UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8473813356

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **October/November 2012**

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.

For Examiner's Use	
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11	
12	
Total	

This document consists of **28** printed pages.

1 Flowers are organs in which sexual reproduction takes place.

(a) (i) Complete the definition of sexual reproduction.

Sexual reproduction is the process involving the fusion of

..... nuclei to form a diploid .....

and the production of genetically ..... offspring. [3]

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

..... [1]

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

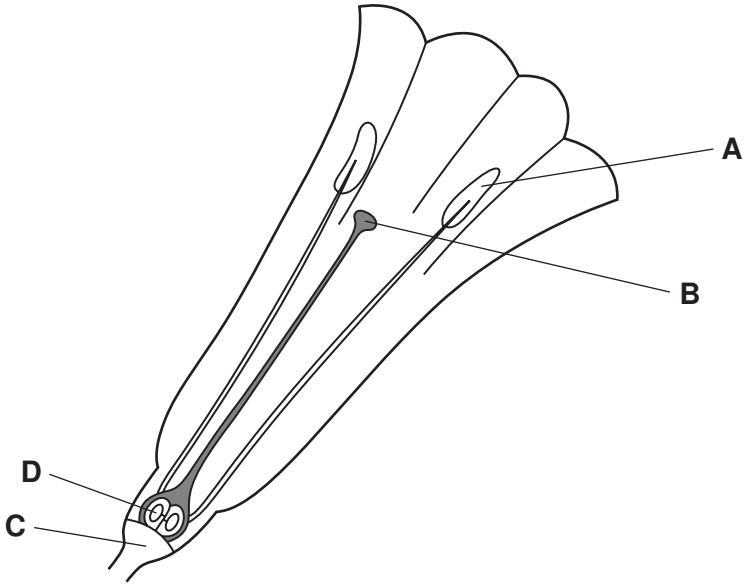


Fig. 1.1

(i) Name the parts labelled **A** and **B**.

A .....

B ..... [2]

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

the male gametes are produced, ...

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

(c) After pollination, seeds are produced. A student set up an experiment to investig 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.

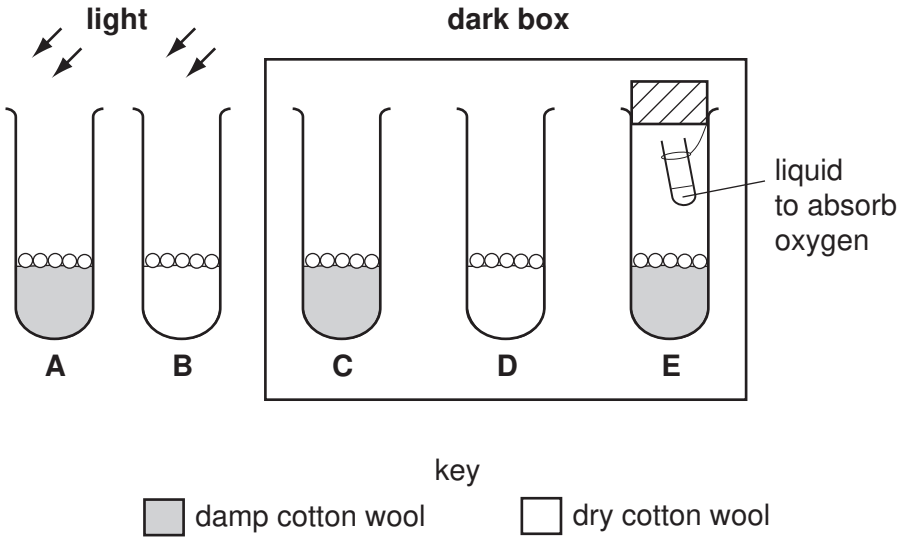


Fig. 1.2

Table 1.1 shows his results.

Table 1.1

tube	conditions			number of seeds that germinated
A	water	oxygen	light	5
B	no water	oxygen	light	0
C				5
D				0
E				0

(i) Complete Table 1.1 to show the conditions present in each tube. Tubes **A** and **B** have been done for you. [2]

(ii) What conclusions can the student make from these results?

.....

.....

.....

..... [3]

2 The air is a mixture of gases which includes nitrogen and oxygen.

(a) (i) State the percentage of nitrogen in the air. ..... [1]

(ii) Air is drawn into car engines where some of the nitrogen and oxygen combine to form oxides of nitrogen.

Use the examples of air and oxides of nitrogen to state **two** differences between a mixture and a compound.

1 .....

.....

2 .....

..... [2]

(iii) Oxides of nitrogen in the exhaust (waste) gases from car engines cause air pollution.

Name **one** other gaseous oxide in car exhaust gases which is poisonous to humans if it is inhaled.

..... [1]

(b) Nitrogen gas in the air exists as molecules which have the formula, N_2.

When magnesium burns in air a white solid is formed. This white solid contains magnesium oxide, MgO, and magnesium nitride, Mg_3N_2.

(i) Name the type of chemical bonding in nitrogen and in magnesium nitride.

nitrogen .....

magnesium nitride ..... [2]

(ii) Explain your answers to **(i)**.

.....

.....

.....

..... [2]

(iii) State what is shown by the chemical formula of magnesium nitride, Mg_3N_2.

.....

..... [1]

(c) A student carries out a test on a sample of ammonium sulfate as shown in Fig. 2.

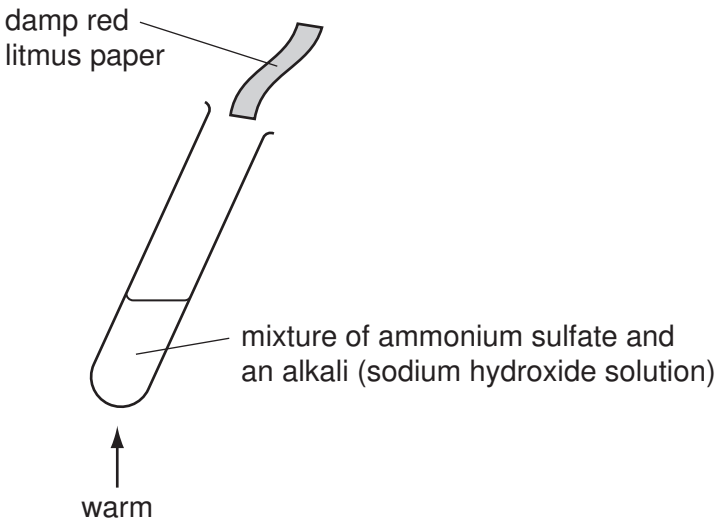


Fig. 2.1

Describe and explain the change in colour of the damp red litmus paper.

.....

.....

..... [2]

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

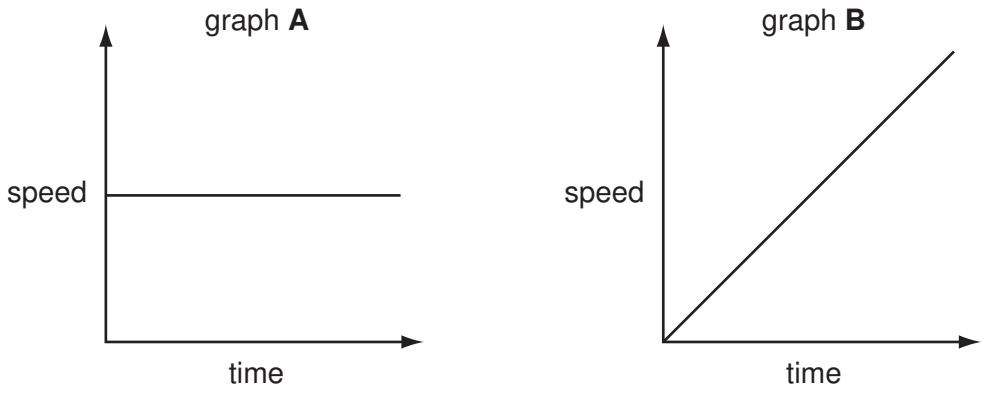


Fig. 3.1

Describe the motion of the car in

graph **A**, ...

graph **B**. ..... [2]

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

Calculate the distance covered.

State the formula that you use and show your working.

formula used

working

..... m [2]

(c) One of the car's headlamps has a current of 2 A, when the voltage across it is 12

(i) Show that the resistance of the headlamp is 6 Ω.

State the formula that you use and show your working.

formula used

working

[2]

(ii) The car has two of these identical headlamps connected in series .

Calculate the total resistance of these two headlamps.

State the formula that you use and show your working.

formula used

working

..... Ω [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.

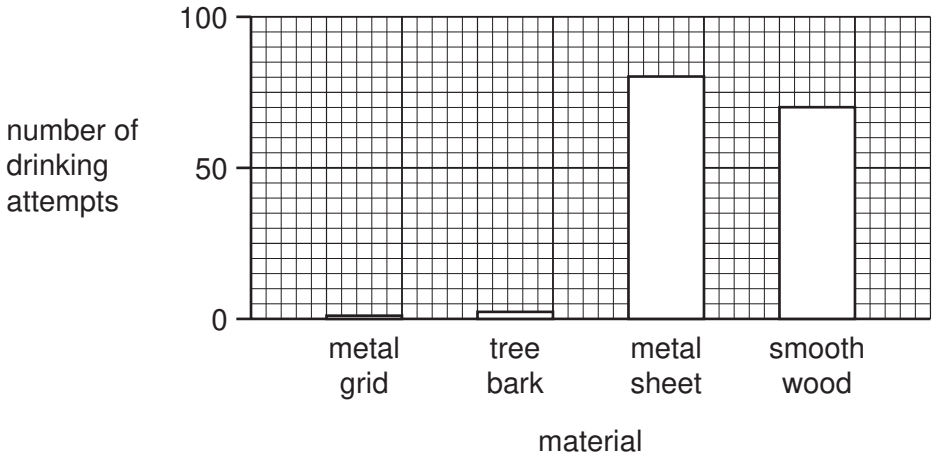


Fig. 4.1

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

.....

.....

..... [2]

(ii) The ultrasound waves reflect from surfaces and are detected by receptors 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) Many bats feed on moths. Tiger moths have reflex actions that help them to e... from bats.

A tiger moth has two simple 'ears', each containing a sensory neurone. The sensory neurone produces nerve impulses when it detects ultrasound.

This causes the moth to fly in rapid zig-zags, which makes it more difficult for the bat to catch.

(i) What is the stimulus for this reflex action? ..... [1]

(ii) The path taken by a nerve impulse in a reflex action in a tiger moth is similar to that in a human.

Fig. 4.3 shows three neurons involved in the reflex action.

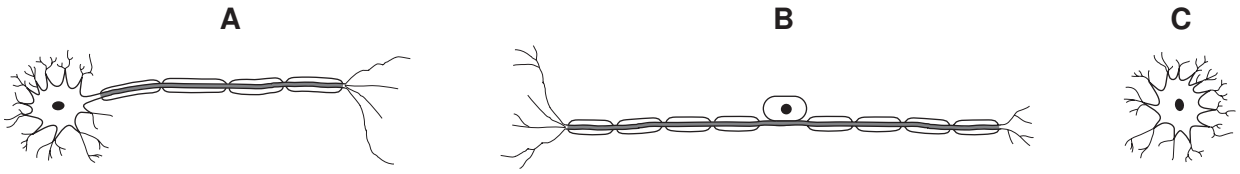


Fig. 4.3

Which neurone, **A**, **B** or **C**

is a sensory neurone, ...

carries the nerve impulse to the moth's flight muscles? ..... [2]

(iii) Some tiger moths do **not** show this reflex action.

Explain why these moths are less likely to pass their genes to the next generation.

.....

.....

.....

..... [2]

Please turn over for Question 5.

5 **(a)** In many countries, river water is collected and treated to make it safe for hum
drink.

State and explain which **two** of the processes shown below are used to treat river water so that it becomes safe to drink.

chlorination

crystallisation

filtration

evaporation

first process .....

reason why this process is carried out .....

.....

second process .....

reason why this process is carried out .....

..... [4]

(b) Fig. 5.1 shows chromatography being used by a student to investigate mixtures of (coloured compounds) used to colour sweets.

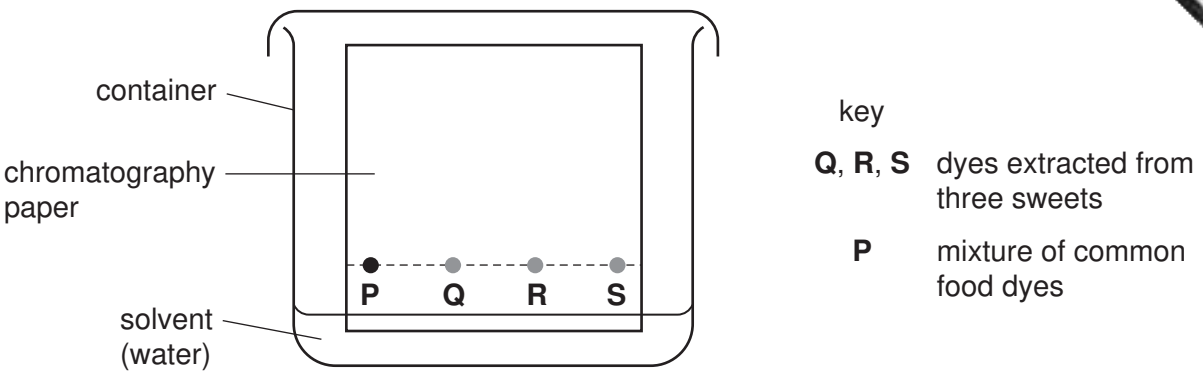


Fig. 5.1

Fig. 5.2 shows the appearance of the chromatography paper after several minutes.

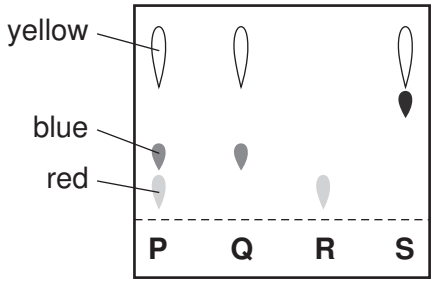


Fig. 5.2

(i) Deduce and explain the colour of the sweet which contains only one dye.

colour .....

explanation .....

..... [2]

(ii) State which sweet contained a dye which was **not** one of the food dyes in the mixture **P**.

..... [1]

(iii) Explain **one** reason why companies that make food dyes must ensure that their products are pure.

.....

..... [1]

6 **(a)** Fig. 6.1 shows a washing machine.

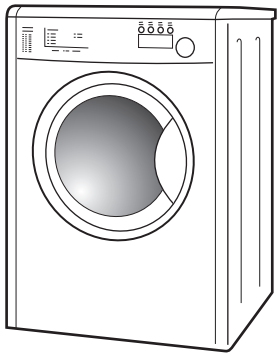


Fig. 6.1

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]

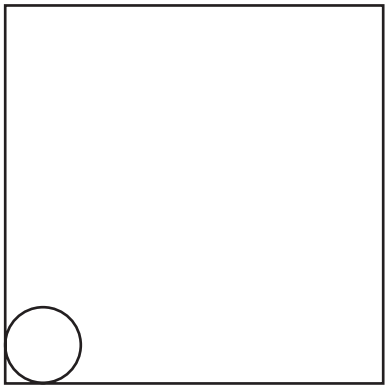
(ii) Explain why evaporation has a cooling effect.

.....

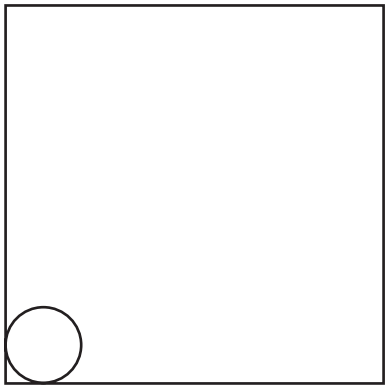
..... [1]

(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.



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.

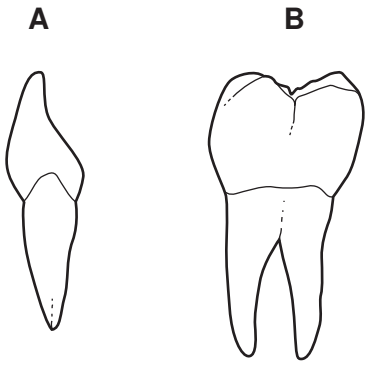


Fig. 7.1

(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) For each part of the digestive system in the list below, tick (✓) the correct function or functions.

part	ingestion	digestion	absorption
mouth	☐	☐	☐
stomach	☐	☐	☐
small intestine	☐	☐	☐

[3]

(c) Starch is a carbohydrate found in many foods that come from plants. Starch mo
are very large, and must be broken down into smaller sugar molecules before they
be absorbed.

(i) Name the enzyme in the human digestive system that breaks down starch molecules.

..... [1]

(ii) State **one** place in the human digestive system where this enzyme is secreted.

..... [1]

(d) Glucose molecules, formed from the digestion of starch, are absorbed from the digestive system into the blood. The blood carries the glucose to the liver.

Describe what happens to the glucose when it reaches the liver if the concentration of glucose in the blood is too high.

.....

.....

..... [2]

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

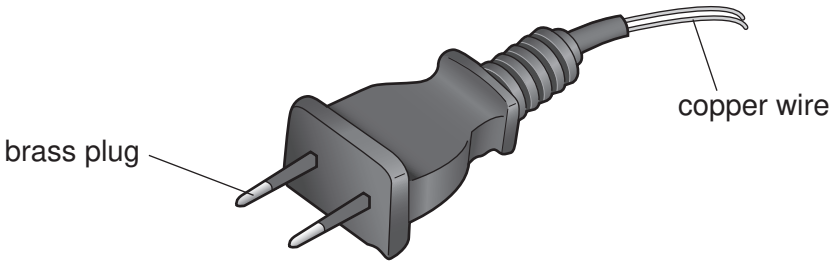
(a) (i) The wires used in many electrical devices are made from copper.

State the **two** properties of metals such as copper, that make them suitable for making electrical wires.

1 .....

2 ..... [2]

(ii) Copper wires are connected to the mains electrical supply using brass plugs. Brass is an alloy.



Explain the meaning of the term *alloy* and state **one** difference in the physical properties of brass compared to copper.

meaning of *alloy* .....

.....

difference in physical property .....

..... [2]

(iii) One of the processes used in the extraction of copper involves heating copper(I) sulfide in air.

One of the reactions that occurs is between copper(I) sulfide and oxygen. This reaction also produces sulfur dioxide.

Construct the **word** chemical equation for this reaction.

..... [1]

(b) Copper may also be formed by the electrolysis of an aqueous solution of chloride using electrodes made of graphite (carbon).

Fig. 8.1 shows a laboratory apparatus a student used to carry out this electrolysis reaction.

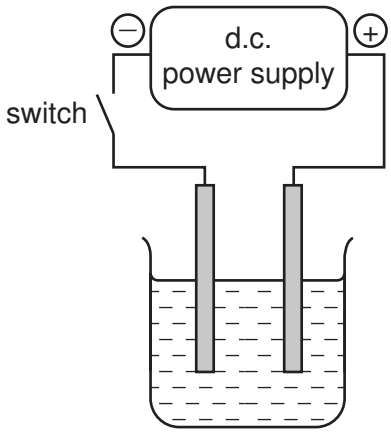


Fig. 8.1

(i) Name the electrolyte in this electrolysis reaction.

..... [1]

(ii) Name the product formed and describe what is observed at the surface of each electrode when an electric current is passing through the circuit.

positive electrode

product .....

observation .....

negative electrode

product .....

observation ..... [4]

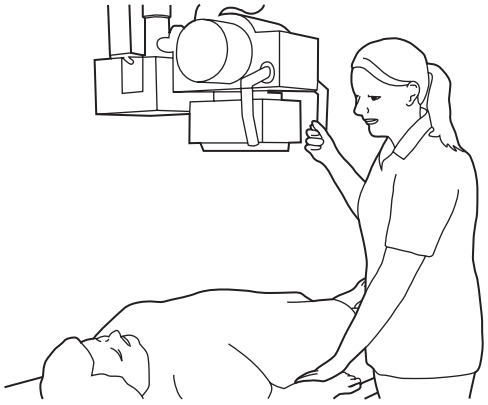
9 **(a)** X-rays and γ (gamma) -rays are two examples of ionising radiation.

Explain the meaning of the term *ionising radiation*.

.....

..... [2]

(b) A radiographer uses X-rays to see the bones in a patient's body. She carries out this procedure many times each day.



The radiographer goes behind a screen before switching on the X-ray machine.

Explain why she does this.

.....

.....

..... [2]

(c) Draw three straight lines to link each type of radiation in the left hand column with its property in the right hand column.

α (alpha)	not dangerous
β (beta)	stopped by paper
γ (gamma)	least ionising
	travels up to 1 metre in air

[3]

(d) Use words from the list to complete the sentences below.

electrons **energy** **nuclear** **nuclei** **radioactive**

In a ..... reactor, ... of elements like uranium are split. Small quantities of uranium can release large amounts of ..... . [3]

(e) Generators are used to produce electricity in power stations.

Explain how energy from a named fossil fuel is transferred to the generator in a power station.

.....

.....

.....

.....

..... [3]

10 Fig. 10.1 shows a plant growing in soil.

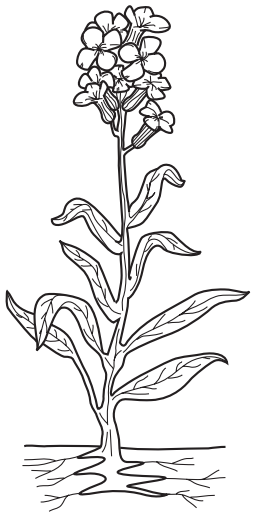


Fig. 10.1

(a) (i) On Fig. 10.1, use a label line and the letter **A** to indicate the part of the plant that absorbs water. [1]

(ii) On Fig. 10.1, use a label line and the letter **L** to indicate the part of the plant from which most water vapour is lost to the air. [1]

(iii) Name the vessels through which water travels up the plant.

..... [1]

(b) Trees lose large amounts of water vapour to the air. This can help to produce [illegible]. If too many trees are cut down, rainfall may decrease.

Explain how trees can also help to reduce the following harmful effects on the environment.

(i) soil erosion

.....

.....

.....

..... [2]

(ii) global warming

.....

.....

.....

..... [2]

11 Carbon occurs naturally as the free element and also combined in an extremely number of different compounds.

(a) An isotope of carbon has a nucleon (mass) number of 14.

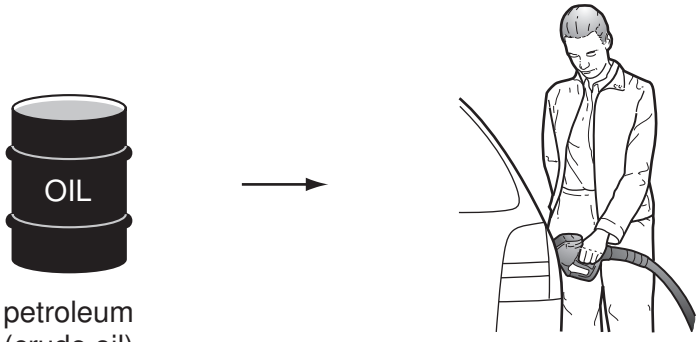
State the numbers of protons, neutrons and electrons in one atom of this isotope.

protons .....

neutrons .....

electrons ..... [3]

(b) Petroleum (crude oil) is a raw material which contains many different carbon compounds. Some of these compounds are separated from petroleum to produce gasoline which is used as a fuel.



petroleum
(crude oil)

(i) State **two** ways in which the properties of petroleum differ from the properties of gasoline.

1 .....

2 ..... [2]

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

Explain whether fractional distillation involves physical or chemical changes.

type of change .....

explanation .....

..... [1]

(iii) Fig. 11.1 shows a typical molecule in gasoline.

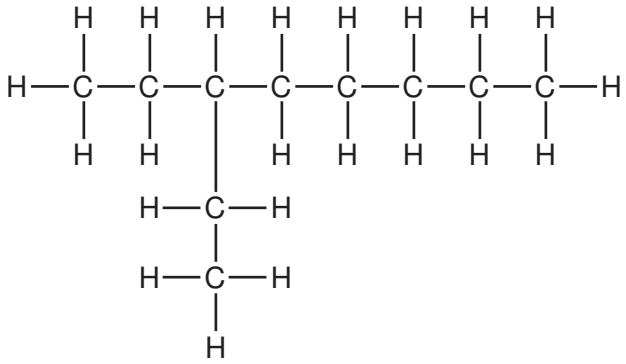


Fig. 11.1

Explain whether this is an example of a saturated or an unsaturated molecule.

.....

..... [1]

(iv) A small amount of the compound made of the molecules in Fig. 11.1 was shaken with an orange-coloured solution of bromine.

State and explain briefly what effect, if any, this has on the colour of the bromine solution.

.....

.....

..... [2]

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

One possible alternative fuel is hydrogen gas, H_2.

Hydrogen burns in air according to the equation

$$2H_2 + O_2 \longrightarrow 2H_2O$$

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

.....

.....

.....

..... [2]

12 **(a)** Complete Table 12.1 to show the circuit symbol for each of the named componen

Table 12.1

component	symbol
ammeter	
fuse	
variable resistor	

[3]

(b) Fig. 12.1 shows an electrical circuit for a torch (flashlight).

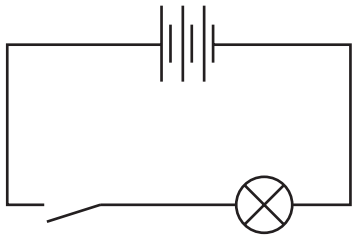


Fig. 12.1

(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]

(c) A single ray of light from a torch is shone onto a mirror as shown in Fig. 12.2.

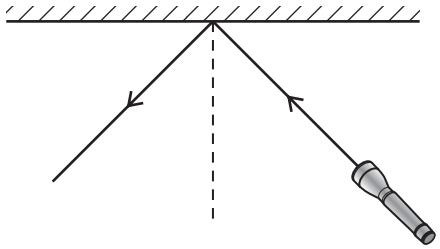


Fig. 12.2

(i) On Fig. 12.2 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]

(d) A ray of white light from the torch is now passed into a glass prism.

This is shown in Fig. 12.3.

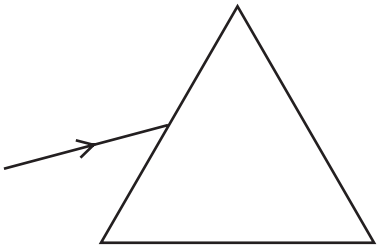


Fig. 12.3

Complete the diagram to show what happens to the light as it passes through and out of the prism. [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 †															

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.).