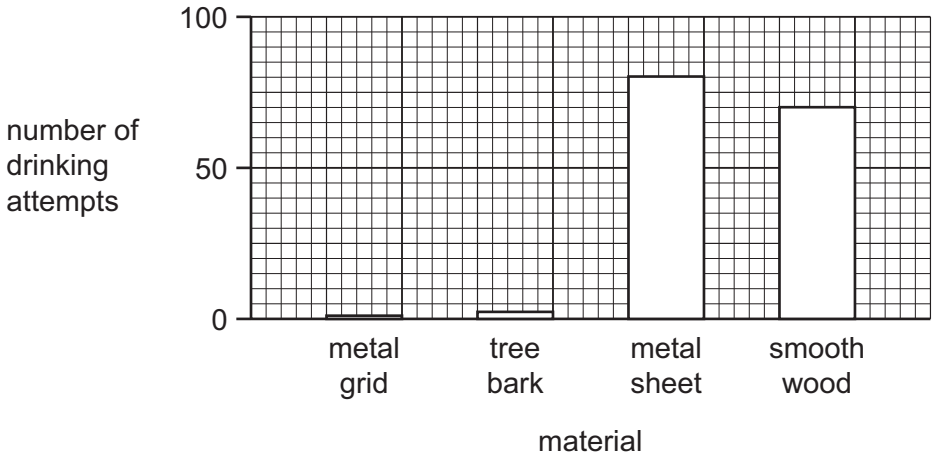

Fig. 4.1

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

0653/33/O/N/12

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..... [2]

For Examiner's Use

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

0653/33/O/N/12

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.

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..... [2]

4 (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.

0653/33/O/N/12

Explain how this can cause fish to die.

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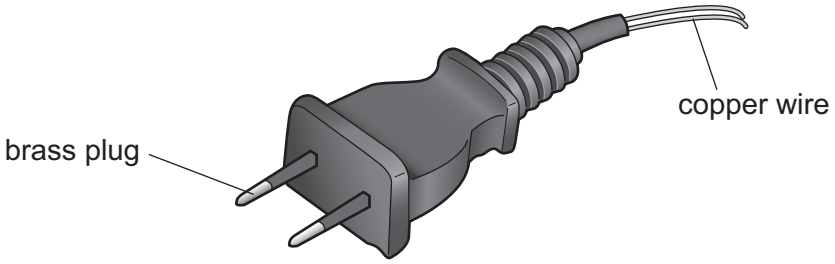
..... [3]

For Examiner's Use

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

5 **(a)** Copper is used to make electrical wires. 0653/33/O/N/12

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.

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..... [3]

5 **(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. 0653/33/O/N/12

Construct a balanced symbolic equation for this reaction.

..... [1]

For Examiner's Use

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

0653/33/O/N/12

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

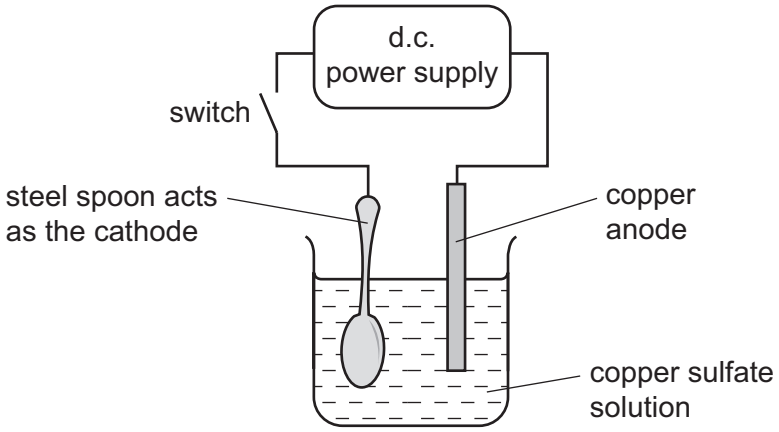

Fig. 5.1

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.

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

0653/33/O/N/12

.....

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..... [2]

5 c **(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.

0653/33/O/N/12

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..... [3]

For Examiner's Use

6 Fig. 6.1 shows a washing machine.

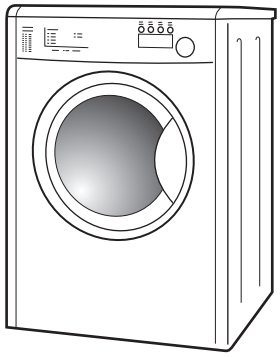

Fig. 6.1

6 (a) Complete the sentence below using **two** of the words in the list. 0653/33/O/N/12

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

A washing machine is designed to transform electrical energy into ..... energy and ..... energy. [2]

6 (b) (i) Some of the water inside the washing machine evaporates. 0653/33/O/N/12

Explain the process of evaporation in terms of particles.

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..... [2]

6 b (ii) Explain why evaporation has a cooling effect. 0653/33/O/N/12

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..... [1]

6 b (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.
0653/33/O/N/12

.....

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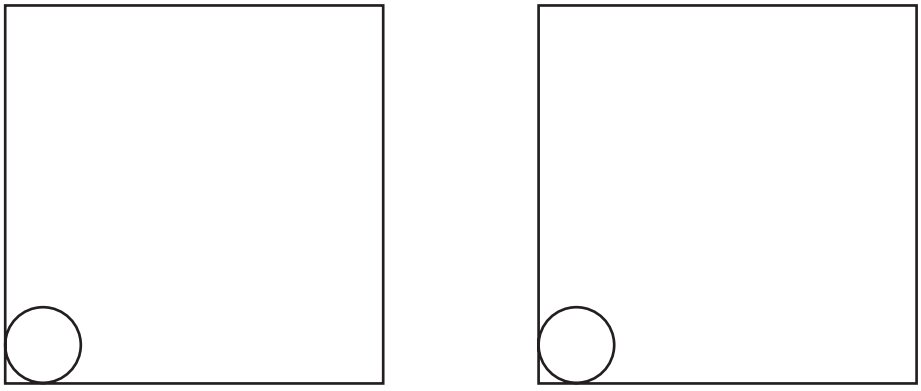
..... [2]

For Examiner's Use

6 (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 a liquid.

0653/33/O/N/12



solid liquid

[2]

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

0653/33/O/N/12

Explain the meaning of the term *efficiency*.

.....

..... [1]

For Examiner's Use

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

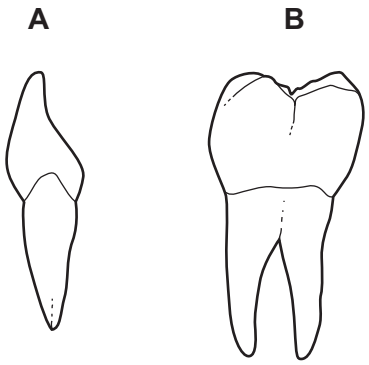


Fig. 7.1

7 a (i) Name the **two** types of teeth shown in Fig. 7.1. 0653/33/O/N/12

tooth **A** .....

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

7 a (ii) Explain how tooth **B** helps to digest a food such as bread. 0653/33/O/N/12

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..... [2]

7 (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.

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

0653/33/O/N/12

..... [1]

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

0653/33/O/N/12

..... [1]

For Examiner's Use

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

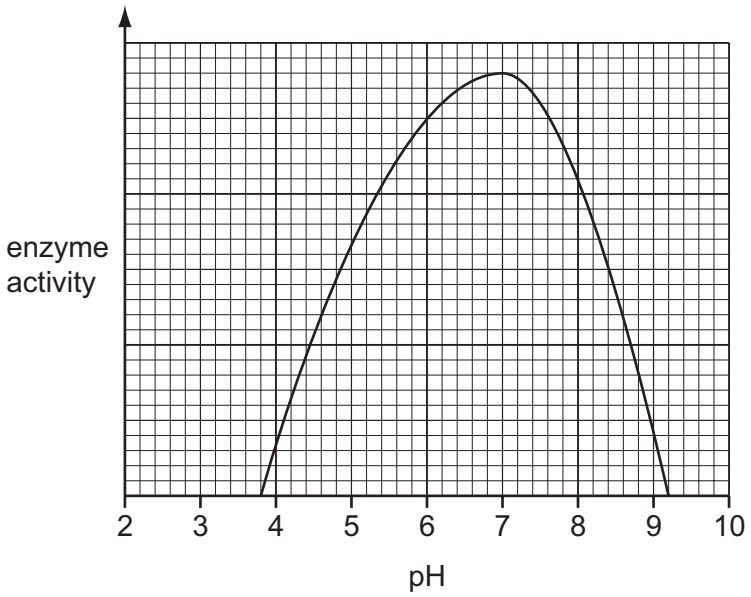

Fig. 7.2

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

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..... [3]

For Examiner's Use

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

8 (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.

0653/33/O/N/12

[2]

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

0653/33/O/N/12

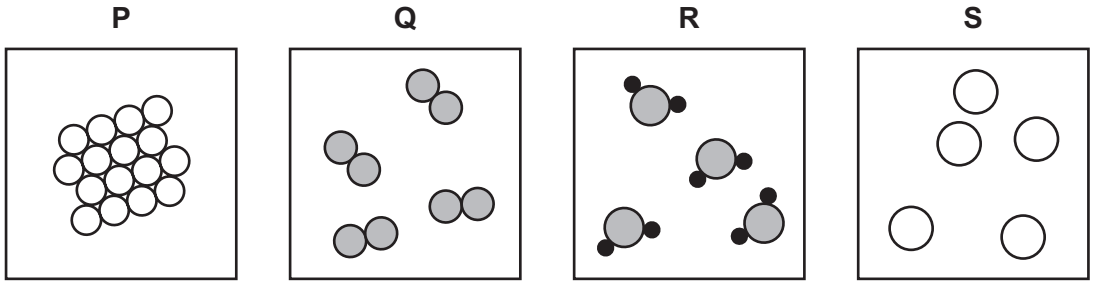


Fig. 8.1

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 .....

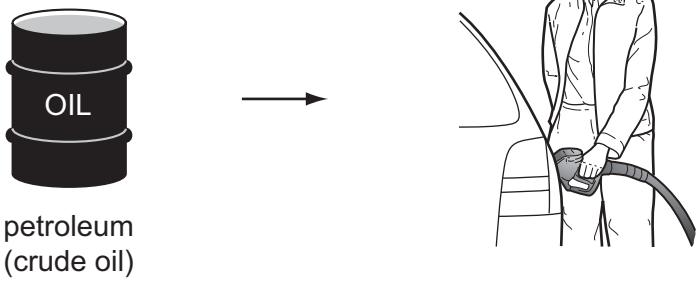
explanation .....

..... [4]

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

0653/33/O/N/12

For Examiner's Use



petroleum (crude oil)

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

0653/33/O/N/12

Explain whether fractional distillation involves physical or chemical changes.

main type of change .....

explanation .....

..... [1]

For Examiner's Use

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

0653/33/O/N/12

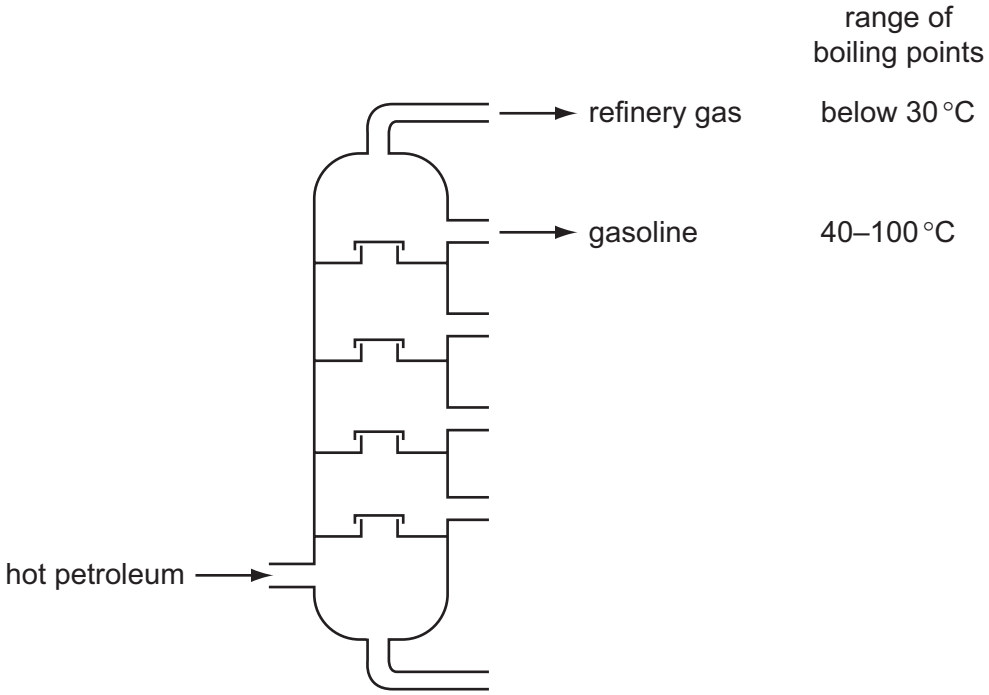


Fig. 8.2

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

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..... [2]

8 (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.

0653/33/O/N/12

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..... [3]

For Examiner's Use

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

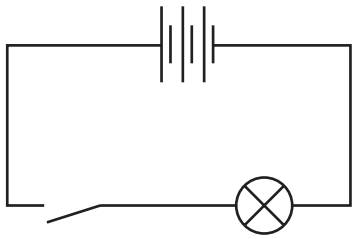

Fig. 9.1

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

0653/33/O/N/12

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

0653/33/O/N/12

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

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

0653/33/O/N/12

Calculate the resistance of the light bulb.

Show your working and state the formula that you use.

formula used

working

..... [2]

For Examiner's Use

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

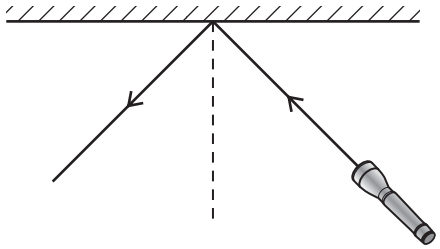

Fig. 9.2

0653/33/O/N/12

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

9 b (ii) **The angle of incidence = 45°.**

0653/33/O/N/12

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		
															4 He Helium 2		
					1 H Hydrogen 1						12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10		
7 Li Lithium 3	9 Be Beryllium 4									11 B Boron 5	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18		
23 Na Sodium 11	24 Mg Magnesium 12									27 Al Aluminium 13	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36		
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	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
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 = 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.).