Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3128619326

CO-ORDINATED SCIENCES **0654/31**

Paper 3 (Core) **May/June 2017**

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 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.

CAMBRIDGE International Examinations

1 Fig. 1.1 shows a drawing of an animal cell.

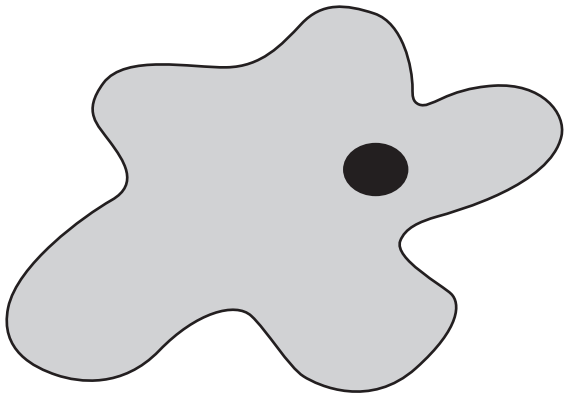

Fig. 1.1

(a) (i) On Fig. 1.1, use label lines to label each of the following parts of the cell.

- cell membrane
- cytoplasm
- nucleus [3]

(ii) State **two** ways in which a plant cell differs from an animal cell.

1 .....

2 .....
[2]

(b) Respiration takes place in every living cell to release energy.

(i) State the reactants needed for respiration.

.....[1]

(ii) State **two** uses of the energy released from respiration in humans.

1 .....

2 .....
[2]

2 **(a)** Fig. 2.1 shows an electric kettle.

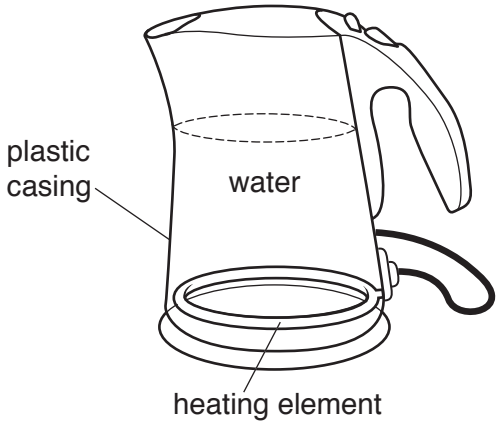

Fig. 2.1

(i) Name the process by which thermal energy is transferred from the kettle heating element to the water in contact with it.

.....[1]

(ii) Explain why the heating element is at the bottom of the kettle.

.....

.....

.....

.....[2]

(iii) Explain one advantage, other than cost, of using plastic for the casing of the kettle.

.....

.....[1]

(b) An electric kettle is supplied with 3000 joules of energy each second.

The water in the kettle only gains 2600 joules of thermal energy each second.

(i) Suggest what happens to the rest of the energy supplied.

.....[1]

(ii) The owner of the kettle thinks that the kettle has a low efficiency.

State the meaning of the term *efficiency*.

.....

.....[1]

[Turn over

(c) Fig. 2.2 shows an electrical hazard for a kettle.

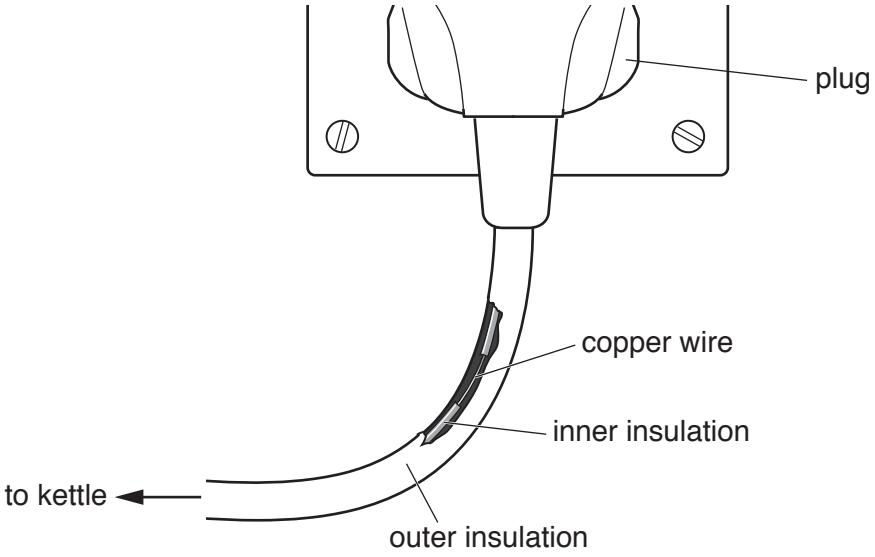

Fig. 2.2

State the hazard shown and explain why the hazard is dangerous.

hazard .....

.....

explanation .....

.....

[2]

(d) The kettle is switched on and the water reaches its boiling point.

(i) State the meaning of the term *boiling point*.

.....

.....[1]

(ii) When the water boils, it changes into steam. Water is a liquid and steam is a gas.

Fig. 2.3 shows the different arrangement of particles in a gas, liquid and solid.

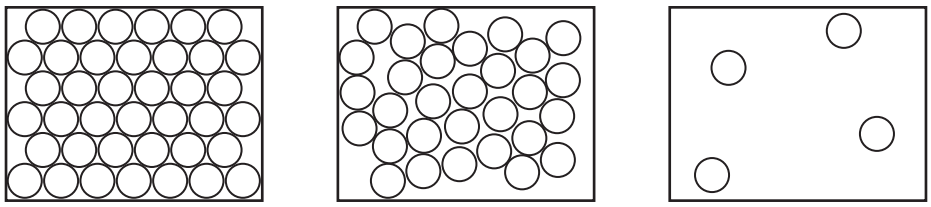

Fig. 2.3

State and explain which diagram, **A**, **B** or **C**, best represents

a liquid .....

explanation .....

.....

a gas .....

explanation .....

.....

[2]

3 **(a)** State the percentages of nitrogen and oxygen in clean air.

nitrogen .....%

oxygen .....% [2]

(b) Fig. 3.1 shows a pie chart of the composition of a sample of polluted air taken in a busy city.

Large numbers of cars and trucks travel through the city every day.

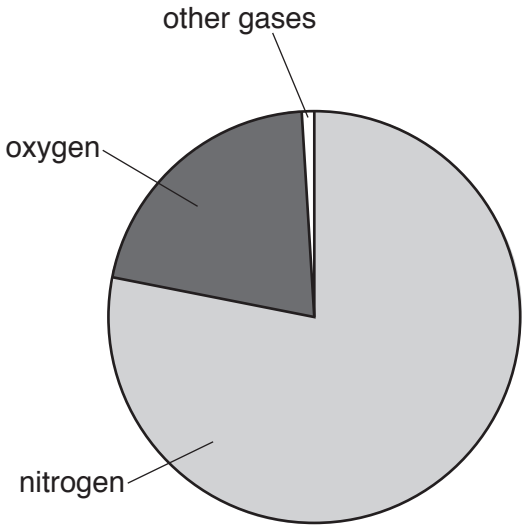

Fig. 3.1

The section of the chart in Fig. 3.1 labelled *other gases* includes carbon monoxide.

(i) Suggest how carbon monoxide is formed.

.....[1]

(ii) State **one** harmful effect of carbon monoxide.

.....

.....[1]

(c) Polluted air also contains oxides of nitrogen.

Nitrogen dioxide, NO_2, is a non-metallic oxide.

Some nitrogen dioxide is dissolved in water containing full-range indicator (Universal Indicator).

Predict the colour change observed in the liquid when the gas dissolves.

Explain your answer.

colour changes from ..... to .....

explanation .....

.....

[2]

(d) Nitrogen molecules react with hydrogen molecules to make ammonia.

Fig. 3.2 shows diagrams of the molecules involved in this reaction.

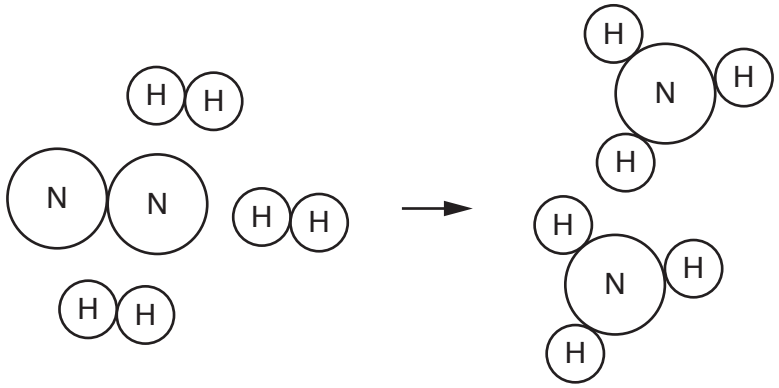

Fig. 3.2

(i) State the chemical formula of an ammonia molecule.

.....[1]

(ii) Use the examples in Fig. 3.2 to explain the difference between a molecule of an element and a molecule of a compound.

.....

.....

.....[2]

4 Fig. 4.1 is a diagram of the female reproductive system.

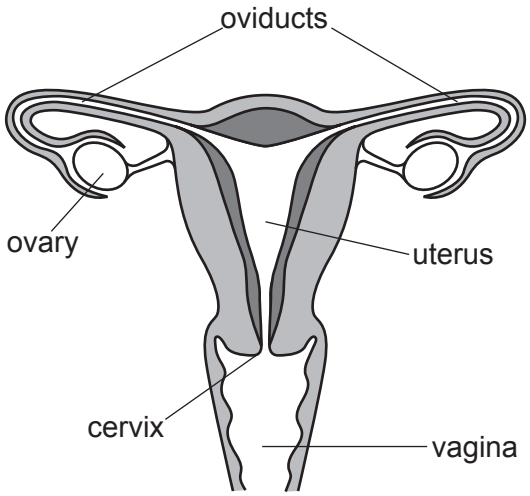

Fig. 4.1

(a) (i) Draw **one** line from each part of the female reproductive system to its correct function.

part of the female reproductive system	**function**
ovary	where fetus develops
vagina	carries egg to the uterus
oviduct	produces egg cells
uterus	receives penis during intercourse

[3]

(ii) Name the part of the female reproductive system where fertilisation occurs.

.....[1]

(iii) Describe fertilisation in humans.

.....

.....

.....[2]

(b) Fertilisation takes place during sexual reproduction.

Describe **two** ways in which asexual reproduction differs from sexual reproduction.

1 .....

2 .....

[2]

5 Fig. 5.1 shows a list of items that have been bought from a food shop.

Shopping list

- Bread
- Butter
- Fish
- Melon
- Pasta
- Tomatoes
- Water (bottled)

Fig. 5.1

(a) Name one food on the **shopping list** in Fig. 5.1 that is a major source of

fat, ...

protein, ...

vitamin C. .....

[3]

(b) **(i)** State **one** reason why proteins are needed in our diet.

.....

.....[1]

(ii) State the chemical elements contained in a protein.

.....[1]

(iii) Name the smaller (basic) units that are produced during the digestion of protein.

.....[1]

(c) Table 5.1 shows the different energy requirements for different people.

Table 5.1

	energy requirement per day / kJ	
	male	female
14 year old	12 000	9500
adult office worker	10 000	9000
athlete	13 500	12 000

(i) Suggest **one** reason for the difference in energy requirements between a male 14 year old and a male office worker.

.....

.....[1]

(ii) Suggest **one** reason for the difference in energy requirements between a male athlete and a female athlete.

.....

.....[1]

6 Natural gas and petroleum are fossil fuels.

(a) Natural gas contains methane.

Methane is a hydrocarbon.

(i) Complete Fig. 6.1 to show one molecule of methane.

H

[2]

Fig. 6.1

(ii) Name the **two** compounds that are produced by the complete combustion of methane.

1 .....

2 .....

[2]

(b) Petroleum is a black liquid.

Fig. 6.2 shows apparatus used to investigate petroleum.

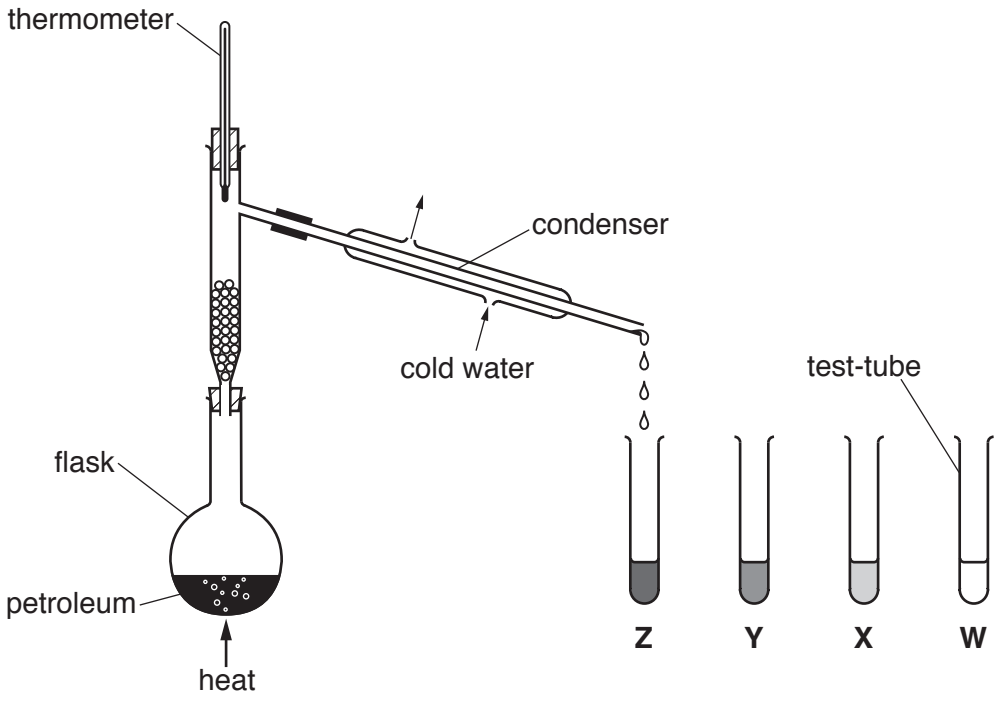

Fig. 6.2

When the petroleum boils, vapour rises, turns to liquid in the condenser and is then collected in a test-tube.

During the process, four test-tubes are used to collect four liquids, **W**, **X**, **Y** and **Z**. Liquid **W** is collected first and liquid **Z** is collected last.

(i) Name the process shown in Fig. 6.2.

.....[1]

(ii) State **one** similarity and one difference between liquid **W** and liquid **Z**.

similarity .....

.....

difference .....

.....
[2]

(c) An orange solution of element **J** is used to test if a hydrocarbon is saturated or unsaturated.

(i) Name element **J**.

.....[1]

(ii) Describe and explain what is observed, if anything, when the solution of **J** is shaken with a **saturated** hydrocarbon.

observation .....

explanation .....

.....
[2]

(iii) Name the **unsaturated** hydrocarbon that contains two carbon atoms in each of its molecules.

.....[1]

7 **(a)** Fig. 7.1 shows a speed-time graph for a car over a period of 50 seconds.

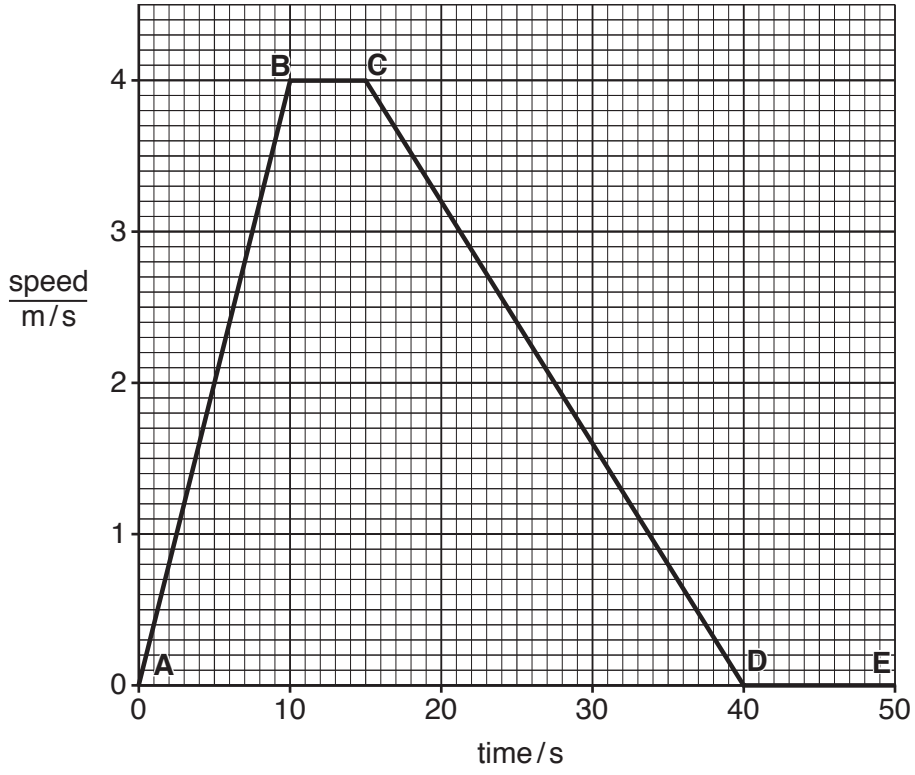

Fig. 7.1

(i) State a time when the car is not moving.

..... s [1]

(ii) State the maximum speed reached by the car.

..... m/s [1]

(iii) Calculate the distance travelled by the car between 10 seconds and 15 seconds.

Show your working.

distance = ... m [2]

(b) A man has been riding in a car which has plastic seats.

Suggest why an electric charge builds up on the man.

.....

.....[1]

(c) The car has a warning triangle to alert other motorists.

Fig. 7.2 shows a warning triangle.

Fig. 7.2

The triangle contains many tiny prisms.

Fig. 7.3 shows one prism.

The rays of light undergo total internal reflection inside the prism.

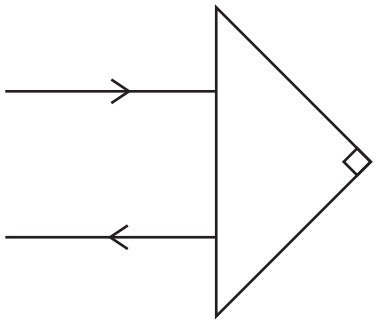

Fig. 7.3

Rays of light enter and leave the prism as shown.

Complete Fig. 7.3 to show the path of the ray of light through the prism. [2]

(d) The temperature of the air in car tyres increases during a journey.

(i) Describe what happens to the motion of the air particles as the air warms up.

.....

.....[1]

(ii) When the temperature of the air in the tyres increases, the pressure in the tyres increases.

Explain in terms of the motion of the air particles why the pressure increases.

.....

.....

.....[2]

8 Fig. 8.1 is a drawing of a green plant.

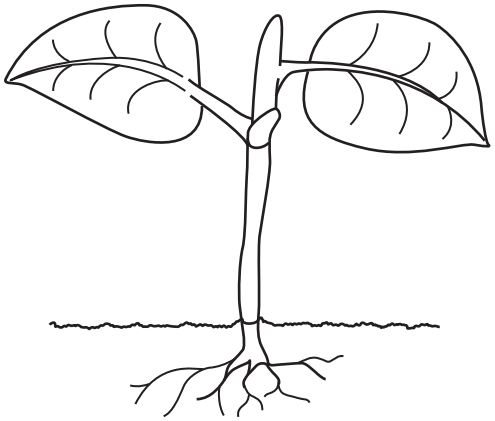

Fig. 8.1

(a) Add **two** arrows to Fig. 8.1 to show the direction of movement of water into **and** out of the plant. [2]

(b) State the name of the vessel that carries water through the plant.

.....[1]

(c) Water is needed by the plant for photosynthesis.

Name **one** other requirement for photosynthesis.

.....[1]

(d) Water is lost from the plant by a process called transpiration.

State **two** environmental conditions that will increase the rate of transpiration.

1 .....

2.....
[2]

[Turn over

9 Magnesium is an element in Group II of the Periodic Table.

(a) (i) An atom of magnesium has an atomic number of 12 and a mass number of 26.

State the numbers of protons, neutrons and electrons in this magnesium atom.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

(ii) State the total number of elements that are in the same period of the Periodic Table as magnesium.

.....[1]

(b) Fig. 9.1 shows apparatus that a student uses to investigate the temperature change when excess magnesium reacts with dilute hydrochloric acid.

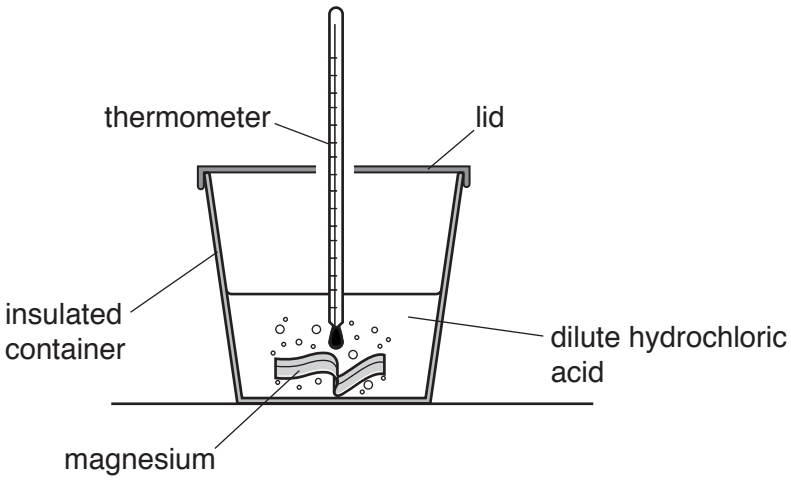

Fig. 9.1

Table. 9.1 shows temperature measurements the student records during the investigation.

Table 9.1

temperature of the acid before the reaction / °C	20
temperature of the mixture when reaction has finished / °C	45

(i) Name the gas that is produced when magnesium reacts with dilute hydrochloric acid.

.....[1]

(ii) Suggest the change in the pH of the mixture inside the insulated container during the reaction.

Explain your answer.

change .....

explanation .....

.....

[2]

(iii) The student concludes that the reaction between magnesium and dilute hydrochloric acid is endothermic.

State and explain whether or not the student has made a correct conclusion.

.....

.....

.....[2]

(c) Fig. 9.2 shows the apparatus the student uses to investigate the rate of reaction between magnesium and dilute hydrochloric acid.

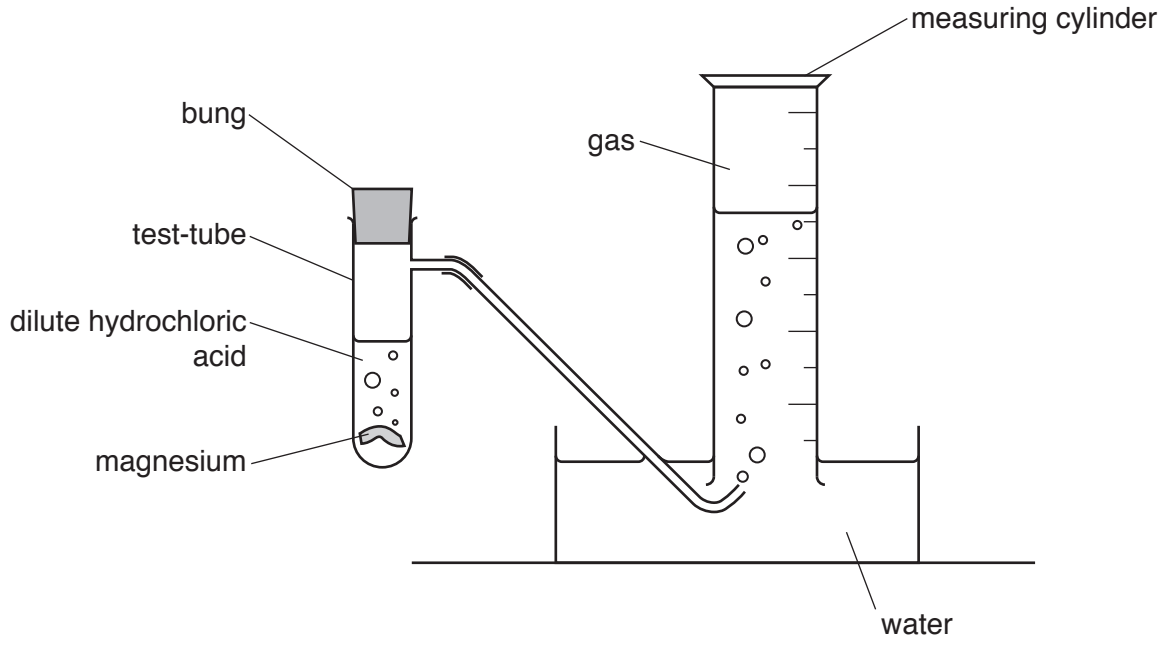

Fig. 9.2

State **two** changes to the reaction conditions the student could make which increase the speed that gas fills the measuring cylinder.

1 .....

2 .....

[2]

10 Fig. 10.1 is a diagram of a woodland food web.

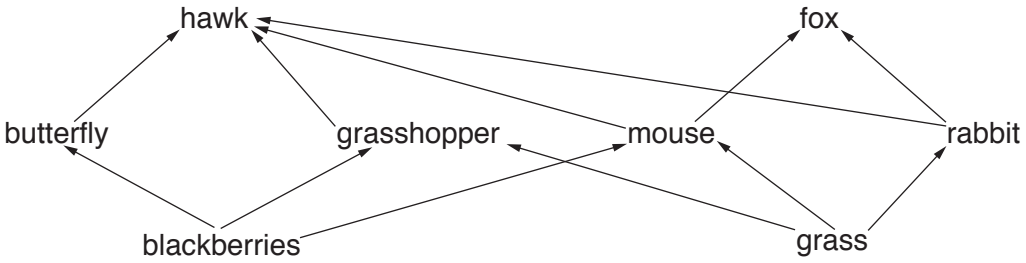

Fig. 10.1

(a) A food web is a network of interconnected food chains.

Define the term *food chain*.

.....

.....[2]

(b) **(i)** Use Fig. 10.1 to draw **one** food chain that contains a rabbit.

.....[2]

(ii) From the food web in Fig. 10.1 name **one**

producer, ...

carnivore, ...

herbivore. .....

[3]

(c) In the food web in Fig. 10.1 a disease kills the hawks.

Use Fig. 10.1 to suggest and explain the effect this would have on the fox population.

.....

.....

.....

.....[3]

11 **(a)** Oil is burned in a power station to generate electricity.

Complete the sentences using suitable words to describe how this happens.

When oil is burned, ... energy is transformed into thermal energy.

The thermal energy heats ..... in a boiler to produce steam.

The steam drives a ..... which turns a generator. [3]

(b) **(i)** A small quantity of radioactive material from a nuclear power station is tested.

Describe how a scientist could prove that the material is releasing γ-rays.

.....

.....

.....

.....[2]

(ii) State **one** way in which the scientist could be harmed by the radiation emitted from the radioactive material.

.....

.....[1]

(c) An overhead power cable transmits electrical power from a power station to a town.

(i) State the effect on the resistance of the cable if the diameter of the cable is decreased.

.....[1]

(ii) Apart from changing the diameter, state one **other** way of changing the resistance of the cable.

.....

.....[1]

[Turn over

(d) The overhead power cables are hung from pylons (towers).

Fig. 11.1 shows cables hanging between two pylons.

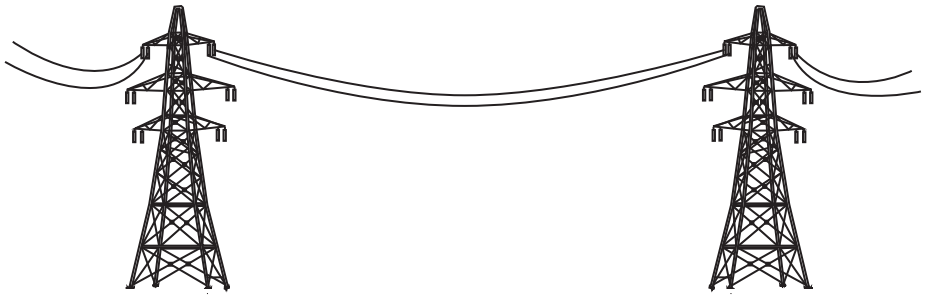

Fig. 11.1

The power cables were hung loosely between the two pylons during hot weather.

Explain why the cables were hung loosely between the pylons.

.....

.....

.....[2]

12 (a) Table 12.1 shows some physical properties of five elements, **P** to **T**. These letters are **not** the chemical symbols of the elements.

Table 12.1

element	melting point / °C	boiling point / °C	electrical conductor or insulator
P	146	759	conductor
Q	115	445	insulator
R	1414	3265	insulator
S	–7.2	59	insulator
T	–39	357	conductor

(i) State which **one** of the elements, **P** to **T**, is both a non-metal and a liquid at 20 °C.

Explain your answer.

element .....

explanation .....

.....

.....
[2]

(ii) Suggest **one** other **physical** property, not shown in Table 12.1, of element **P**.

.....

.....[1]

[Turn over

(b) Sodium and chlorine combine to form an ionic compound, **X**.

Fig. 12.1 shows sodium reacting with chlorine gas.

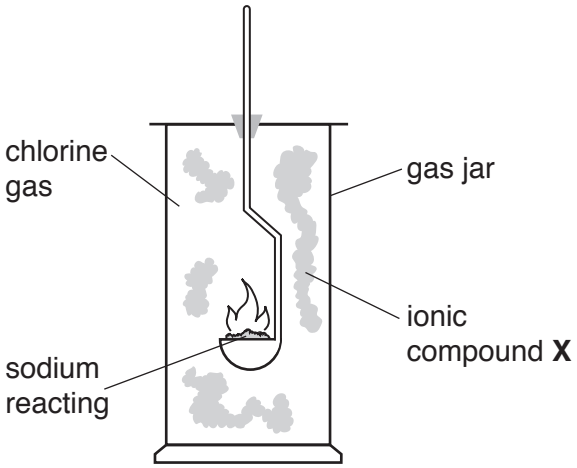

Fig. 12.1

Fig. 12.2 shows how the ions are arranged in compound **X**.

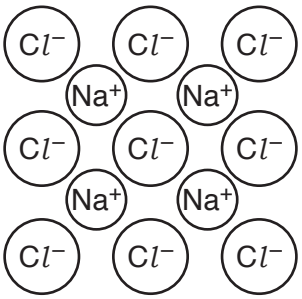

Fig. 12.2

(i) Name ionic compound **X**.

.....[1]

(ii) Describe what happens when a sodium atom changes into an ion in this reaction.

.....

.....[1]

(iii) State why the ions in compound **X** are attracted to each other.

.....

.....[1]

(c) Fig. 12.3 shows apparatus used to produce chlorine gas from an aqueous solution of compound **X**.

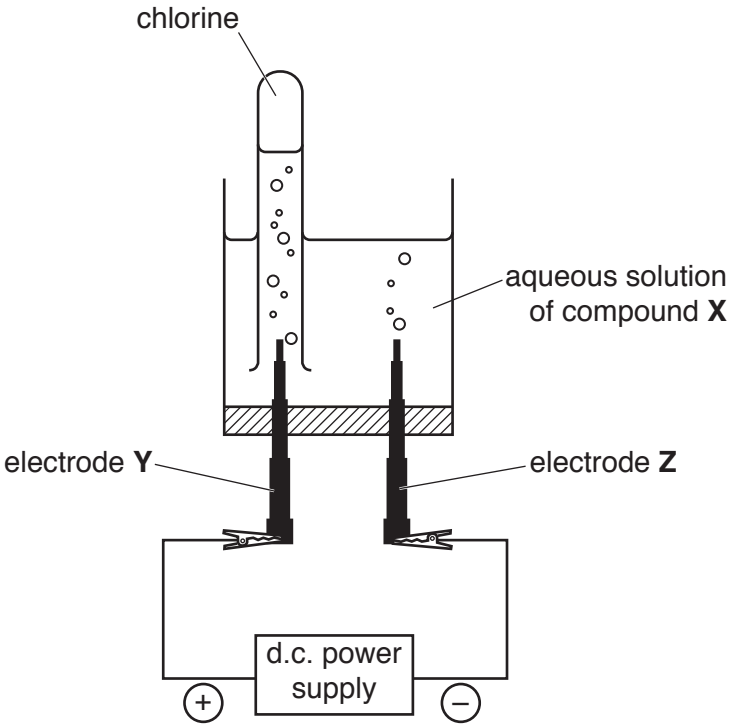

Fig. 12.3

(i) Name this process.

.....[1]

(ii) Name electrodes **Y** and **Z**.

Y .....

Z .....

[2]

13 (a) A student is climbing a mountain.

State the type of energy gained by the student as she climbs.

..... energy [1]

(b) The student makes a loud noise as she climbs and hears the echo from another mountain a few seconds later. The student knows the distance to the other mountain.

Describe how she can calculate a value for the speed of sound in air.

.....

.....

.....

.....

.....

.....[3]

(c) On the mountain, the student is exposed to both infra-red and ultraviolet waves.

Infra-red and ultraviolet are part of the electromagnetic spectrum.

On Fig. 13.1, put infra-red and ultraviolet waves in their correct places in the incomplete electromagnetic spectrum.

γ-rays			visible light		microwaves	

Fig. 13.1

[2]

(d) The student uses a camera to take photographs when she reaches the top of the mountain.

The camera uses a converging lens.

Fig. 13.2 shows an incomplete ray diagram for a converging lens forming an image.

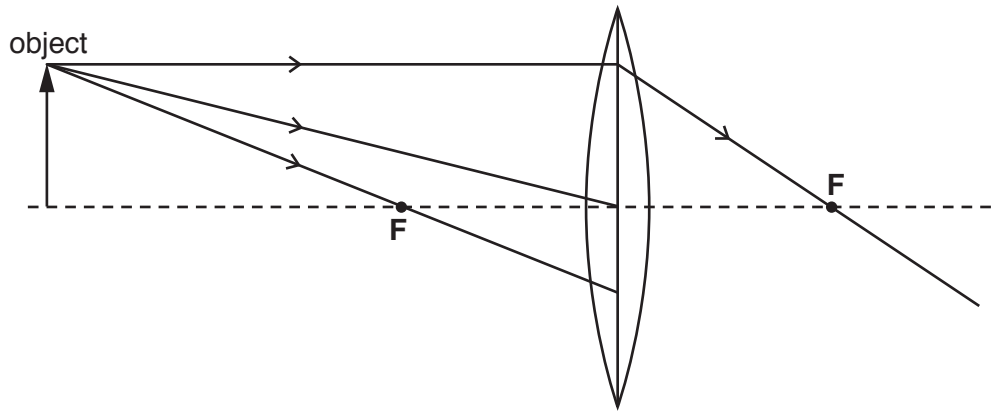

Fig. 13.2

(i) On Fig. 13.2, complete the ray diagram to show the three rays of light after they have passed through the lens. One ray has been drawn for you. [1]

(ii) On Fig. 13.2, draw an arrow ↓ to show where the image is formed. [1]

(iii) State the name of points **F**.

.....[1]

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)