Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0559592856O

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **May/June 2018**

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

CAMBRIDGE International Examinations

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1 Fig. 1.1 shows a diagram of the gas exchange system.

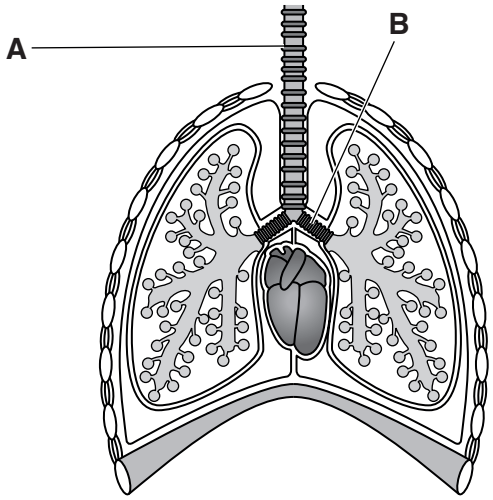

Fig. 1.1

(a) (i) Name the parts labelled **A** and **B** in Fig. 1.1.

A .....

B .....
[2]

(ii) Add a label line and the letter **C** to Fig. 1.1 to identify the organ responsible for pumping blood around the body. [1]

(b) Describe **two** ways in which the composition of inspired (breathed in) air differs from expired (breathed out) air.

1 .....

2 .....
[2]

(c) Describe how the pattern of breathing changes during exercise.

.....

.....

.....[2]

(d) Movement and respiration are two of the characteristics of living organisms.

State **two** other characteristics of living organisms.

1 .....

2 .....
[2]

2 A student investigates what happens when she adds magnesium to dilute hydrochloric acid.

Fig. 2.1 shows the apparatus she uses.

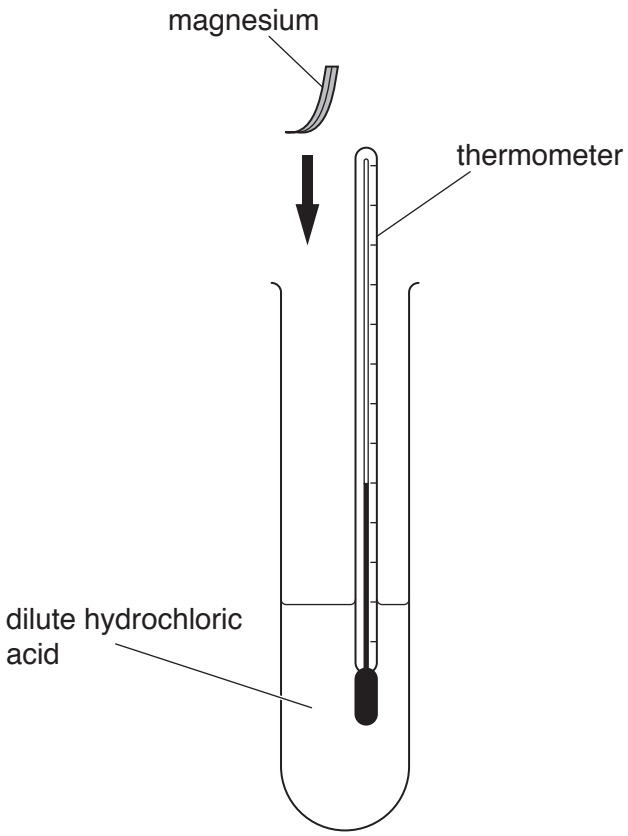

Fig. 2.1

(a) (i) The reaction is exothermic.

Describe **two** observations that show a chemical reaction occurs in her investigation.

1 .....

2 .....
[2]

(ii) Name the magnesium compound that forms.

.....[1]

(b) Fig. 2.2 shows magnesium reacting with carbon dioxide.

The reaction produces magnesium oxide and carbon.

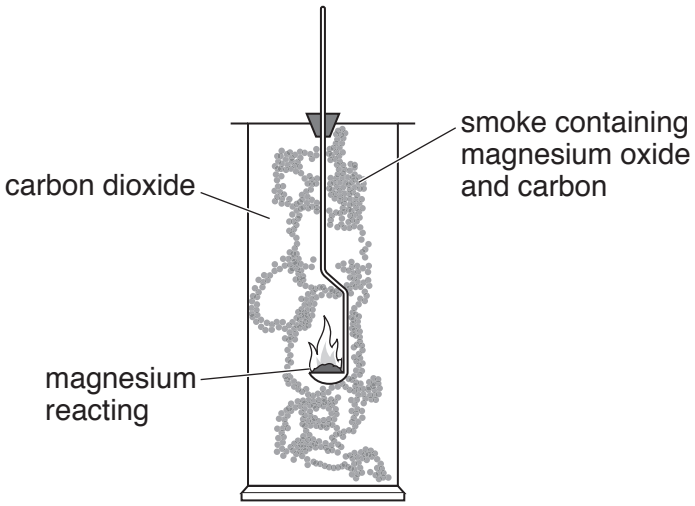

Fig. 2.2

(i) State the **word** equation for this reaction.

carbon dioxide	+		→		+	

[1]

(ii) Identify which substance is **reduced** during this reaction.

Explain your answer.

substance .....

explanation .....

.....

[2]

(c) Table 2.1 shows information about the composition of an alloy.

The table is incomplete.

Table 2.1

element	% by mass
aluminium	
calcium	2.0
magnesium	91.5
manganese	0.4
zinc	0.1

(i) Calculate the mass of aluminium in 100 g of the alloy.

Show your working.

mass = ... g [1]

(ii) Parts of aircraft are made of alloys.

State **one** reason, other than density, for using an alloy rather than a pure metal to make parts for aircraft.

.....

.....[1]

(d) Magnesium and manganese are metals shown in different periods in the Periodic Table.

(i) State what is meant by a *period* in the Periodic Table.

.....

.....[1]

(ii) Manganese is a transition metal.

State **two** properties of manganese that are **not** properties of magnesium.

1 .....

2 .....
[2]

3 **(a)** In a nuclear power station, the fission of uranium-235 nuclei takes place.

Describe what happens to the nucleus of a uranium-235 atom in this process.

.....[1]

(b) The nuclear power station produces waste radioactive isotopes.

Suggest **one** way of safely **storing** waste radioactive isotopes.

.....

.....[1]

(c) The electricity generated in the power station is transmitted using overhead power cables.

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

.....[1]

(ii) State **one** other way by which the resistance of the cable could be changed.

.....[1]

(d) In the power station, thermal energy is used to heat liquid water and turn it into steam, a gas.

(i) Fig. 3.1 shows the arrangement of particles in a solid.

Each circle represents one particle.

Complete Fig. 3.1 to show the arrangement of particles in a liquid and in a gas.

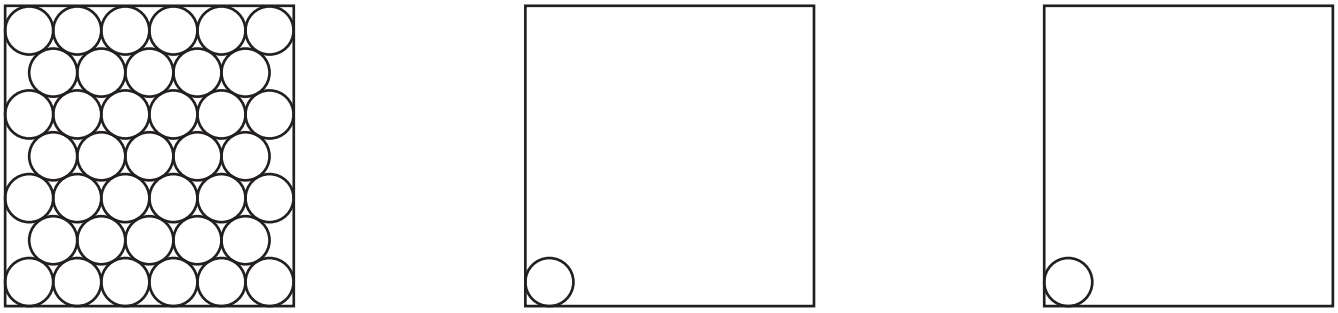

Fig. 3.1

[2]

(ii) The boiling point of water is 100 °C.

State the meaning of the term *boiling point*.

.....

.....[1]

4 Fig. 4.1 shows a diagram of a cross-section of a leaf as it appears under a microscope.

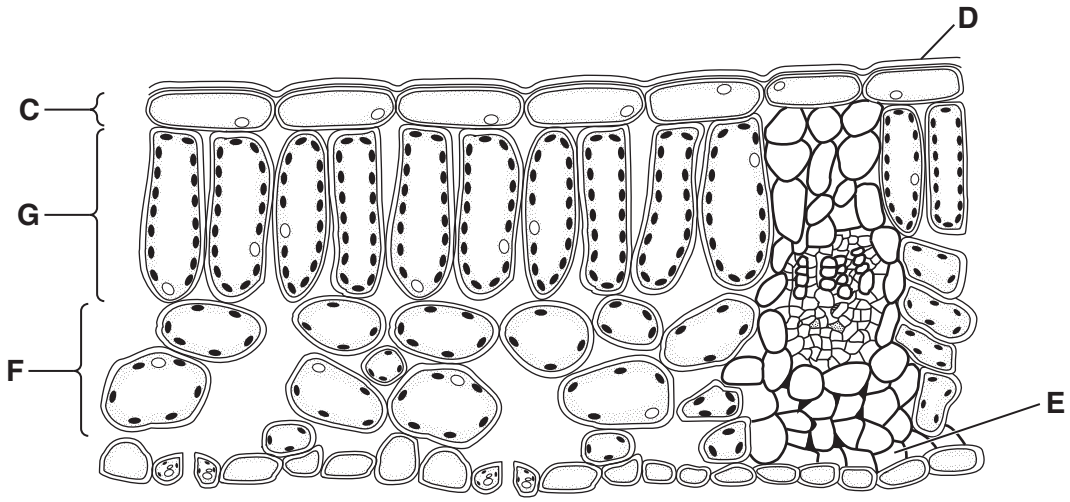

Fig. 4.1

(a) (i) Using Fig. 4.1, state the letter which represents the cuticle.

..... [1]

(ii) Using Fig. 4.1, state the letter which represents the palisade mesophyll layer.

..... [1]

(iii) Add a label line and the letter **V** to Fig. 4.1 to identify a vascular bundle. [1]

(b) Leaves are adapted for photosynthesis.

(i) State the **two** products of photosynthesis.

1 .....

2 .....
[1]

(ii) State the form of energy required for photosynthesis.

.....[1]

(iii) Describe **one** way in which the palisade mesophyll cells are adapted for photosynthesis.

.....

.....[1]

(c) Carbon dioxide is one of the raw materials required for photosynthesis.

Complete the sequence to show the pathway of carbon dioxide from the atmosphere to a chloroplast.

atmosphere

↓

…….....

↓

air space in leaf

↓

mesophyll cell wall

↓

…….....

↓

chloroplast

[2]

5 **(a)** Table 5.1 shows the numbers of protons and of neutrons in five atoms **A** to **E**.

The letters are **not** the chemical symbols of the elements.

Table 5.1

atom	number of protons	number of neutrons
A	9	10
B	10	12
C	10	10
D	18	22
E	20	20

(i) State the atomic number of atom **B**.

..... [1]

(ii) State the mass number of atom **D**.

..... [1]

(iii) State which **two** atoms are of the same element.

Explain your answer.

atoms ..... and .....

explanation .....

..... [1]

(iv) State **and** explain which atom in Table 5.1 contains the greatest number of electrons.

atom .....

explanation .....

..... [1]

(b) Fig. 5.1 shows industrial apparatus used to make ammonia gas, NH_3, from nitrogen, N_2, and hydrogen, H_2.

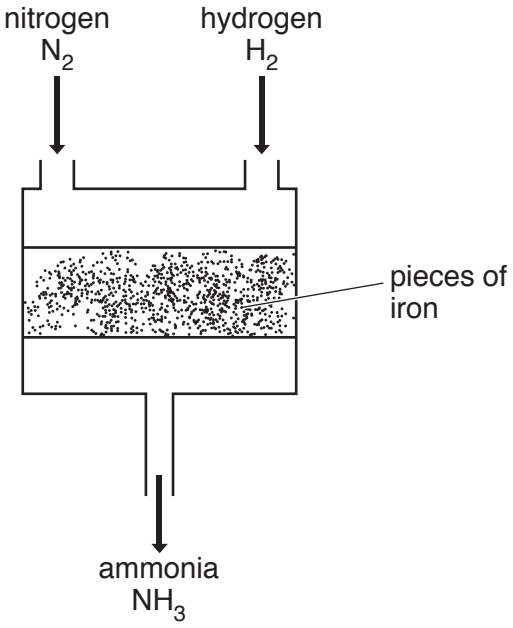

Fig. 5.1

(i) In this apparatus the iron is a catalyst for the reaction.

Define the term *catalyst*.

.....

.....

.....[2]

(ii) Explain why ammonia is **not** shown in the Periodic Table.

.....

.....[1]

(iii) Deduce the type of chemical bond in a molecule of ammonia, NH_3.

Explain your answer.

type of bond .....

explanation .....

.....

[2]

(c) Ammonia is used to make urea, $(NH_2)_2CO$.

Calculate the total number of atoms in one molecule of urea.

total number of atoms .....[1]

6 **(a)** Fig. 6.1 shows the forces **P**, **Q**, **R** and **S** acting on a tractor when a farmer is driving it at constant speed.

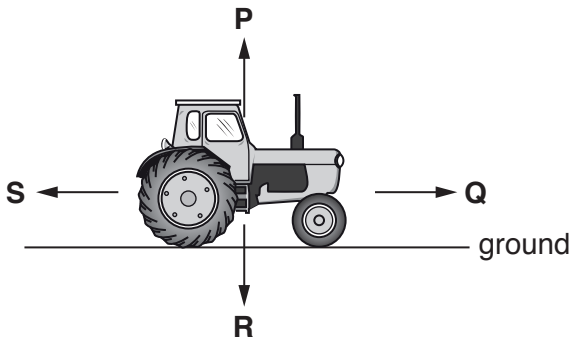

Fig. 6.1

(i) State which force, **P**, **Q**, **R** or **S**, is the weight of the tractor.

..... [1]

(ii) State why forces **Q** and **S** must be equal and opposite.

.....

.....[1]

(iii) The tractor travels 1.1 km in 12 minutes.

Calculate the speed of the tractor in m/s.

State the formula you use and show your working.

formula

working

speed = ... m/s [3]

(b) Fig. 6.2 shows a tractor and a car next to each other on muddy ground.

The tractor is much heavier than the car but the car has sunk into the muddy ground.

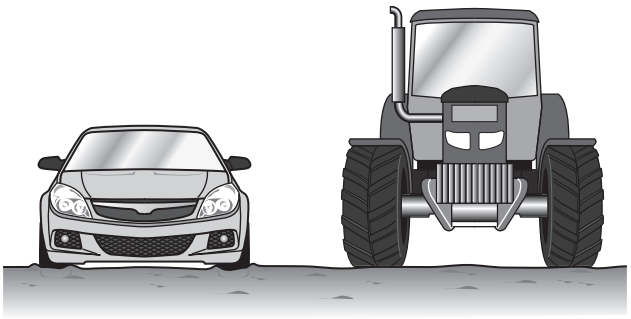

Fig. 6.2

Explain why the tractor has not sunk into the muddy ground.

Use the word **pressure** in your answer.

.....

.....

.....[2]

(c) Fig. 6.3 shows a ray of light from the Sun incident on the surface of the farmer's pond.

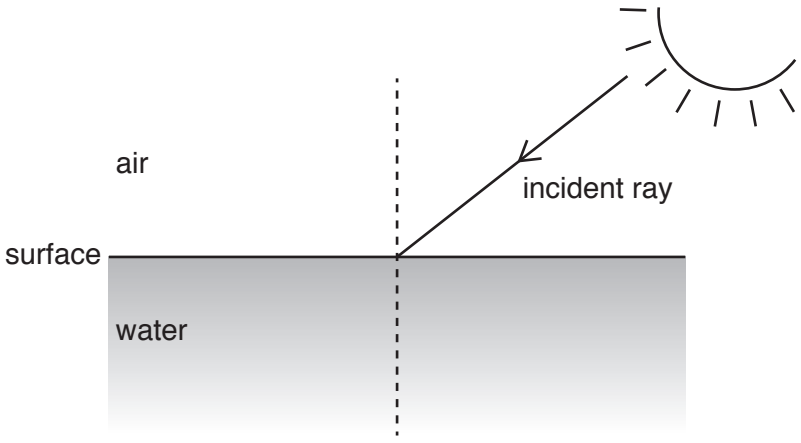

Fig. 6.3

On Fig. 6.3, draw the refracted ray entering the water at the surface.

Label the angle of incidence ***i*** and the angle of refraction ***r***. [3]

(d) On a hot day, some water from the farmer's pond evaporates.

Describe how molecules of water are able to evaporate.

.....

.....

.....

.....

.....[3]

7 Deforestation is the clearing of an area of trees.

Table 7.1 shows the area of land which has been cleared each year in Brazil over a ten-year period.

Table 7.1

year	area of land cleared / km^2
2000	18 226
2001	18 165
2002	21 523
2003	25 396
2004	27 772
2005	19 014
2006	14 196
2007	11 633
2008	12 911
2009	7 008

(a) (i) State the year in which the highest rate of deforestation occurred.

..... [1]

(ii) Calculate the percentage decrease in deforestation between **2008** and **2009**.

Show your working.

decrease = ... % [2]

(b) Deforestation can cause species to become extinct.

Suggest how deforestation leads to the extinction of species.

.....

.....

.....[2]

(c) Deforestation causes a change in the environment. When changes occur, only the best adapted organisms are able to survive and pass on their genes.

State the name of the process which is defined as the greater chance of passing on of genes by the best-adapted organisms.

.....[1]

8 **(a)** Chlorine is a very reactive element in Group VII.

(i) Chlorine is used to treat water supplies.

State why untreated water can be dangerous to drink, and explain why treating with chlorine can make water safer to drink.

.....

.....

.....[2]

(ii) Describe what is observed when chlorine is mixed with colourless sodium iodide solution.

Explain your answer using ideas about reactivity.

observation .....

explanation .....

.....

[2]

(iii) Predict **and** explain whether chlorine reacts with argon gas.

prediction .....

explanation .....

.....

[1]

(b) Chlorine combines with hot copper metal to form the ionic compound copper(II) chloride.

(i) State whether a chloride ion has a positive or a negative electrical charge.

Explain your answer.

charge .....

explanation .....

.....

[1]

(ii) Describe a chemical test to show that a copper chloride solution contains copper(II) ions.

test .....

result .....

[2]

[Turn over

9 **(a)** Table 9.1 shows the power generated by a wind turbine at different wind speeds.

Table 9.1

power generated / kW	wind speed / km per hour
0.00	0
0.00	2
0.14	4
0.91	10
1.11	12
1.16	14
1.16	16
1.16	18

(i) Name the unit with the symbol kW.

.....[1]

(ii) Suggest the power generated by a windspeed of 25 km / h.

..... kW [1]

(iii) Use Table 9.1 to estimate the lowest wind speed needed to generate 1.00 kW.

wind speed = ... km / h [1]

(b) The wind turbines are noisy when they are turning. When they turn more slowly, the sound waves emitted have a lower frequency.

State how the pitch of the sound of the wind turbine changes when the frequency of the sound waves emitted is decreased.

.....[1]

(c) Thermal energy from the Sun heats the Earth's atmosphere.

This causes convection currents of air that we feel as wind.

The kinetic energy in wind is therefore a renewable energy resource.

(i) State **one** other renewable energy resource.

.....[1]

(ii) State the direction of the movement of warm air in a convection current.

.....[1]

(iii) Name the process responsible for the thermal energy transfer from the Sun to the Earth.

.....[1]

(iv) Name the part of the electromagnetic spectrum responsible for most thermal energy transfer from the Sun to the Earth.

.....[1]

10 Fig. 10.1 shows a diagram of the female reproductive system.

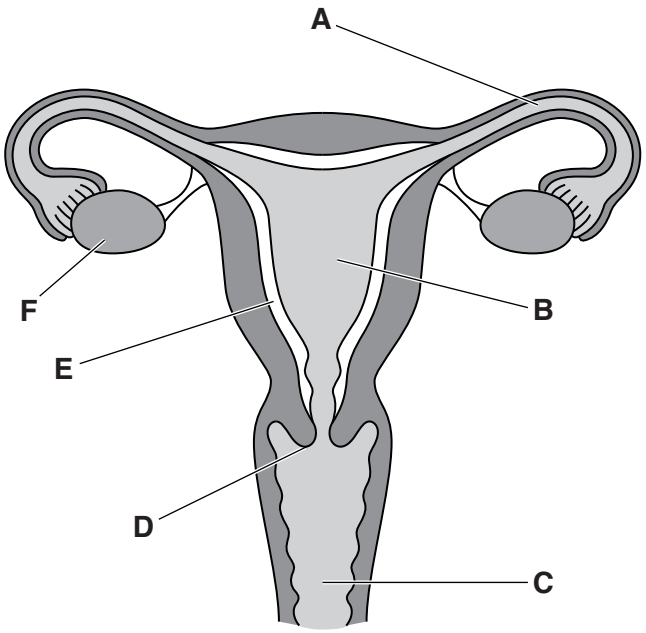

Fig. 10.1

(a) Table 10.1 shows the names, letters and functions of some of the parts of the female reproductive system shown in Fig. 10.1.

Use the information in Fig. 10.1 to complete Table 10.1.

Table 10.1

name of part	letter on Fig. 10.1	function
		where fertilisation occurs
	F	
		where implantation occurs
vagina		receives penis during intercourse

[4]

(b) (i) Complete the sentence to describe the process of fertilisation.

Fertilisation is the joining of the ..... of the male gamete and the female gamete. [1]

(ii) After fertilisation, a zygote is formed.

Describe what happens to the zygote between fertilisation and implantation.

.....

.....

.....

.....[2]

(c) Humans reproduce by sexual reproduction.

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

1 .....

.....

2 .....

.....

[2]

11 Gasoline is separated from raw material **J**.

Gasoline is a mixture of hydrocarbons.

(a) (i) Name **J**.

.....[1]

(ii) State the process used to separate gasoline from **J**.

.....[1]

(iii) Gasoline contains the hydrocarbon hexane.

Fig. 11.1 shows the structure of a hexane molecule.

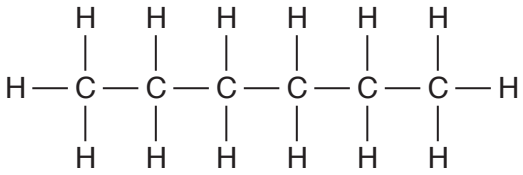

Fig. 11.1

Complete the sentences about hexane using words from the list.

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

alcohol **alkane** **alkene** **double**

reactive **saturated** **single** **unsaturated**

Hexane is an ..... .

Hexane molecules are ..... because they contain only ..... chemical bonds.

[3]

(b) Gasoline is used as fuel in cars.

Car engines produce exhaust gas, which is a mixture of gases.

Fig. 11.2 shows the exhaust gas released from a car engine.

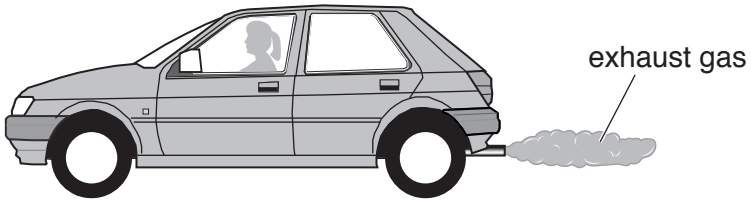

Fig. 11.2

Table 11.1 shows the composition of clean, dry air and of exhaust gas.

Table 11.1

gases	% by volume	
	clean, dry air	exhaust gas
nitrogen		67
carbon dioxide and other gases	1	13
water vapour	0	11
oxygen		9

(i) Complete Table 11.1 by stating the percentages of nitrogen and oxygen in clean, dry air. [2]

(ii) Suggest why the exhaust gas contains more carbon dioxide and water vapour than the clean, dry air used by the car engine.

.....

.....

.....[2]

(iii) State **two** harmful common air pollutants, **not** named in Table 11.1, that may be present in car exhaust gas.

1 .....

2 .....
[2]

12 (a) Fig. 12.1 shows a washing machine connected by a cable to a 230 V mains supply.

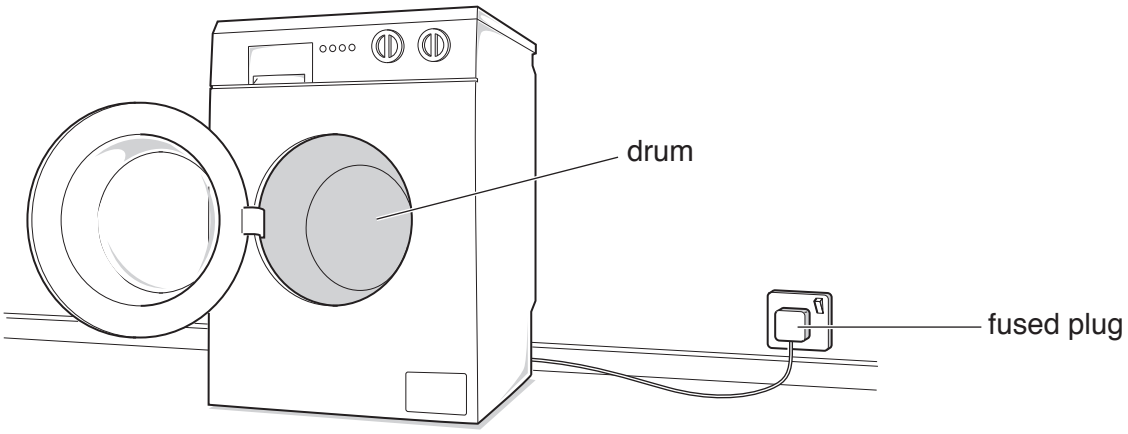

Fig. 12.1

When switched on, an electric motor rotates the drum and the clothes.

Complete the sentences below to describe some of the energy transformations occurring in the washing machine.

The useful energy transformation occurring in the electric motor is from

..... energy to ..... energy.

Some of the energy supplied to the motor is wasted as .....

energy and ..... energy.

[2]

(b) The fuse in the plug for the washing machine has to be replaced.

The maximum current through the washing machine when in use is 9 A.

The list shows available fuses that have different current ratings.

1 A 3 A 5 A 13 A 30 A

(i) State **and** explain which of these fuses should be used.

fuse rating ..... A

explanation .....

.....

[2]

(ii) State the purpose of the fuse in the plug for the washing machine.

.....

.....[1]

(c) The washing machine has an electric heater to heat the water.

A current of 4.5 A passes through the heater when the voltage across it is 230 V.

Calculate the resistance of the heater.

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

formula

working

resistance = ... unit ..... [3]

(d) The casing of the washing machine is made from steel.

(i) State **one** difference between the magnetic properties of steel and iron.

.....

.....[1]

(ii) The steel casing is made from a steel block. Each block is a cube with sides of 13 cm.

Calculate the volume of the steel block.

volume = ... cm^3 [1]

(iii) Steel has a density of 7.80 g / cm^3.

Use your answer to **(d)(ii)** to calculate the mass of the steel block.

State the formula you use and show your working.

formula

working

mass = ... g [2]

13 Fig. 13.1 shows a graph of the changes to blood glucose concentration immediately after eating a meal.

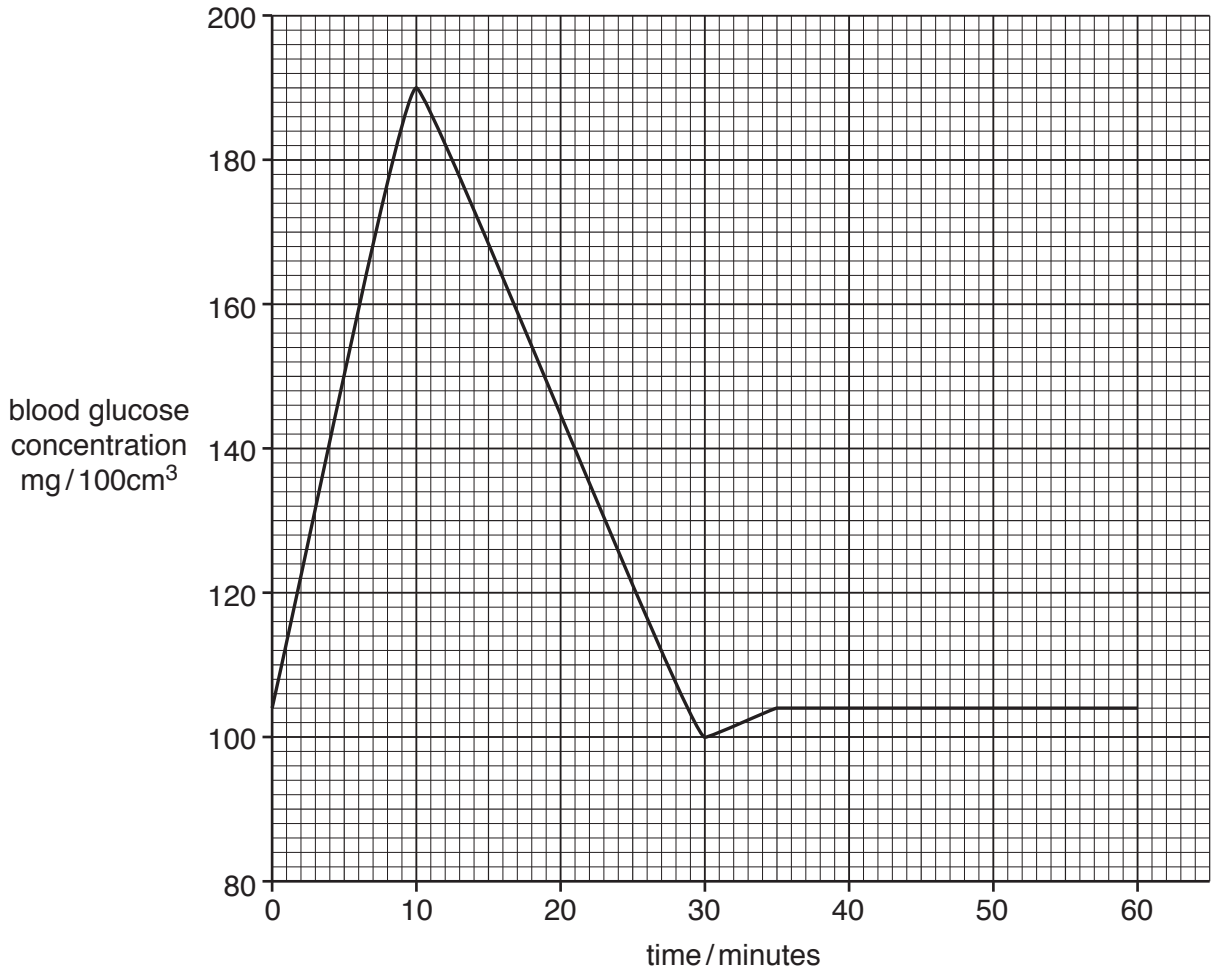

Fig. 13.1

(a) Describe the changes to blood glucose concentration after a meal.

from 0–10 minutes .....

.....

from 10–30 minutes .....

.....

from 30–60 minutes .....

.....

[3]

(b) Respiration requires glucose.

State the **word** equation for respiration.

.....[2]

(c) Name a hormone that increases blood glucose concentration.

.....[1]

(d) Describe what happens to a hormone between the time it is produced by a gland until it is destroyed.

.....

.....

.....[2]

The Periodic Table of Elements

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 –		

Key

atomic number
atomic symbol
name
relative atomic mass

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.).