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 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 **28** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 Fig. 1.1 shows a diagram of a cross-section through an artery.

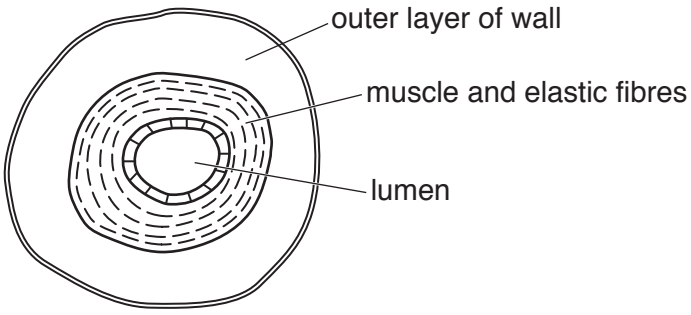

Fig. 1.1

(a) Blood vessels have structural adaptations depending on their function.

(i) Describe the structural adaptations of the artery shown in Fig. 1.1.

.....

.....

..... [2]

(ii) Describe **two** ways in which the structure of a vein differs from the structure of the artery.

1 .....

2 .....

[2]

(b) Table 1.1 shows some of the blood vessels carrying blood to and from the body's organs.

Complete Table 1.1 with the names of the blood vessels.

Table 1.1

organ	blood vessel bringing blood to the organ	blood vessel taking blood away from the organ
heart		aorta
kidney	renal artery	
liver		hepatic vein
lungs		

[4]

2 **(a)** **(i)** State **one** physical property of **all** metals.

..... [1]

(ii) Name the collection of metals in the Periodic Table that includes copper.

..... [1]

(iii) State **two** properties of copper that are **not** typical properties of all metals.

1 .....

2 .....

[2]

(b) Fig. 2.1 shows apparatus a teacher uses to obtain copper by heating a mixture of copper oxide and carbon.

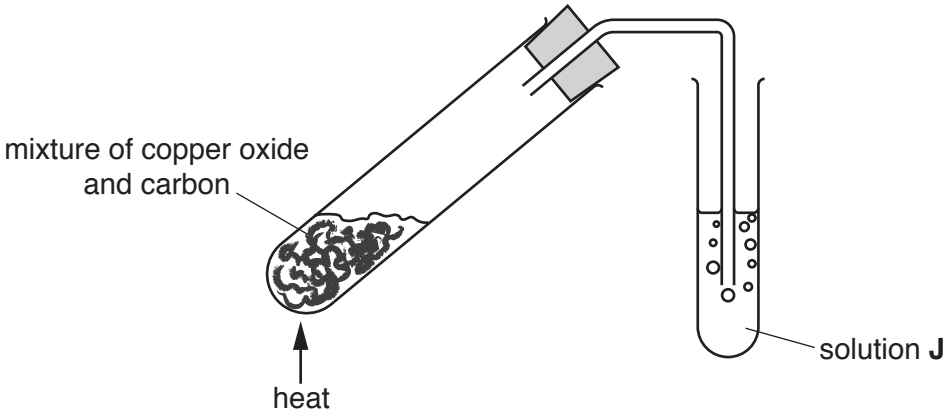

Fig. 2.1

(i) In this reaction, carbon dioxide gas is also produced.

Construct the **word** equation for the reaction between copper oxide and carbon.

	+		→	carbon dioxide	+	

[1]

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

Explain your answer.

substance .....

explanation .....

.....

[2]

(iii) Solution **J** is used to test for carbon dioxide.

Name solution **J** and describe the change in its appearance when it reacts with carbon dioxide.

solution **J** .....

change .....

[2]

3 Fig. 3.1 shows a boat pulling a water skier across a lake.

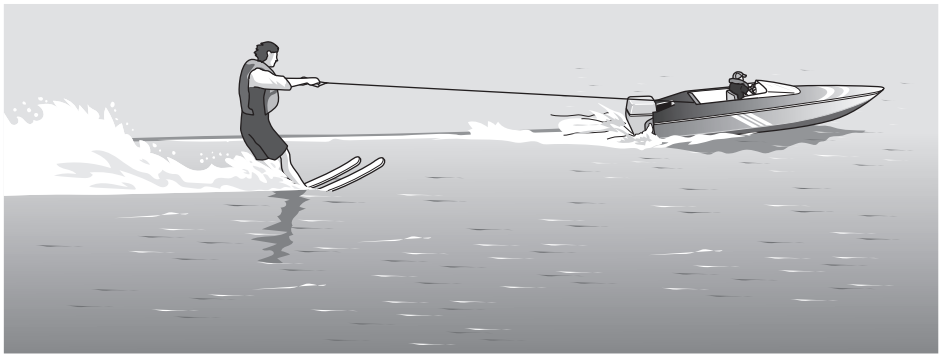

Fig. 3.1

(a) Fig. 3.2 shows the speed-time graph for the water skier over a 50 second period.

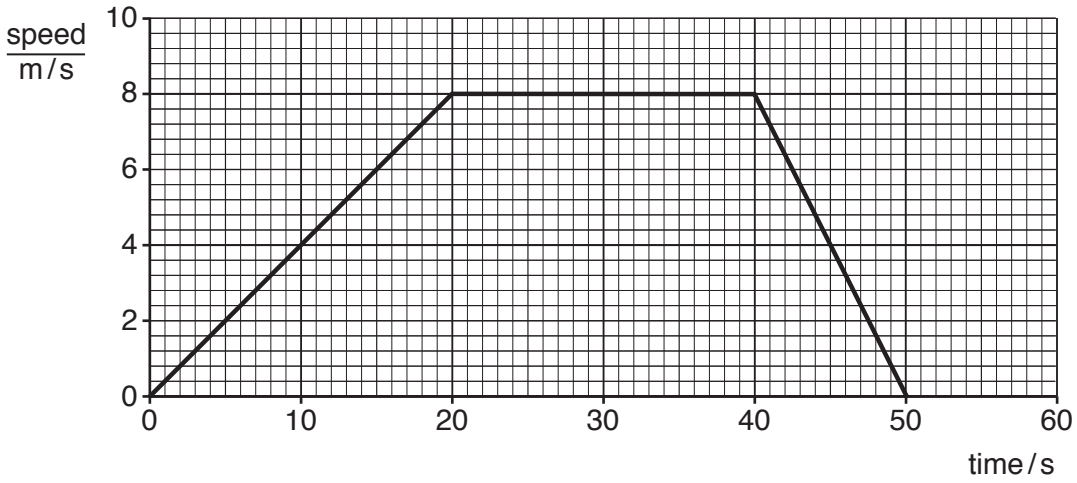

Fig. 3.2

(i) On the graph in Fig. 3.2, mark with a letter **X** a point when the water skier is not moving. [1]

(ii) On the graph in Fig. 3.2, mark with a letter **M** a point when the water skier is travelling at maximum speed. [1]

(iii) Determine the number of seconds the water skier is travelling at maximum speed.

..... s [1]

(b) Fig. 3.3 shows the two horizontal forces acting on the water skier.

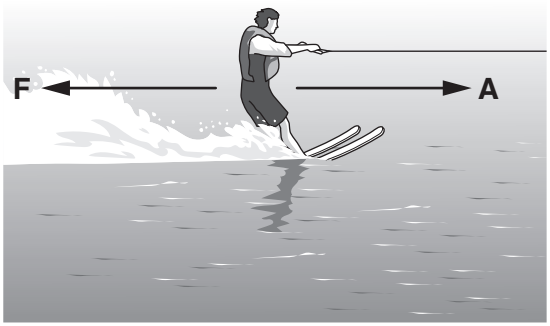

Fig. 3.3

A forward force **A** acts along the rope from the boat.

A frictional force **F** caused by air resistance and water resistance acts in the opposite direction.

Place a tick (✓) in the box next to the statement that correctly describes the relative sizes of forces **A** and **F** when the skier is accelerating forwards.

Force **A** is greater than force **F**. ☐

Force **A** is equal to force **F**. ☐

Force **A** is less than force **F**. ☐

[1]

(c) The boat produces waves on the surface of the lake. This is shown in Fig. 3.4.

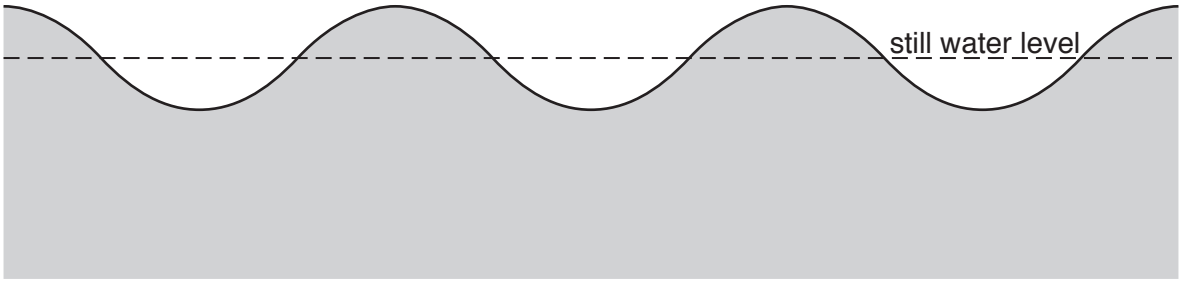

Fig. 3.4

(i) On Fig. 3.4, use a double headed arrow (⟷) to show the wavelength of a wave. [1]

(ii) State what is meant by the *amplitude* of a wave.

.....

.....

..... [1]

(d) Use the words in the list to complete the labels on the diagram in Fig. 3.5 to describe the energy changes that occur in the engine of the boat.

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

chemical	**geothermal**	**kinetic**	**light**
nuclear	**potential**	**sound**	**thermal**

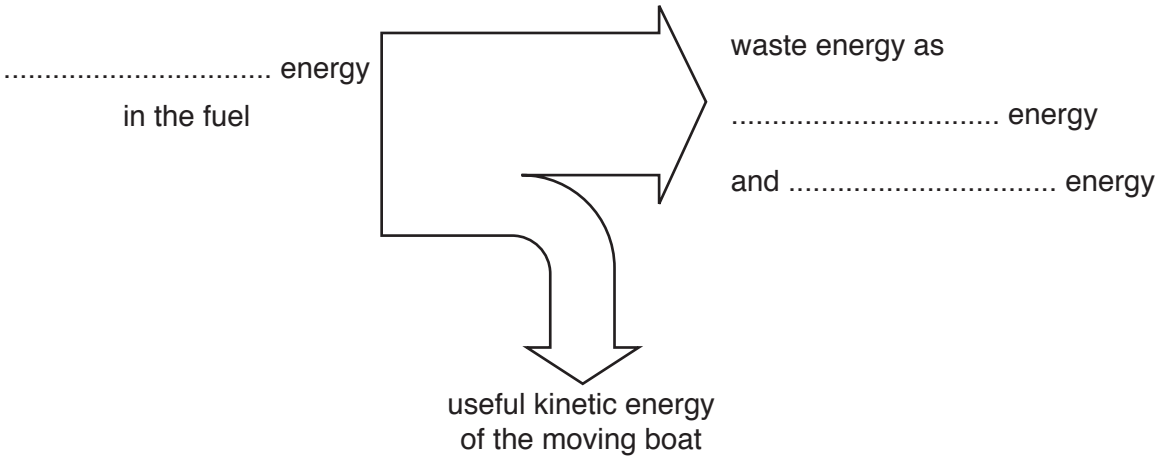

Fig. 3.5

[2]

(e) When the water skier has finished skiing, he dries himself off in the sun by allowing the water on his body to evaporate.

Describe the process of this evaporation in terms of the energy and movement of water molecules.

.....

.....

.....

.....

..... [3]

4 A person exercises for 30 minutes. Their internal body temperature during this time is recorded.

Table 4.1 shows the results.

Table 4.1

time / minutes	temperature / °C
0	36.8
10	37.5
20	38.8
30	39.4

(a) (i) Use Table 4.1 to calculate the difference in internal body temperature between the start and the end of exercise.

Show your working.

temperature ..... °C [1]

(ii) Predict what happens to the internal body temperature after the exercise stops.

.....

..... [1]

(b) Internal body temperature increases during exercise.

Describe the changes in the skin that occur when the body gets too hot.

.....

.....

..... [2]

(c) Internal body temperature increases during exercise due to the increased rate of respiration in cells.

Explain why the increased rate of respiration causes the internal body temperature to increase.

.....

.....

..... [2]

(d) Pulse rate also increases during exercise.

Describe the changes that happen to the heart which increase pulse rate.

.....

..... [1]

5 Sodium is a metal in Group I of the Periodic Table.

(a) A teacher adds a piece of sodium to a beaker of distilled, pH-neutral water.

The water contains full-range indicator (Universal Indicator).

This is shown in Fig. 5.1.

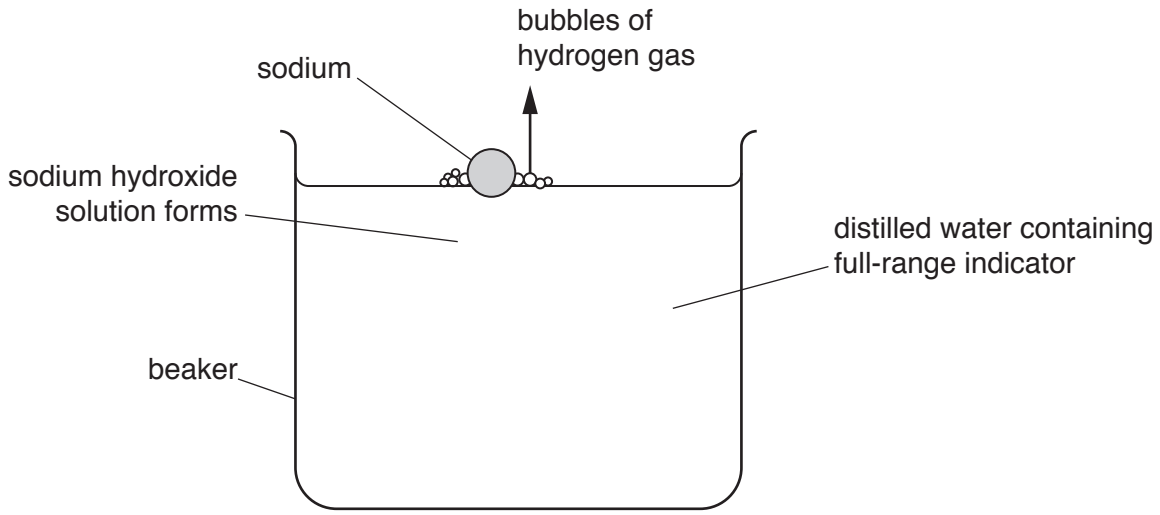

Fig. 5.1

(i) State the indicator colour change that shows that an alkaline solution is forming in this reaction.

from ..... to ..... [2]

(ii) Suggest the change in pH of the liquid in the beaker when sodium reacts with water.

from ..... to ..... [1]

(iii) The reaction between sodium and water also produces hydrogen gas.

Describe the test for hydrogen.

test .....

result .....
[1]

(iv) Describe how the teacher can show that the reaction between sodium and water is exothermic.

.....

.....

..... [2]

(b) (i) Chlorine is an element in Group VII of the Periodic Table.

State the type of chemical bond in sodium chloride.

..... [1]

(ii) Fig. 5.2 shows a process that separates the elements combined in copper chloride.

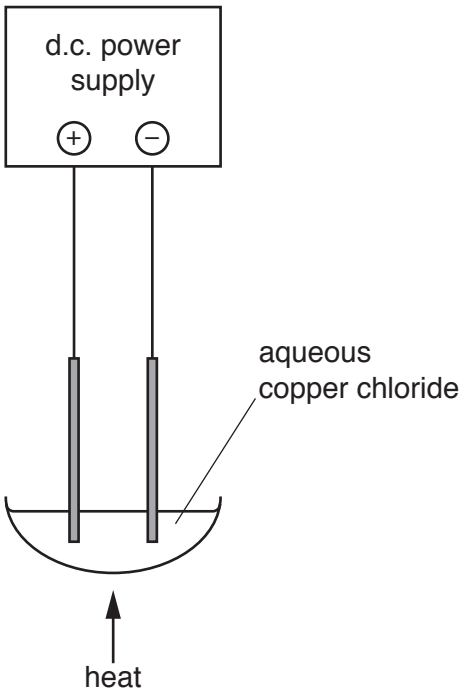

Fig. 5.2

Name this process.

..... [1]

(iii) Use a label line and the letter **A** to label the anode in Fig. 5.2. [1]

(iv) State the non-metallic element produced during the process in Fig. 5.2.

..... [1]

[Turn over

6 An astronaut is living on the International Space Station (ISS).

The astronaut uses a telescope to view a star.

(a) Fig. 6.1 shows a lens that is used in the telescope.

Light rays from the star pass through the lens and a clear image of the star is formed, 10 cm from the lens, at point **P**.

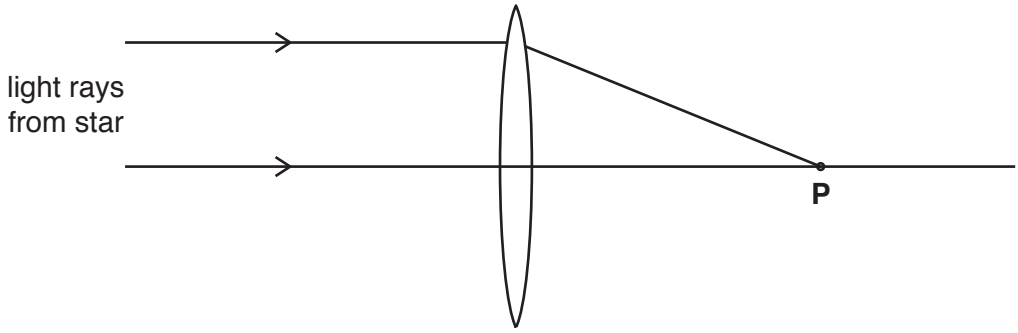

Fig. 6.1

(i) State the focal length of the lens.

..... cm [1]

(ii) Name point **P**.

..... [1]

(b) Different types of telescope detect different radiations within the electromagnetic spectrum.

Fig. 6.2 shows the electromagnetic spectrum.

γ-rays	**A**	ultraviolet	visible light	**B**	microwaves	radio waves

Fig. 6.2

(i) Identify **A** and **B** in Fig. 6.2.

A .....

B .....

[2]

(ii) State the part of the electromagnetic spectrum that has the highest frequency.

..... [1]

(c) The astronaut communicates with Earth using radio waves.

The International Space Station (ISS) is 400 km above the Earth in space.

(i) Radio waves travel at a speed of 300 000 km / s.

Calculate the time taken for a radio signal to travel from the ISS to Earth.

State the formula you use and show your working.

formula

working

time = ... s [2]

(ii) State **one** reason why it is impossible to use sound waves for communication between the astronaut and Earth.

.....

..... [1]

(d) The ISS has several solar panels which convert solar energy to electricity.

Solar energy is a renewable energy source.

(i) State **one** other renewable energy source on Earth.

..... [1]

(ii) State **one** non-renewable energy source on Earth.

..... [1]

[Turn over

7 Fig. 7.1 shows a cross-section through a flower.

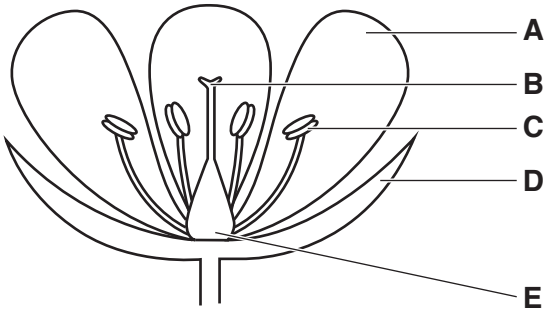

Fig. 7.1

(a) Using the letters from Fig. 7.1, identify the parts of the flower that have the following functions.

attracting insects for pollination .....

producing ovules .....

producing pollen .....

protecting the plant when in bud .....

[4]

(b) Sexual reproduction in the flower involves pollination and the production of seeds.

One way in which pollen is transferred is by animals such as insects.

(i) Name **one** other way in which pollen can be transferred to the flower from another plant.

..... [1]

(ii) Tick (✓) the boxes of **all** the statements that describe **sexual** reproduction.

all offspring are genetically identical to each other	
involves gametes	
involves the fusion of nuclei	
offspring are genetically identical to the parents	
produces genetically dissimilar offspring	
requires only one parent	

[3]

Please turn over for Question 8.

8 **(a)** Brass is a mixture of copper and zinc.

(i) State the term used for a mixture of metals.

..... [1]

(ii) State **one** physical property that will be different in brass and copper.

.....[1]

(b) Iron forms rust.

Explain why painting iron prevents rusting.

.....

.....

..... [2]

(c) A student uses the apparatus shown in Fig. 8.1 to investigate the rate of reaction between magnesium and dilute sulfuric acid.

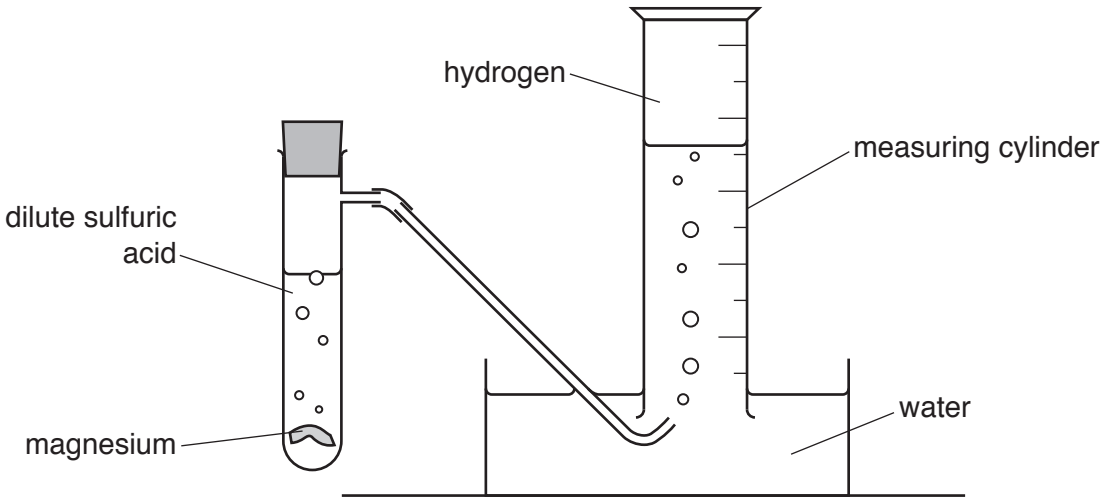

Fig. 8.1

(i) It takes 50 seconds for 25 cm^3 of hydrogen gas to collect in the measuring cylinder.

Calculate the average volume of hydrogen gas that is produced each second.

Show your working.

volume = ... cm^3 [1]

(ii) State **two** changes the student can make in his experiment to increase the rate of this reaction.

1 .....

2 .....
[2]

(d) The reaction between magnesium and dilute sulfuric acid produces the salt, magnesium sulfate.

State **two** magnesium compounds that can react with dilute sulfuric acid to produce magnesium sulfate.

1 .....

2 .....
[2]

[Turn over

9 **(a)** A piece of metal expands when it is heated.

(i) State **one** example where the expansion of a metal is useful.

.....

..... [1]

(ii) State **one** example where the expansion of a metal is a problem.

.....

..... [1]

(b) A piece of aluminium has a mass of 40.5 g and a volume of 15.0 cm^3.

Calculate the density of the piece of aluminium.

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

formula

working

density = ... units ..... [3]

(c) An isotope of aluminium has a nuclide notation $^{28}_{13}Al$.

State the number of protons and neutrons present in an atom of this isotope.

protons .....

neutrons .....

[2]

(d) Aluminium has several isotopes.

State the way in which these isotopes differ from each other.

.....

..... [1]

(e) Table 9.1 shows information about four pieces of aluminium wire.

Table 9.1

wire	length / cm	diameter / mm
J	50	6
K	50	12
L	100	6
M	100	12

(i) Deduce which wire, **J**, **K**, **L** or **M**, has the least resistance.

Explain your answer.

wire ..... has the least resistance

explanation .....

.....

[2]

(ii) A current of 5000 A passes through wire **L** when a potential difference of 6 V is applied across it.

Calculate the resistance of wire **L**.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

10 Fig. 10.1 shows the activity of an enzyme at different temperatures.

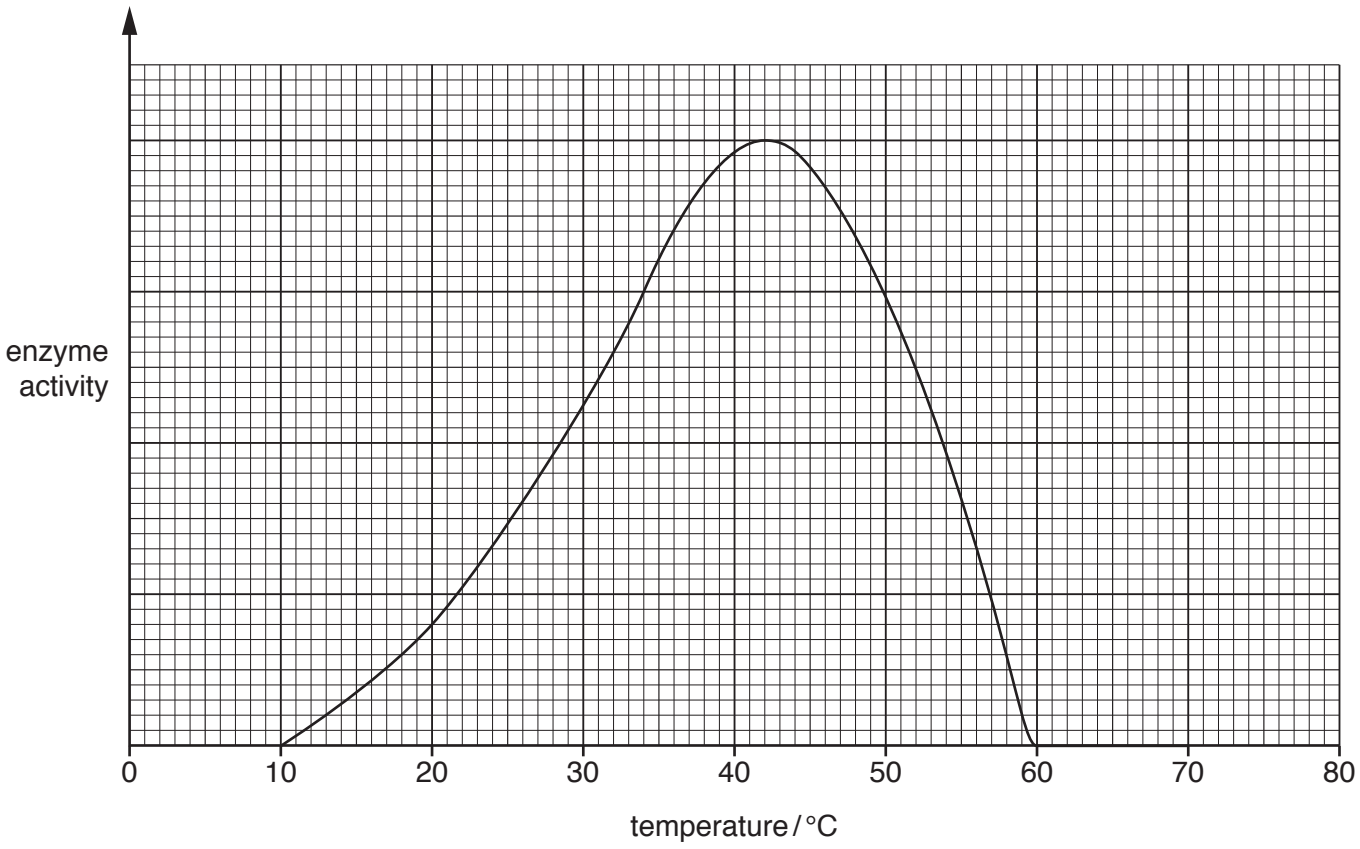

Fig. 10.1

(a) **(i)** Using Fig. 10.1, state the optimum temperature for this enzyme.

..... °C [1]

(ii) Using Fig. 10.1, state a temperature where there is no enzyme activity.

..... °C [1]

(b) Suggest why most enzymes in the body have an optimum temperature of 37 °C.

.....

..... [1]

(c) The boxes on the left show some substrates.

The boxes in the middle show some digestive enzymes.

The boxes on the right show some products of digestion.

Draw three lines to link each substrate with its correct enzyme, and three lines to link each enzyme with its correct product.

substrate	**enzyme**	**product**
fat	amylase	amino acids
protein	protease	glucose
starch	lipase	glycerol and fatty acids

[3]

(d) Describe the role of enzymes in the process of digestion.

.....

.....

.....

.....

..... [3]

[Turn over

11 **(a)** **(i)** State the process used to obtain gasoline from petroleum.

..... [1]

(ii) Gasoline is a mixture of compounds.

Name the **two** elements combined in these compounds.

..... and ..... [1]

(iii) Name **one** other useful product separated from petroleum.

State **one** use of this product.

product .....

use .....

[2]

(b) Alkanes are changed into alkenes by cracking.

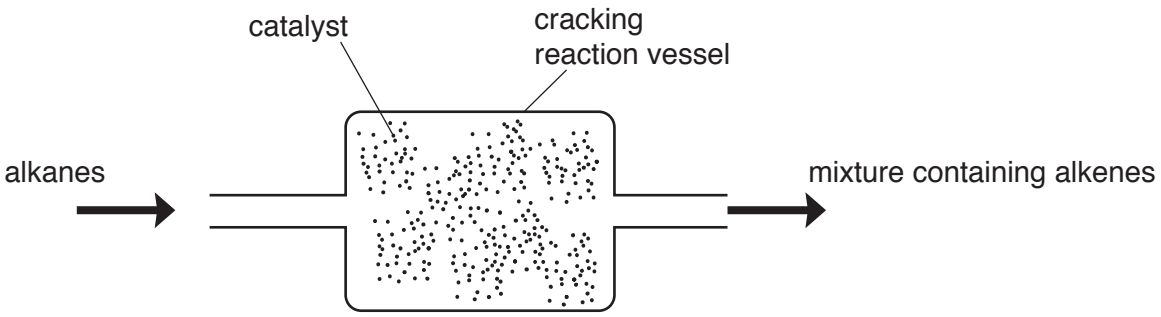

Fig. 11.1

(i) The cracking reaction in Fig. 11.1 involves a catalyst.

Define the term *catalyst*.

.....

.....

..... [2]

(ii) Describe how the mixture produced by cracking can be tested to show that it contains alkenes.

test .....

result .....

.....

[2]

(c) **(i)** Complete Fig. 11.2 to show the molecular structure of one molecule of ethene.

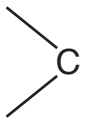

Fig. 11.2

[2]

(ii) State the **chemical formula** of the compound that reacts with ethene to produce ethanol.

..... [1]

(iii) Poly(ethene) is a white solid that is produced from ethene.

Explain why molecules of poly(ethene) are **much** larger than molecules of ethene.

.....

..... [1]

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

Suggest why friction between the man and the seat causes an electric charge to build up.

.....

..... [1]

(b) The car has two headlamps connected in parallel with each other across a 12 V battery.

Complete the circuit diagram in Fig. 12.1 to show how the lights are connected to the battery.

Include a switch in the circuit which will control both headlamps.

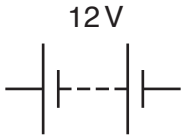

Fig. 12.1

[3]

(c) One of the headlamps is shown in Fig. 12.2.

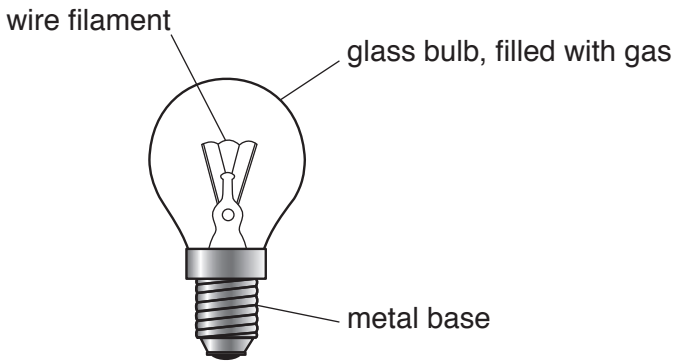

Fig. 12.2

The hot lamp transfers thermal energy by conduction, convection and radiation.

State the energy transfer process that allows thermal energy to be transferred through the metal base.

..... [1]

(d) The red reflectors found on cars and bicycles use total internal reflection to allow car drivers to see the back of another vehicle.

They reflect the light from car headlamps.

Fig. 12.3 shows the first part of the path of a ray of light as it passes through the reflector.

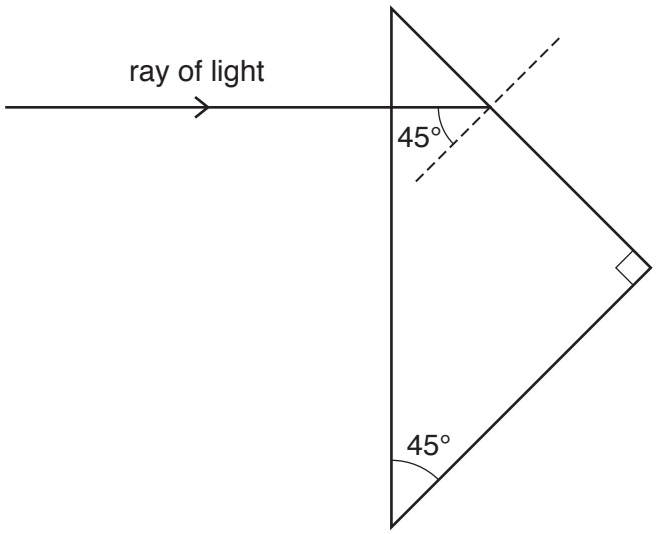

Fig. 12.3

On Fig. 12.3, complete the path of the ray of light to show how it emerges from the reflector. [2]

13 **(a)** Fig. 13.1 is a drawing of the chromosomes in a human.

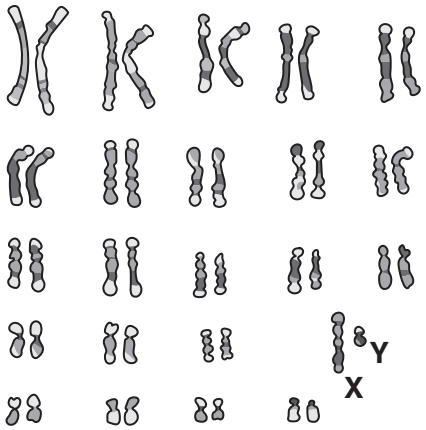

Fig. 13.1

(i) State the number of chromosomes shown in Fig. 13.1.

..... [1]

(ii) State whether the drawing of the chromosomes shown in Fig. 13.1 is from a male or female.

Explain your answer.

.....

..... [1]

(iii) Describe how the sex of the person in your answer in **(a)(ii)** is inherited.

.....

.....

..... [2]

(b) Complete the definition of the term *chromosome* using the words from the list.

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

DNA	**embryos**	**gametes**
genes	**nuclei**	**mitochondria**

A chromosome is a thread of ..... , made up of a string

of ..... .

[2]

(c) The transmission of genetic material occurs during fertilisation.

Describe the process of fertilisation.

.....

.....

..... [2]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).