



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
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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.



- 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**.

For
Examiner's
Use

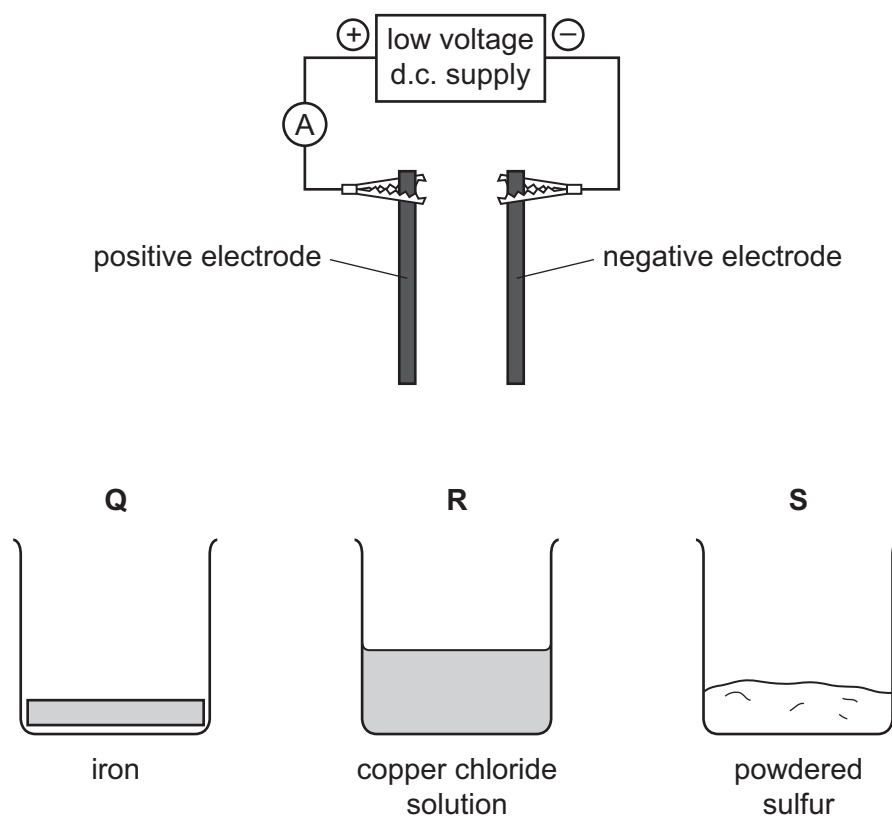


Fig. 1.1

- (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]

- (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.

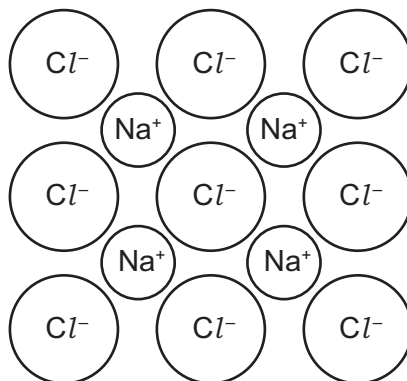


Fig. 1.2

- (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]

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.

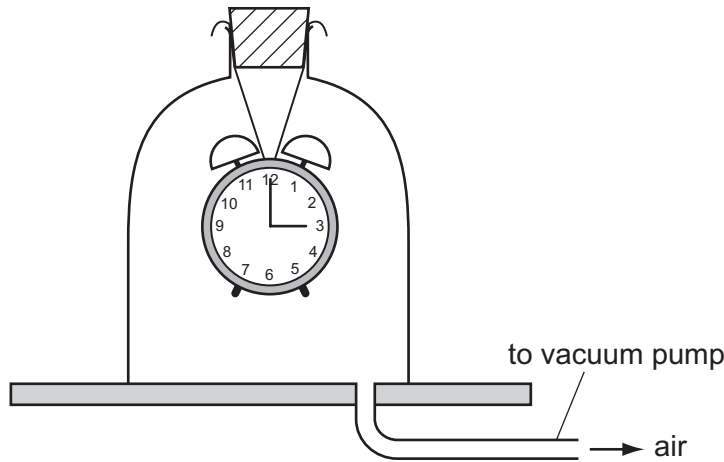


Fig. 2.1

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]

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

For
Examiner's
Use

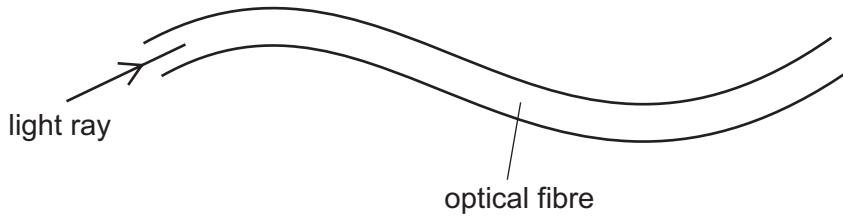


Fig. 2.2

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]

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

For
Examiner's
Use

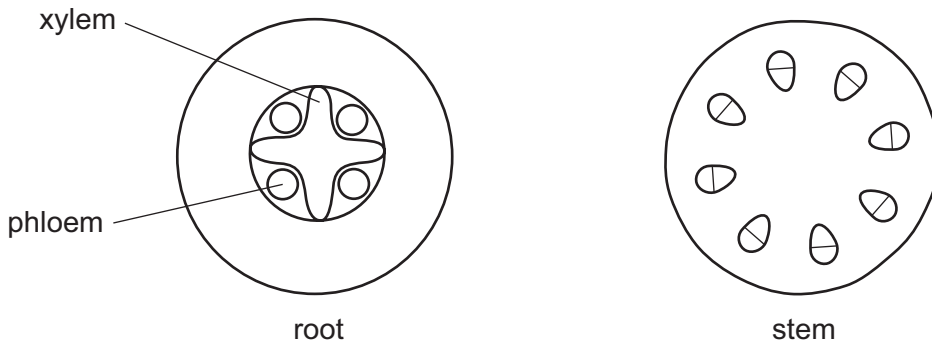


Fig. 3.1

(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]

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

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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Examiner's
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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.

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

.....

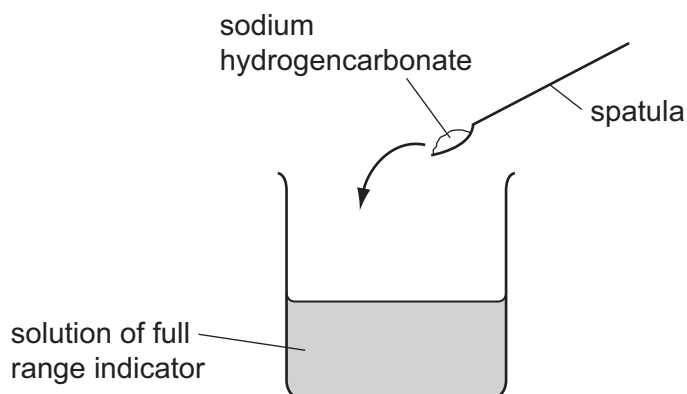
.....

..... [2]

*For
Examiner's
Use*

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]

For
Examiner's
Use

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

For
Examiner's
Use

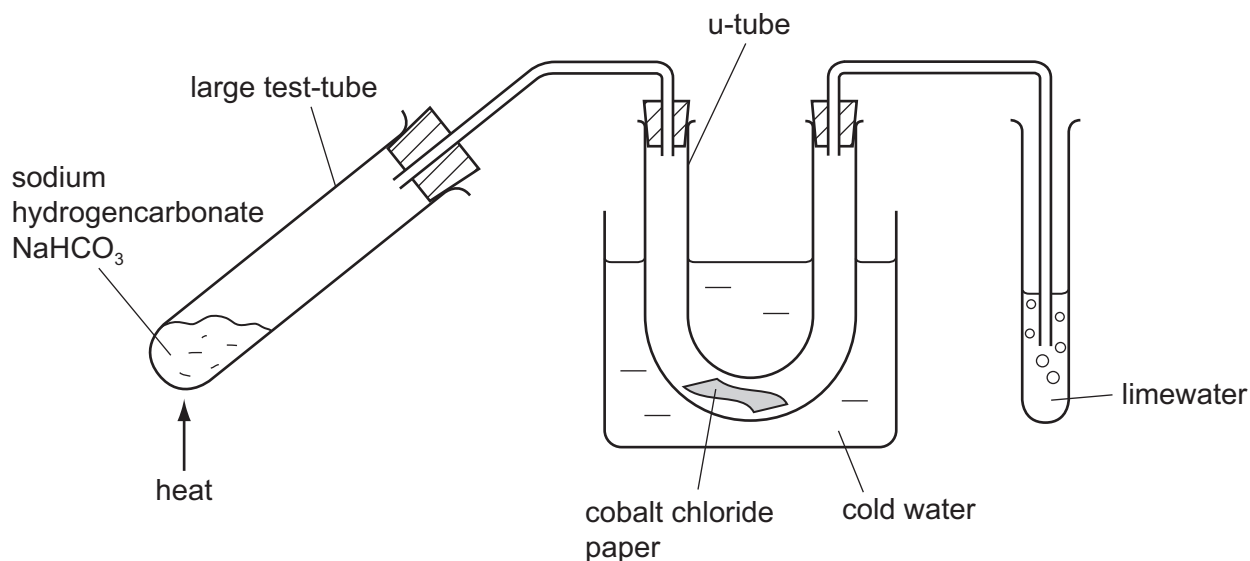


Fig. 4.1

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]

- (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.



[1]

For
Examiner's
Use

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

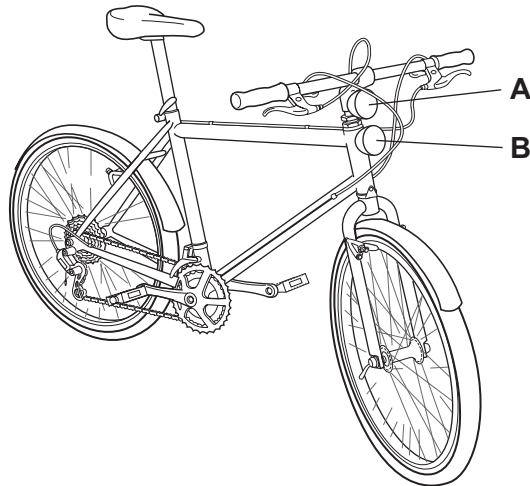


Fig. 5.1

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

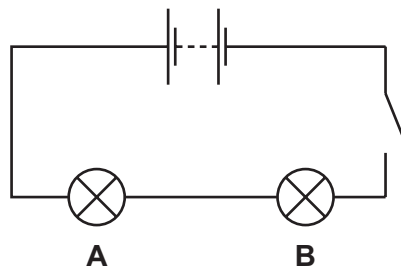


Fig. 5.2

- (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]

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

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 $9V$.

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 $9000g$ and volume $3000cm^3$.

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]

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

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

*For
Examiner's
Use*

.....

.....

.....

..... [3]

6 Fig. 6.1 shows the male reproductive system.

For
Examiner's
Use

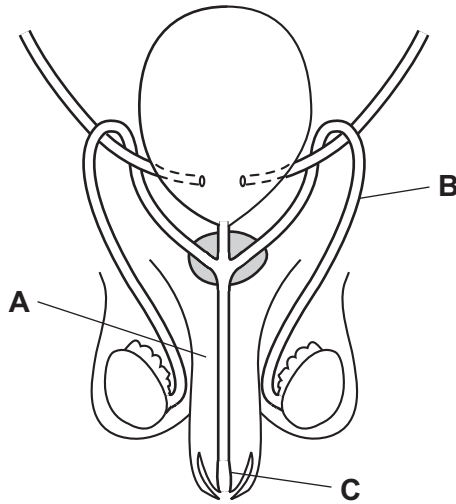


Fig. 6.1

(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]

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	

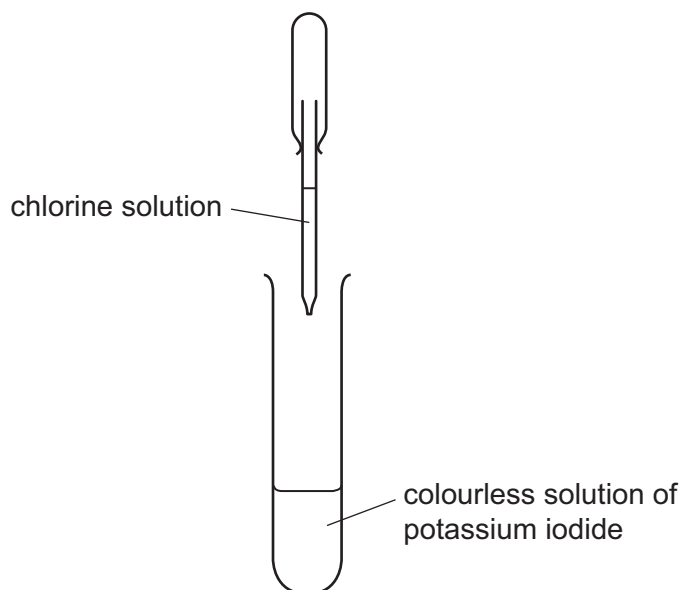
[1]

- (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]

For
Examiner's
Use

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

.....
.....
..... [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]

*For
Examiner's
Use*

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]

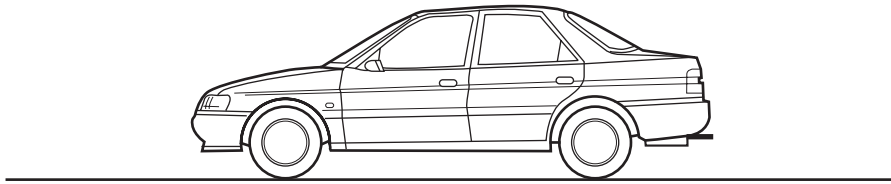


Fig. 8.1

(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 400m 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]

(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]

- 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.

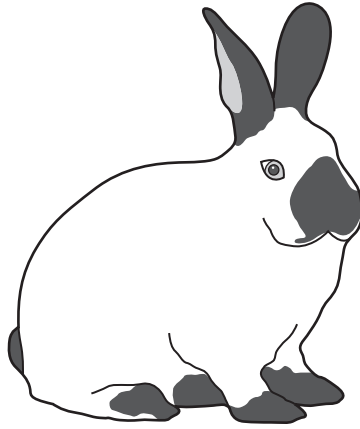


Fig. 9.1

- (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]

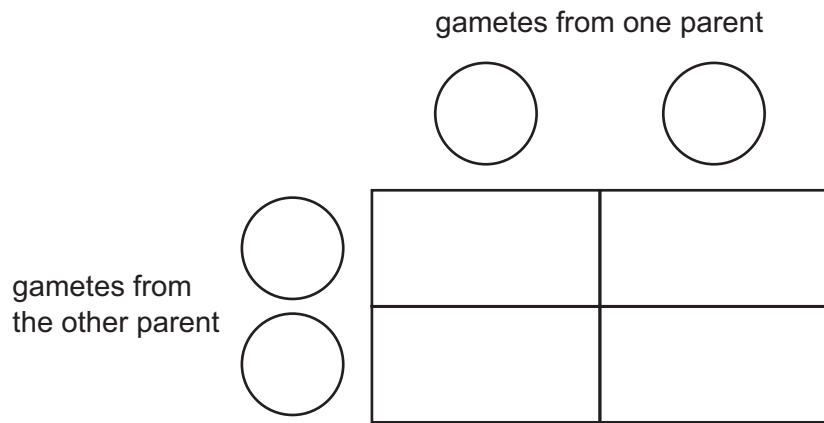
- (ii) State the phenotype of a rabbit that is heterozygous for these alleles.

..... [1]

- (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]

- (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]

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

For
Examiner's
Use

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

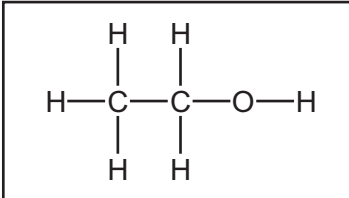
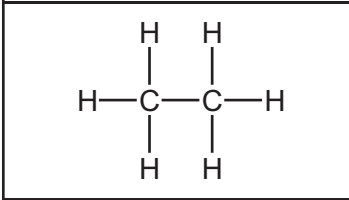
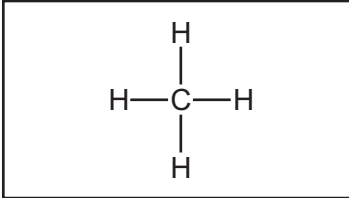
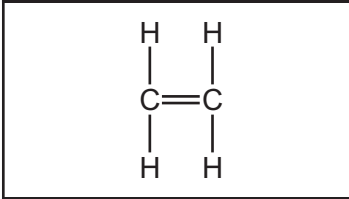
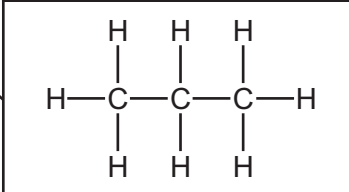
ethane	
methane	
ethanol	
propane	
ethene	

Fig. 10.1

[3]

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

1

2 [2]

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

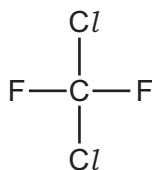


Fig. 10.2

- (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]

For
Examiner's
Use

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

For
Examiner's
Use

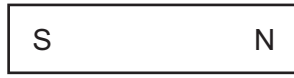


Fig. 11.1

[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.

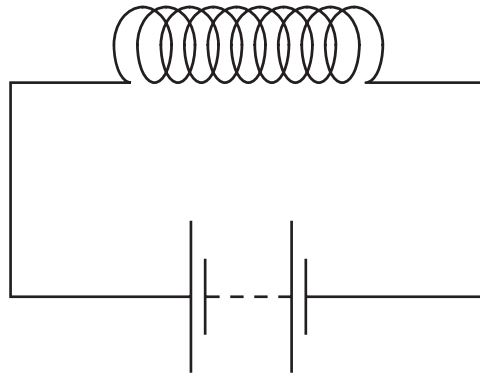


Fig. 11.2

[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]

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

For
Examiner's
Use

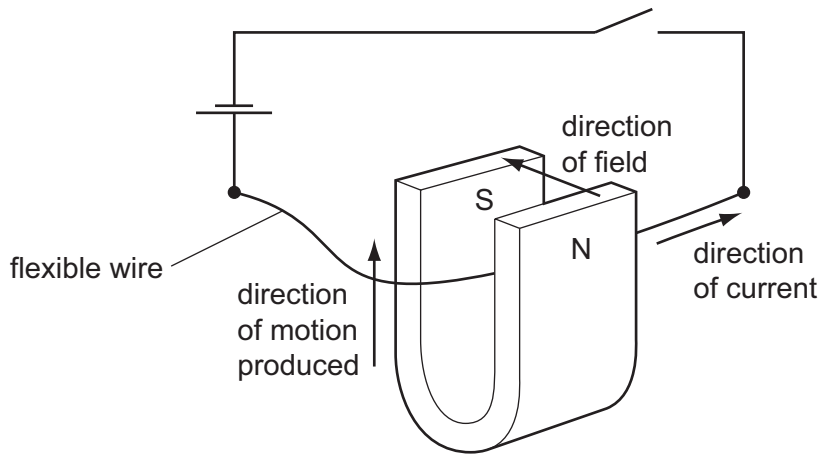


Fig. 11.3

(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]

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

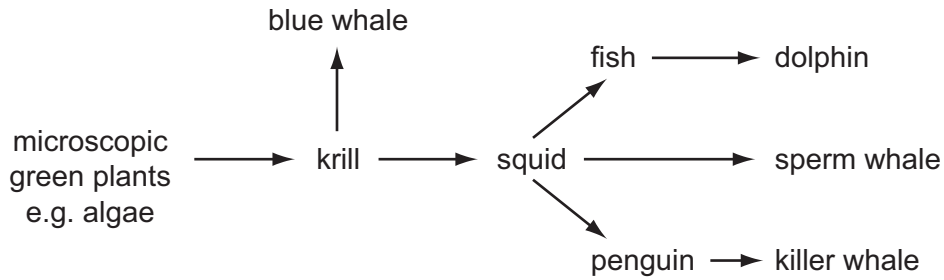


Fig. 12.1

(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]

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	96 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
X
b

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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