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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6115638287

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **October/November 2013**

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 pencil for any diagrams or graphs.
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.

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For Examiner's Use

1 **(a)** Fig. 1.1 shows apparatus that can be used to test the electrical conductivity of the materials contained in the beakers **Q**, **R** and **S**.

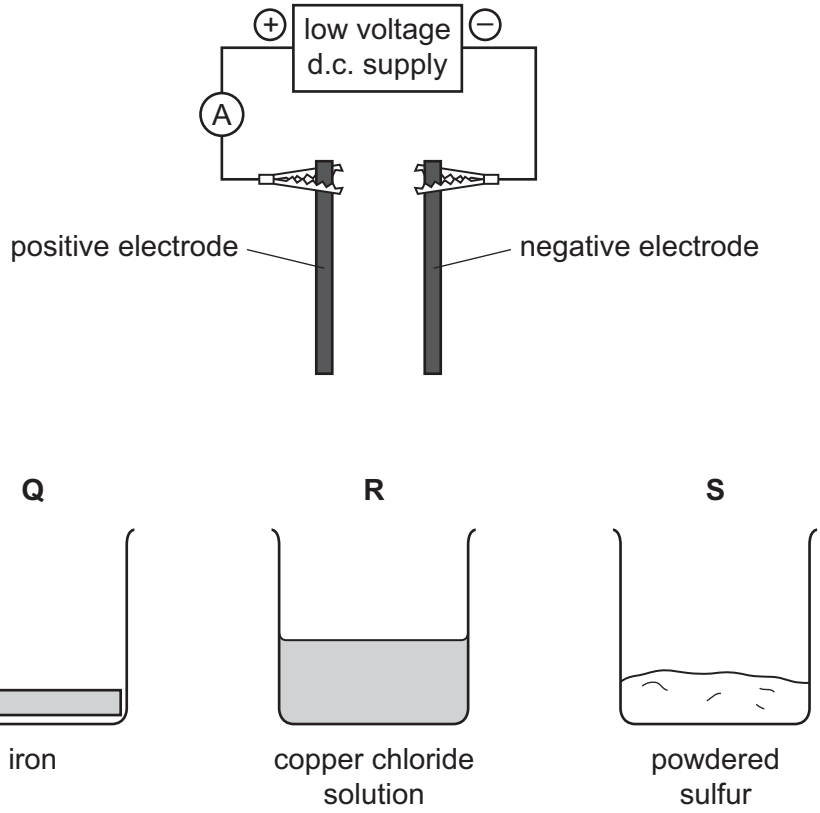

Fig. 1.1

(i) Describe briefly how the apparatus is used to test the electrical conductivity of the contents of the beakers.

.....

.....

..... [2]

(ii) Predict and explain the results that are expected when the contents of beakers **Q** and **S** are tested for electrical conductivity.

beaker **Q**

prediction .....

explanation .....

beaker **S**

prediction .....

explanation ..... [3]

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(iii) When the solution in beaker **R** is tested, the following observations are made.

- Bubbles of gas form on the surface of the positive electrode.
- A layer of an orange solid appears on the surface of the negative electrode.

Name the gas that forms and the substance in the orange layer.

gas .....

orange layer ..... [2]

(iv) State the name of the process described in **(iii)**.

..... [1]

(v) Describe a safe **chemical** test for the gas you have named in **(iii)**.

test .....

result .....

..... [2]

(b) Fig. 1.2 shows a diagram that represents the way in which the particles in solid sodium chloride are arranged.

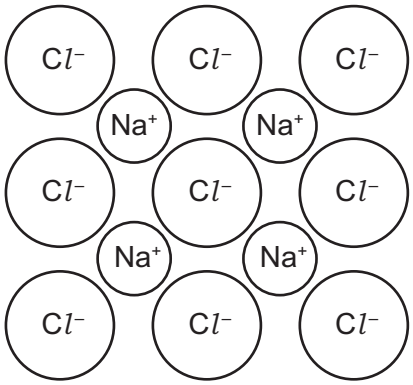

Fig. 1.2

(i) State, in terms of electrons, what happens to an atom of sodium, Na, when it is changed into an ion of sodium, Na^+.

.....

..... [1]

(ii) Explain why the sodium and chloride ions stay bonded together in a crystal of sodium chloride.

.....

.....

..... [2]

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For Examiner's Use

2 **(a)** Use the words or phrases below to complete the sentences.

amplitudes **frequencies** **slows down** **speed** **speeds up**

Each word or phrase can be used once, more than once or not at all.

(i) Light ..... when it travels from air to glass.

(ii) In the electromagnetic spectrum, the waves are arranged in order of

..... .

(iii) 20 Hz to 20 000 Hz is the approximate human range of audible

..... .

(iv) The ..... of sound waves determines the loudness of the sounds.

[4]

(b) Fig. 2.1 shows a demonstration of sound transmission using a bell jar.

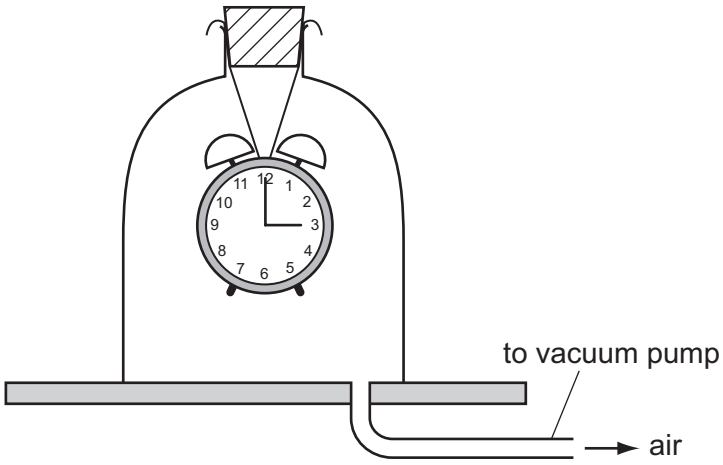

Fig. 2.1

As the air is removed from the bell jar, the ringing sound from inside the bell jar gets quieter. When all the air has been removed, the bell cannot be heard.

Explain these observations.

.....

.....

.....

..... [2]

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(c) Fig. 2.2 shows a light ray entering an optical fibre at one end.

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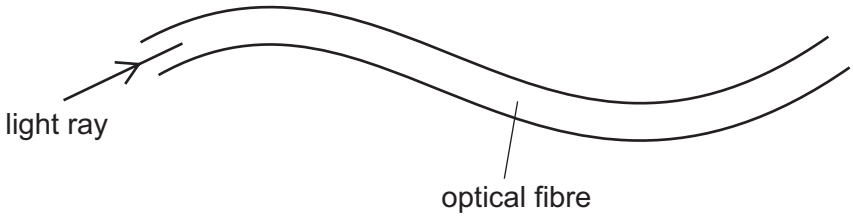

Fig. 2.2

The light ray travels all the way through the optical fibre.

Explain why the light ray is able to stay inside the optical fibre. You may draw on the diagram if it helps your answer.

.....

.....

..... [2]

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3 **(a)** Fig. 3.1 shows cross-sections of a root and a stem.

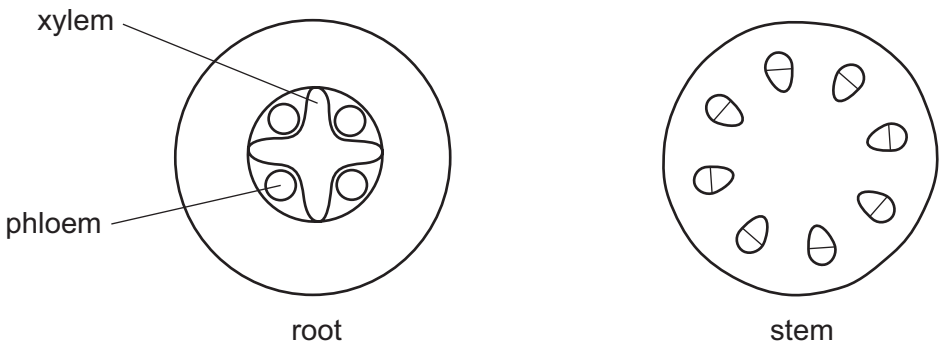

Fig. 3.1

(i) On Fig. 3.1, use label lines to indicate the positions of the xylem and phloem on the diagram of the stem. [2]

(ii) Describe the functions of xylem and phloem.

xylem .....

.....

.....

phloem .....

.....

.....

[4]

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(b) The roots of most plants have root hairs near their tips.

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Researchers grew two types of plants, **A** and **B**, in soil with different concentrations of phosphate ions. They measured the mean number of root hairs in a small area of the roots, and also the mean length of the root hairs.

Table 3.1 shows their results.

Table 3.1

type of plant	phosphate concentration	mean number of root hairs per unit area	mean length of root hairs / micrometres
A	low	1.26	175
	high	1.70	149
B	low	1.41	225
	high	1.85	52

(i) Describe **two** ways in which the addition of phosphate ions to the soil affects the root hairs in type **A** plants.

1 .....

.....

2 .....

..... [2]

(ii) Compare the effect of adding phosphate ions to the soil for type **A** plants and for type **B** plants.

.....

.....

..... [2]

(iii) Explain why a reduction in the length of its root hairs could reduce the rate of growth of a plant.

.....

.....

.....

.....

..... [3]

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(c) Farmers often add fertilisers containing phosphate ions, potassium ions and nitrate ions to the soil in which they grow crops.

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Explain why adding nitrate ions to the soil helps the crop plants to grow faster and larger.

.....

.....

..... [2]

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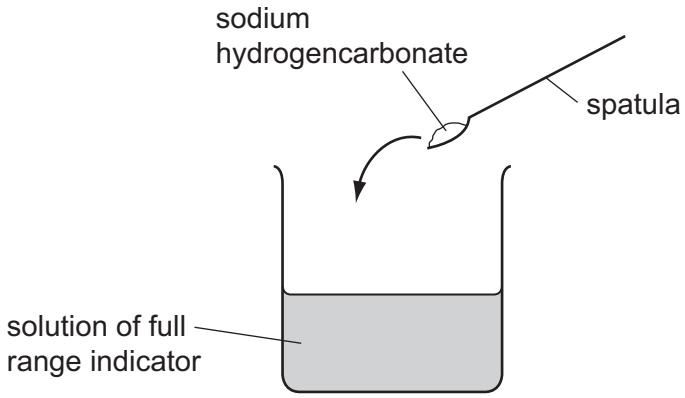
4 Sodium hydrogencarbonate, $NaHCO_3$, is a white solid compound which is soluble in water.

(a) A student adds some sodium hydrogencarbonate to a beaker which contains an aqueous solution of full range indicator (Universal Indicator).



When the sodium hydrogencarbonate dissolves, the solution changes colour from green to blue.

(i) State and explain how the pH of the mixture changes when the sodium hydrogencarbonate dissolves.

.....

..... [2]

(ii) The student then added excess dilute hydrochloric acid to the blue solution.

State what is observed to show that the reaction in the large test-tube has finished.

.....

.....

.....

..... [2]

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(b) Fig. 4.1 shows apparatus a teacher uses to demonstrate the heating of sodium hydrogencarbonate.

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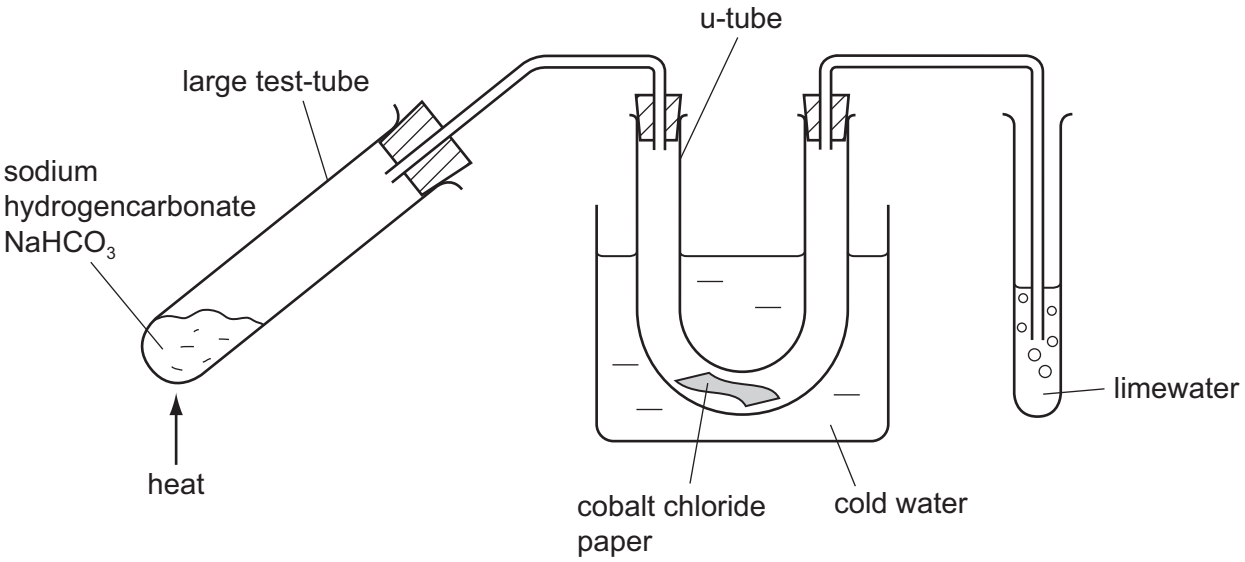

Fig. 4.1

The solid sodium hydrogencarbonate is heated strongly for a few minutes.

- The cobalt chloride paper changes colour from blue to pink.
- A gas bubbles out through the limewater, turning it cloudy.

After the reaction, a white solid remains in the large test-tube.

(i) Explain how the observations show that both water and carbon dioxide are produced.

.....

.....

..... [2]

(ii) State the observation that shows that the reaction has finished.

.....

..... [1]

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(iii) The white solid that remains in the test-tube when the reaction is finished is sodium carbonate.

Predict and explain how the mass of the remaining sodium carbonate compared to the mass of the original sodium hydrogencarbonate.

prediction .....

explanation .....

.....

.....

[2]

(iv) Suggest the **word** chemical equation for the reaction that occurs when sodium hydrogencarbonate is heated.

sodium hydrogencarbonate	→		+		+	

[1]

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For Examiner's Use

5 **(a)** Fig. 5.1 shows a bicycle with two lights **A** and **B** at the front.

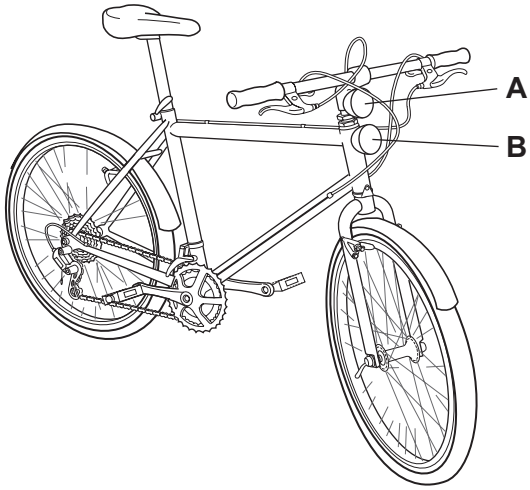

Fig. 5.1

Fig. 5.2 shows the circuit used to power the two lights.

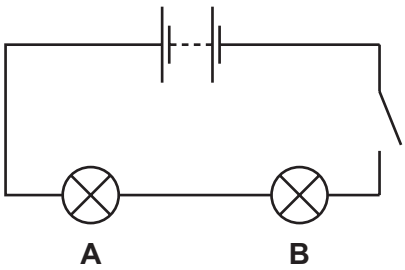

Fig. 5.2

(i) State the name given to this type of circuit arrangement.

.....

[1]

(ii) To calculate the resistance of light **A**, the current flowing through it and the voltage across it must be measured.

On Fig. 5.2, using the correct symbols, draw an ammeter and a voltmeter correctly connected to make these measurements. [2]

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(iii) The resistance of light **A** in the circuit is 5 Ω and the resistance of light **B** is 10 Ω.

Calculate the combined resistance of the two lights.

State the formula that you use and show your working.

formula

working

..... Ω [2]

(iv) The voltage supplied by the battery is 9 V.

Calculate the current passing through the circuit.

State the formula that you use and show your working.

formula

working

..... A [2]

(b) The bicycle was made from a block of aluminium alloy of mass 9000 g and volume 3000 cm^3.

Calculate the density of aluminium in g/cm^3.

State the formula that you use and show your working.

formula

working

..... g/cm^3 [2]

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(c) The bicycle is ridden by a cyclist. The cyclist is cooled by sweating.

Explain, in terms of particles, how sweating cools his body.

.....

.....

.....

..... [3]

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6 Fig. 6.1 shows the male reproductive system.

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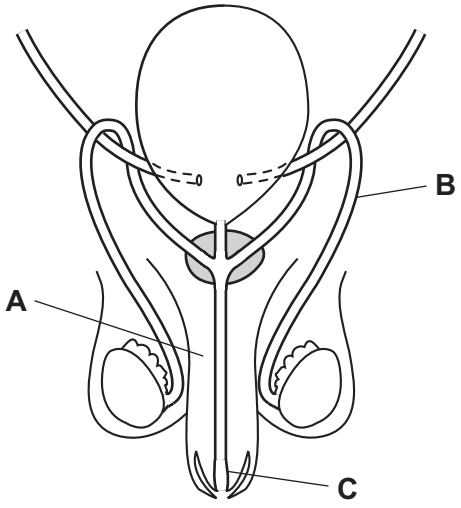

Fig. 6.1

(a) Name the parts labelled **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(b) When a sperm cell fuses with an egg cell, a zygote is produced which may eventually develop into a baby.

Explain why it is the sperm cell, not the egg cell, that determines the sex of the baby.

.....

.....

.....

..... [3]

(c) HIV / AIDS is a disease that can be passed on by sexual intercourse.

(i) What does HIV stand for?

..... [1]

(ii) State **one** way in which a man with HIV / AIDS can avoid passing it to another person.

..... [1]

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7 **(a)** The elements chlorine, bromine and iodine are found in Group 7 of the Periodic Table.

(i) Complete Table 7.1 by writing the physical state (solid, liquid or gas) at room temperature (20 °C) of the elements.

Table 7.1

element	physical state
bromine	
iodine	

[1]

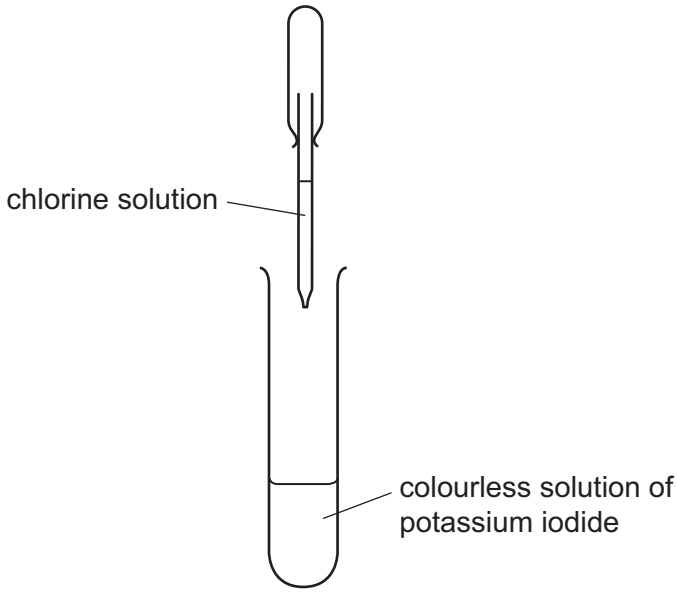
(ii) Explain why an iodine atom is larger and heavier than a bromine atom.

.....

.....

..... [2]

(iii) An aqueous solution containing chlorine is added to a colourless solution of potassium iodide.



Describe and explain briefly what is observed in this reaction.

observation .....

explanation .....

..... [2]

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(b) Explain why a dilute solution of chlorine is usually added to drinking water before it is supplied to homes.

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.....

.....

..... [2]

(c) Helium is a gas found in Group 0 of the Periodic Table.

Some helium is added to a flask containing chlorine and left for a few days.

Predict and explain whether the flask now contains a mixture of the two elements or a compound.

.....

.....

..... [2]

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8 **(a)** Fig. 8.1 shows a car moving along a road.

(i) Draw and label arrows on Fig. 8.1 to show the directions of the driving and friction forces acting on the car. [1]

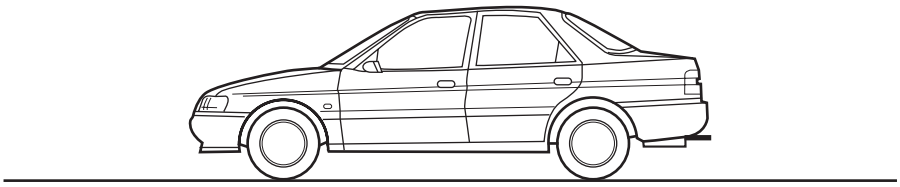

Fig. 8.1

(ii) State **one** source of friction on the moving car.

..... [1]

(iii) The driving and friction forces are balanced.

Explain what is meant by the phrase *forces are balanced*.

.....

..... [1]

(iv) Describe the movement of the car when these forces are balanced.

.....

..... [1]

(v) Apart from the driving and friction forces there are other forces acting on the car.

Name **one** of these forces.

..... [1]

(b) **(i)** The car travels a distance of 400 m down a hill in 25 seconds.

Calculate the average speed of the car.

State the formula that you use and show your working.

formula

working

..... m / s [2]

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(ii) The car is going faster at the bottom of the hill than it was at the top.

State the type of energy which the car has gained. ..... [1]

(iii) State the type of energy which the car will have lost as it travels down the hill.

..... [1]

(c) By the end of the car's journey, the temperature of the air in the tyres has increased. The volume of the air in the tyres remained the same.

Explain, in terms of particles, what happened to the pressure of the air in the tyres during this heating process.

.....

.....

.....

..... [2]

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9 Rabbits are often kept as pets. People try to breed rabbits with unusual colours, such as himalayan colouring.

Fig. 9.1 shows a rabbit with himalayan fur colour. The rabbit's fur is white with some black areas.

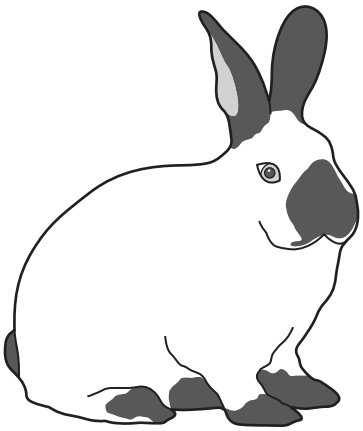

Fig. 9.1

(a) Completely-white fur and himalayan-coloured fur are produced by two alleles of a gene.

The allele for white colour, **F**, is dominant to the allele for himalayan colour, **f**.

(i) Define the term *dominant*.

.....

..... [1]

(ii) State the phenotype of a rabbit that is heterozygous for these alleles.

..... [1]

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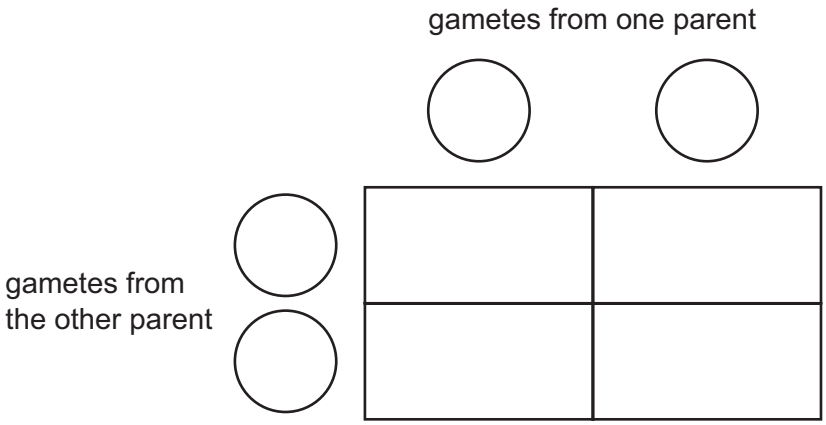
(iii) Complete the genetic diagram to explain the results of crossing two rabbits that are heterozygous for these alleles.

genotype of parents ..... Ff ..... and .....

gametes ○ and ○ ○ and ○



[3]

(iv) State the ratio of offspring that you would expect from this cross.

ratio of white : himalayan offspring = ... : ..... [1]

(b) Rabbits, like humans, keep their internal body temperature constant. The body temperature of a rabbit is 38.5 °C.

Respiration transforms chemical potential energy to heat energy, which helps to keep the body temperature above the temperature of the rabbit's environment.

(i) Describe how respiration transforms chemical potential energy to heat energy.

.....

.....

..... [2]

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(ii) Suggest how the fur of a rabbit helps to maintain its body temperature higher than that of its environment.

.....

.....

..... [2]

(iii) When himalayan rabbits are first born, they are white all over. The black colour develops gradually. The black pigment is produced by the action of an enzyme that is only active at temperatures below 25 °C.

Use this information to suggest a reason for the distribution of black fur on the body of a himalayan rabbit.

.....

.....

..... [2]

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10 **(a)** Fig. 10.1 shows names and molecular structure diagrams of some compounds containing carbon.

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(i) Draw straight lines to match the structures with names. One line has been drawn as an example.

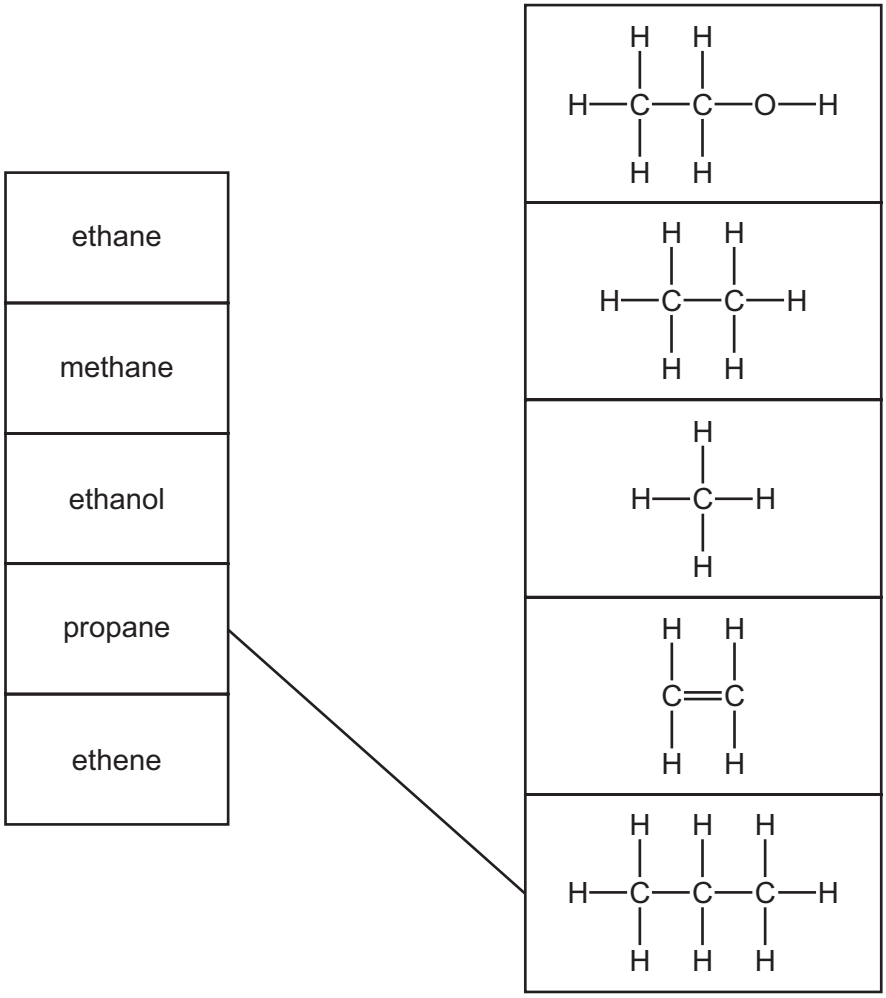

Fig. 10.1

[3]

(ii) State **two** uses of ethanol.

1 .....

2 ..... [2]

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(b) Fig. 10.2 shows the structure of one molecule of a type of compound called a CFC (chlorofluorocarbon).

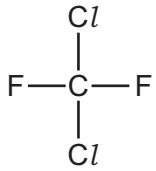

Fig. 10.2

(i) State the chemical formula of the molecule whose structure is shown in Fig. 10.2.

..... [1]

(ii) State the type of chemical bonding between the atoms in the molecule in Fig. 10.2.

Give a reason for your answer.

type of bonding .....

reason .....

..... [2]

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11 (a) (i) Draw lines to show the magnetic field around the bar magnet in Fig. 11.1.

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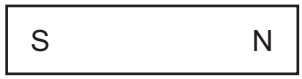

Fig. 11.1

[2]

(ii) Draw lines to show the shape of the magnetic field produced by the solenoid coil in Fig. 11.2 when an electric current passes through it.

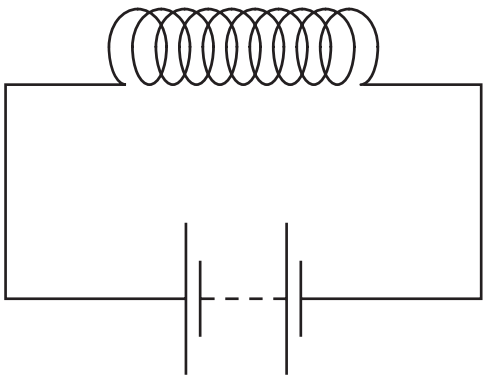

Fig. 11.2

[1]

(iii) The magnet in Fig. 11.1 is a permanent magnet. The magnet in Fig. 11.2 is an electromagnet.

Suggest **one** advantage of using an electromagnet rather than a permanent magnet.

.....

..... [1]

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(b) Fig. 11.3 shows a wire passing between the poles of a permanent magnet. The wire moves upwards, when the switch is closed.

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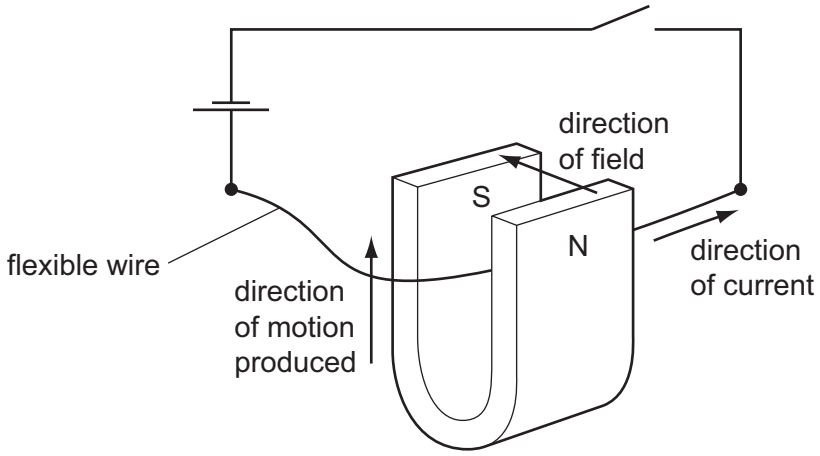

Fig. 11.3

(i) Use the words or phrases below to complete the sentences.

current **electrical** **gravitational** **magnetic**
resistance **stronger** **weaker**

Each word may be used once, more than once or not at all.

The wire moves because of the force produced when the ..... field of the permanent magnet interacts with the magnetic field caused by the ..... in the wire. The force can be increased by using a ..... magnet. [3]

(ii) Describe **two** ways by which the direction of motion of the wire could be reversed.

1 .....

2 ..... [2]

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12 **(a)** Fig. 12.1 shows a food web in the Antarctic Ocean.

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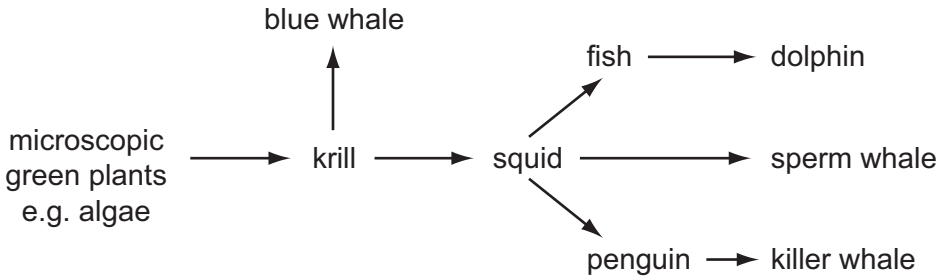

Fig. 12.1

(i) State the term used for organisms such as the microscopic green plants that make their own organic nutrients.

..... [1]

(ii) Name **one** organic nutrient that is made by the green plants.

..... [1]

(iii) State what is shown by the arrows in the food web.

..... [1]

(b) There is concern that global warming will damage the environment in the Antarctic Ocean.

Name **two** gases that contribute to global warming.

1 .....

2 ..... [2]

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DATA SHEET
The Periodic Table of the Elements

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 above **X**, b below

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.).

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