Candidate Name _____ Centre Numb... ...late

**International General Certificate of Secondary Education**

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

# CO-ORDINATED SCIENCES 0654/2

PAPER 2

**OCTOBER/NOVEMBER SESSION 2002**

2 hours

Candidates answer on the question paper.
No additional materials are required.

**TIME** 2 hours

**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

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 20.

| FOR EXAMINER'S USE | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| TOTAL | |

**1** Fig. 1.1 shows a food web for an ecosystem in Africa.

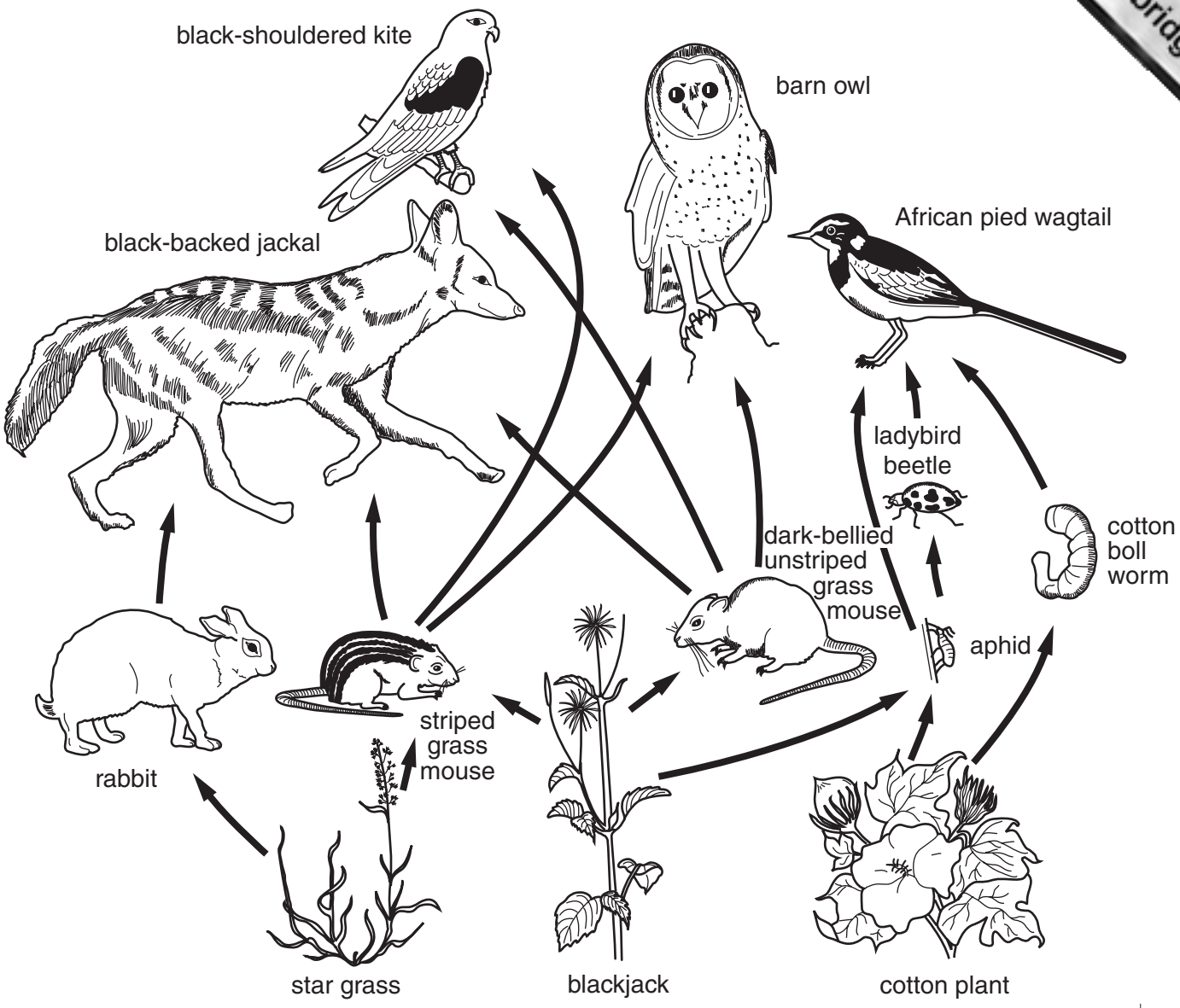



**Fig. 1.1**

**(a)** Explain the meaning of the term *ecosystem*.

.....

.....

.....[2]

**(b)** **(i)** Using the information in Fig. 1.1, write one food chain that contains four organisms.

.....

.....[1]

**(ii)** Name the producer in this food chain.

.....[1]

**(c)** The arrows on the food web diagram show the direction of energy flow.

**(i)** Describe how energy enters the ecosystem.

.....

.....

.....[2]

**(ii)** Describe how energy passes from the rabbit to the black-backed jackal.

.....

.....

.....[2]

**(iii)** Suggest which of the following animals will have the **smallest** population, and give a reason for your answer.

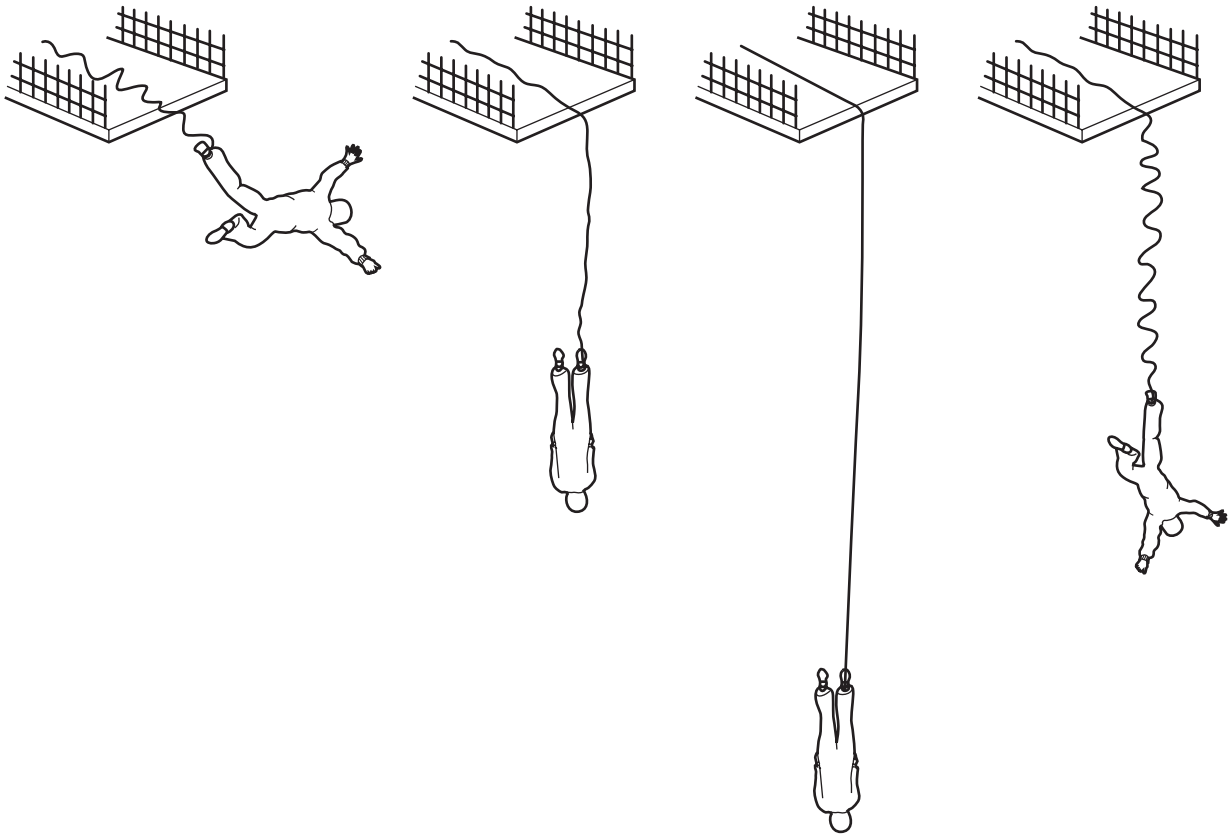
**aphid** **black-shouldered kite** **star grass** **striped grass mouse**

.....

.....

.....[2]

**2** A stuntman jumps from a platform to which he is attached by a strong elastic rope. Fig. 2.1 shows what happens.



| Stage **A** | Stage **B** | Stage **C** | Stage **D** |
|---|---|---|---|
| A stuntman jumps from a platform | The rope is straight but not stretched | The rope is stretched | The rope has pulled the stuntman back |

**Fig. 2.1**

**(a)** **(i)** Describe the forces acting on the stuntman at stage **B**.

.....

.....

**(ii)** Describe the forces acting on the stuntman at stage **C**.

.....

.....[2]

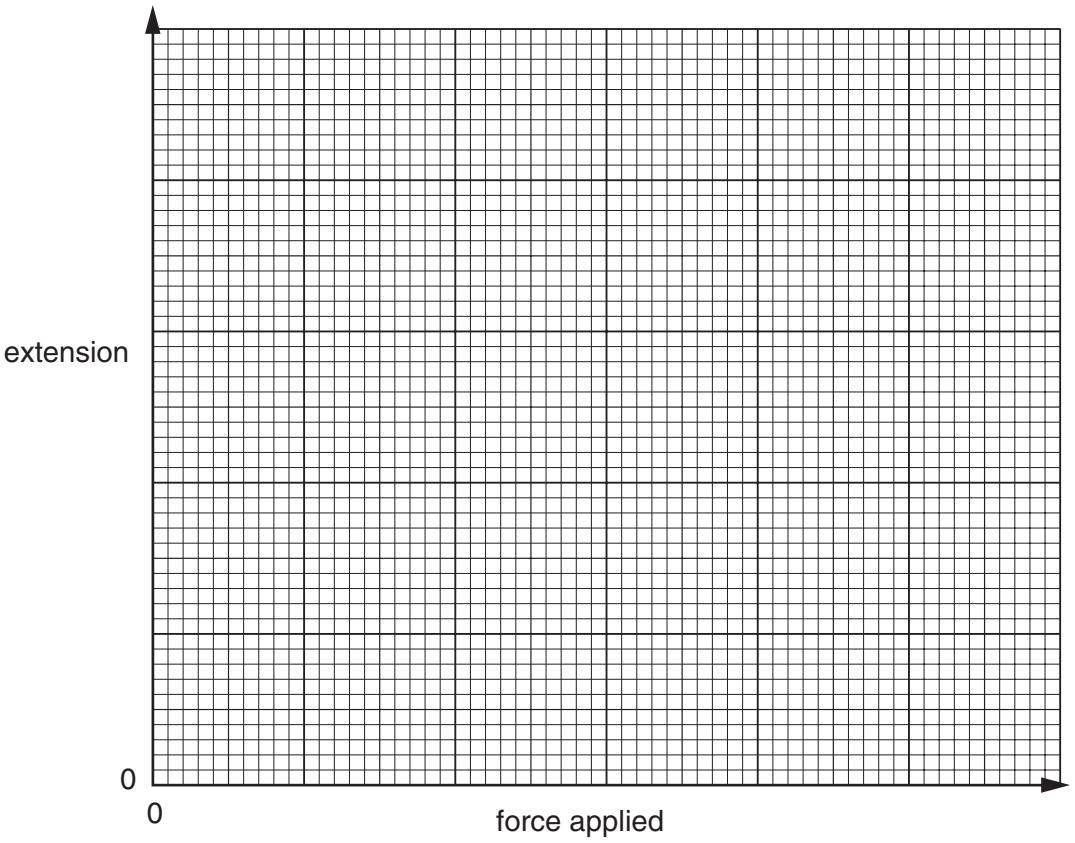
**(b)** At which stage **A**, **B**, **C** or **D** does the stuntman have the most kinetic energy?
Explain your answer.

stage .....

explanation .....

.....[2]

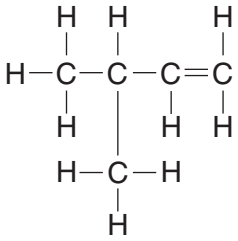
**(c)** The rope is elastic and behaves like a spring.
On the axes below, sketch a line to show the relationship between the force applied to a spring and its extension.



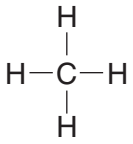

[2]

**3** The diagrams **A** to **E** in Fig. 3.1 show the displayed formulae of some hydro molecules.

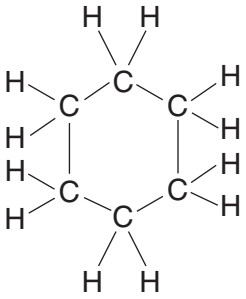
**A**



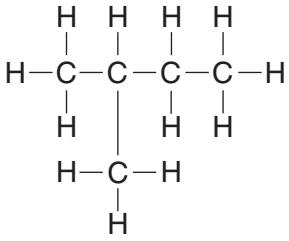
**B**



**C**



**D**



**E**

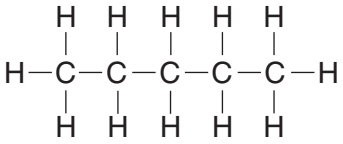


**Fig. 3.1**

**(a)** Give the letter of the diagram that shows a molecule of

methane, .....

an unsaturated hydrocarbon, .....

an **alkane** which has a branched chain of carbon atoms. ..... [3]

**(b)** Methane is the main compound in natural gas. Natural gas is a fossil fuel.

Biogas is another source of methane. Biogas is produced by the action of bacteria on animal and plant waste.

**(i)** Explain briefly why natural gas is called a fossil fuel.

.....

.....

.....[2]

**(ii)** A student carried out two experiments to compare the properties of natural g biogas.

In the first experiment he bubbled each gas separately through limewater.

In the second experiment he measured the heat energy released when 1.0 $dm^3$ of each gas was burnt.

His results are shown in Fig. 3.2.

| | reaction with limewater | heat energy released when 1.0 $dm^3$ is burned / J |
|---|---|---|
| natural gas | no reaction | 37 000 |
| biogas | cloudy | 22 250 |

**Fig. 3.2**

Explain these results.

.....

.....

.....

.....[2]

**(c)** Much of the ethene produced by the petrochemical industry is used to make poly(ethene) which is a thermoplastic polymer.

Explain the meaning of the term *thermoplastic polymer*.

.....

.....

.....

.....[2]

**4** **(a)** Fig. 4.1 shows a bean seed, cut in half.

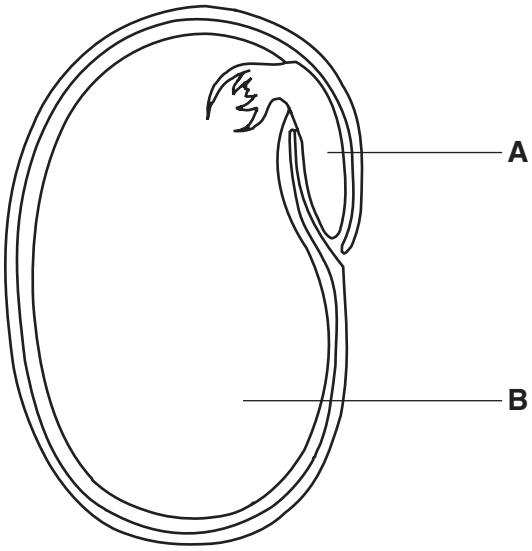



**Fig. 4.1**

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

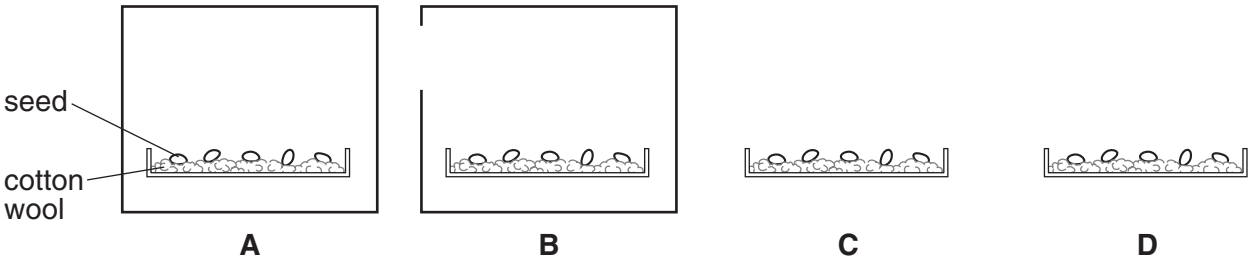
**A** .....

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

**(ii)** From which part of the bean flower has the seed formed?

.....[1]

**(b)** An experiment was carried out to find the conditions that mustard seeds n germination. Four sets of mustard seeds, all of the same age and taken from the s plant, were placed on damp cotton wool in petri dishes. The dishes were left in differe conditions, as shown in Fig. 4.2.




| A | B | C | D |
|---|---|---|---|
| dark, 15°C | light from one side, 15°C | light, 3°C | light, 15°C |

**Fig. 4.2**

**(i)** The seeds in dishes **A**, **B** and **D** germinated, but those in **C** did not.

What conclusions can be made from these results?

.....

.....

.....[2]

**(ii)** After one week, the seedlings in dish **A** and dish **B** had grown tall and thin.

Describe and explain **one** difference you would expect between the seedlings in dish **A** and those in dish **B**.

description .....

explanation .....

.....[2]

**5** Some power stations burn fossil fuels to generate electricity. The energy released is used to boil water and turn it into steam. The moving steam turns a turbine which drives a generator to produce electricity.

This is shown in Fig. 5.1.

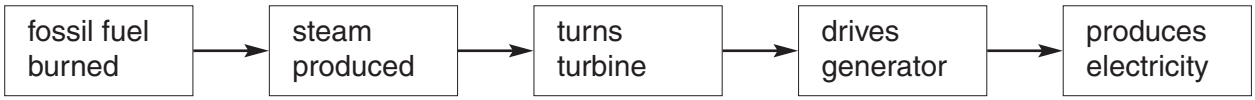



**Fig. 5.1**

**(a)** The turbine in a power station has an efficiency of 40%.

**(i)** Calculate the energy input per second if the turbine output is 100 megajoules per second.
(1 megajoule = 1 000 000 joules).

..... megajoules per second [1]

**(ii)** What happens to the energy which is not usefully converted by the turbine?

.....[1]

**(iii)** What is the power output of the turbine?

..... megawatts [1]

**(b)** **(i)** State two reasons, other than cost, why engineers are developing alternatives to fossil fuels as sources of energy to generate electricity.

1. .....

2. .....[2]

**(ii)** State **one** alternative energy source and briefly describe how it can be used to generate electricity.

energy source .....

description .....

.....[2]

**(c)** The electrical output from the generator is at a low voltage. For transmission, this voltage must be increased.

**(i)** Name the device which does this.

.....[1]

**(ii)** Explain why the electricity is transmitted at a high voltage.

.....

**6** The full chemical symbols of atoms of copper and rubidium are shown below.

$$^{63}_{29}Cu \qquad ^{85}_{37}Rb$$

**(a)** State the number of

protons in the copper atom, .....

neutrons in the rubidium atom, .....

electrons in the copper atom, .....

electrons in the outer shell of the rubidium atom. ..... [4]

**(b) (i)** Rubidium is a member of the family of alkali metals.
To what family of metals does copper belong?

.....[1]

**(ii)** Suggest **one** difference, apart from colour, in the properties of copper and rubidium.

.....

.....[1]

**(c)** Copper can be produced by heating a mixture of copper oxide and carbon.

**(i)** Complete the **word** equation for the reaction

**copper oxide + carbon** $\rightarrow$ [1]

**(ii)** Explain briefly why 80.0 g of copper oxide gives only 64.0 g of copper metal.

.....

.....

.....[1]

**7** A student is investigating some properties of metals.

**(a)** An iron rod is heated at one end.

**(i)** Describe what happens to the **atoms** in the iron, when it is heated.

.....

.....

.....[2]

**(ii)** Explain how the iron atoms transfer heat energy along the rod.

.....

.....[2]

**(b)** The student tries to stretch an iron rod. Explain, in terms of the atoms, why this is very difficult.

.....

.....[1]

**(c)** The student measured the specific heating capacity of a block of copper of mass 0.5 kg. He found it to be 400 J / kg °C. The student repeated the experiment using a block of copper of mass 1 kg.

Predict the value for the specific heating capacity that the student would find for this block.

Explain your answer.

predicted value ..... J / kg °C

explanation .....

.....[2]

**(d)** The student heated a block of copper until it melted. While it was melting, the temperature of the copper did not change, even though it was still being heated. Explain why this happened.

.....

.....

.....[2]

**8** Fig. 8.1 shows a sperm cell.

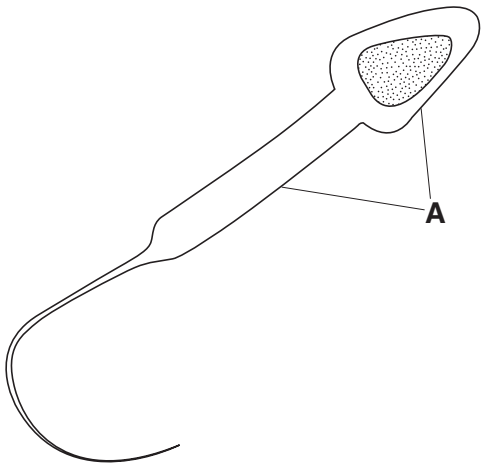



**Fig. 8.1**

**(a)** Name the part labelled **A**, and describe its function.

.....

.....

.....[2]

**(b)** **(i)** Draw a label line to the part of the sperm cell that contains chromosomes, and label it **B**. [1]

**(ii)** Most cells in the human body contain 46 chromosomes, but human sperm cells contain only 23 chromosomes.
Explain why this is so.

.....

.....

.....[2]

**(iii)** Chromosomes contain DNA.
Describe the functions of DNA in a cell.

.....

.....

.....[2]

**(c)** **(i)** Name the part of the human body in which sperm cells are made.

.....[1]

**(ii)** This part of the body also secretes the hormone testosterone.
Describe **one** function of testosterone.

.....

[1]

**9** The Earth provides raw materials which can be processed into useful products.

**(a)** Choose products from the list to complete the right hand column of the table, Fig. 9.1. The first one has been done for you.

**aluminium bleach ceramics fuels glass paper steel**

| raw material | useful product from this raw material |
|---|---|
| petroleum | fuels |
| wood | |
| clay | |
| iron ore | |
| sand and metal oxides | |

**Fig. 9.1** [4]

**(b)** Air is a mixture of elements and compounds. Nitrogen is produced by the fractional distillation of air which has been liquefied.

**(i)** State **one** difference between a mixture of two elements and a compound of the same elements.

.....

.....

.....[1]

**(ii)** Suggest, in terms of changes in pressure and temperature, how air may be liquefied.

.....

.....[2]

**(iii)** Explain briefly why it is possible to separate the components in liquefied air by fractional distillation.

.....

.....[1]

**(c)** Nitrogen is used to make ammonia, $NH_3$, by reacting it with hydrogen.

**(i)** The reaction requires a catalyst.

State the purpose of a catalyst in chemical reactions.

.....

.....[1]

**(ii)** The reaction also requires a high temperature and a high pressure.
Explain why these conditions are needed.

.....

.....[1]

**10** An electric light bulb is marked '110 V, 100 W'. It contains a length of fine tungsten wire about 1 metre long. The wire is wound in a coil, as shown in Fig. 10.1.

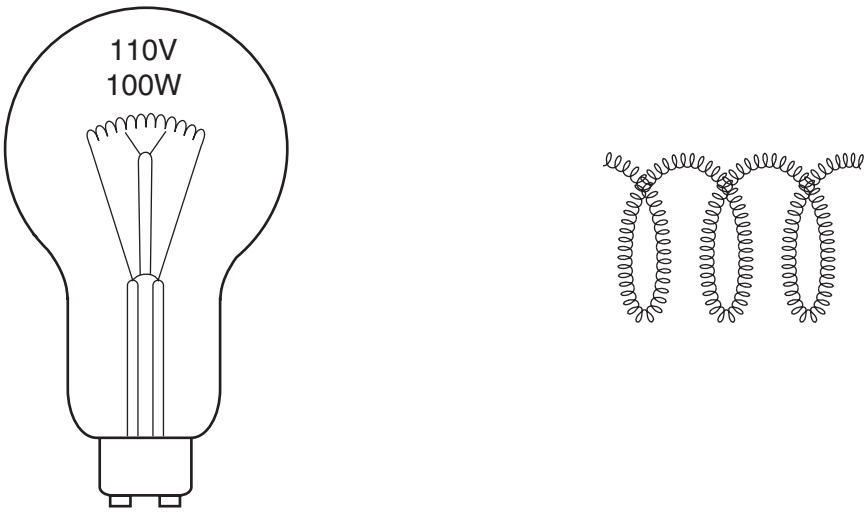



**Fig. 10.1**

**(a)** State the power consumption of this light bulb.

.....[1]

**(b)** When the bulb is switched on, the resistance of the wire is about 600 Ω.
If the bulb was made with only half the length of tungsten wire, what effect would it have on the resistance?

.....[1]

**(c)** The bulb is on. Describe the energy transfers that are taking place in the light bulb by completing the sentence.

..... energy is transferred into ..... energy

and ..... energy. [3]

**(d)** Visible light is one part of the electromagnetic spectrum.
Name **one** other part of the electromagnetic spectrum and give a use for it.

part of the electromagnetic spectrum .....

use .....[2]

**11** **(a)** A tube made from a partially permeable membrane was filled with a mixture of starch and glucose. The tube was then placed in a beaker of water, as shown in Fig. 11.1.

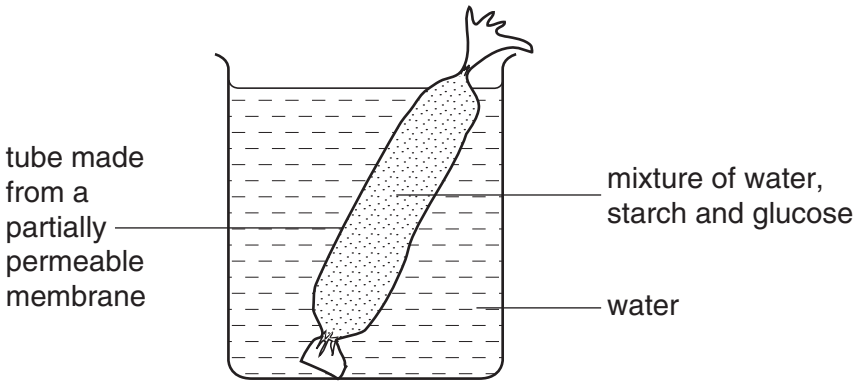



**Fig. 11.1**

The apparatus was left for one hour. The contents of the tube and the water in the beaker were then tested for starch and for reducing sugar. The table shows the results.

| test | result | |
|---|---|---|
| | **contents of tube** | **water in beaker** |
| starch | blue-black | orange-brown |
| reducing sugar | brick red precipitate | brick red precipitate |

**(i)** Name the reagent that would be used for the starch test.

.....[1]

**(ii)** Explain why the results of the starch test for the contents of the tube and for the water in the beaker are different.

.....

.....

.....[2]

**(iii)** Explain why the results of the reducing sugar test for the contents of the tube and for the water in the beaker are the same.

.....

.....

.....[2]

**(b)** The enzyme amylase is found in saliva.
Describe the function of amylase in the human digestive system.

.....

.....

**12** A student uses pH and temperature sensors connected to a computer to investigate liquids. The apparatus is shown in Fig. 12.1.

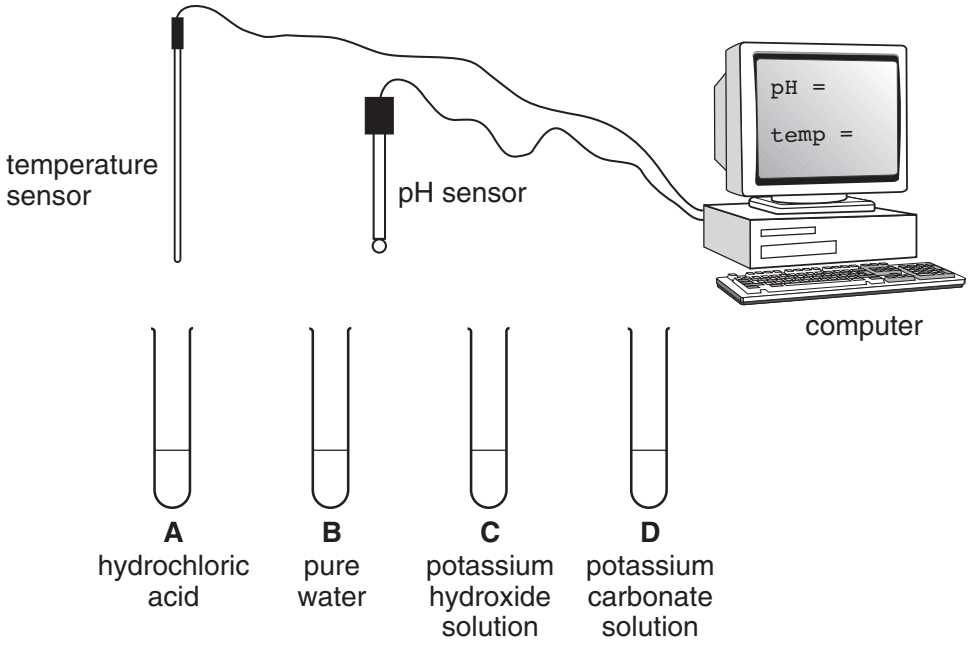



**Fig. 12.1**

**(a) (i)** Predict the pH value shown on the computer screen when the pH sensor is placed into the water in tube **B**.

.....[1]

**(ii)** The student places both the temperature and pH probes together into the hydrochloric acid in tube **A**.

She then adds the potassium hydroxide solution from tube **C** slowly into tube **A**.

Describe and explain the pH and temperature changes which she observes.

pH .....

.....

.....

temperature .....

.....[4]

**(iii)** Complete the word equation for the reaction

**hydrochloric acid + potassium hydroxide →**

[2]

**(b)** Predict and explain briefly what would be observed, **other** than pH or temperature changes, when some fresh hydrochloric acid is added to the potassium carbonate solution in tube **D**.

.....

.....[2]

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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 otassium | 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 ubidium | 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 rancium | 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 Lawre 103 |

3-71 Lanthanoid series
0-103 Actinoid series

y

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.).