Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CO-ORDINATED SCIENCES 0654/03

Paper 3

May/June 2004

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 in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 24.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
1	
2	
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4	
5	
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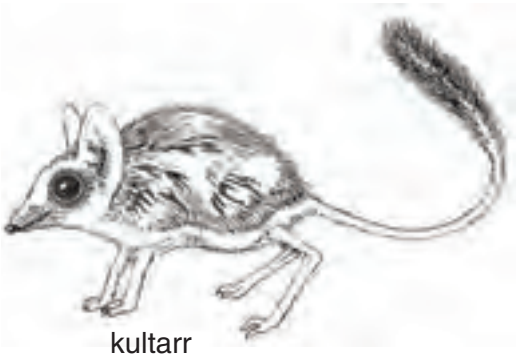
10	
Total	

This document consists of **22** printed pages and **2** blank pages.

1 Fig. 1.1 shows five animals that live in Australia.

echidna



kultarr

fruit bat

wallaby

quoll

Fig. 1.1

(a) Construct a key to enable the identification of these five animals. The first part of has been done for you.

1	a	Front pair of legs modified to form wings.	fruit bat
	b	No wings	go to 2

[4]

(b) State **one** feature, visible in the diagrams, which indicates that all of these animals are mammals.

.....[1]

(c) Echidnas feed on ants and termites, and have no teeth. They are active during b and night, and shelter in burrows or hollow logs. They mate in winter and early sp and fertilisation takes place in the female's oviducts. She later lays a single egg in nest. After hatching, the young echidna feeds on its mother's milk for 8 months, before changing to an adult diet.

Using the information above, state

(i) **two** features of echidnas that make them different from other mammals;

.....

.....[2]

(ii) **two** features of echidna reproduction that are characteristic of mammals.

.....

.....[2]

2 A television set receives radio signals from a transmitter. The television set deco signals and produces a picture on the screen by firing electrons at it. The pictu composed of many tiny coloured dots of light.

(a) Radio waves and light are two types of electromagnetic wave.

Name **one** other type of electromagnetic wave and state a use for this radiation.

electromagnetic wave .....

use .....[2]

(b) State **one** property that all electromagnetic waves have in common.

.....[1]

(c) The screen of a television set is often found coated with dust which has been attracted to the screen. Suggest why the dust is attracted to the screen.

.....

.....

.....[2]

(d) The dots of light produced on the screen consist of the three primary colours of light.

(i) Name these three colours.

1. .....

2. .....

3. ..... [2]

(ii) Suggest why only three colours are needed.

.....

.....[1]

3 The metal magnesium is used to make alloys for use in car and aircraft manufacture.

(a) Suggest and explain **one** desirable property of an alloy which would make it particularly suitable for making aircraft parts.

.....

.....

.....[2]

(b) Magnesium metal is made industrially by electrolysis using molten magnesium chloride as the electrolyte.

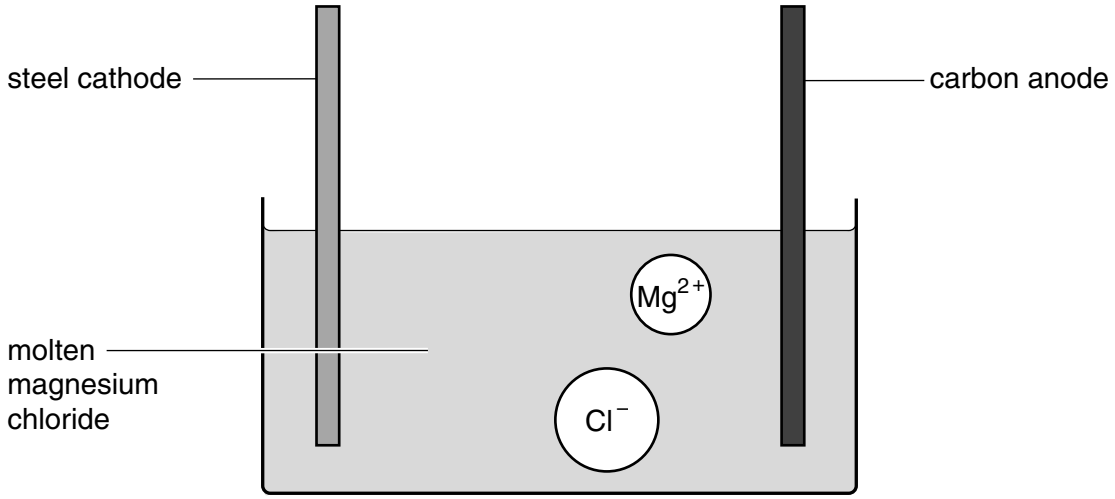


Fig. 3.1

The schematic diagram of the electrolysis in Fig. 3.1 also includes symbols representing a magnesium ion and a chloride ion.

(i) Deduce the chemical formula of magnesium chloride and explain your answer briefly.

.....

.....[2]

(ii) Explain why the magnesium chloride used in this process has to be molten.

.....

.....[2]

(iii) Describe how magnesium ions are converted into magnesium atoms electrolysis.

.....

.....

.....[2]

(iv) In the factory making magnesium, the container of electrolyte is **not** open to the air that the workers breathe.

Suggest the reason for this.

.....

.....[1]

(c) Fig. 3.2 shows two electrical cells in which magnesium ribbon is used as one of the electrodes. In both cells magnesium is the more reactive metal.

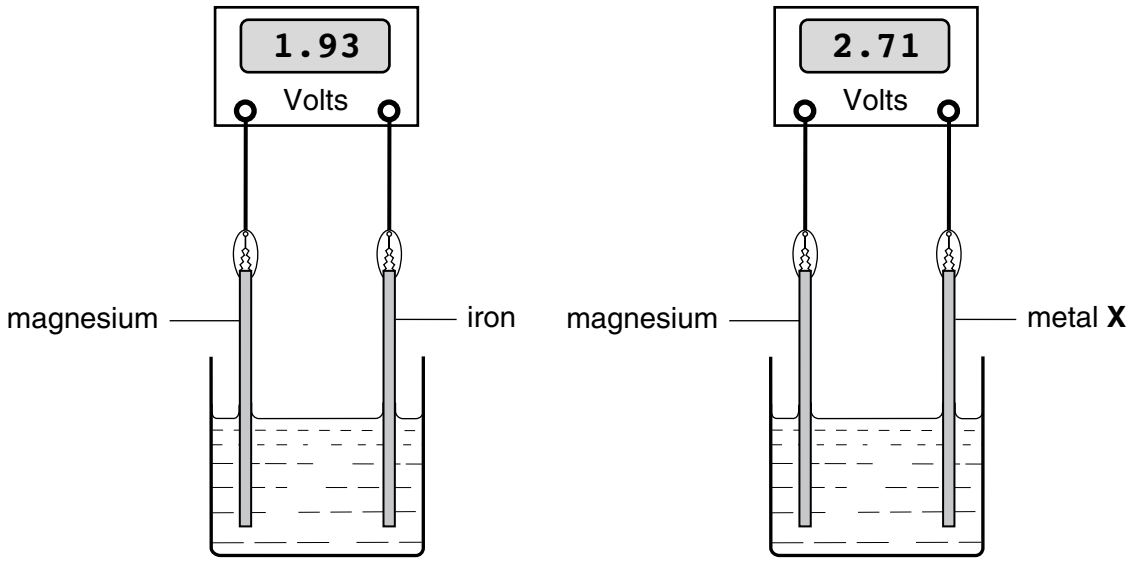


Fig. 3.2

Use the information in Fig. 3.2 to deduce how the reactivity of metal **X** compares with that of iron.

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.....

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.....[2]

4 Milk contains a sugar called lactose. Many people do not have the enzyme lactase, which digests lactose, in their digestive system, so drinking milk can make them feel ill.

Several large food companies therefore produce and sell lactose-reduced milk. They add lactase to warm milk and allow time for the lactase to catalyse this reaction:

$$\text{lactose} \longrightarrow \text{glucose} + \text{galactose}$$

One food company uses lactase obtained from a fungus. Fig. 4.1 shows how the rate of the reaction is affected by temperature when this fungal lactase is used.

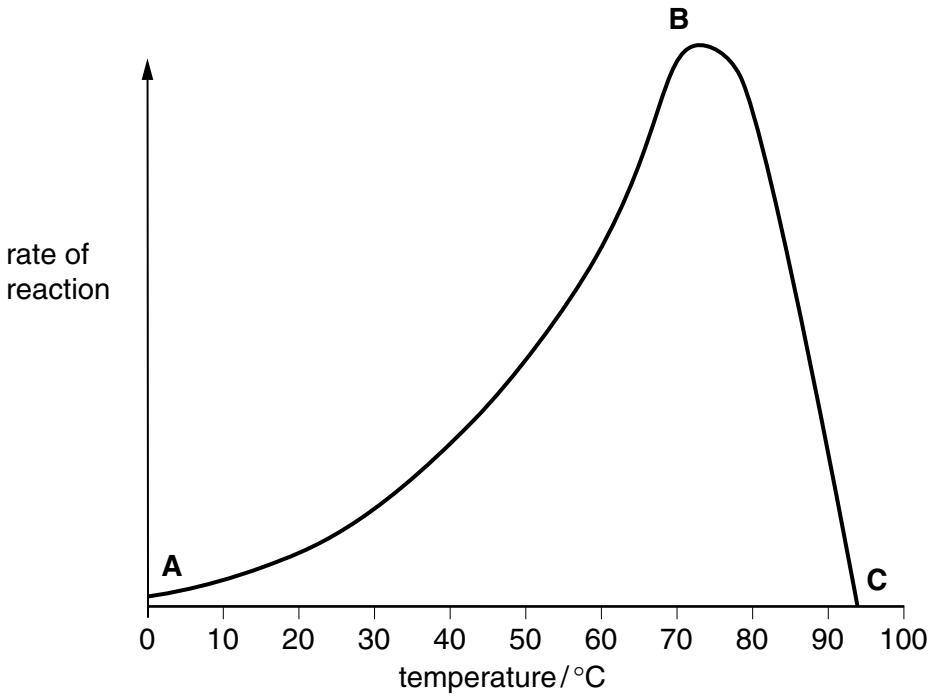


Fig. 4.1

(a) Explain the reasons for the shape of the graph between

(i) **A** and **B**; .....

.....

.....

.....[3]

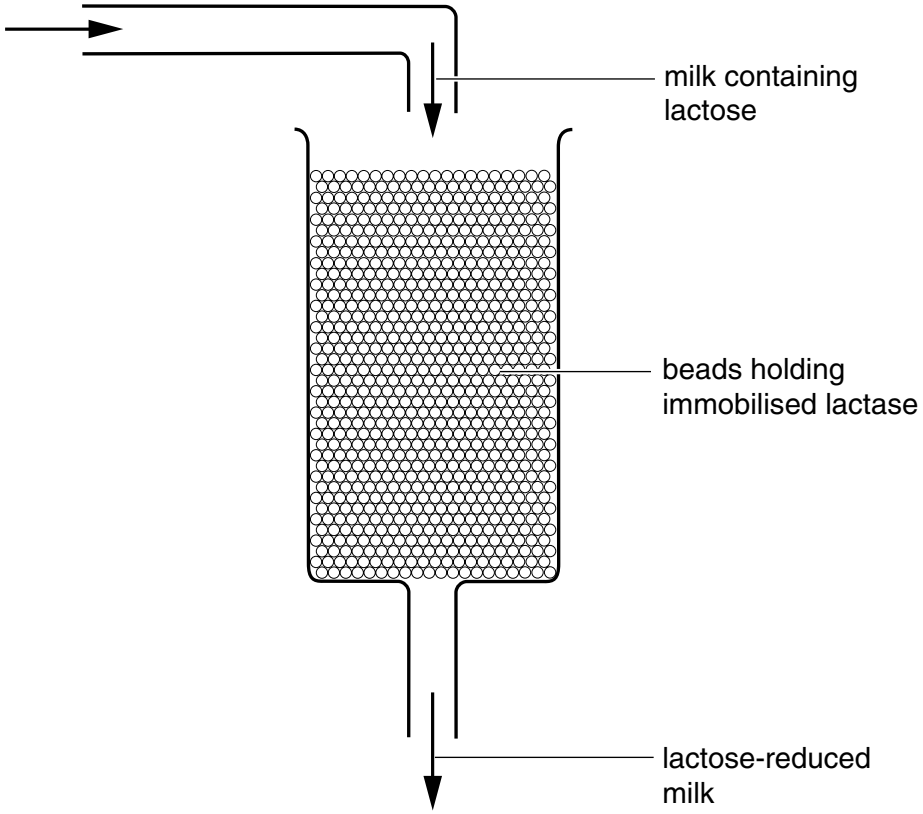
(ii) **B** and **C**. .....

.....

.....[2]

(b) On the graph, draw a curve to show the result you would expect if lactase from a human was used, rather than the lactase obtained from a fungus. [2]

(c) The food company uses lactase in a special form. Rather than just mixing a solution with milk, the lactase is attached to little beads of jelly. The lactase is said to be immobilised. The milk is then allowed to run through the beads holding the immobilised lactase.



(i) Explain, in terms of the way in which enzymes work, why these beads can be used over and over again.

.....

.....

.....[2]

(ii) Suggest **one** advantage, other than being able to reuse the beads, of using immobilised lactase rather than a lactase solution.

.....

.....[1]

(d) Describe where and how the glucose produced from the breakdown of lactose is absorbed from the human digestive system.

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.....[2]

5 Fig. 5.1 shows a fishing boat using ultrasound waves to detect shoals of fish.

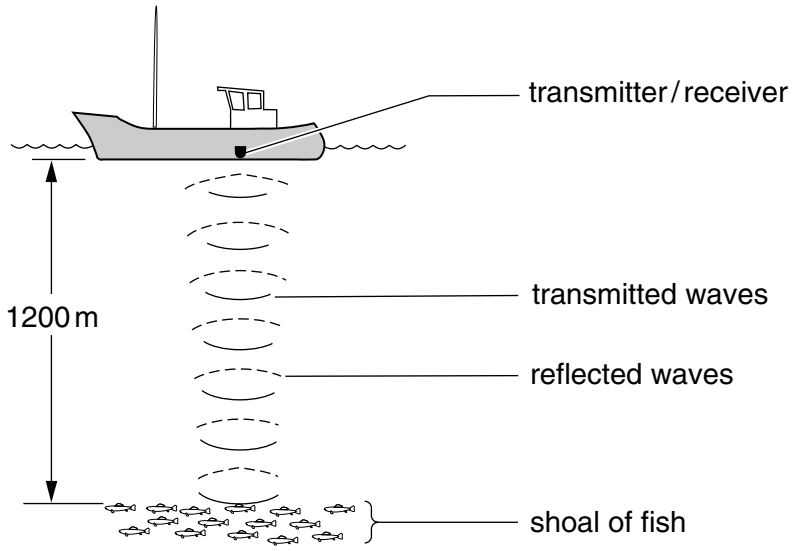

Fig. 5.1

(a) The speed of ultrasound waves in water is 1500 m / s.

The frequency of the ultrasound waves used for detecting fish is 50 000 Hz.

Calculate the wavelength of the ultrasound waves.

Show your working and state the formula that you use.

formula

working

.....[3]

(b) The fish are at a depth of 1200 m.

Calculate the time it would take for the ultrasound waves to travel from the transmitter to the fish and back to the receiver.

Show your working and state the formula that you use.

formula

working

.....[3]

(c) Ultrasound waves can also be used to scan an unborn baby in the mother's uterus.

Suggest why ultrasound waves are used rather than X-rays.

.....

.....[2]

(d) Ultrasound waves are waves with a frequency higher than a human can hear.

State the highest frequency that a human can usually hear.

.....[1]

6 Fig. 6.1 shows the path of a river.

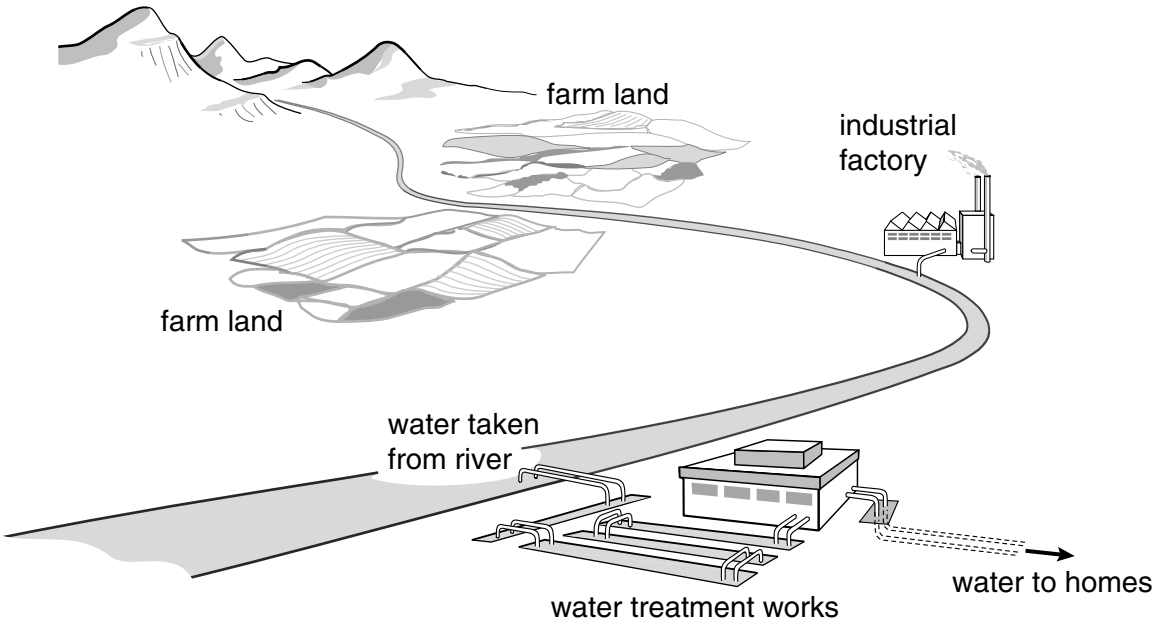

Fig. 6.1

(a) (i) Describe briefly **two** ways in which the water in this river could become polluted.

.....

.....

.....

.....[2]

(ii) In the water treatment works, water from the river is filtered.

Explain why filtering alone does not make the water safe for humans to drink.

.....

.....

.....

.....[3]

(iii) State another process which might be carried out in the water treatment works that makes the water safe for human consumption.

.....[1]

(b) Temporary hard water contains dissolved calcium hydrogencarbonate, $Ca(HCO_3)_2$.

When temporary hard water is boiled the following reaction occurs, causing limescale to form.

$$Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$$

(i) Explain why boiling removes temporary hardness from water.

.....

.....[1]

(ii) A student boiled a 0.5 dm^3 sample of temporary hard water until only solid calcium carbonate remained.

The mass of the calcium carbonate residue was 0.25 g.

Calculate the concentration in mol / dm^3 of calcium hydrogencarbonate in the original water sample.

Show your working.

.....

.....[3]

7 **(a)** Fig. 7.1 shows a circuit containing five ammeters, A_1, A_2, A_3, A_4 and A_5.

The reading on ammeter A_3 is 2.0 A and the reading on ammeter A_4 is 1.5 A.

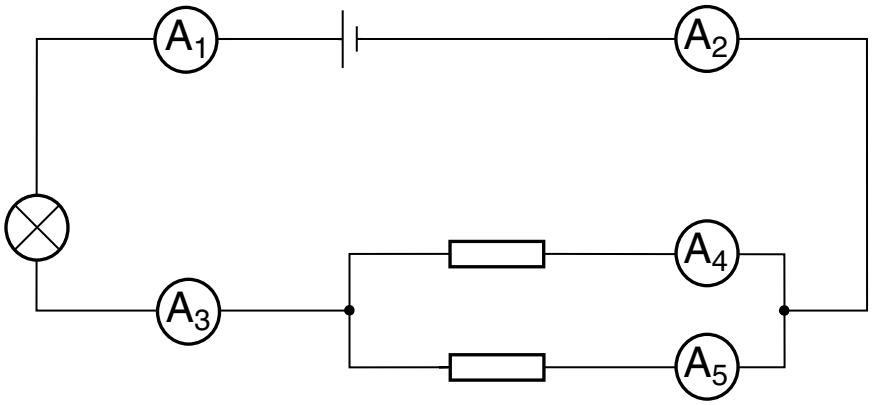

Fig. 7.1

(i) Calculate the readings on the other ammeters.

A_1 reads .....

A_2 reads .....

A_5 reads ..... [2]

(ii) State the number of coulombs per second passing through ammeter A_3.

.....[1]

(b) Fig. 7.2 shows another circuit containing three voltmeters, V_1, V_2 and V_3.

The reading on voltmeter V_2 is 6 V.

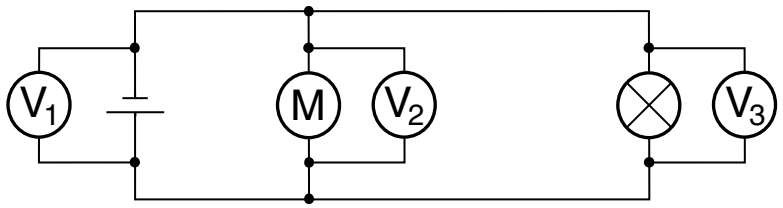

Fig. 7.2

State the readings on the other two voltmeters.

V_1 reads .....

V_3 reads ..... [1]

(c) Fig. 7.3 shows a bathroom. Explain why it can be dangerous to have power p
bathrooms.

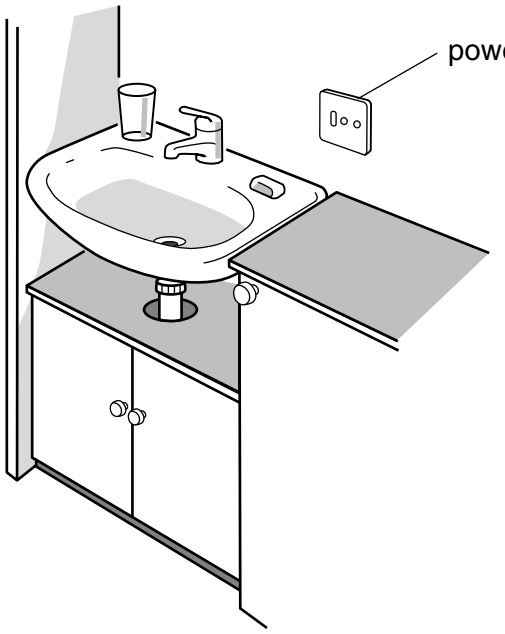

Fig. 7.3

.....

.....

.....[2]

8 **(a)** A student carried out an investigation to find out if the leaves on the shady side of were longer than the leaves on the sunny side of the same tree. He collected 30 le from the shady side, measured the length of each leaf, and calculated the averag length. He repeated this on the sunny side of the tree. Table 8.1 summarises his results.

Table 8.1

position on tree	length of shortest leaf / mm	length of longest leaf / mm	average length of leaves / mm
shady side	22	56	42
sunny side	23	48	39

(i) When the student collected the leaves, he was careful always to pick leaves near to the end of a branch rather than leaves close to the trunk of the tree.

Explain why this would help to make his results more reliable.

.....

.....

.....[2]

(ii) The student thought that his results suggested that the leaves on the sha were longer than those on the sunny side, but he was not quite sure about this

State **one** piece of evidence in Table 8.1 that supports this conclusion, and **one** piece of evidence which does not support it.

evidence that supports this conclusion .....

.....

evidence that does not support this conclusion .....

.....[2]

(iii) Variation can be caused by genetic factors or by environmental factors. Explain why variation in leaf length on the two sides of the tree must be caused by environmental factors.

.....

.....[1]

(b) One branch of the tree had leaves which were partly pale yellow and partly green. The student decided that this must have happened because of a mutation in the cells from which that branch grew.

(i) Explain what is meant by the term *mutation*.

.....

.....

.....[2]

(ii) Explain how a mutation that happened in one cell in the tree could result in many cells all containing this mutation.

.....

.....

.....[2]

(iii) Explain why a tree with partly yellow and partly green leaves is likely to grow more slowly than a tree with normal, green leaves.

.....

.....

.....

.....[3]

9 Gasoline and diesel are liquid mixtures of hydrocarbons used as fuels. Fig. 9.1 sho graphical (displayed) formula of a typical molecule in gasoline.

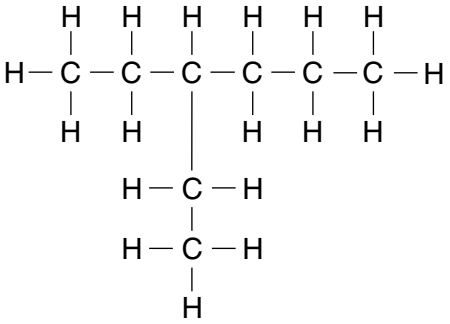

Fig. 9.1

(a) (i) Why is this molecule described as a *hydrocarbon*?

.....

.....[1]

(ii) Write the molecular formula of the molecule in Fig. 9.1.

.....[1]

(iii) Name the homologous series to which the molecule in Fig. 9.1 belongs.

.....[1]

(b) Table 9.1 shows some properties of gasoline and diesel.

Table 9.1

fuel	temperature range over which the fuel boils / °C	viscosity (how easily the liquid flows)
gasoline	40 to 205	runny (flows easily)
diesel	250 to 350	viscous (does not flow so easily)

Explain briefly why the properties of these fuels are different.

.....

.....

.....[2]

(c) Ethene, C_2H_4, is an important unsaturated hydrocarbon.

(i) Explain why ethene is described as *unsaturated*.

.....

.....[1]

(ii) Describe a chemical test and its result which would show that ethene is unsaturated.

.....

.....

.....[2]

(iii) Millions of tonnes of ethene are used in chemical industries world-wide each year. Ethene burns easily and releases much heat when it does so.

Suggest why the world's chemical industries consider ethene too valuable to use as a fuel.

.....

.....

.....[2]

(d) Describe briefly how ethene can be converted into ethanol, C_2H_6O, and write a balanced equation for the reaction.

.....

.....

.....

.....[3]

10 A student compares four different wires to see which is the best conductor of electri
passes a current of 0.8 A through each wire and measures the voltage needed.

Table 10.1 shows his results.

Table 10.1

wire	voltage / V
aluminium	2.4
copper	1.6
silver	1.4
steel	24.0

(a) Which wire is the best conductor of electricity? Explain your answer.

.....

.....

.....[2]

(b) Calculate the resistance of the silver wire.

Show your working and state the formula that you use.

formula

working

.....[2]

(c) While doing this experiment, the student notices that one of the wires gets warm.

(i) Which wire is most likely to become noticeably warm?

.....[1]

(ii) Calculate the power in this wire.

Show your working and state the formula that you use.

formula

working

.....[2]

(d) The data in Table 10.2 are obtained using samples of copper, aluminium and steel wires. Each wire is 100 m long and has a diameter of 2 mm.

Table 10.2

material	resistance / Ω	force needed to break wire / N	density / kg per m^3	cost of wire / $
aluminium	3	150	2700	4
copper	2	300	8900	14
steel	30	1500	7700	1

Use these data to explain why many overhead power cables are made out of aluminium with a steel core.

.....

.....

.....

.....[3]

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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	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	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium	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	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	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	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

* 57-71 Lanthanoid series
† 89-103 Actinoid series

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.).