Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CO-ORDINATED SCIENCES **0654/33**

Paper 3 (Extended) **October/November 2015**

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 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 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.

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

CAMBRIDGE International Examinations

1 Table 1.1 shows the composition of 100 cm^3 of a typical human breast milk and 100 cm^3 of a type of baby's bottle milk.

Table 1.1

amount per 100 cm^3	human breast milk	bottle milk
energy (kJ)	290	275
fat (g)	4.2	3.4
protein (g)	1.1	1.3
carbohydrate (g)	7.1	7.4
calcium (mg)	30	45
iron (mg)	0.47	0.53
vitamin C (mg)	4.0	9.2
vitamin D (mg)	0.0015	0.0012

(a) (i) Using the information in Table 1.1, name **two** substances that are present in breast milk at higher concentrations than in bottle milk.

1 .....

2 ..... [2]

(ii) Using the information in Table 1.1, calculate what volume of bottle milk a baby would need to meet an energy requirement of 825 kJ per day.

..... cm^3 per day [2]

(b) Bottle milk contains larger amounts of some nutrients than breast milk. Suggest why this does **not** necessarily mean that bottle milk is better as a source of these nutrients.

.....

..... [1]

(c) Suggest **two** advantages of feeding a baby with breast milk rather than bottle milk, apart from any differences in nutrient content.

1 .....

2 ..... [2]

2 Fig. 2.1 shows apparatus a student uses to investigate the reaction between dilute hydrochloric acid and sodium hydroxide solution.

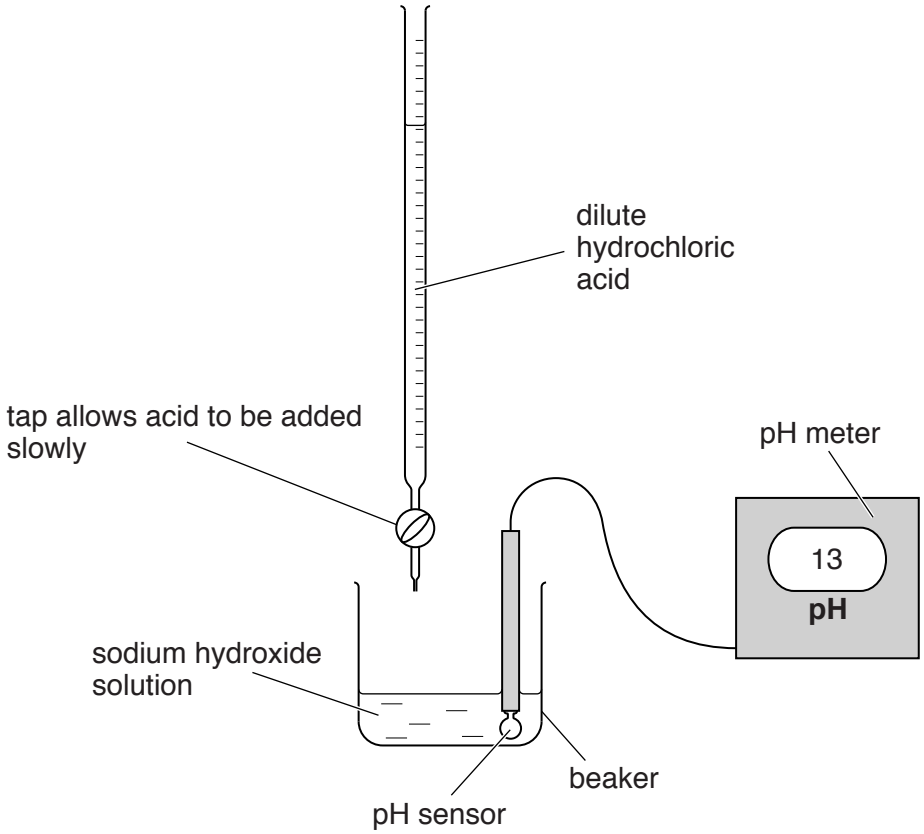


Fig. 2.1

(a) (i) Name the type of chemical reaction which occurs between dilute hydrochloric acid and sodium hydroxide.

..... [1]

(ii) Suggest **one** advantage of using an electronic pH meter to measure pH rather than using a coloured indicator such as litmus solution.

.....

..... [1]

(b) The student places 20.0 cm^3 of 0.1 mol/dm^3 sodium hydroxide solution into the beaker.

The student then adds dilute hydrochloric acid carefully, in stages, and records the pH of the mixture after each addition.

Fig. 2.2 shows a graph of the results.

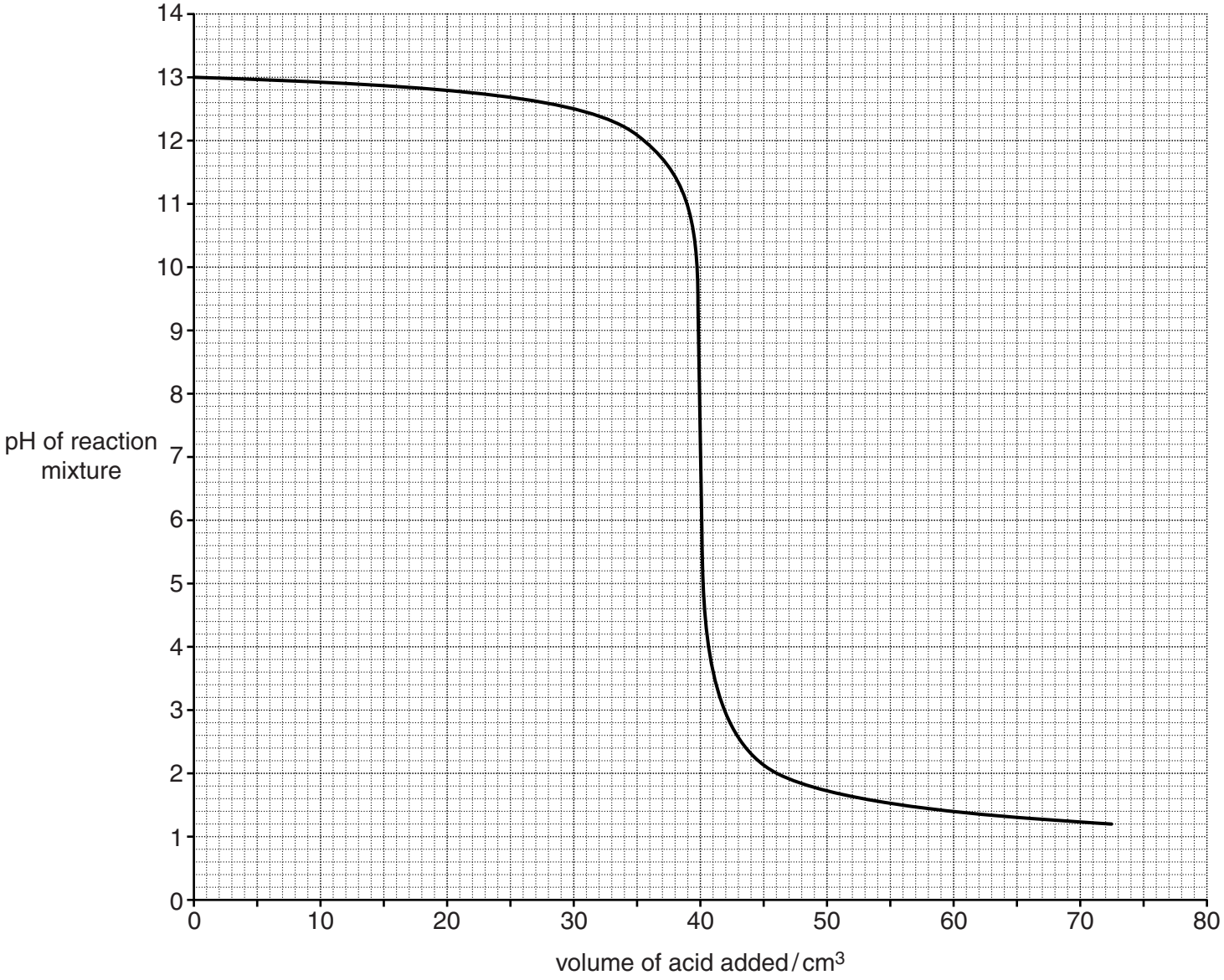


Fig. 2.2

(i) Calculate the number of moles of sodium hydroxide present in the beaker before any acid is added.

Show your working.

number of moles of sodium hydroxide = ... [2]

(ii) Use the data in Fig. 2.2 to deduce the smallest volume of acid that is required to react with all of the sodium hydroxide in the solution.

Explain your answer.

volume of acid = ... cm^3

.....

..... [2]

(iii) The balanced equation for the reaction is

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Deduce the concentration of the acid in mol/dm^3.

Explain your answer.

concentration of acid = ... mol/dm^3

.....

.....

..... [2]

3 A boy, sitting on a beach, is exposed to many forms of electromagnetic radiation.

(a) Fig. 3.1 shows an incomplete electromagnetic spectrum.

On Fig. 3.1 write the names infra-red, radio waves, ultraviolet and X-rays in their correct positions.

gamma radiation			visible light		microwaves	

Fig. 3.1

[1]

(b) The boy has two inflated rubber rings, one black and one white, which he has left on the hot beach in the Sun.

Fig. 3.2 shows the two rubber rings.

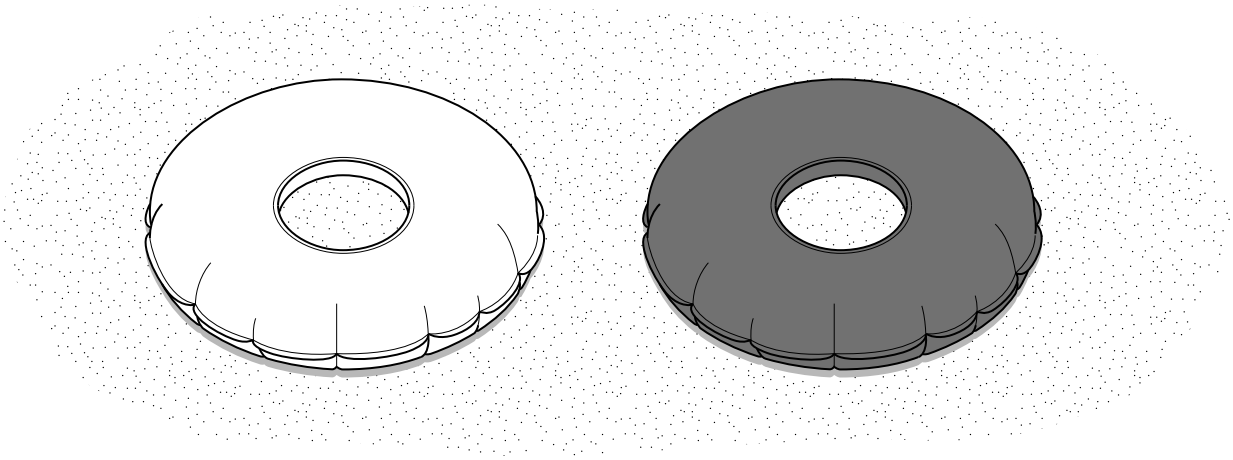


Fig. 3.2

Explain why the temperature of the air inside the black rubber ring rises more quickly than the temperature of the air inside the white rubber ring.

.....

..... [1]

(c) Someone has left some broken glass on the beach. The curved glass acts like a lens focussing the Sun's rays onto a piece of paper and setting it alight.

Fig. 3.3 shows a lens focussing the rays of light.

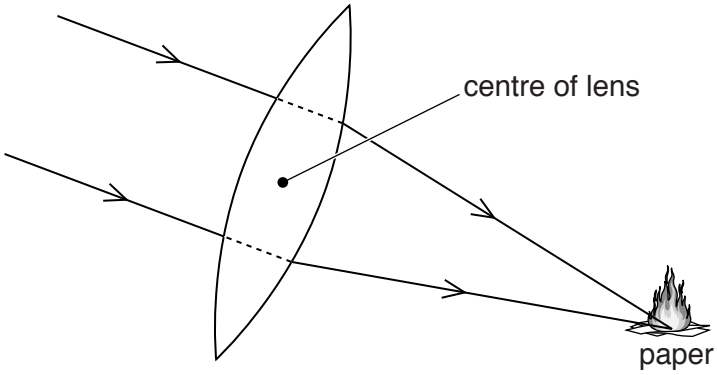


Fig. 3.3

(i) On Fig. 3.3 use a label line and the letter **P** to label the principal focus of the lens. [1]

(ii) The lens produces a real image of the Sun.

Describe the difference between a *real* image and a *virtual* image.

.....

..... [1]

(d) Fig. 3.4. shows a penguin walking on a beach.

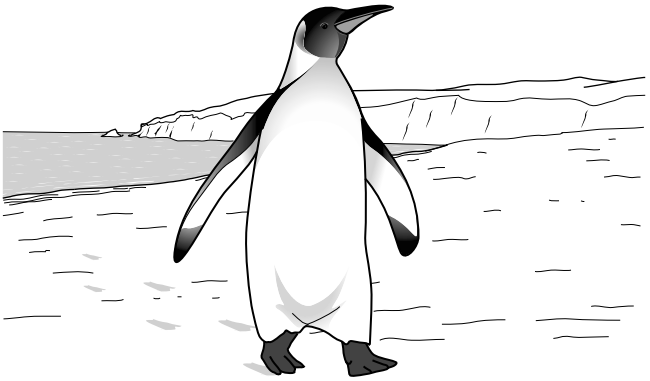


Fig. 3.4

The penguin has a weight of 20 N and each foot has an area of 12 cm^2.

(i) Calculate the pressure exerted by the penguin on the beach, when it is standing on both feet.

State the formula that you use and show your working.

formula

working

pressure = ... N/cm^2 [3]

(ii) Pressure is sometimes measured in Pascals (Pa). 1 Pa = 1 N/m^2.

Write down the pressure that you calculated in **(d)(i)** in Pa.

pressure = ... Pa [1]

(e) A scuba diver is swimming in the sea near the beach. Fig. 3.5 shows a scuba diver.

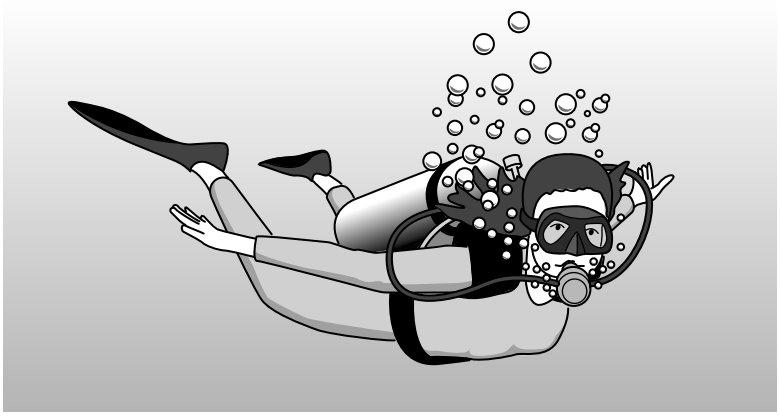


Fig. 3.5

The scuba diver can breathe underwater because she carries a cylinder of air on her back. Air is a mixture of gases.

(i) The molecules of gas in the cylinder move randomly.

Describe how the gas molecules exert a pressure on the wall of the cylinder.

.....

.....

.....

..... [2]

(ii) The cylinder contains air at a pressure of 20 000 kPa.

The volume of the compressed air in the cylinder is 0.015 m^3.

The air is allowed to expand into a larger cylinder of volume 0.065 m^3.

The temperature of the air does not change.

Calculate the new pressure of the air.

State the formula that you use and show your working.

formula

working

pressure = ... kPa [2]

4 Magnesium is a metal found in Group II of the Periodic Table.

(a) When burning magnesium is placed into a gas jar filled with carbon dioxide, it continues to burn as shown in Fig. 4.1.

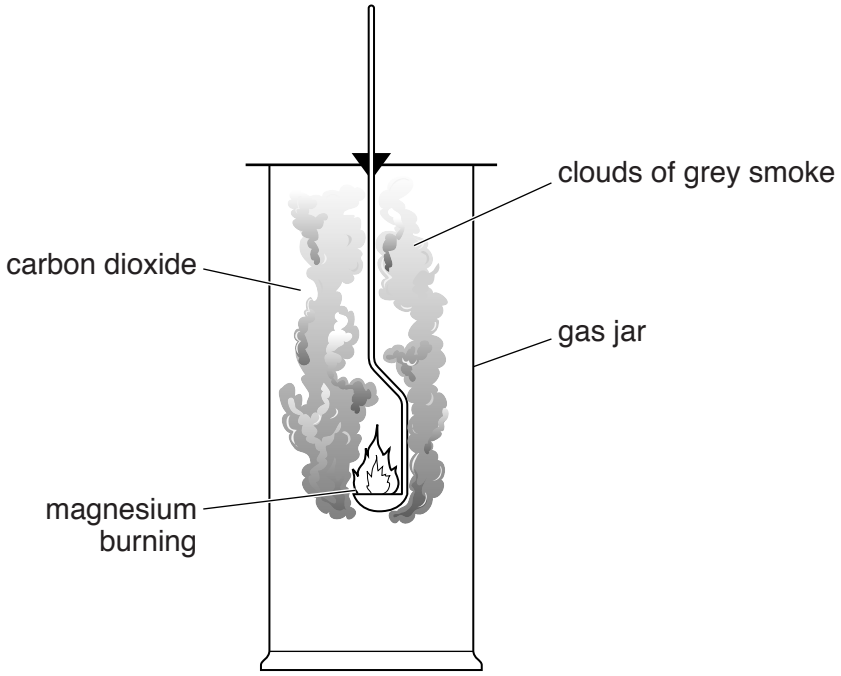


Fig. 4.1

The clouds of grey smoke formed in this reaction are a mixture of magnesium oxide, MgO, and carbon.

Construct a balanced symbol equation including the state symbols, (s) and (g), for the reaction between magnesium and carbon dioxide.

..... [3]

(b) Magnesium is produced by the electrolysis of magnesium chloride.

Fig. 4.2 shows a simplified diagram of the process.

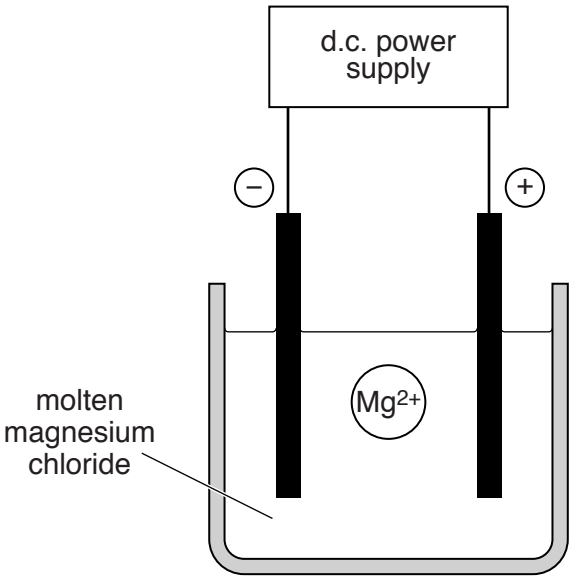


Fig. 4.2

(i) In this electrolysis magnesium ions are changed into atoms.

Fig. 4.2 shows a magnesium ion in the middle of the electrolyte some distance from the electrodes.

Describe in detail how this magnesium ion is changed into a magnesium atom.

.....

.....

.....

..... [3]

(ii) Explain why this electrolysis has to be carried out using molten magnesium chloride rather than an aqueous solution of magnesium chloride.

.....

.....

..... [1]

(iii) State the name and chemical formula of the substance produced at the anode in the electrolysis of molten magnesium chloride.

name .....

formula ..... [2]

5 **(a)** Use words from the list to complete the sentences about cell division. You may use each word once, more than once, or not at all.

different **diploid** **doubled** **halved** **haploid**

identical **maintained** **meiosis** **mitosis**

Gametes are produced by a type of nuclear division called ..... , which

results in cells that are genetically ..... .

During this type of cell division, the chromosome number is ..... , and

so the cells produced are described as ..... .

[4]

(b) Apart from production of gametes, name **three** other processes, in living things, that depend on cell division.

1 .....

2 .....

3 ..... [3]

6 **(a)** A motorcyclist begins a journey on a motorcycle. The motorcycle starts from rest and stops at a road junction after 80 seconds.

Fig. 6.1 shows a speed / time graph for the journey.

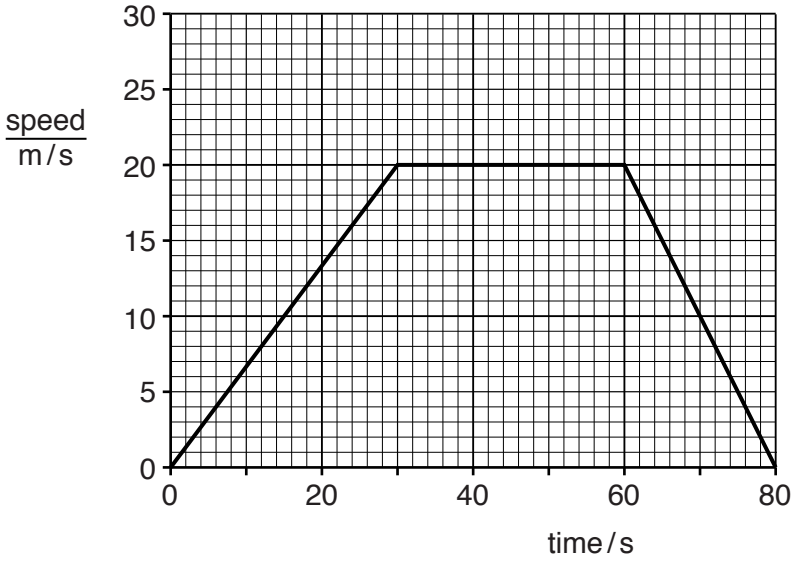


Fig. 6.1

Calculate the distance travelled by the motorcyclist during the journey.

Show your working.

distance = ... m [2]

(b) During another journey, the motorcycle travels at a constant speed for 1.5 km using a constant driving force of 800 N.

Calculate the work done by this driving force.

State the formula that you use and show your working.

formula

working

work done = ... J [2]

(c) Table 6.1 shows information about two different lamps used on the motorcycle.

They are connected in parallel across a 12V battery.

Table 6.1

type of lamp	lamp power / W	current through lamp / A
headlamp		4.5
rear lamp	6	0.5

(i) The value of the power of the headlamp is missing from the table.

Calculate the power of the headlamp.

State the formula that you use and show your working.

formula

working

power = ... W [2]

(ii) Calculate the resistance of the headlamp.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

(iii) The resistance of the rear lamp is 24 Ω.

Use your answer to **(c)(ii)** to calculate the combined resistance of the two lamps connected in parallel.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

7 Part of a plant shoot was cut, and then placed in a beaker of coloured water, as shown in Fig. 7.1.

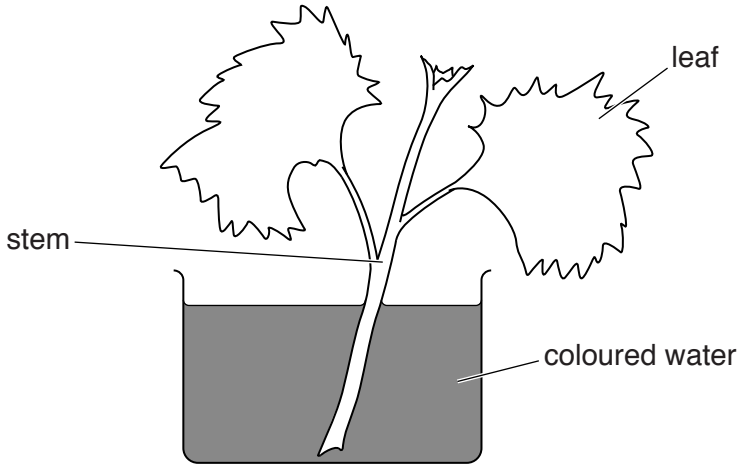


Fig. 7.1

After two hours, the shoot was removed. Fig. 7.2 shows what the shoot looked like.

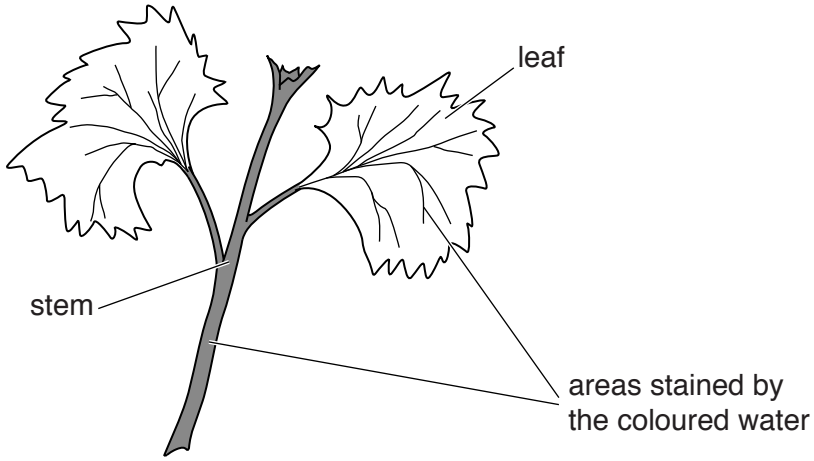


Fig. 7.2

(a) Name the main tissue that has been stained by the coloured water.

..... [1]

(b) Describe the mechanism by which the coloured water moves up through the stem.

You should use these terms in your explanation.

cohesive **tension** **transpiration** **water potential**

.....

.....

.....

.....

.....

..... [4]

(c) Suggest how the result shown in Fig. 7.2 would have been different if the cut shoot had been left for the two hours

(i) in more humid conditions,

.....

..... [1]

(ii) in cooler conditions.

.....

..... [1]

8 Gasoline (petrol) is used as car fuel.

(a) Complete the sentence.

Gasoline is separated from the raw material known as .....

using the process of ..... . [2]

(b) Waste gases are produced in car engines by burning gasoline in air.

The waste gases are released into the air.

(i) Oxides of nitrogen are found in the exhaust gases from cars.

Suggest why these gases are formed in car engines.

.....

.....

..... [2]

(ii) State **one** harmful effect of oxides of nitrogen in the environment.

.....

..... [1]

(iii) State how oxides of nitrogen are removed from the waste gas mixture before it passes into the air.

.....

..... [1]

(c) Gasoline contains alkanes.

(i) State the meaning of the term *alkane*.

.....

.....

.....[2]

(ii) Complete the diagram below to show the molecular structure of one molecule of butane.

C—C

[3]

(d) Fig. 8.1 shows an incomplete equation for the combustion of methane in air.

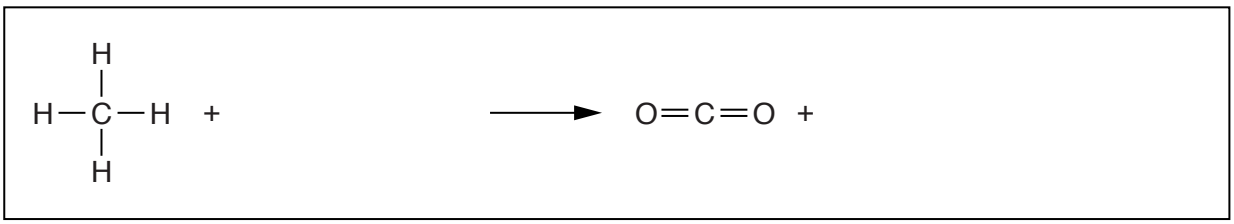


Fig. 8.1

Complete the balanced equation for the combustion of methane. Use similar diagrams to represent the structures of the missing molecules. [2]

9 **(a)** A nuclear powered submarine contains a small nuclear reactor.

Radiation is released from the reactor during nuclear fission in the reactor. The reactor has to be shielded to protect the crew from this radiation.

(i) Suggest a material which could be used to shield a nuclear reactor to stop β-radiation escaping.

..... [1]

(ii) Waste from the nuclear reactor contains radioactive material with a half-life of 300 years.

A sample of this material gives a count rate of 6400 counts per minute.

Calculate the time taken for the count rate to drop to 800 counts per minute.

Show your working.

..... years [2]

(b) The submarine has its own electrical generator for generating electricity for the submarine.

Fig. 9.1 shows a simple a.c. generator.

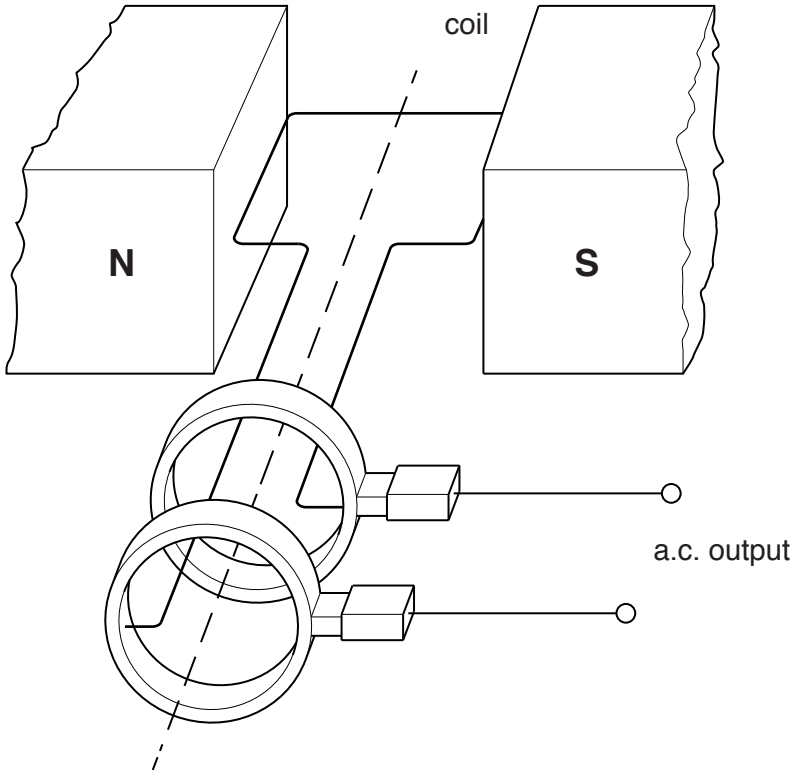


Fig. 9.1

Describe how the rotation of the coil in the magnetic field and the use of slip rings produce an alternating current.

.....

.....

.....

.....

..... [3]

(c) The permanent magnets in the generator shown in Fig. 9.1 are made from steel rather than iron.

Describe **one** difference between the magnetic properties of iron and steel.

.....

..... [1]

(d) An electric heater uses the electricity generated at 240 V.

The current passing through the heater is 24 A.

Calculate the charge passing through the heater in one minute.

State the formula that you use and show your working.

State the unit for your answer.

formula

working

charge = ... unit = ... [3]

10 Fig. 10.1 shows an okapi. Okapis are rare animals. Their habitat is in the forests of central Africa.

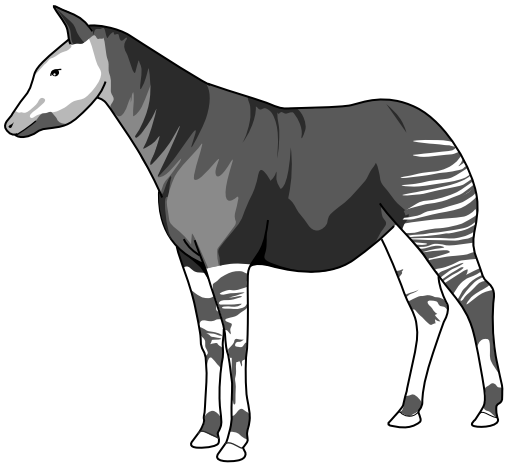


Fig. 10.1

Okapis are threatened with extinction. The two main causes of this are hunting and deforestation.

(a) (i) Explain why the loss of the okapi's habitat may lead to its extinction.

.....

.....

..... [2]

(ii) Suggest **two** reasons why humans clear large areas of forest.

1 .....

.....

2 .....

..... [2]

(iii) Give **one** other undesirable effect of deforestation apart from extinction.

..... [1]

(b) Suggest **two** ways in which the extinction of the okapi could be prevented.

1.....

2..... [2]

(c) Explain why conservation of okapis is important for the other organisms in their habitat.

.....

..... [1]

11 Table 11.1 shows some data about the elements in the second period of the Periodic Table.

Table 11.1

symbol	**Li**	**Be**	**B**	**C**	**N**	**O**	**F**	**Ne**
melting point/°C	181	1283	2027	3727	–210	–219	–220	–248
electron configuration of atoms	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8

(a) (i) Describe the trend in the melting points shown in Table 11.1.

.....

.....

..... [2]

(ii) Similar trends to those shown in Table 11.1 are observed for the elements in the third period of the Periodic Table, sodium to argon.

Use the Periodic Table on page 28 to predict which element in the third period has the highest melting point.

..... [1]

(b) The element carbon can have two different values for its density.

Suggest why there are two different values.

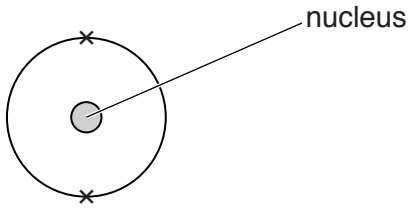
.....

..... [1]

[Turn over

(c) An element in the same group as oxygen is found in the **third** period.

Complete the diagram below to show how all of the electrons are arranged in one atom of this element.



[2]

(d) Lithium, Li, is combined with fluorine, F, in the crystalline compound, lithium fluoride.

(i) Predict the type of chemical bonding in lithium fluoride.

..... [1]

(ii) State and explain the chemical formula of lithium fluoride. You may draw a diagram if it helps you to answer.

chemical formula .....

explanation

.....

.....

..... [3]

12 (a) An astronaut has a mass of 70 kg on Earth, where the gravitational field strength is 10 N/kg.

The astronaut is training to go to Mars. On Mars, the gravitational field strength is 3.7 N/kg.

State the astronaut's mass on Mars. Explain your answer.

mass = ... kg

explanation .....

..... [2]

(b) At one stage during the journey, the mass of the rocket will be 1 500 000 kg and the speed of the rocket will be 2500 m/s.

Calculate the kinetic energy of the rocket in kilojoules.

State the formula that you use and show your working.

formula

working

kinetic energy = ... kJ [3]

(c) The astronaut remains in communication with Earth, on his journey to Mars, using radio waves.

(i) State **one** reason why it is impossible to use sound waves for communication between the astronaut and Earth.

.....

..... [1]

(ii) When Mars is 2.25×10^8 km from Earth, a radio signal takes 750 s for a radio wave to travel between Mars to Earth. Show that the speed of radio waves is 3×10^8 m/s.

[1]

(iii) State the speed at which infra-red radiation travels.

speed = ... m/s [1]

13 **(a)** Define the term *aerobic respiration*.

.....

.....

.....

..... [3]

(b) State how anaerobic respiration differs from aerobic respiration in

(i) the substances used up, ...

..... [1]

(ii) the energy released. .....

..... [1]

(c) Fig. 13.1 shows some of the stages in the production of beer.

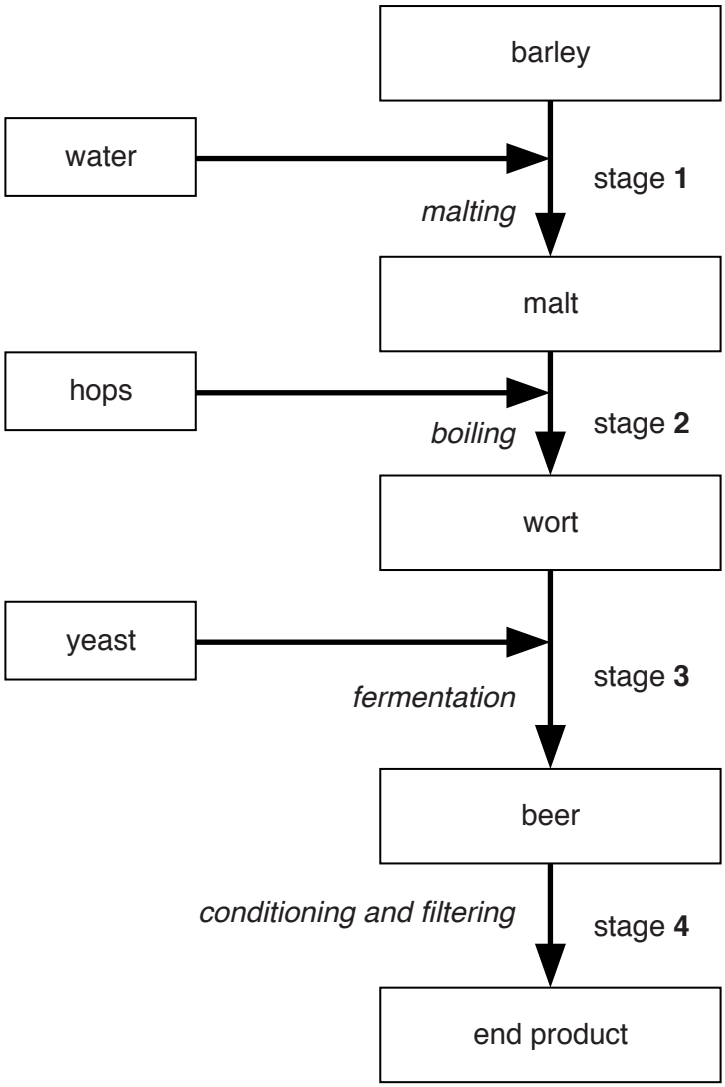


Fig. 13.1

(i) Boiling in stage **2** produces sterilised wort. Suggest why it is important that the wort is sterile before fermentation starts.

.....

.....

.....

..... [2]

(ii) Describe fully the role of the yeast that is added at stage **3**.

.....

.....

.....

.....

..... [3]

(iii) Towards the end of the fermentation process, the yeast usually dies.

Suggest why the yeast dies.

.....

..... [1]

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.).