UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7779176824

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **October/November 2010**

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 soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 24.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

This document consists of **22** printed pages and **2** blank pages.

1 Fig. 1.1 shows a section through the human thorax.

For Examiner's Use

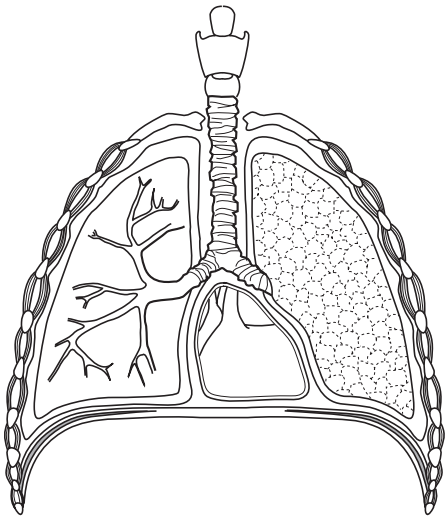


Fig. 1.1

(a) On the diagram, use label lines to label each of the following structures:

the trachea

the heart

a bronchiole [3]

(b) List the structures through which blood passes as it flows from the heart to the lungs and back to the heart again.

Choose from these words:

aorta	**artery**	**capillaries**	**left atrium**	**left ventricle**
pulmonary artery	**pulmonary vein**	**right atrium**	**right ventricle**	**vena cava**

The first structure has been done for you.

1 right ventricle

2 .....

3 .....

4 .....

5 ..... [4]

(c) Describe how the blood transports oxygen.

.....

.....

..... [2]

For Examiner's Use

(d) Describe how oxygen is supplied to a developing fetus in its mother's uterus.

.....

.....

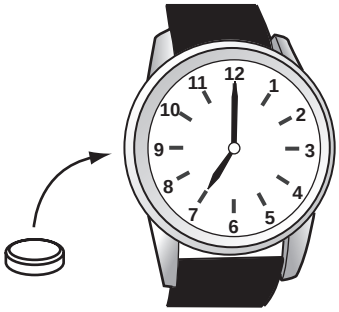
.....

..... [3]

2 In electrochemical cells (batteries), electrical energy is obtained from chemical reactions.

(a) Fig. 2.1 shows some uses of electrochemical cells.

watch



torch (flashlight)

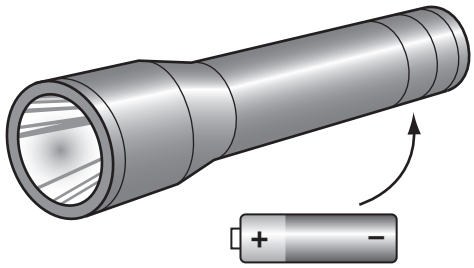


Fig. 2.1

(i) Electrochemical cells like those in Fig. 2.1 have to be replaced when they have stopped working.

Explain briefly what has happened inside the cells to cause them to stop working.

.....

..... [1]

(ii) State **one** reason why different cells are used in the watch and the torch (flashlight).

.....

..... [1]

For Examiner's Use

(b) Some types of digital clocks use electrical energy which is obtained from an electrochemical cell. These cells can be made by placing metal electrodes into a potato.

Fig. 2.2 shows a simplified diagram of such a clock.

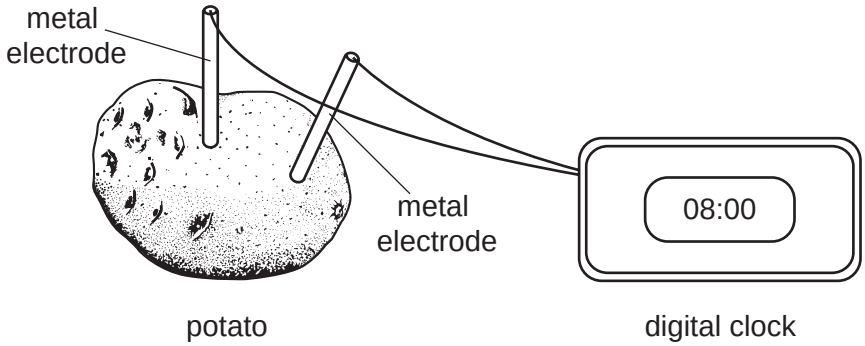


Fig. 2.2

(i) Suggest why a potato can be used as part of an electrochemical cell.

.....

..... [1]

(ii) State how the voltage supplied by the cell can be changed.

.....

..... [1]

(c) Some modern cars, known as hybrids, have two engines.

In one of these engines, hydrocarbon fuel is burnt to provide the energy required to move the car. In the other, electrical energy is provided by a powerful electrochemical cell.

At lower speeds, the electric engine drives the car and the other engine is switched off.

(i) Name a liquid hydrocarbon which is used as car fuel.

..... [1]

(ii) Name the process which is used to separate car fuel from petroleum.

..... [1]

(iii) Name **two** compounds which are produced when hydrocarbon fuel is burnt in a car engine.

1 .....

2 ..... [2]

(iv) Suggest why air pollution in towns and cities might be reduced if hybrid cars replaced ordinary cars.

.....

.....

.....

.....

..... [3]

For Examiner's Use

3 **(a)** A student wrote down some properties of alpha, beta and gamma radiations.

Draw a line from each property to the correct radiation.

property	radiation
has no charge	
has no mass	alpha
passes through paper but stopped by a few millimetres of aluminium	
	beta
passes through several centimetres of lead	
contains positively charged particles	gamma
stopped by paper	

[3]

(b) Alpha, beta and gamma radiations are known as ionising radiations.

(i) Explain the meaning of the term *ionising radiation*.

.....

..... [1]

(ii) Explain why alpha radiation is more effective at ionising than beta radiation.

..... [1]

(iii) State **two** effects of ionising radiation on the human body.

1 .....

2 ..... [2]

4 Nitrogen compounds in soil are taken up by growing crops.

Fig.4.1 shows two ways in which nitrogen compounds may be added to soil used for growing crops.

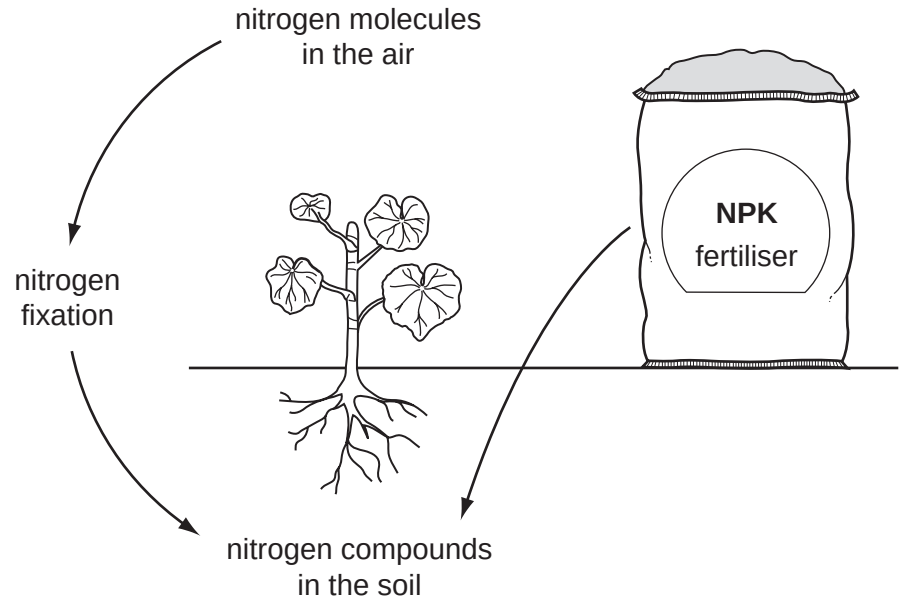


Fig. 4.1

(a) (i) State the meaning of the term *nitrogen fixation*.

.....

..... [1]

(ii) Outline **one** way in which nitrogen fixation occurs.

.....

.....

..... [2]

(iii) Explain why nitrogen molecules taken directly from the air **cannot** be used by most growing crops.

.....

..... [1]

(b) Table 4.1 shows how much of three elements, nitrogen, phosphorus and potassium, was removed from the soil by different crops. In this table, the elements are shown by their chemical symbols.

Table 4.1

crop	mass removed in kg / hectare		
	N	**P**	**K**
oats	72	13	18
sugar beet	86	14	302
wheat	115	22	26

(i) State the crop in Table 4.1 which took up the **highest** mass of potassium per hectare.

..... [1]

(ii) The sugar beet was planted in a field of 2.5 hectares.

Calculate the combined mass of nitrogen and phosphorus taken up by the crop of sugar beet.

Show your working.

..... kg [1]

For Examiner's Use

(c) The nitrogen in NPK fertiliser exists in the form of compounds such as the salts ammonium nitrate, NH_4NO_3, and diammonium phosphate, $(NH_4)_2HPO_4$.

Ammonium nitrate is made by reacting ammonia with nitric acid.

(i) Name the type of chemical reaction which occurs between ammonia and nitric acid.

..... [1]

(ii) State the total number of atoms which are shown combined in the formula of diammonium phosphate.

..... [1]

(iii) Describe a chemical test to show whether a solution contains ammonium ions.

.....

.....

.....

..... [3]

(d) Starch molecules are polymers of glucose.

(i) Draw a small section of a molecule of starch, using the symbol

to represent a glucose molecule.

[1]

(ii) **Name** the elements that are combined in glucose.

..... [1]

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Please turn over for Question 5.

5 **(a)** A student investigated the relationship between the potential difference across a lamp and the current in the lamp.

(i) List the apparatus she would need to carry out this investigation.

.....

.....

..... [2]

Fig. 5.1 shows a graph of the results of this investigation.

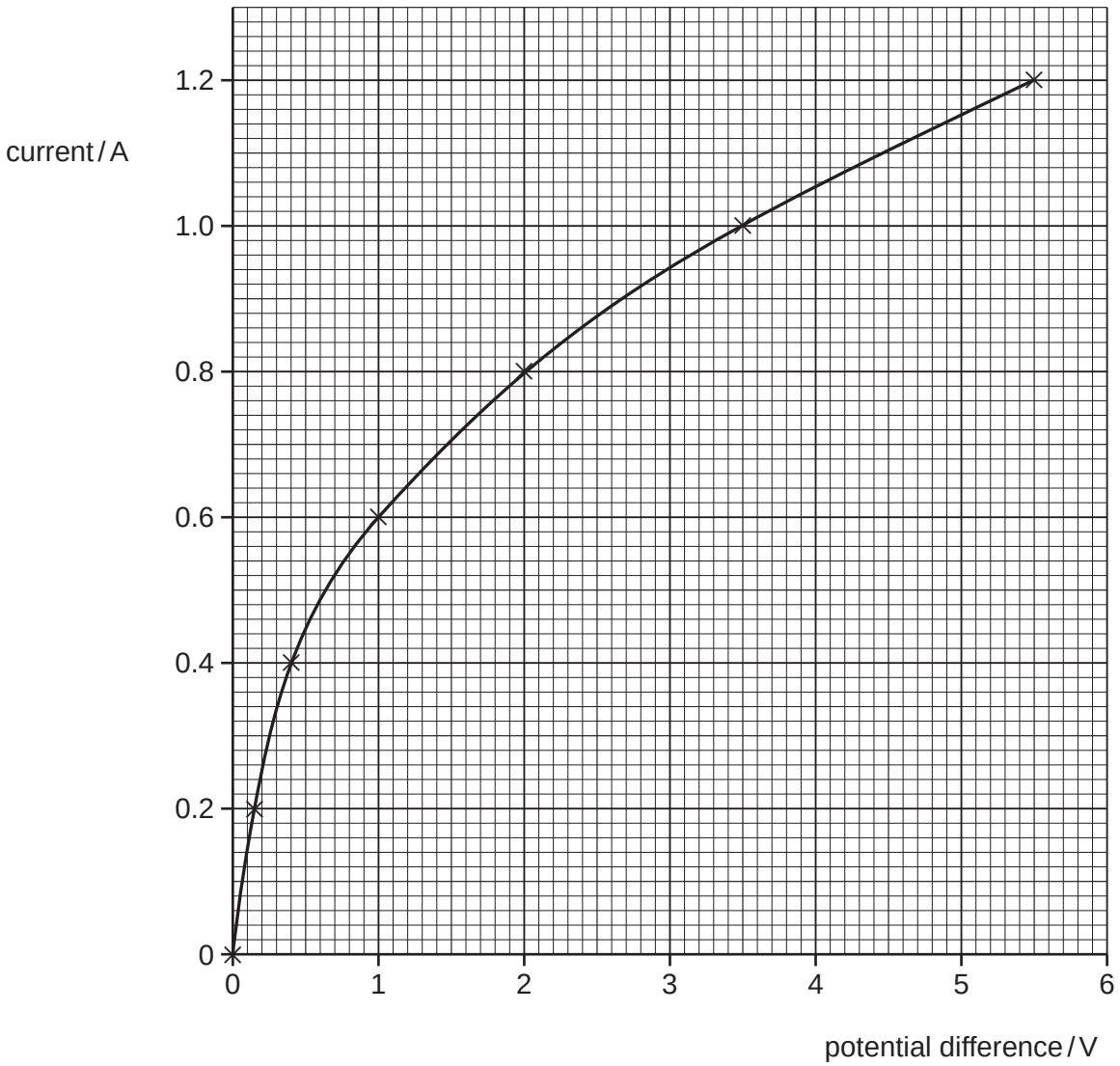

Fig. 5.1

For Examiner's Use

(ii) Calculate the resistance of the lamp when the current was 0.6 A.

State the formula that you use and show your working.

formula used

working

..... ohms [2]

(b) (i) The generator at a power station supplies a current of 50 A at a voltage of 25 000 V.

Use the formula

power = voltage × current

to calculate the power output of the generator.

Show your working.

..... W [1]

(ii) Electrical energy is transmitted along cables at a very high voltage of 400 000 V.

Explain how this reduces the cost of supplying the electricity. Use the ideas of energy loss and current in your answer.

.....

.....

.....

..... [3]

(iii) State **two** properties of aluminium which make it suitable for overhead power cables.

1 .....

2 ..... [2]

For Examiner's Use

6 Fig. 6.1 shows two plant cells. One has been placed in a blue dye and the other in a red dye.

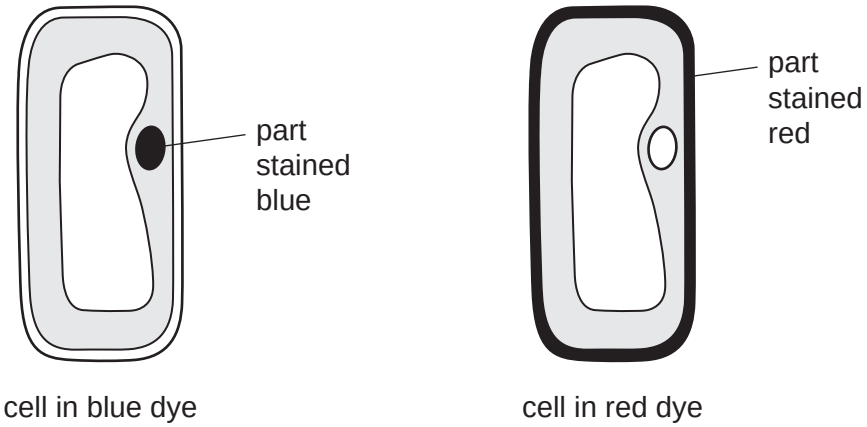

Fig. 6.1

(a) (i) Name the part of the cell that has been stained by each dye.

the blue dye .....

the red dye ..... [2]

(ii) Which dye(s) has passed through a cell membrane? Tick the correct box.

☐ neither blue or red

☐ both blue and red

☐ blue only

☐ red only [1]

(iii) Which dye(s) would stain part of an animal cell? Tick the correct box.

☐ neither blue or red

☐ both blue and red

☐ blue only

☐ red only [1]

(b) (i) Cells from the palisade layer of a leaf contain structures **not** shown in Fig. 6.1.

These structures contain a green pigment that absorbs energy from sunlight. This energy is used to help the plant to make its own food.

On the cell in blue dye in Fig. 6.1, **draw** and **name** one of these structures. [2]

(ii) Describe how a plant makes its own food.

.....

.....

.....

..... [3]

(iii) Explain how the process you have described in **(ii)** benefits animals.

.....

.....

.....

..... [3]

For Examiner's Use

7 An athlete is running in a sprint race.

(a) Fig. 7.1 shows the athlete's speed during the race.

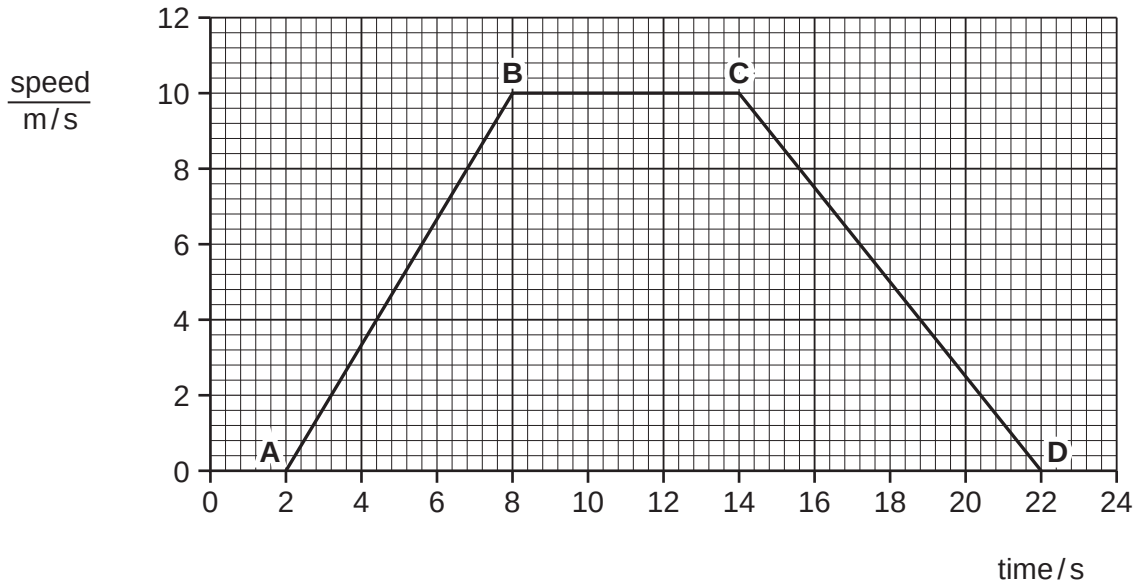

Fig. 7.1

(i) Describe the athlete's motion between **B** and **C**.

.....

..... [1]

(ii) Describe the athlete's motion between **C** and **D**.

.....

..... [1]

(b) Complete the sentence by choosing suitable words.

As the athlete runs, the ..... energy in the food he has eaten changes to ..... energy and heat energy. [2]

(c) At the end of the race, evaporation helps to cool the athlete.

(i) Use the idea of particles to explain how evaporation helps the athlete to cool down.

.....

.....

..... [2]

(ii) At the end of a long race, an athlete may be wrapped in a shiny foil blanket to prevent him cooling down too quickly.

Explain how the shiny foil blanket helps reduce energy losses. Use ideas about conduction, convection and radiation in your answer.

.....

.....

.....

..... [3]

For Examiner's Use

8 **(a)** The disease cystic fibrosis is caused by a recessive allele, **f**, of a gene. The symbol for the normal, dominant allele is **F**.

(i) State the genotype of a person with cystic fibrosis.

..... [1]

(ii) State the phenotype of a person who is heterozygous for cystic fibrosis.

..... [1]

(iii) Explain why a person who has the alleles **FF** cannot have a child with cystic fibrosis.

You can use a genetic diagram as part of your answer if it helps your explanation.

.....

.....

.....

..... [3]

(b) A person with cystic fibrosis often has a blockage of the duct that leads from the pancreas into the alimentary canal.

This duct usually carries pancreatic juice, which contains the enzymes amylase, protease and lipase.

(i) Describe the function of amylase.

.....

..... [2]

(ii) Explain why a person with a blocked pancreatic duct will not be able to absorb as many nutrients from their food as a person with a normal pancreatic duct.

.....

.....

..... [2]

9 Fig. 9.1 shows the driving force and frictional force acting on a car of mass 1200 kg travelling at a constant speed of 18 m / s.

For Examiner's Use

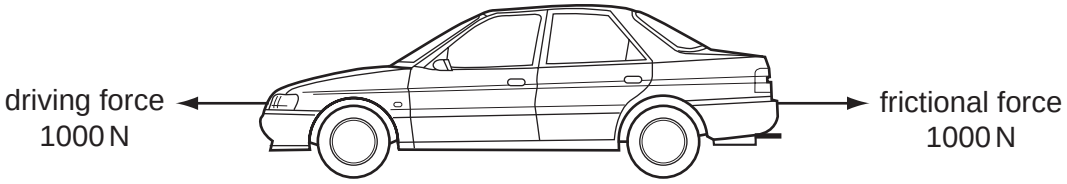

Fig. 9.1

(a) (i) Calculate the distance travelled in one minute.

.....m [1]

(ii) Calculate the work done by the driving force in one minute.

State the formula that you use and show your working.

formula used

working

.....J [2]

(b) Explain, in terms of forces, why the car is travelling at a constant speed.

.....

..... [1]

For Examiner's Use

(c) Fig. 9.2 shows a car on a hydraulic lift in a garage. The total weight being lifted is 18 000 N. The lift uses four large pistons. Each large piston has an area of 0.03 m^2. The smaller piston **X** has an area of 0.01 m^2.

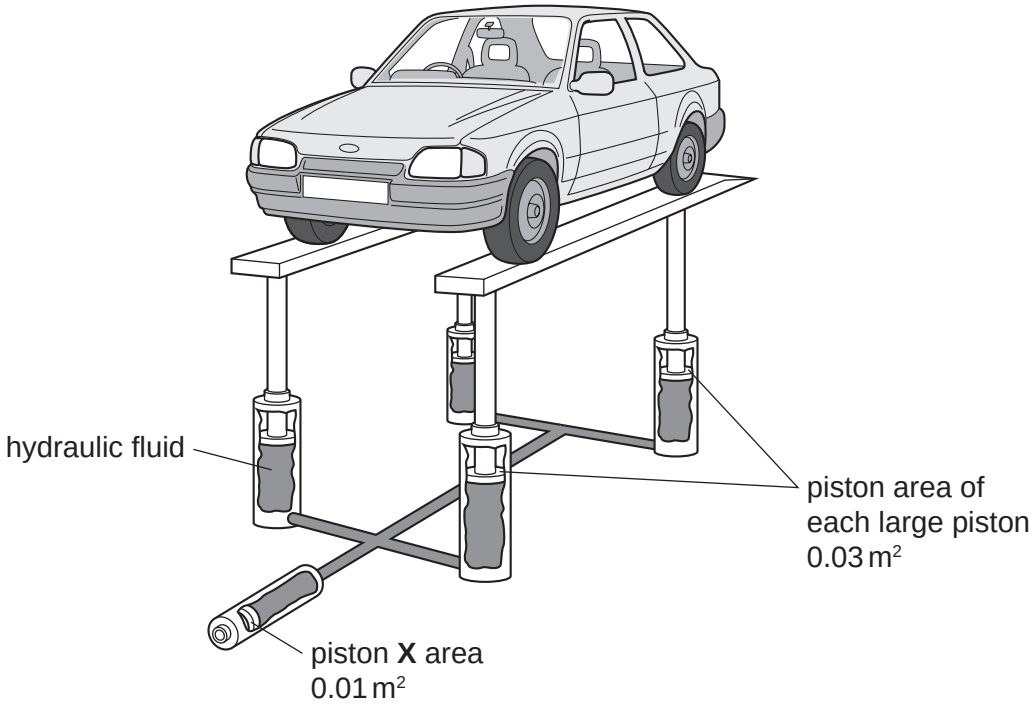

Fig. 9.2

(i) Calculate the total area of the four large pistons.

..... m^2 [1]

(ii) Use the formula

pressure = force / area

to calculate the pressure in the hydraulic fluid used in the lift.

Show your working.

..... N/m^2 [1]

(iii) This pressure is caused by piston **X**.

Calculate the minimum force which piston **X** must exert to lift the car.

Show your working.

..... N [2]

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Please turn over for Question 10.

10 Table 10.1 shows some properties of five elements, **P** to **T**. The code letters are **not** the chemical symbols of the elements.

For Examiner's Use

Table 10.1

element code letter	melting point / °C	boiling point / °C	conduction of electricity	number of outer electrons in an atom
P	-89	-186	insulator	8
Q	650	1090	conductor	2
R	-7	58	insulator	7
S	181	1342	conductor	1
T	-220	-188	insulator	7

Answer the following questions, using **only** the elements shown in the table.

(a) (i) State and explain which elements are from the same **group** of the Periodic Table.

elements .....

explanation .....

..... [1]

(ii) State and explain which elements are metals.

elements .....

explanation .....

..... [1]

(iii) State and explain which elements are gases at a room temperature of 20 °C.

elements .....

explanation .....

..... [1]

(b) Fig. 10.1 shows atoms of the two elements **R** and **S**. Only the outer electron shells are shown.

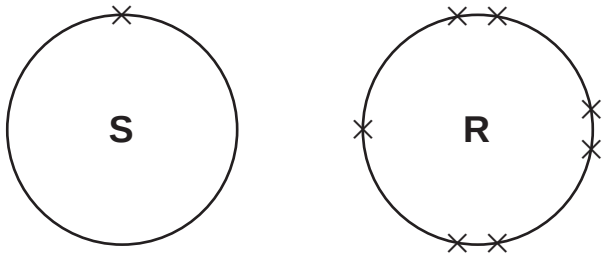

Fig. 10.1

When element **R** reacts with element **S** the atoms of both elements change and become **ions**.

(i) Describe, in terms of electrons, how an atom of element **S** would change into an ion.

.....

..... [1]

(ii) Predict and explain whether the compound formed between elements **S** and **R** is likely to be a solid, liquid or gas at room temperature.

Explain your answer.

state .....

explanation .....

.....

..... [3]

(c) The element bromine is produced when compounds dissolved in seawater react with chlorine.

The word equation for a typical reaction producing bromine is shown below.

chlorine + sodium bromide ⟶ sodium chloride + bromine

(i) State the colour change which would show that bromine is produced in this reaction.

..... [1]

(ii) Explain briefly, in terms of reactivity, why these reactants produce bromine.

.....

..... [1]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 †															

*58-71 Lanthanoid series
†90-103 Actinoid series

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

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 dm^3 at room temperature and pressure (r.t.p.).