UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

CO-ORDINATED SCIENCES **0654/21**

Paper 2 (Core) **October/November 2011**

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	
Total	

This document consists of **23** printed pages and **1** blank page.

For Examiner's Use

1 **(a)** Fig. 1.1 shows a section through a human eye.

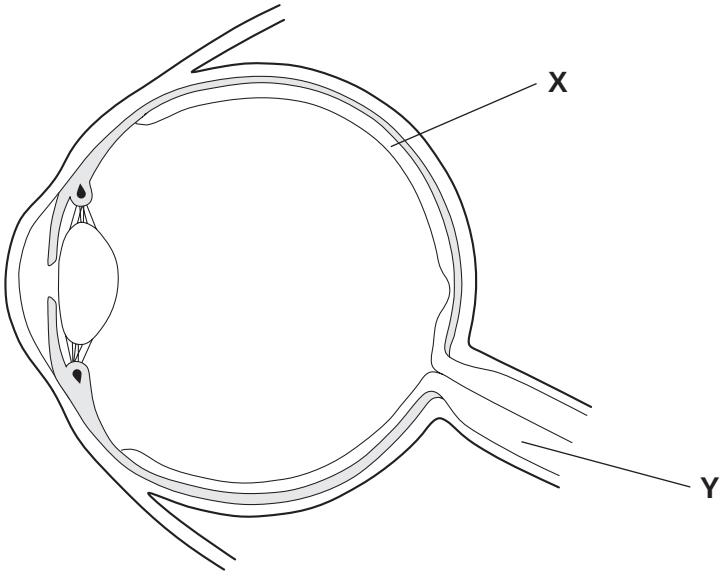


Fig. 1.1

(i) Name parts **X** and **Y**.

X .....

Y ..... [2]

(ii) On Fig. 1.1, draw **one** ray of light entering the eye and reaching an area where light-sensitive cells are found. [2]

(iii) On Fig. 1.1, use a label line and the letter **F** to label **one** part of the eye that helps to focus light onto the light-sensitive part of the eye. [1]

(iv) Describe how information is sent from the light-sensitive cells to the brain.

.....

.....

..... [2]

For Examiner's Use

(b) Almost all cells in the body have a nucleus, which contains chromosomes made of DNA.

(i) Name **one** type of cell in the human body that does **not** contain a nucleus.

..... [1]

(ii) In humans, a sperm cell has 23 chromosomes.

Suggest the number of chromosomes that are present in **one** of the light-sensitive cells in the human eye.

..... [1]

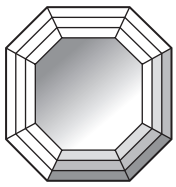
(iii) Outline the function of DNA.

.....

.....

..... [2]

2 Diamonds, sapphires and rubies are found in the Earth's crust and are valuable as industrial materials and for making jewellery.



(a) Table 2.1 shows the numbers of protons, neutrons and electrons in three atoms, **X**, **Y** and **Z.**

Table 2.1

atom	number of protons	number of neutrons	number of electrons
X	5	6	5
Y	6	7	6
Z	12	12	12

(i) Diamonds are made of the element carbon.

Explain which one of the atoms, **X**, **Y** or **Z**, shown in Table 2.1 is a carbon atom.

atom .....

explanation .....

..... [1]

(ii) State the nucleon number (mass number) of atom **X** in Table 2.1.

..... [1]

(b) The main compound in sapphires and rubies is aluminium oxide.

Aluminium oxide is an ionic compound.

(i) Aluminium oxide has the chemical formula, Al_2O_3.

Explain what this formula means.

.....

.....

..... [2]

(ii) State **one** way in which an ion differs from an atom.

.....

..... [1]

(c) Fig. 2.1 shows a simplified diagram of a process which is used to obtain metallic aluminium.

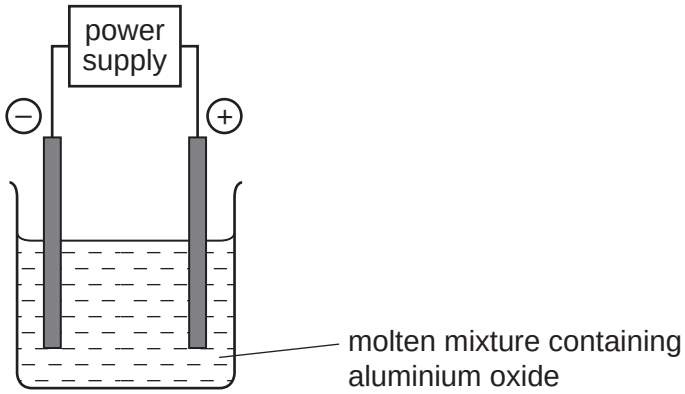


Fig. 2.1

(i) Name the process shown in Fig. 2.1, and state the meaning of the word *anode*.

name of process .....

meaning of anode .....

..... [2]

(ii) Explain why the mixture containing aluminium oxide in Fig. 2.1 must be kept molten.

.....

.....

..... [2]

(iii) Complete the simple **word** chemical equation below which describes the main reaction taking place in the process in Fig. 2.1.

aluminium oxide ⟶ ..... + ... [1]

For Examiner's Use

3 Fig. 3.1 shows a speed-time graph for the performance of an athlete in a race.

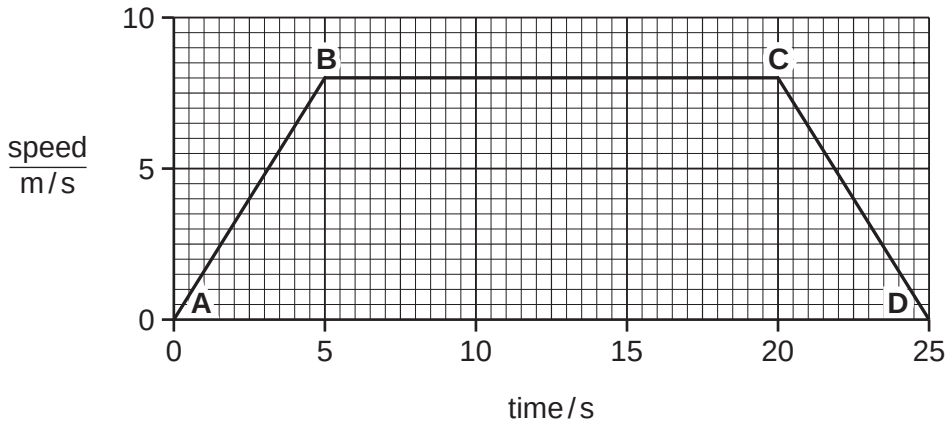


Fig. 3.1

(a) Use the graph to describe the motion of the athlete between

(i) **B** and **C**, ...

(ii) **C** and **D**. ..... [2]

(b) Use the graph to calculate the acceleration of the athlete between **A** and **B**.

Show your working.

..... m/s^2 [2]

(c) The athlete runs a distance of 160 m in 25 s.

Calculate the average speed of the athlete.

State the formula that you use and show your working.

formula used

working

..... m / s [2]

For Examiner's Use

(d) The power output of the athlete is 600 W.

Calculate the amount of work done by the athlete over 5 seconds.

Show your working.

..... J [2]

(e) After the race the athlete is sweating. The sweat evaporates from the surface of the athlete's skin.

Describe the process of evaporation in terms of particles.

.....

.....

.....

..... [2]

For Examiner's Use

4 **(a)** Draw lines to link each term to its correct definition.

term	definition
egestion	the removal of undigested food through the anus
peristalsis	breaking large food molecules down to small ones
digestion	muscular contractions that move food along the alimentary canal
absorption	the movement of digested food from the alimentary canal into the blood

[3]

(b) Table 4.1 shows some information about enzymes found in the human alimentary canal.

Complete the table.

Table 4.1

enzyme	substrate	product
amylase		maltose
	proteins	amino acids
		fatty acids and glycerol

[4]

For Examiner's Use

(c) Nutrients such as amino acids and glucose are carried from the alimentary canal to the liver. The liver converts any excess amino acids to a nitrogenous waste product.

(i) Name this waste product. ..... [1]

(ii) Name the organs that excrete this waste product.

..... [1]

(iii) The liver converts excess glucose in the blood into glycogen. The glycogen is then stored in cells in the liver. Glycogen is an insoluble substance.

Using your knowledge of osmosis, suggest why liver cells might swell and burst if they stored large quantities of a soluble substance such as glucose.

.....

.....

.....

..... [2]

(iv) When body cells need glucose, liver cells convert some of their stored glycogen back into glucose. The cells then release the glucose into the blood.

Explain why body cells need glucose.

.....

.....

..... [2]

[Turn over

For Examiner's Use

5 **(a)** Fig. 5.1 shows a 230 V 60 W light bulb.

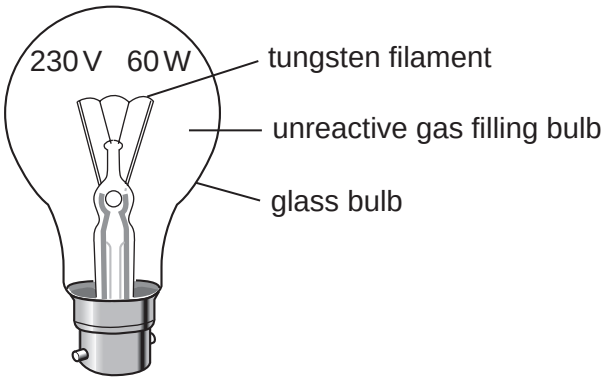


Fig. 5.1

(i) Explain the meaning of

60 W on the bulb,

.....

230 V on the bulb.

..... [2]

(ii) Describe the energy transformations which occur in the light bulb when it has been switched on.

.....

.....

.....

..... [3]

(iii) Suggest why the light bulb is filled with an unreactive gas.

.....

..... [1]

(b) The graph in Fig. 5.2 shows how the current through a different light bulb changes after it is switched on.

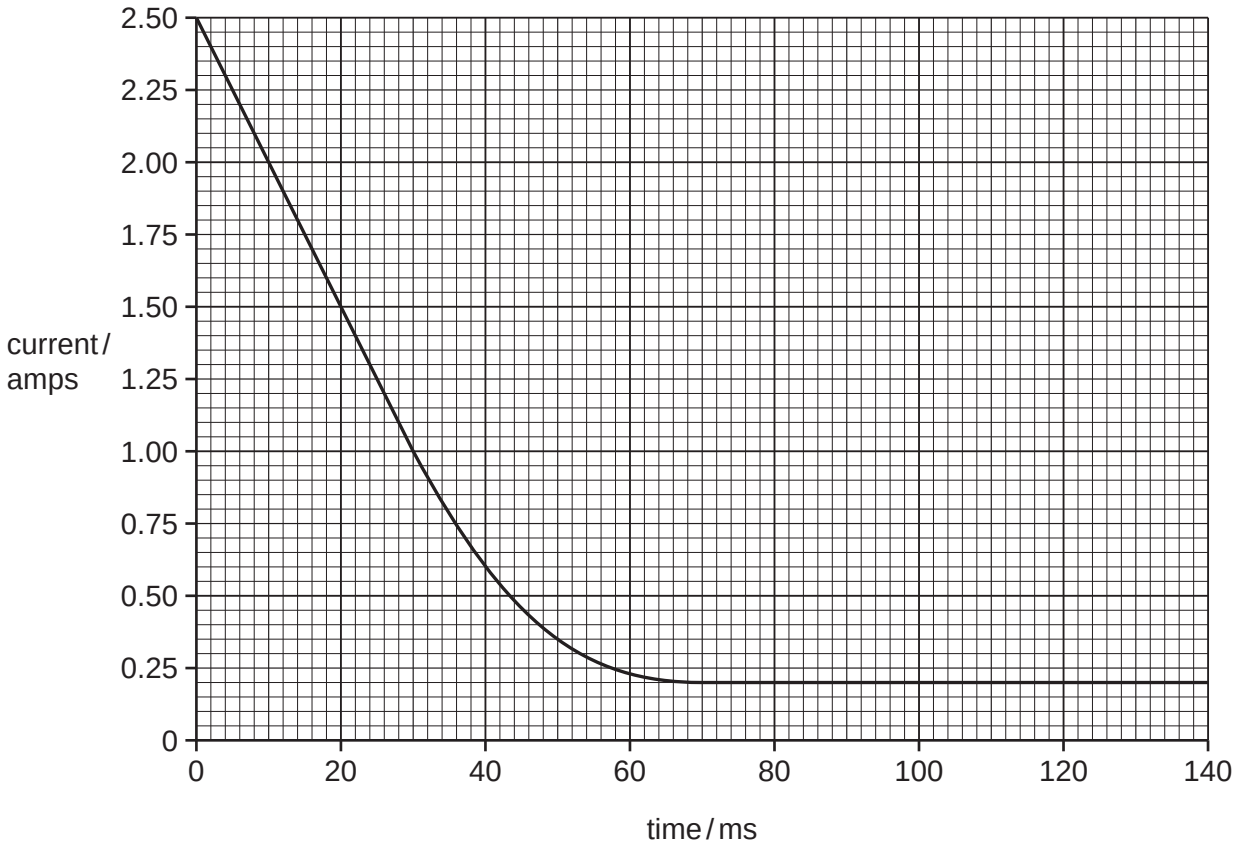


Fig. 5.2

(i) Describe what happens to the current after the bulb is switched on.

.....

.....

..... [2]

(ii) Use the graph to find the current through the light bulb 80 ms after it is switched on.

..... A [1]

For Examiner's Use

(c) (i) A lamp with a resistance of 1000 Ω, when lit, is connected in series with another lamp with a resistance of 2000 Ω, when lit.

Calculate the combined resistance of these two lamps.

State the formula that you use and show your working.

formula

working

..... Ω [2]

(ii) The resistance of a piece of wire depends on a number of variables such as the length of the wire and the material from which it is made.

State **two other** factors which can affect the resistance of a piece of wire.

1 .....

2 ..... [2]

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Please turn over for Question 6.

For Examiner's Use

6 **(a)** Table 6.1 shows some properties of three solid elements **A**, **B** and **C**.

Table 6.1

element	density	electrical conductivity	melting point
A	low	high	low
B	low	low	high
C	high	high	high

(i) Suggest and explain which element, **A**, **B** or **C**, has properties that are typical of a non-metal.

element .....

explanation .....

..... [1]

(ii) Suggest and explain which element, **A**, **B** or **C**, has properties that are typical of a **transition** metal.

element .....

explanation .....

..... [1]

For Examiner's Use

(b) Components in electrical circuits are often joined by soldering them together.

Solder is an alloy which has a lower melting point than any of the pure metals it contains.

Fig. 6.1 shows part of an electrical circuit into which a resistor has been soldered.

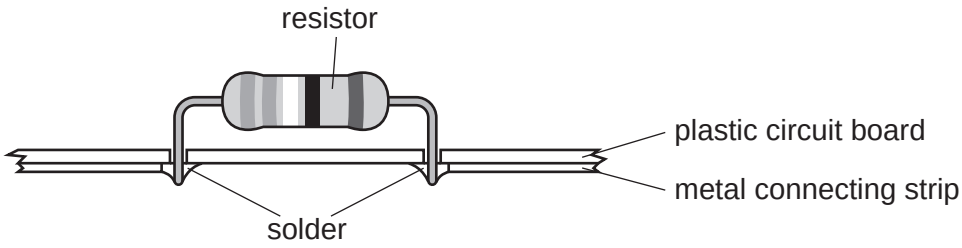

Fig. 6.1

(i) One type of solder is an alloy that contains tin, silver and copper.

Describe briefly what must be done to make this solder.

.....

..... [1]

(ii) Explain why electrical components are joined by soldering rather than by the use of a non-metallic adhesive (glue).

.....

..... [1]

(c) Fig. 6.2 shows part of an electrical cell which a student is making in a school laboratory.

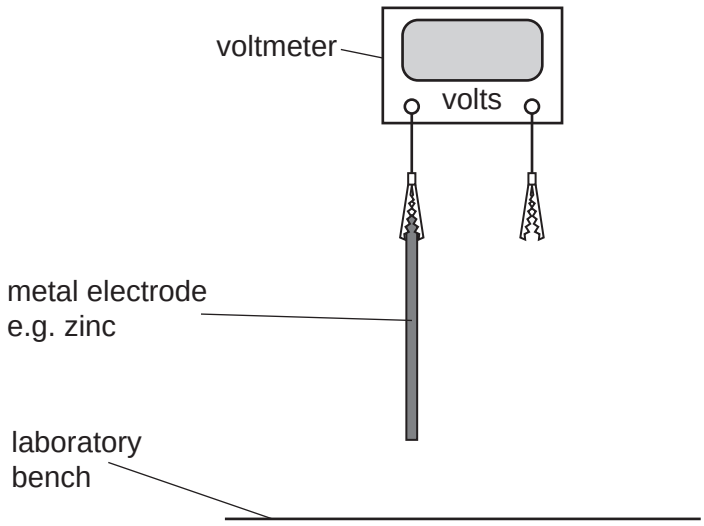

Fig. 6.2

Complete and label the diagram in Fig. 6.2 to show how the cell should appear when the student has finished. [3]

(d) Catalytic converters are used in modern cars to reduce air pollution.

Fig. 6.3 shows a simplified diagram of a catalytic converter in a car.

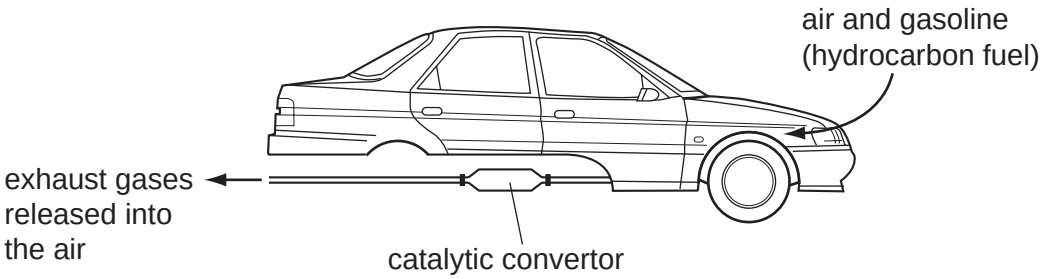

Fig. 6.3

(i) Name **two** gaseous compounds that are produced when a hydrocarbon undergoes complete combustion.

1 .....

2 ..... [2]

(ii) Suggest **one** other gas in the exhaust gas mixture whose concentration is **reduced** by the catalytic converter.

..... [1]

For Examiner's Use

7 **(a)** Fig. 7.1 shows two children playing in a swimming pool.

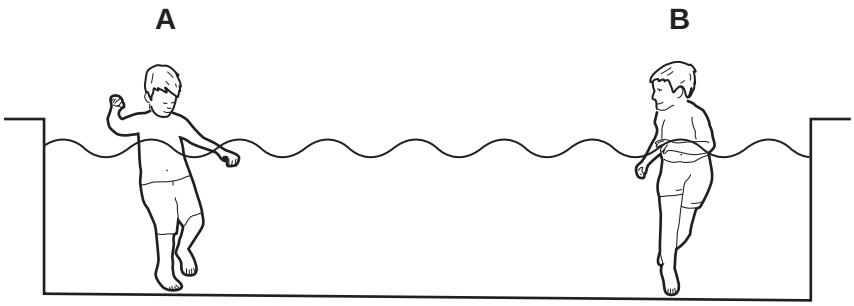

Fig. 7.1

Child **A** makes some small waves on the surface of the water.

(i) In 10 seconds, 5 complete waves pass by child **B** who is standing in the same pool.

Calculate the frequency of the waves.

Show your working.

..... Hz [1]

(ii) Use suitable words to complete the sentences below to describe what waves do.

A wave transfers energy without transferring ..... .

The energy is transferred in the direction that the wave ..... . [2]

(iii) Water waves are transverse waves.

Name **one** example of a longitudinal wave.

..... [1]

For Examiner's Use

(b) **T**he top of a water slide is 10 m above the water in the pool. This is shown in Fig. 7.2.

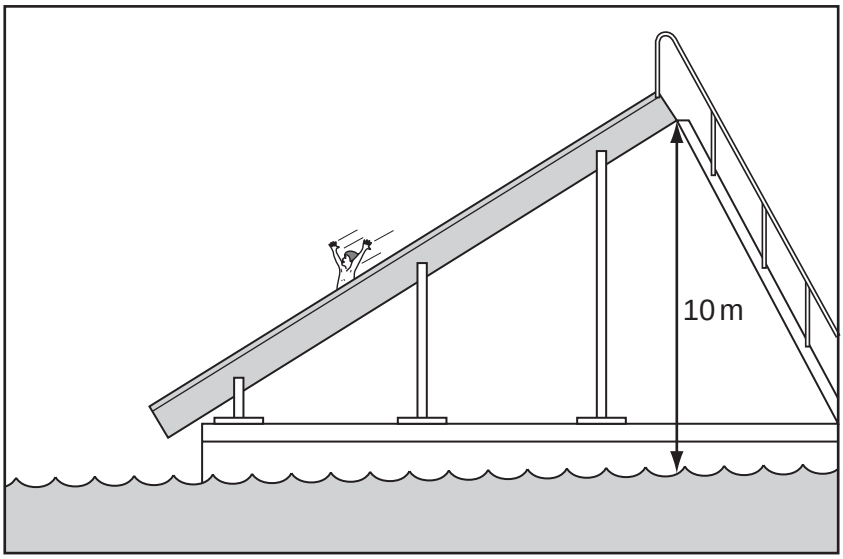

Fig. 7.2

A boy has a mass of 50 kg.

(i) The gravitational field strength of the Earth is 10 N / kg.

State the weight of the boy. ..... N [1]

(ii) The boy climbs a vertical distance of 10 m from the pool to the top of the slide.

Calculate the work done in gaining this height.

State the formula that you use and show your working.

formula used

working

..... J [2]

For Examiner's Use

(iii) The boy slides down to the pool. His speed at the bottom of the slide is 12 m / s.

Calculate his kinetic energy at the bottom of the slide.

State the formula that you use and show your working.

formula used

working

..... J [2]

(c) The water in the swimming pool is heated by the Sun.

State the method of heat transfer by which heat from the Sun reaches the Earth.

..... [1]

For Examiner's Use

8 The golden lion tamarin, *Leontopithecus rosalia*, is a monkey that lives in forests in Brazil. Its diet includes fruits and nectar from trees. Its predators include snakes, bamboo rats and owls.

(a) (i) State the correct biological term for a two-word Latin name such as *Leontopithecus rosalia*.

..... [1]

(ii) Suggest an advantage of giving each species of organism a Latin name like this.

.....

..... [1]

(b) (i) In the space below, use the information provided to construct a food web that includes golden lion tamarins.

[3]

(ii) On your food web, draw a circle around **one** producer. [1]

For Examiner's Use

(c) Golden lion tamarins are important for the dispersal of seeds from many different species of tree. They eat the fruits and then egest the seeds in their faeces.

An investigation was carried out into the distances that golden lion tamarins dispersed seeds from trees.

Fig. 8.1 shows the results of a study in which the distances of the tamarins' faeces from one tree were measured.

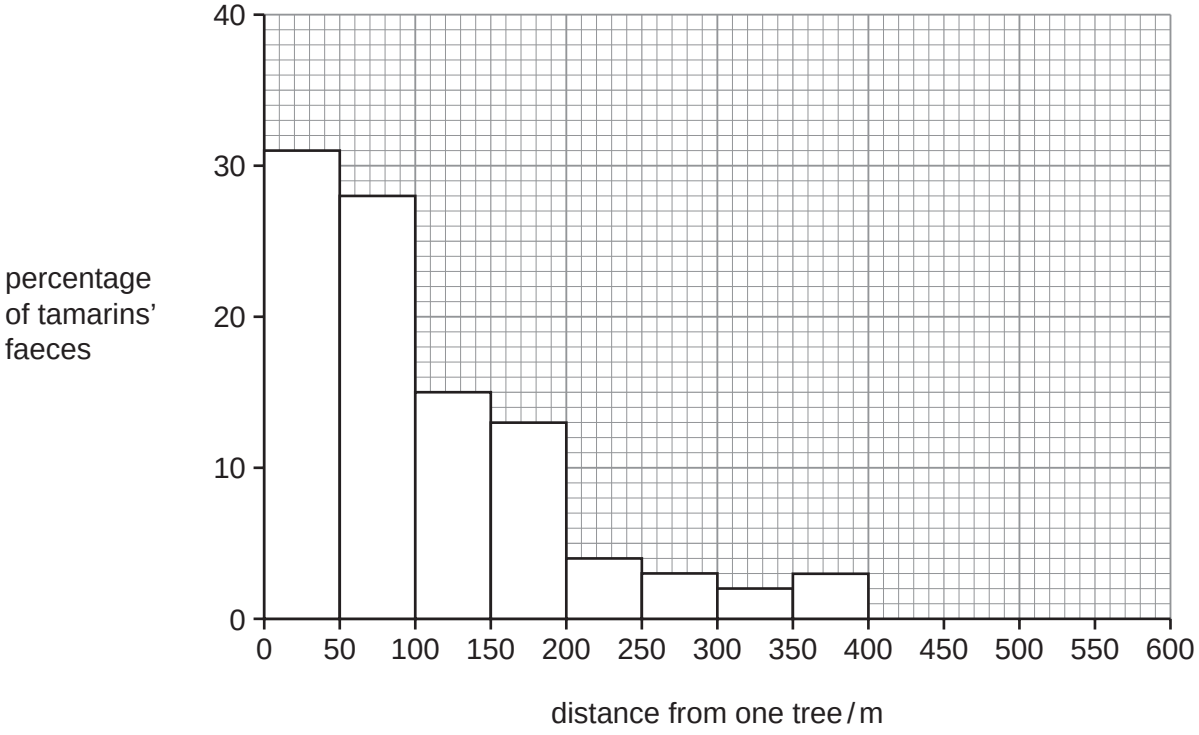

Fig. 8.1

(i) Describe the distribution of golden lion tamarin faeces in relation to this tree.

.....

.....

..... [2]

(ii) Suggest **two** ways in which the dispersal of seeds away from the tree, in golden lion tamarin faeces, could benefit the young plants that grow from the seeds.

1 .....

.....

2 .....

..... [2]

For Examiner's Use

9 The manufacture of ammonia is an important industrial process.

Fig. 9.1 is a simplified diagram of a reaction vessel which is used to make ammonia.

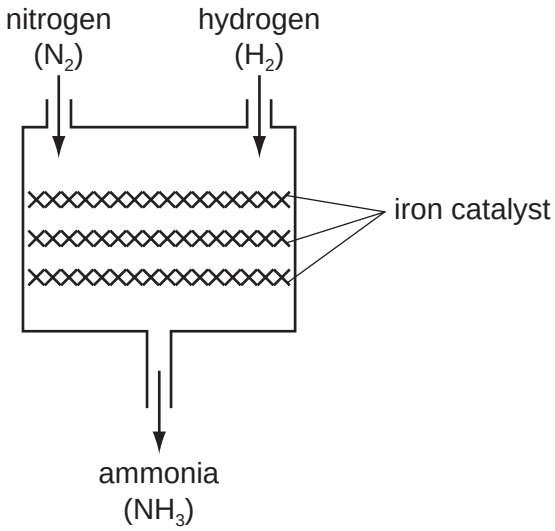

Fig. 9.1

(a) Ammonia is made by combining nitrogen and hydrogen.

(i) Explain **one** difference between an *element* and a *compound*. You may use these substances as examples.

.....

.....

.....

..... [2]

(ii) Describe a chemical test for ammonia gas.

.....

.....

..... [2]

For Examiner's Use

(b) Ammonia is used to make the compound ammonium nitrate. When it is added to soil, ammonium nitrate is a useful source of nitrogen for plants. Some of the nitrogen taken in by plants is combined with other elements to make amino acids.

(i) Explain briefly why nitrogen gas from the air cannot be used directly by most plants.

.....

..... [1]

(ii) Suggest a compound that neutralises ammonia to produce ammonium nitrate.

..... [1]

(iii) Name the **three** other elements which are always combined with nitrogen in amino acids.

..... [2]

(iv) Describe briefly what happens to amino acid molecules when they form protein molecules.

.....

.....

..... [2]

(c) The reaction between nitrogen and hydrogen requires an iron catalyst.

(i) State what is meant by the term *catalyst*.

.....

.....

..... [2]

(ii) State **one** reason why the catalyst in the reaction in Fig. 9.1 could **not** be made of the alkali metal sodium.

.....

..... [1]

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	**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 above, **X** in the centre, b at the bottom left

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.).