Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8654793352

CO-ORDINATED SCIENCES **0654/31**

Paper 3 (Core) **October/November 2017**

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

[Turn over

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1 Fig. 1.1 shows a diagram of a plant cell.

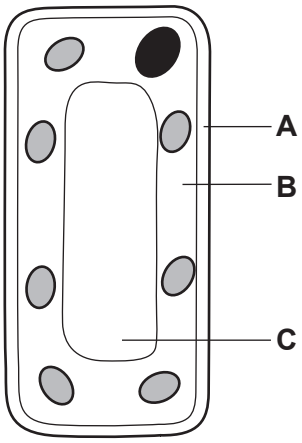


Fig. 1.1

(a) (i) Name the parts of the plant cell labelled **A**, **B** and **C** in Fig. 1.1.

A .....

B .....

C .....

[3]

(ii) Photosynthesis occurs in chloroplasts.

Add a label line and the letter **P** to Fig. 1.1 to show a chloroplast. [1]

(b) State the **word** equation for photosynthesis.

..... + ... $\xrightarrow[\text{chlorophyll}]{\text{light}}$ ..... + ...

[2]

(c) In Table 1.1, tick (✓) the boxes to show which parts are present in **both** animal and plant cells.

Table 1.1

cell wall	
cell membrane	
vacuole filled with sap	
nucleus	
cytoplasm	
chloroplast	

[3]

[Turn over

2 The Periodic Table shows the chemical elements arranged in order of atomic number.

(a) Fig. 2.1 is a diagram of an atom of element **X**.

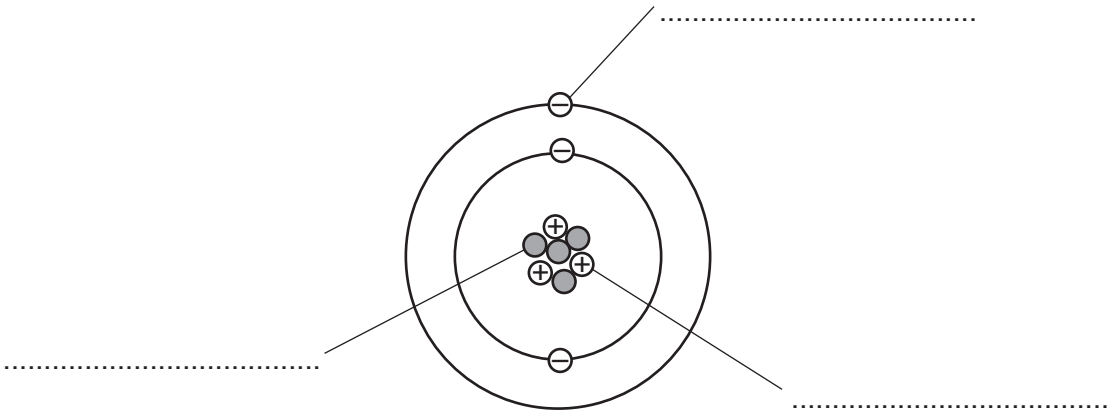


Fig. 2.1

(i) On Fig. 2.1, label the three types of particle that make up this atom. [3]

(ii) State the atomic (proton) number of element **X**. ..... [1]

(iii) Use the Periodic Table on page 28 to identify element **X**.

.....[1]

(iv) State the element in Group VII which is in the same period of the Periodic Table as element **X**.

.....[1]

(b) Fig. 2.2 shows uses and properties of three elements.

Draw straight lines to match each element with its use and property.

One has been done as an example.

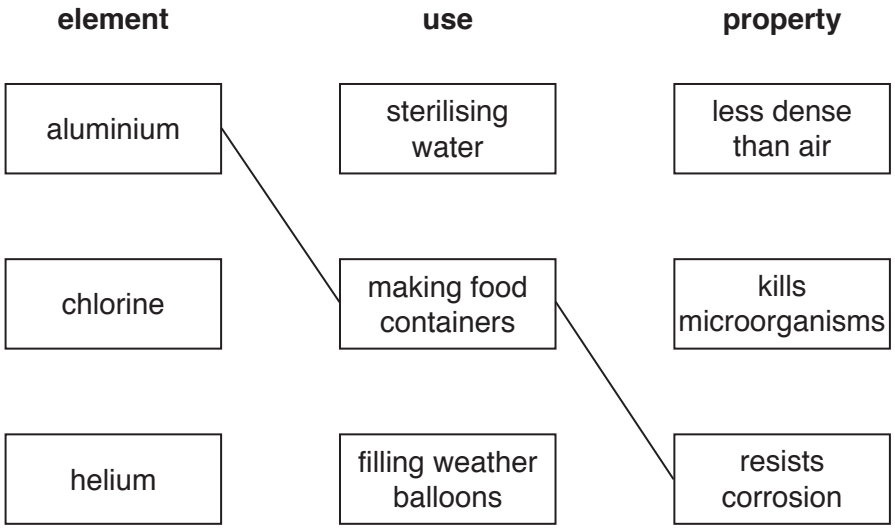


Fig. 2.2

[2]

3 **(a)** Five different types of power station are shown.

A geothermal
B hydroelectric
C gas-fired
D nuclear
E oil-fired

(i) State the letters of the **two** types of power station for which the Sun is **not** the source of energy.

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

(ii) State the letter of **one** type of power station that uses a renewable energy source.

..... [1]

(iii) State the letters of the **two** types of power station that produce carbon dioxide when generating power.

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

(b) **(i)** Overhead power cables supply electrical energy to a town. It is suggested that less energy is lost during transmission if the resistance of the cables is reduced.

Suggest **one** way in which the cables could be changed to lower their resistance.

.....[1]

(ii) Overhead power cables are hung from pylons.

Fig. 3.1 shows cables hanging between two pylons.

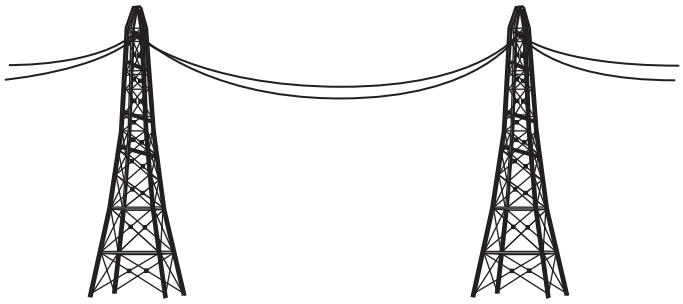


Fig. 3.1

Explain why the cables are hung loosely between the two pylons when they are erected during **hot** weather.

.....

.....

.....[2]

(c) In a nuclear power station, nuclear fission of uranium-235 atoms takes place.

Describe what happens to the nuclei of atoms of uranium-235 during nuclear fission.

.....

.....[1]

(d) In a nuclear power station, there are many radioactive isotopes. These sources emit α-particles, β-particles and γ-rays.

(i) One of these radiations is part of the electromagnetic spectrum.

Write the name of this radiation in the correct position in the incomplete electromagnetic spectrum on Fig. 3.2.

	X-rays		visible light	infra-red		

Fig. 3.2

[2]

(ii) Place the three radiations, α-particles, β-particles and γ-rays, in order of their ionising effect.

.... [1]
most ionising least ionising

4 **(a)** Alleles are alternative forms of genes.

Use the words to complete the definition of a gene.

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

chromosome **DNA** **gamete** **gene**

genotype **heredity** **protein** **reproduction**

A gene is a length of ..... . It is the unit of ..... and codes for a specific ..... . [3]

(b) Fig. 4.1 shows a diagram of a family with their genotypes for tongue rolling.

Tongue rolling is controlled by the dominant allele **T**.

Non-tongue rolling is controlled by the recessive allele **t**.

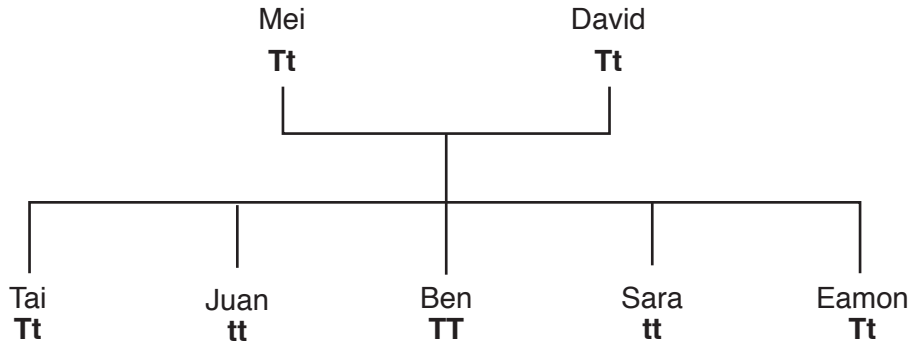


Fig. 4.1

Mei and David have five children.

(i) State the names of **all** the children that **cannot** roll their tongues.

.....[1]

(ii) Ben has a child.

Circle the correct percentage likelihood that the child will inherit the ability to roll its tongue.

0% 25% 50% 75% 100%

[1]

(iii) Give **one** reason for the percentage you have circled in **(ii)**.

.....

.....[1]

(c) Eamon has a child with someone who has the same genotype as he does.

Complete Fig. 4.2 to show the possible genotypes their child could inherit.

		male alleles	
		T	**t**
female alleles	**T**	.....	.....
	t	.....	.....

Fig. 4.2

[1]

5 **(a)** **(i)** State the percentage of nitrogen in the air.

.....% [1]

(ii) Nitrogen and oxygen together make up most of the air.

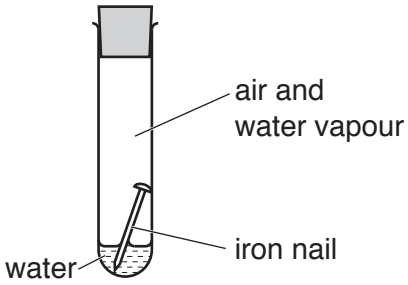
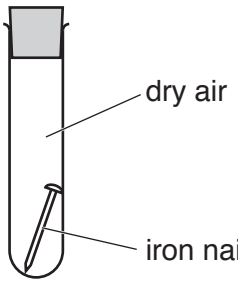
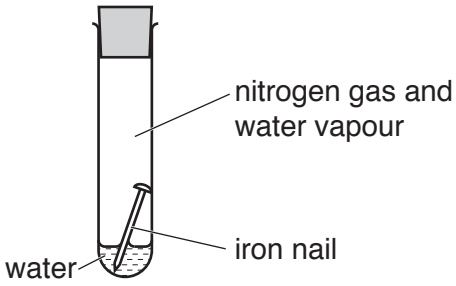
Name one **other** uncombined gaseous element in unpolluted air.

.....[1]

(b) A student investigates the rusting of iron.

Table 5.1 shows his experiments and the results.

Table 5.1

test-tube	experiment	result
A		rust appears
B		no rust
C		no rust

(i) Explain why the iron nails in test-tube **B** and test-tube **C** do **not** rust.

test-tube **B** .....

test-tube **C** .....
[2]

(ii) Predict **and** explain if there is a change in the mass of test-tube **A** and its contents during the experiment.

prediction .....

explanation .....

.....
[1]

(c) Nitrogen is used to make ammonia, NH_3.

Ammonia gas dissolves in water to make an alkaline solution.

(i) Describe a test to show that a solution of ammonia is alkaline.

test .....

result .....
[2]

(ii) Suggest the name of the acid that reacts with ammonia to form ammonium nitrate, NH_4NO_3.

.....[1]

(iii) Explain why farmers add fertiliser containing ammonium nitrate to soil.

.....

.....

.....

.....[2]

[Turn over

6 **(a)** Many houses in colder countries are designed to conserve thermal energy.

The houses are built with walls that have two layers of bricks.

Polymer foam sheets containing many trapped air bubbles are placed between the layers of bricks.

This is shown in Fig. 6.1.

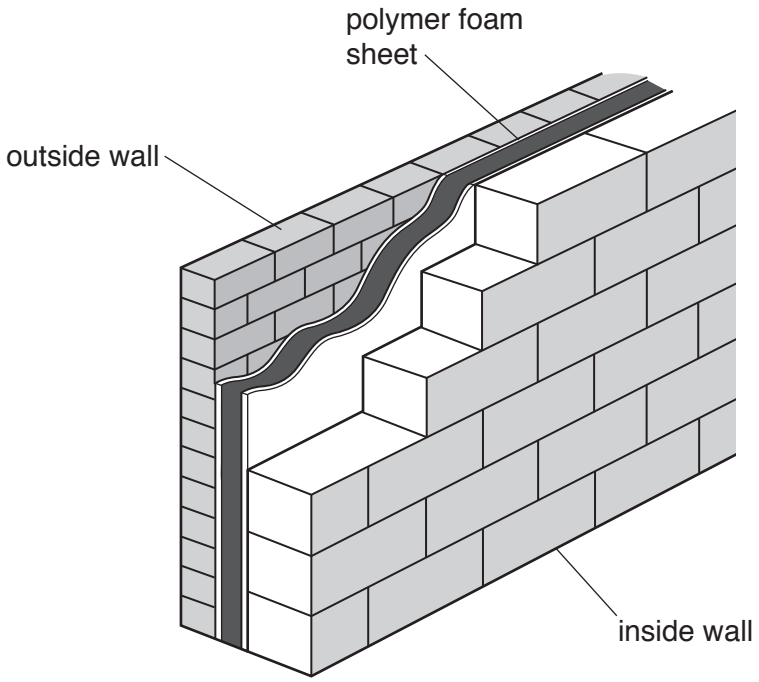


Fig. 6.1

Describe how polymer foam sheets reduce the heat lost by conduction and by convection.

conduction .....

.....

convection .....

.....

[2]

(b) A house has an electric doorbell.

(i) Draw a circuit diagram to show a doorbell connected in series with a switch and a battery.

Use the circuit symbol,  , for an electric doorbell.

[2]

(ii) The bell produces a sound when a metal hammer strikes the bell.

Describe how this action produces a sound.

.....

.....[1]

(iii) The bell emits a loud sound with a high pitch.

Describe the sound in terms of the amplitude of the sound wave and the frequency of the sound wave.

amplitude .....

frequency .....

[2]

[Turn over

(c) Fig. 6.2 shows the circuit diagram for a lamp in a room in the house.

Switches **A** and **B** are 2-way switches.

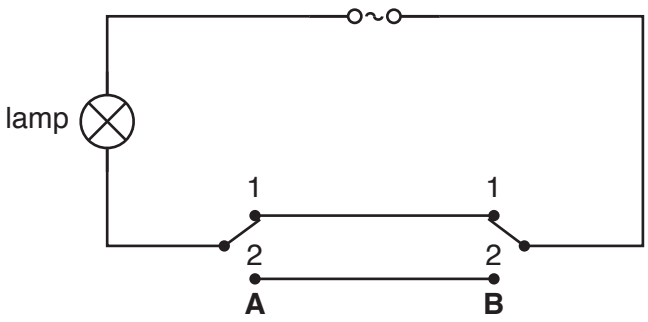


Fig. 6.2

Complete Table 6.1 to show whether the lamp is on or off for each of the switch positions.

Table 6.1

position of switch **A**	position of switch **B**	lamp on or off
1	1	
1	2	
2	1	
2	2	

[2]

7 Table 7.1 shows the incidence of new HIV infections in the USA between the years 1980 – 2010.

Table 7.1

year	number of new HIV infections
1980	20 000
1985	130 000
1990	80 000
1995	50 000
2000	58 000
2005	45 000
2010	40 000

(a) (i) Describe the trend shown by the results in Table 7.1.

.....

.....

.....[2]

(ii) Calculate the percentage change in new HIV infections between the years 1990 and 2010.

Show your working.

.....% [2]

(b) (i) State **two** ways in which HIV can be spread.

1 .....

2 .....
[2]

(ii) Suggest **two** ways in which governments could try to reduce the spread of HIV.

1 .....

2 .....
[2]

[Turn over

8 Fig. 8.1 shows apparatus a student uses to collect the gas that is made when a solid reacts with a liquid.

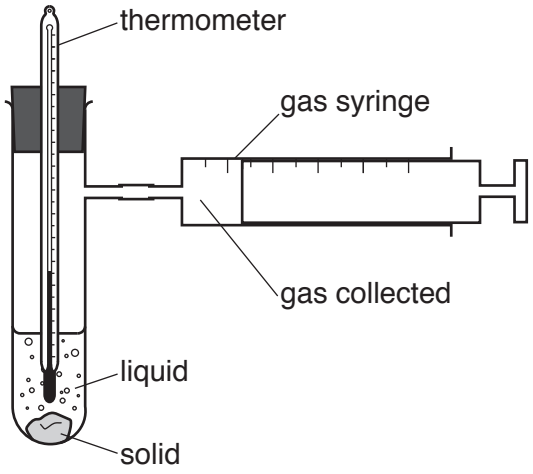


Fig. 8.1

Table 8.1 shows information about five experiments, **P**, **Q**, **R**, **S** and **T**, the student does.

Table 8.1

experiment	liquid	solid	temperature / °C		gas made
			at start	after 2 mins	
P	dilute hydrochloric acid	sodium hydrogencarbonate	20	17	carbon dioxide
Q	dilute sulfuric acid	magnesium	20	29	
R	dilute hydrochloric acid	magnesium	20	29	
S	water	calcium	20	32	
T	dilute hydrochloric acid	calcium carbonate	20	22	

(a) (i) Complete Table 8.1 to show the gases made in experiments **Q**, **R**, **S** and **T**. [2]

(ii) Describe the test for carbon dioxide.

test .....

result .....
[2]

(iii) Describe the pH changes, if any, in experiment **R** and in experiment **S**.

Explain your answers.

pH change in **R** .....

explanation .....

.....

pH change in **S** .....

explanation .....

.....
[2]

(iv) Using the information in Table 8.1, state whether the reaction in experiment **P** is exothermic or endothermic.

Explain your answer.

reaction in **P** .....

explanation .....
[1]

(b) (i) The student repeats experiment **T**.

State the effect of increasing the surface area of calcium carbonate on the rate of reaction.

.....[1]

(ii) State the effect on the rate of reaction in experiment **T** of

reducing the temperature of the acid,

.....

increasing the concentration of the acid.

.....
[2]

[Turn over

9 Fig. 9.1 shows a snowboarder on a ski slope.

Fig. 9.1

(a) On Fig. 9.1, draw an arrow to indicate the direction in which the force of gravity acts on the snowboarder. [1]

(b) Fig. 9.2 shows the speed-time graph for the snowboarder as she moves down the slope.

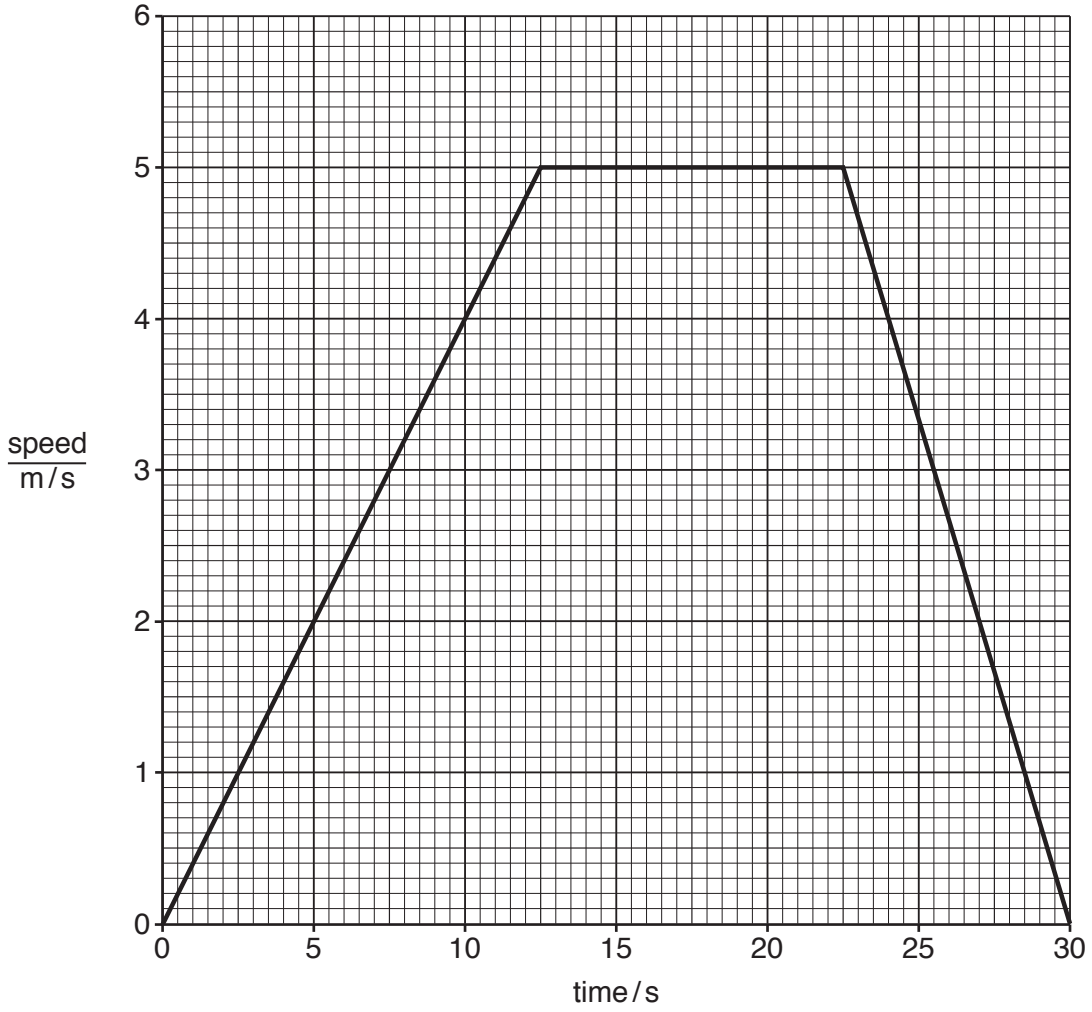


Fig. 9.2

(i) State a time when the snowboarder is accelerating.

.....s [1]

(ii) State a time when the snowboarder is travelling at her maximum speed.

.....s [1]

(c) Some of the snow is melting into water.

(i) Fig. 9.3 shows the arrangement of particles in a gas, liquid and solid.

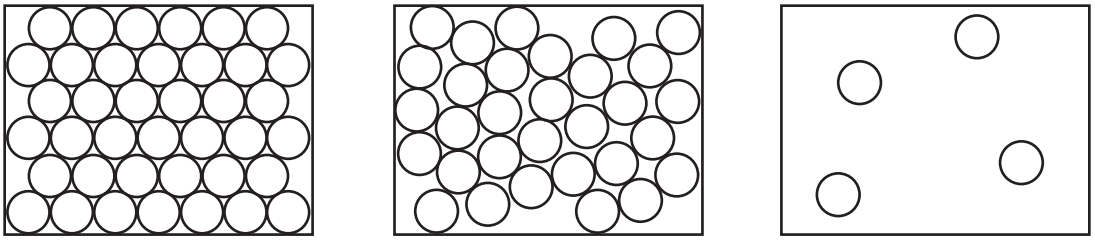


Fig. 9.3

State which diagram, **A**, **B** or **C**, best describes water.

Explain your answer.

diagram .....

explanation .....

.....

[1]

(ii) Some snow is steadily heated in a beaker.

The temperature of the snow is measured as it is heated.

Fig. 9.4 shows a graph of the results.

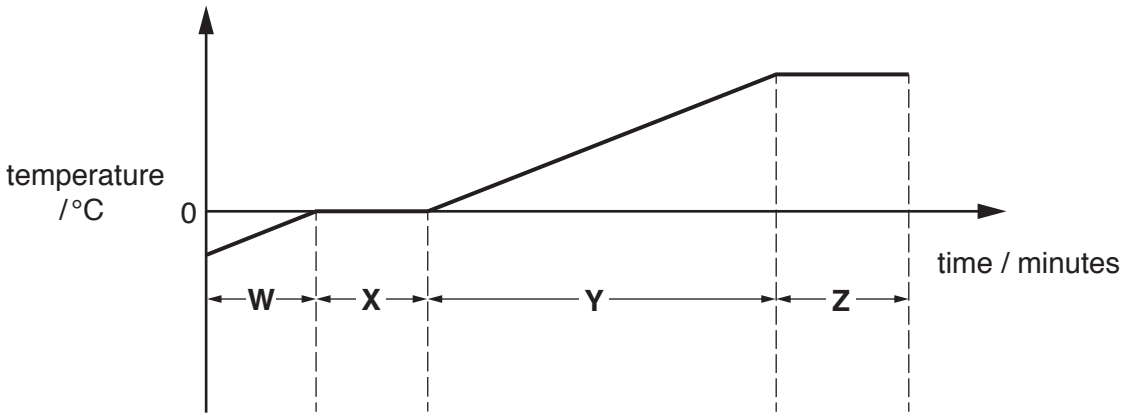


Fig. 9.4

State the section of the graph, **W**, **X**, **Y** or **Z**, where the snow is melting.

Explain your answer.

melting happens in section .....

explanation .....

.....

[2]

10 (a) A person touches a hot saucepan and immediately removes their hand. This is an example of a reflex action.

Stages in the pathway of a reflex arc are listed with the letters **A** to **E**. They are **not** in the correct order.

effector	**A**
motor neurone	**B**
receptor	**C**
relay neurone	**D**
sensory neurone	**E**

Put the letters in the correct order to show a reflex arc. The first one has been done for you.

C				

[1]

(b) Name the area of the body where the relay neurones are located.

.....[1]

(c) Circle **two** terms that can be used to describe a reflex action.

automatic **conscious** **rapid**

slow **voluntary**

[2]

(d) The human nervous system consists of two parts.

Name the **two** parts.

1 .....

2 .....

[2]

(e) A stimulus that results in a reflex action involving the eye will go to the unconscious part of the brain rather than the spinal cord.

Suggest **and** explain a reason for this.

.....

.....

.....[2]

11 Petroleum is a liquid fossil fuel.

Petroleum is a mixture containing many different hydrocarbons.

Petroleum is extracted from the Earth and is then processed into useful products.

(a) (i) Name a **solid** fossil fuel.

.....[1]

(ii) Suggest why petroleum is described as a *fossil* fuel, but wood is not a *fossil* fuel.

.....

.....[1]

(b) Fractional distillation is used to separate petroleum into simpler, more useful mixtures called fractions.

Fig. 11.1 shows this process and two of the useful fractions obtained.

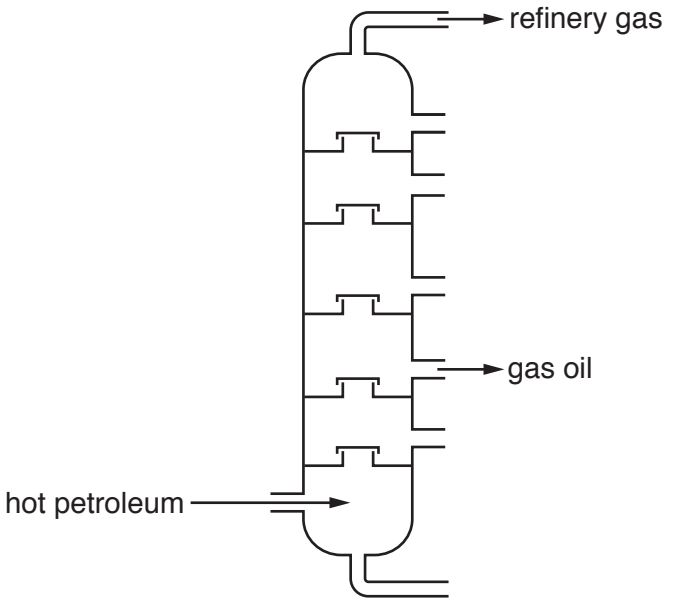


Fig. 11.1

(i) State **one** use for each of the fractions shown in Fig. 11.1.

refinery gas .....

gas oil .....
[2]

(ii) Explain why fractional distillation involves physical changes and **not** chemical changes.

.....

.....[1]

(c) Fig. 11.2 shows the structures of four compounds, **J**, **K**, **L** and **M**.

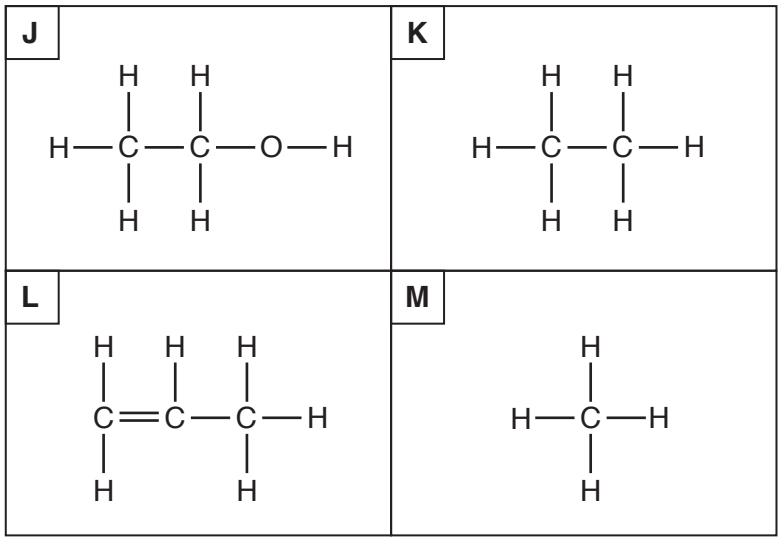


Fig. 11.2

State which of the compounds

are alkanes, ...

is ethanol, ...

is the main compound in natural gas, ...

is an unsaturated hydrocarbon. .....

[4]

(d) Ethene, C_2H_4, is a hydrocarbon that reacts to form poly(ethene) in a polymerisation reaction.

Plastic shopping bags are made from poly(ethene).

(i) Describe how ethene molecules react to form poly(ethene) molecules.

.....

.....[1]

(ii) Hydrocarbons, such as poly(ethene), are destroyed by burning in air.

Suggest **two** compounds that are produced by burning poly(ethene).

1 .....

2 .....

[2]

12 Four swimmers are competing at a swimming pool.

Fig. 12.1 shows the swimmers starting a race.

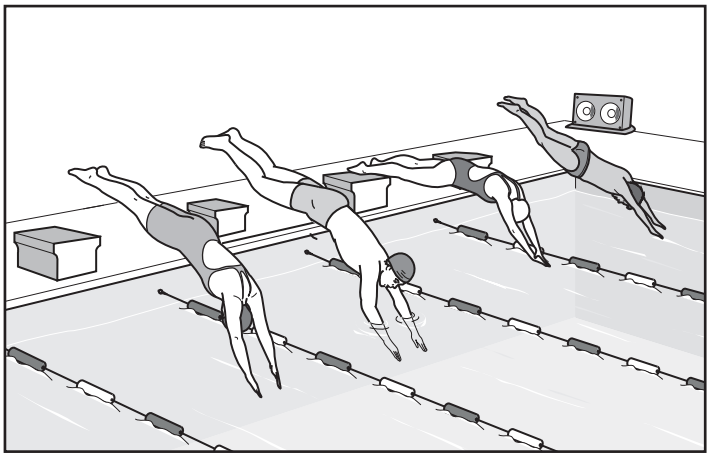


Fig. 12.1

(a) The swimmers start their race when they hear the starting sound from a loudspeaker.

State whether each of the following is an example of a transverse wave or a longitudinal wave.

the sound wave produced by the loudspeaker,

.....

the water waves produced by the swimmers in the swimming pool.

.....

[1]

(b) One of the water waves on the surface of the swimming pool is shown in Fig. 12.2.

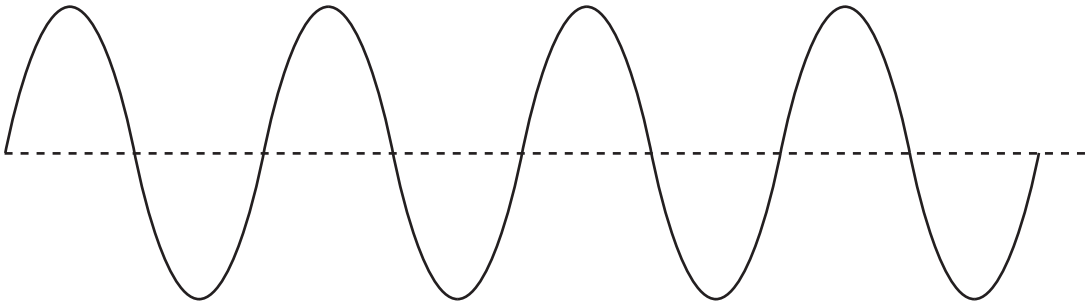


Fig. 12.2

On Fig. 12.2, mark with a double headed arrow (↔) **one** wavelength. [1]

(c) The swimmers dive downwards into the water at the start of the race.

State the type of energy

(i) gained by the swimmers as they start to dive, ...[1]

(ii) lost by the swimmers as they move downwards. .....[1]

(d) Fig. 12.3 shows two forces acting on a swimmer as he swims.

Fig. 12.3

(i) State the size and direction of the resultant force.

size .....

direction .....
[2]

(ii) State how the speed of the swimmer is changing.

Explain your answer.

.....

.....

.....[2]

(e) The swimmer gets out of the water and stands by the side of the pool. As he stands there he begins to feel colder.

Explain, in terms of the evaporation of water, why he feels colder.

.....

.....

.....

.....[2]

(f) The swimming pool is filled with 480 m^3 of water.

The density of water is 996 kg/m^3.

Calculate the mass of water in the swimming pool.

State the formula you use and show your working.

formula

working

mass = ...kg [2]

(g) There are submerged lamps in the pool. Fig. 12.4 shows two light rays from one of these lamps.

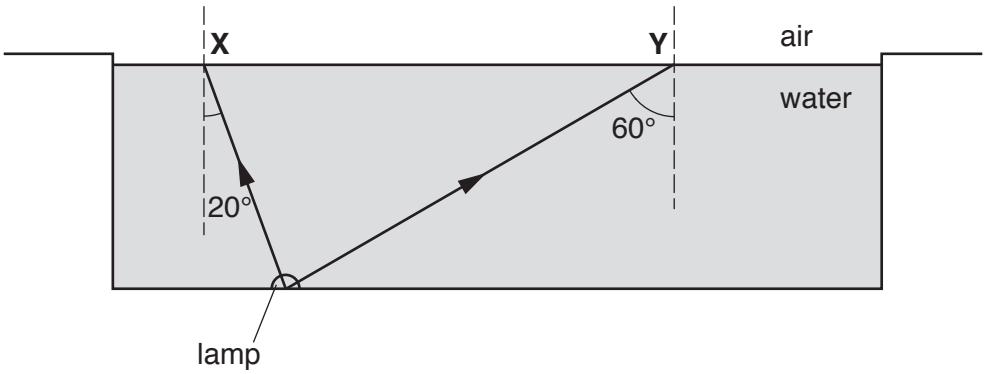


Fig. 12.4

The critical angle for the boundary between water and air is 48°.

On Fig. 12.4, complete the paths of the two rays after they reach the surface at **X** and **Y**.

Explain your answer.

.....

.....

.....[3]

13 (a) The circulatory system transports blood to organs in the body.

(i) Complete Table 13.1 to show the names of the blood vessels that transport blood towards and away from the organs.

Table 13.1

organ	blood vessel that transports blood towards the organ	blood vessel that transports blood away from the organ
heart	vena cava	.....
lungs	..... artery	..... vein
liver	hepatic ..... vein	hepatic vein
kidney	..... artery	..... vein

[4]

(ii) Veins contain structures to ensure the one-way flow of blood.

Name these structures.

.....[1]

(b) Fig. 13.1 is a photograph taken with an electron microscope of red blood cells in the human body.

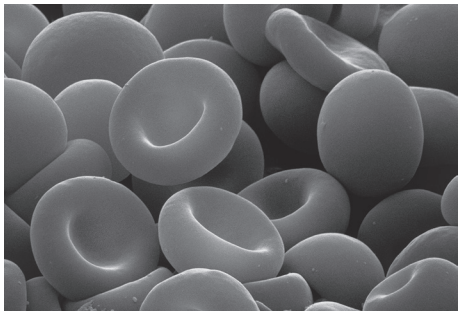


Fig. 13.1

(i) State the function of red blood cells.

.....[1]

(ii) List **two other** main components of blood.

1 .....

2 .....

[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.).