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 2014**

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 soft 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 **27** printed pages and **1** blank page.

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Use the words in the list to complete the sentences, which are about evolution.

You may use each word once, more than once or not at all.

adaptation **reproduction** **respond** **selection**

survive **variation**

Organisms show ..... , which means that no two individuals are exactly alike. Some individuals show better ..... to their environment, and these individuals are more likely to ..... and reproduce. This may lead to evolution as a result of the process of natural ..... .

[4]

(b) Table 1.1 shows, for a species of bacterium, the percentage of bacteria that were resistant to the antibiotic penicillin. The data are for samples of bacteria taken in two different countries in the years 1980 and 2010.

Table 1.1

	country **A**	country **B**
percentage of antibiotic-resistant bacteria in 1980	3	4
percentage of antibiotic-resistant bacteria in 2010	54	12

(i) Compare the incidence of antibiotic-resistance in the two countries

in 1980,

.....

.....

in 2010.

.....

.....

[2]

(ii) In both countries, antibiotic-resistance increased between 1980 and 2010. Use the idea of evolution to explain how this may have happened.

.....

.....

.....

.....

.....[3]

(iii) Suggest a reason why resistance to antibiotics increased faster in country **A** than in country **B**.

.....

.....[1]

2 **(a)** An electric heater is rated at 3 kW. The mains voltage is 250 V.

(i) Show that the current used by the heater is 12 A.

Show your working.

[2]

(ii) Calculate the resistance of the heater.

State the formula that you use, show your working and state the unit of your answer.

formula

working

resistance = ……..unit …… [3]

(b) Fig. 2.1 shows the apparatus used in an experiment.

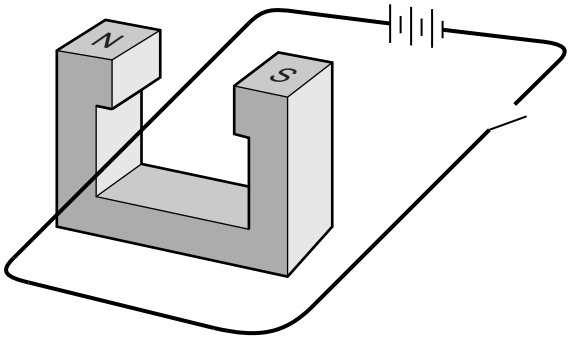

Fig. 2.1

A current passes through a wire placed between the poles of a magnet.

When the switch is closed, the wire moves upwards.

Describe and explain what happens when

(i) the three cells are replaced by six similar cells,

.....

.....[1]

(ii) the three cells are reversed in the circuit.

.....

.....[1]

3 **(a)** The air is a mixture of gases. The two most abundant gases are nitrogen and oxygen.

(i) State, to the nearest whole number, the percentage of the air that consists of gases **other** than nitrogen and oxygen.

.....[1]

(ii) Name **one** gaseous **element other** than nitrogen or oxygen that is found in unpolluted air.

.....[1]

(b) Fig. 3.1 shows containers filled with 1.0 mole of nitrogen and 1.0 mole of oxygen.

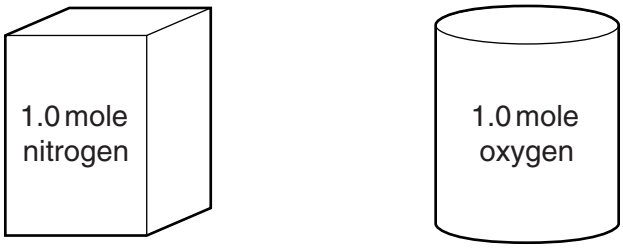

Fig. 3.1

The gases inside the containers are both at room temperature and pressure.

(i) The volume of the nitrogen gas is 24 dm^3.

State the volume of the oxygen gas.

.....[1]

(ii) Explain your answer to **(i)**.

.....

.....[1]

(iii) State **one** difference, other than being different elements, between 1.0 mole of nitrogen and 1.0 mole of oxygen.

.....

.....[1]

(c) Nitrogen combines with hydrogen in the Haber process to form ammonia.

The balanced equation for the formation of ammonia is

$$N_2 + 3H_2 \rightarrow 2NH_3$$

(i) Nitrogen may be obtained from liquid air.

Name the method used to separate nitrogen from liquid air.

.....[1]

(ii) Name **one** raw material that is used to produce hydrogen for the Haber process.

.....[1]

(iii) Work through the steps in the calculation below to find the mass of nitrogen gas that reacts to produce 1000g of ammonia.

Show your working.

- Calculate the number of moles of ammonia in 1000g. The relative formula mass of ammonia is 17.

number of moles of ammonia = ...

- State the number of moles of nitrogen that react to produce 1000g of ammonia.

number of moles of nitrogen = ...

- Calculate the mass of the number of moles of nitrogen gas you found in the previous step.

mass of nitrogen = ...
[4]

4 **(a)** Fig. 4.1 shows a car travelling from left to right.

Two horizontal forces affect its motion. These are the forward driving force and air resistance.

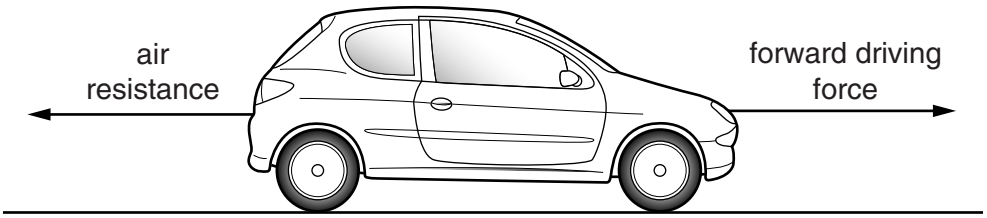

Fig. 4.1

(i) The car is accelerating.

Tick one of the boxes to show which of the following statements is correct.

The driving force is greater than the air resistance. ☐

The driving force is equal to the air resistance. ☐

The driving force is less than the air resistance. ☐

Explain your answer.

.....

.....[1]

(ii) The car accelerates from 16 m/s to 30 m/s in 4 seconds.

The mass of the car is 1200 kg.

Calculate the force required to produce this acceleration.

State the formula that you use and show your working.

formula used

working

force = ... N [3]

(iii) Calculate the change in kinetic energy of the car during this acceleration.

State the formula that you use and show your working.

formula

working

change in kinetic energy = ... J [3]

(b) Car **A** approaches a road junction. Fig. 4.2 shows the road junction seen from above.

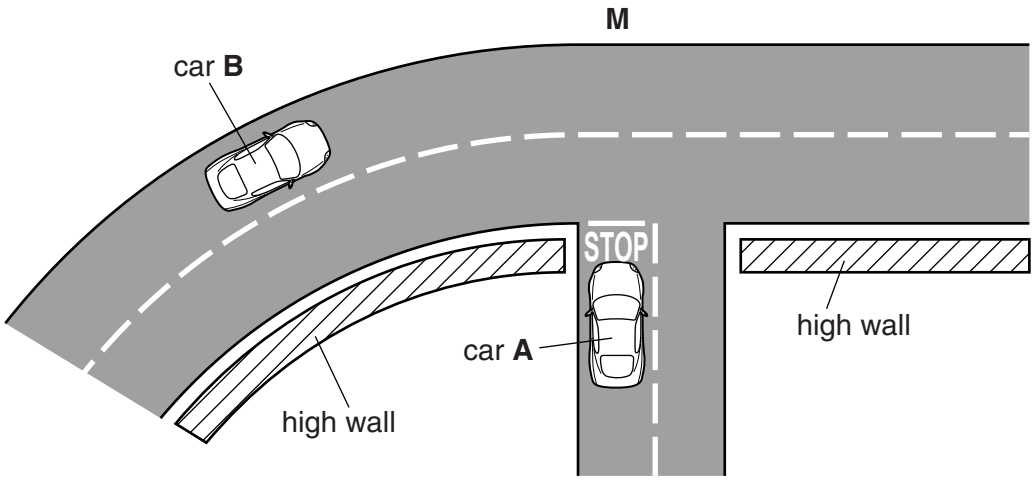

Fig. 4.2

A mirror is placed at point **M** to allow the driver of car **A** to see car **B**.

Draw the mirror at a suitable angle to show how it should be placed so that the driver of car **A** can see car **B**.

Draw a ray of light from car **B** which travels to the driver of car **A**. [3]

(c) The noise vibration from the car engine can be heard by the driver.

Describe in terms of air particles how the sound from the engine is heard by its driver.

.....

.....

.....[2]

5 Fig. 5.1 shows apparatus that can be used to investigate the effect of varying light intensity on the rate of photosynthesis in an aquatic plant.

The light intensity is varied by changing the brightness of the lamp.

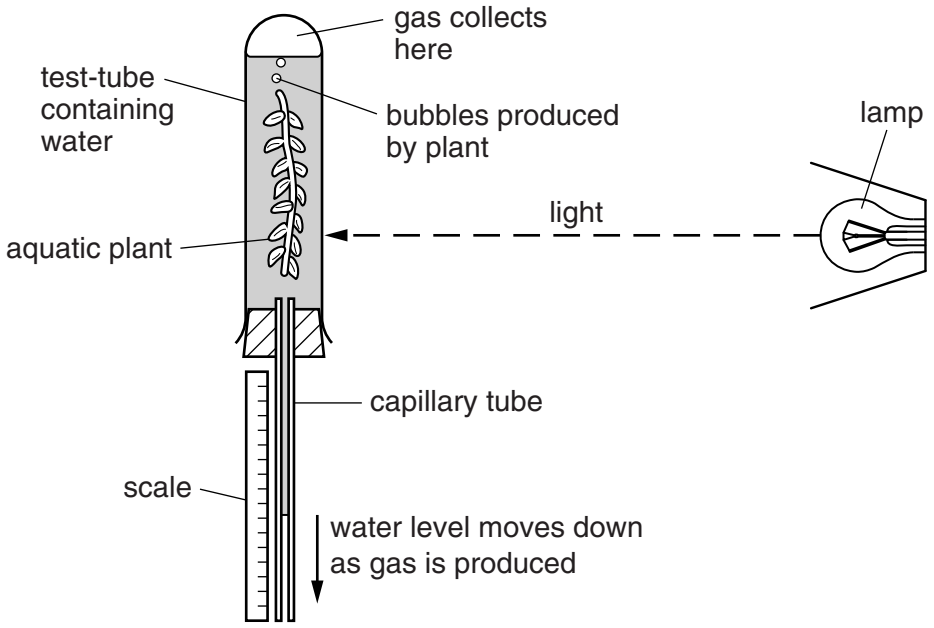

Fig. 5.1

The rate of photosynthesis is determined by measuring the rate at which the water level moves down in the capillary tube. This happens because the gas produced in photosynthesis forces the water down the tube.

(a) State why light is necessary for photosynthesis.

.....

.....[1]

(b) Name the gas that collects at the top of the test-tube in Fig. 5.1.

..... [1]

(c) Write a balanced chemical equation for photosynthesis.

.....[2]

(d) **(i)** Using the axes in Fig. 5.2, sketch a graph to show how the rate of photosynthesis of the plant will change as the light intensity varies from very low to very high.

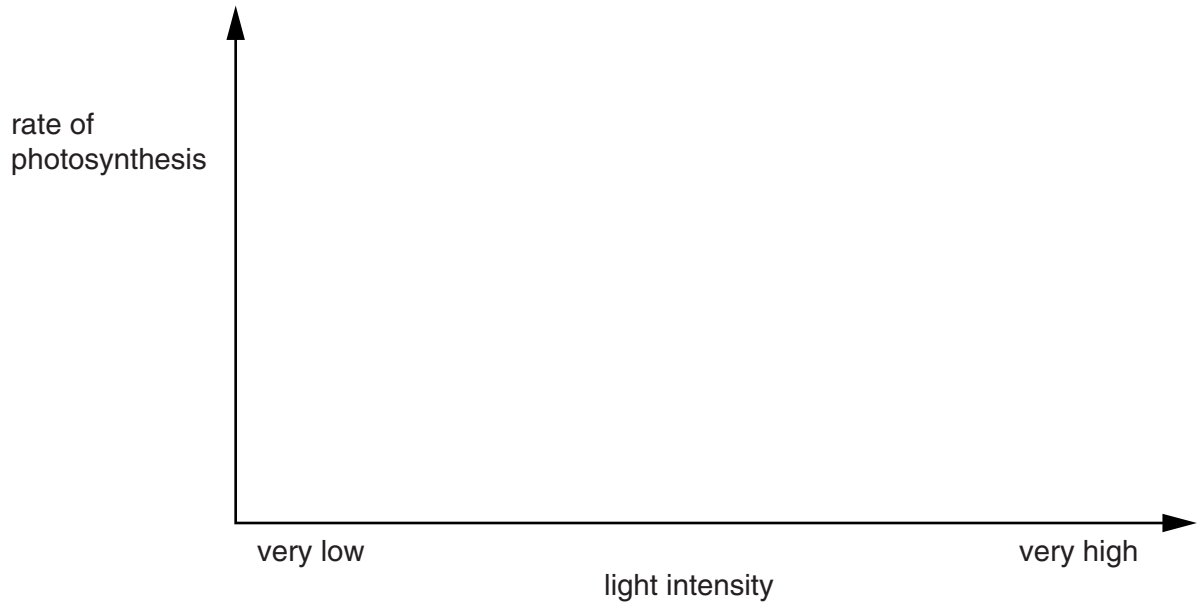

Fig. 5.2

[2]

(ii) Suggest reasons for the shape of your graph

at low light intensities,

.....

.....

at very high light intensities.

.....

.....[2]

(e) Name **two** environmental conditions other than light intensity that affect the rate of photosynthesis.

1 .....

2 .....[2]

(f) Only the green parts of a plant can photosynthesise.

(i) Name the green substance present in plants.

..... [1]

(ii) State why this green substance is needed for photosynthesis.

.....[1]

6 The halogens are found in Group VII of the Periodic Table.

(a) Complete the table which shows some of the properties of chlorine, bromine and iodine.

element	physical state at 20 °C	colour	formula of molecules
chlorine		pale green	
bromine	liquid		
iodine			I_2

[3]

(b) Iodine is found combined in aqueous solutions containing sodium iodide.

Iodine may be extracted from sodium iodide by reaction with chlorine.

Suggest the **word** chemical equation for the reaction of sodium iodide with chlorine.

.....[1]

(c) In many countries, chlorine is added to water supplied to homes.

Predict and explain what may happen to people drinking the water if chlorine is **not** added to the supply.

.....

.....

.....[2]

(d) Fluorine gas reacts violently with water.

Fig. 6.1 shows fluorine gas being blown onto a water surface, and the two products of the reaction.

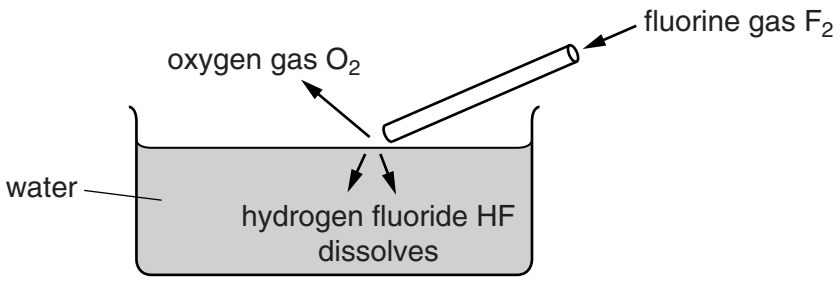

Fig. 6.1

Use the information shown in Fig. 6.1 to construct a balanced chemical equation for the reaction of fluorine gas with water to produce oxygen gas and hydrogen fluoride.

.....[2]

7 Fig. 7.1 shows some of the stages in human reproduction.

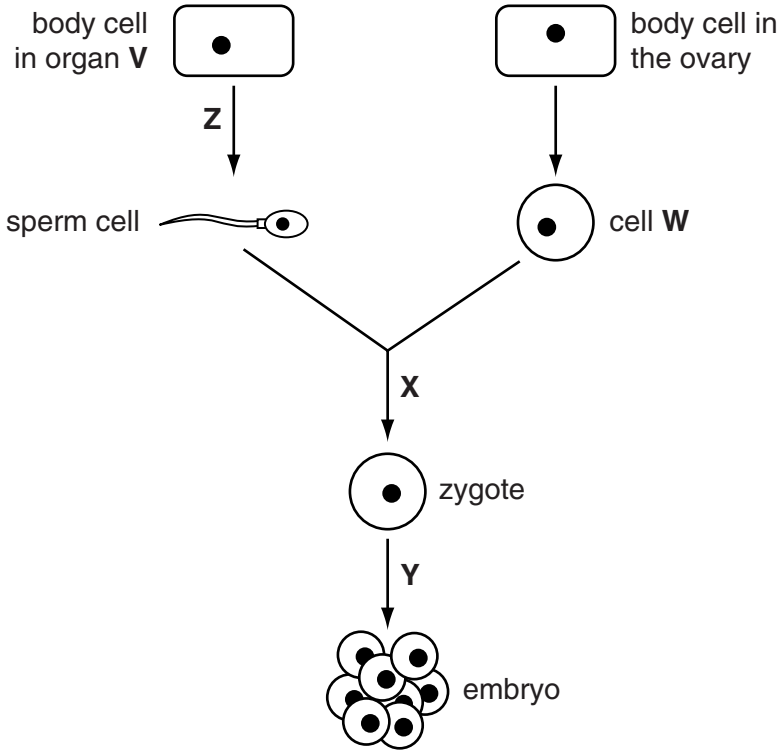

Fig. 7.1

(a) Name organ **V** and cell **W**.

organ **V** .....

cell **W** ..... [2]

(b) Name the process that is occurring at **X**.

..... [1]

(c) State what type of nuclear division is occurring when the cells divide at **Y** and **Z**.

at **Y** .....

at **Z** ..... [2]

(d) The nucleus of the cell in the ovary contains 46 chromosomes.

State the number of chromosomes present in the nuclei of

cell **W**, ...

a cell from the embryo. ..... [2]

Please turn over for Question 8.

8 **(a)** In Australia in 2010, it was decided that only energy efficient (low energy) light bulbs (lamps) should be used in houses.

A scientist measures the electrical power consumption of two types of lamp. The lamps are shown in Fig. 8.1.

type **A**
energy efficient compact fluorescent lamp

type **B**
traditional incandescent light bulb

Fig. 8.1

Type **A** is the energy efficient compact fluorescent lamp and type **B** is the traditional incandescent light bulb.

The scientist takes three sets of measurements for each of the two types of lamp.

His results are shown on the graph in Fig. 8.2.

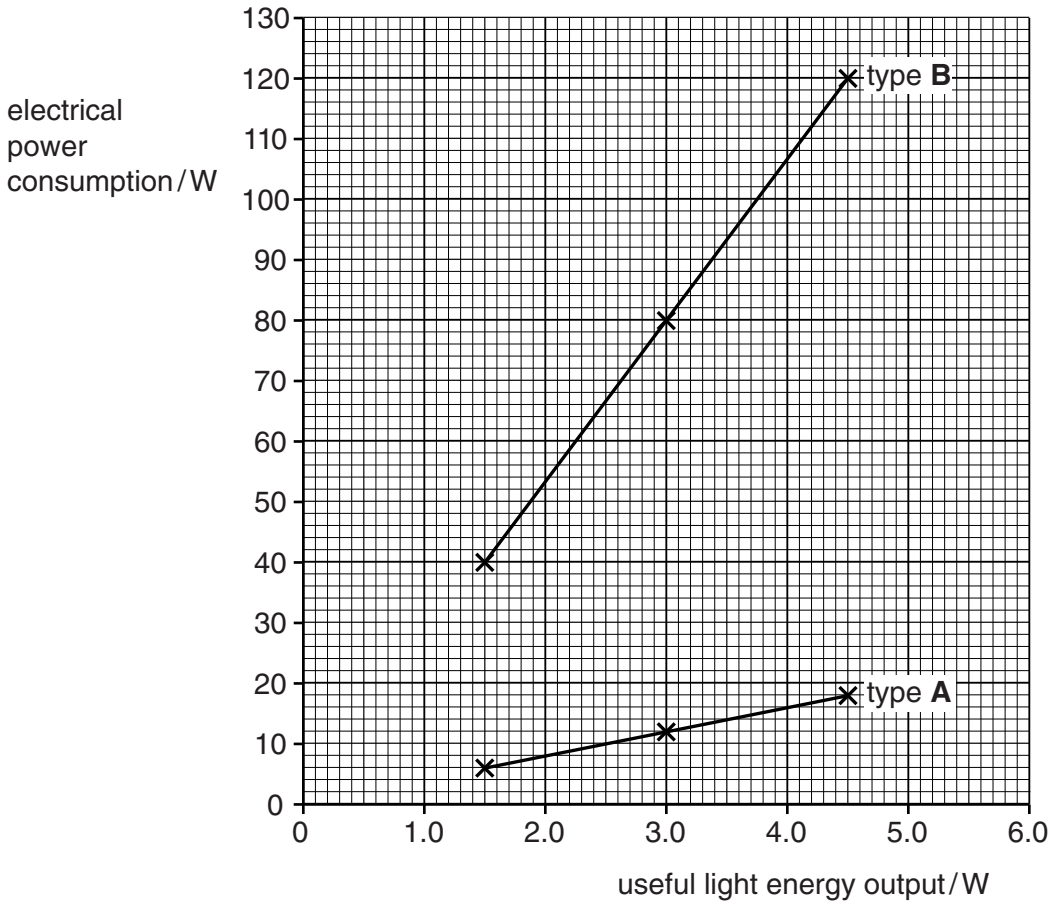

Fig. 8.2

(i) Use the data in Fig. 8.2 to calculate the difference in electrical power consumption of the two types of lamp when the light energy output is 3.0W.

..... W [1]

(ii) Use the data in Fig. 8.2 to calculate the efficiency of the two types of lamp.

Show your working.

efficiency of type **A** = ...

efficiency of type **B** = ... [2]

(iii) In Australia only type **A** lamps can be sold in shops.

Use your answer to **(ii)** to suggest why this decision could benefit the Australian environment.

.....

.....

.....

.....[2]

(b) Power stations generate electricity. In some power stations a nuclear fuel is used.

The thermal energy released in the nuclear reactor is used to turn water into steam.

Complete Fig. 8.3 to show the energy transformations that take place in a nuclear power station.

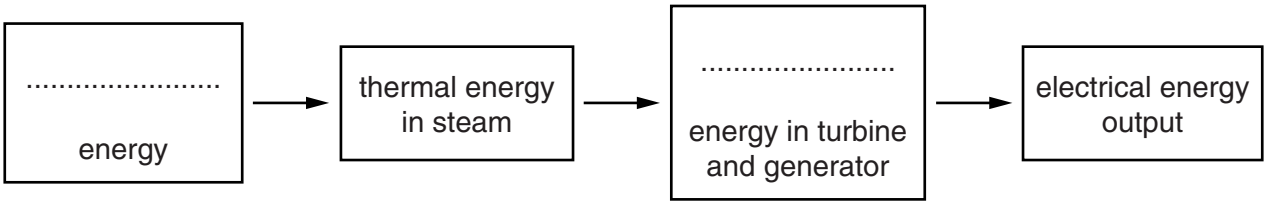

Fig. 8.3

[2]

(c) One waste product from a nuclear power station is the isotope iodine-129. This has a half-life of 15.7 million years and releases β-radiation and γ-radiation.

(i) State the meaning of the term *half-life*.

.....

.....[1]

(ii) State **two** differences between β-radiation and γ-radiation.

1 .....

2 .....[2]

9 **(a)** Ethane and ethene are gaseous hydrocarbons.

Fig. 9.1 shows apparatus that can be used to find out whether gases react with bromine solution.

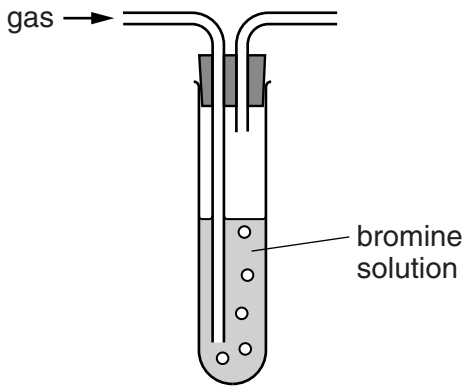

Fig. 9.1

In separate experiments, ethane and ethene are passed into the apparatus. Each gas is passed through the bromine solution for a few seconds at room temperature.

(i) Predict how the observations in the two experiments will be different.

observation with ethane .....

.....

observation with ethene .....

.....[2]

(ii) Butene, C_xH_y, is another gaseous hydrocarbon.

State the values of x and y in the formula of butene and name the homologous series to which butene belongs.

value of x .....

value of y .....

homologous series ..... [3]

(b) When ethene is compressed and heated, a white solid substance, **G**, is produced.

Substance **G** is made of very large hydrocarbon molecules.

Fig. 9.2 shows the structure of a small section of one of these molecules.

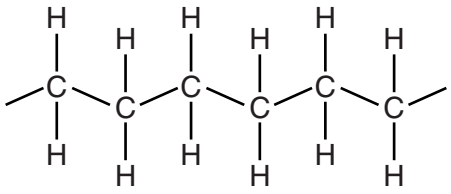

Fig. 9.2

(i) Give the full name of the type of chemical reaction that occurs when ethene is converted into substance **G**.

.....[2]

(ii) Name substance **G**.

.....[1]

(iii) Substance **G** is used to make a wide range of products including plastic bags, most of which are thrown away as plastic waste.

One way of getting rid of plastic waste is to burn it.

State the **two** compounds that will be produced when substance **G** undergoes complete combustion.

..... and ..... [2]

10 (a) Fig. 10.1 is a plan of the human circulatory system.

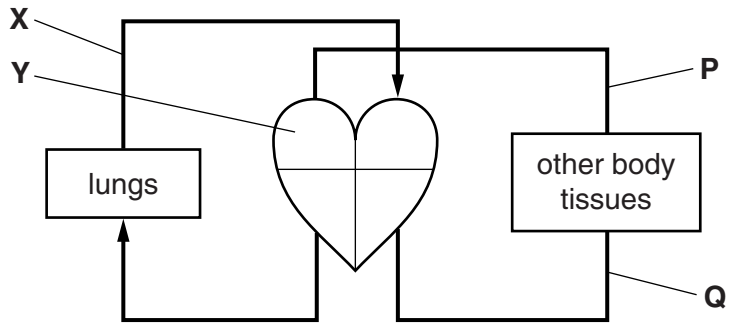

Fig. 10.1

(i) Name the blood vessel labelled **X**, and the chamber of the heart labelled **Y**.

X .....

Y .....[2]

(ii) On Fig. 10.1, draw arrows to show the direction of blood flow in the vessels labelled **P** and **Q**. [2]

(iii) With reference to Fig. 10.1, explain why the human circulatory system is described as a double circulation.

.....

.....

.....[2]

(iv) Explain why the blood travelling to the lungs is at a lower pressure than the blood travelling to the rest of the body.

.....

.....[1]

(b) Fig. 10.2 shows how a person's pulse can be measured by feeling the pulse at the wrist.

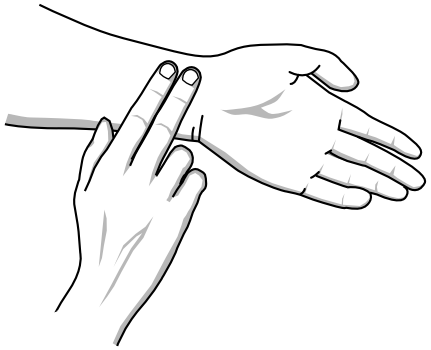

Fig. 10.2

(i) Name the **type** of blood vessel in which the pulse at the wrist occurs.

.....[1]

(ii) The pulse can be used as a way of measuring the heart rate. Explain why the beating of the heart causes a pulse at the wrist.

.....

.....[1]

(iii) When a person starts to run, their pulse rate increases. Explain how this helps the person to run fast.

.....

.....

.....[2]

11 Fig. 11.1 shows some water being heated in a saucepan.

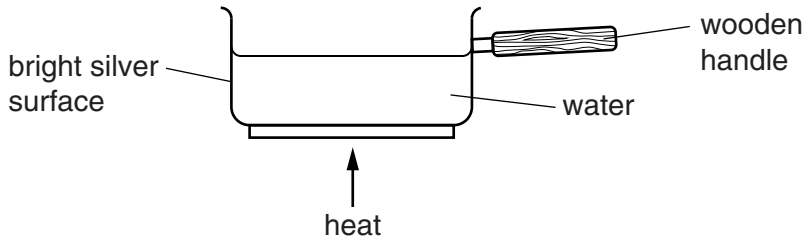

Fig. 11.1

(a) Explain why the materials have been used to make the saucepan shown in Fig. 11.1.

Use ideas of thermal energy transfer (heat energy) in your answer.

(i) wooden handle

.....

.....[1]

.

(ii) bright silver surface

.....

.....[1]

(b) Describe, in terms of particles, how thermal energy is transferred through the base of the saucepan by conduction and heats up all of the water by convection.

.....

.....

.....

.....

.....

.....[4]

(c) The weight of the saucepan and water is 15 N. The area of the saucepan in contact with the cooker is 300 cm^2.

Calculate the pressure exerted by the saucepan on the surface of the cooker in N/cm^2.

State the formula that you use and show your working.

formula

working

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

(d) 500 g of water is heated from 20 °C to 50 °C. The thermal energy required is 63 000 J.

Calculate the specific heating capacity of water.

State the formula that you use and show your working.

formula

working

specific heating capacity = ... J/(kg °C) [3]

12 Aluminium is a metallic element in Group III of the Periodic Table.

Iron is one of the transition metals in Period 4 of the Periodic Table.

(a) State **three** properties of transition metals that are different from non-transition metals such as those in Groups I, II and III.

1 .....

2 .....

3 .....[3]

(b) **(i)** Use the Periodic Table to help you to deduce the number of electrons in one atom of iron.

Explain how you chose your answer.

number of electrons .....

explanation .....[1]

(ii) State the number of electrons in the **outer** shell of an atom of aluminium.

Explain your answer.

number of outer electrons .....

explanation .....

.....[2]

(c) Fig. 12.1 shows some equipment that is used to produce molten iron for use in repairing broken steel rail track.

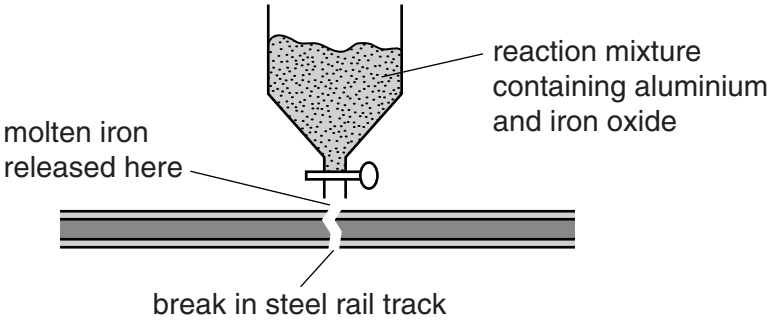

Fig. 12.1

The molten iron is a product of an exothermic reaction between aluminium and iron oxide. The balanced equation for the reaction is

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

(i) Explain, in terms of loss or gain of electrons, which atom or ion is oxidised in the reaction.

particle .....

explanation .....

.....

.....[3]

(ii) State whether the products of the reaction in Fig. 12.1 contain more, less or the same quantity of chemical potential energy as the reactants.

Explain your answer.

.....

.....

.....[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 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: box with a (top), **X** (centre), b (bottom)

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.).