



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
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**CO-ORDINATED SCIENCES**

**0654/32**

Paper 3 (Core)

**October/November 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.

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

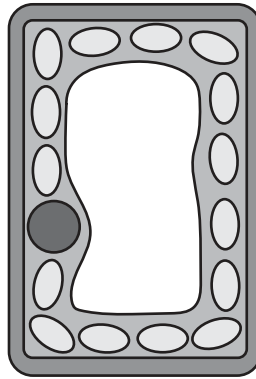


Fig. 1.1

(a) On Fig. 1.1, use label lines to label the:

- nucleus
- cytoplasm.

[2]

(b) Describe **two** ways in which the structure of a palisade cell differs from the structure of an animal cell.

1 .....

.....

2 .....

.....

[2]

(c) Molecules can enter and leave the cell across the cell membrane by the process of diffusion.

Describe how molecules enter the cell by diffusion.

.....

.....

.....

[2]

(d) Respiration occurs in cells.

State **one** substance required for respiration that will diffuse into cells.

..... [1]

2 Air is a mixture of gases.

Most of the air is made up of nitrogen and oxygen.

(a) Fig. 2.1 shows pie charts representing two mixtures of gases **J** and **K**.

These mixtures are different from clean air.

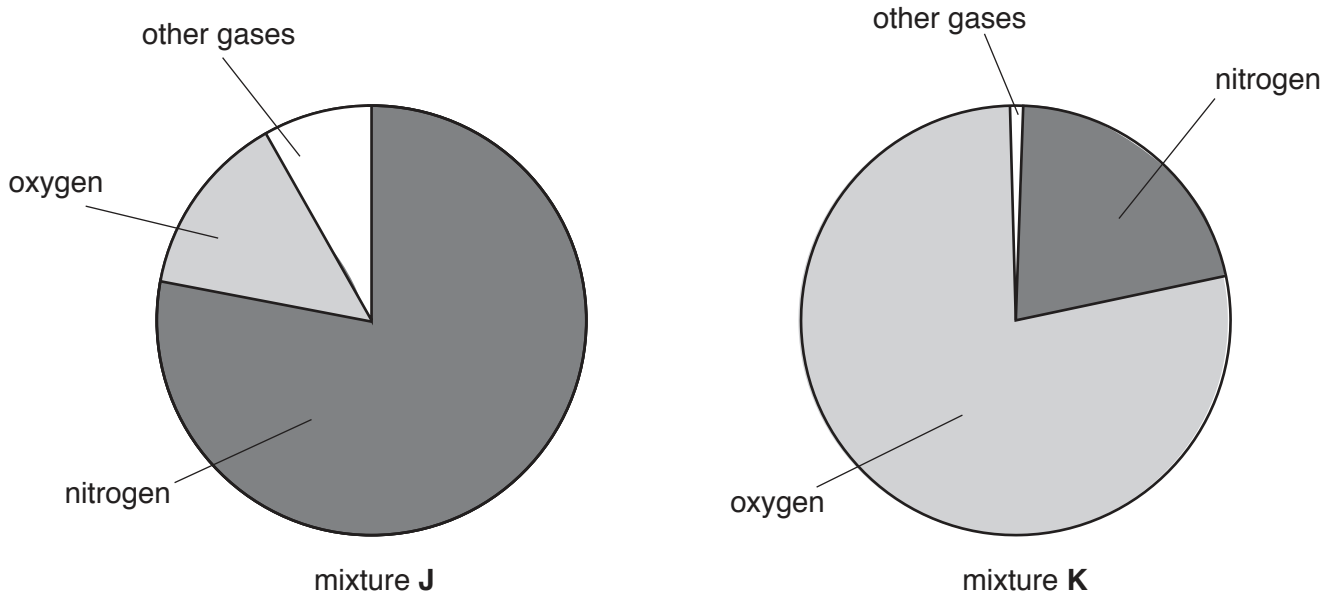


Fig. 2.1

Describe one difference between clean air and:

mixture **J** .....

.....

mixture **K**. .....

.....

[2]

(b) The air in cities contains pollutants including carbon monoxide.

(i) Describe how carbon monoxide is formed.

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

(ii) State why carbon monoxide is harmful to health.

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

(iii) Clean air contains small amounts of elements found in Group VIII of the Periodic Table.

Identify the Group VIII element in the third period of the Periodic Table.

.....[1]

(iv) Explain why clean air containing this Group VIII element is **not** harmful to humans.

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

(c) Fig. 2.2 shows diagrams of some of the molecules in air.

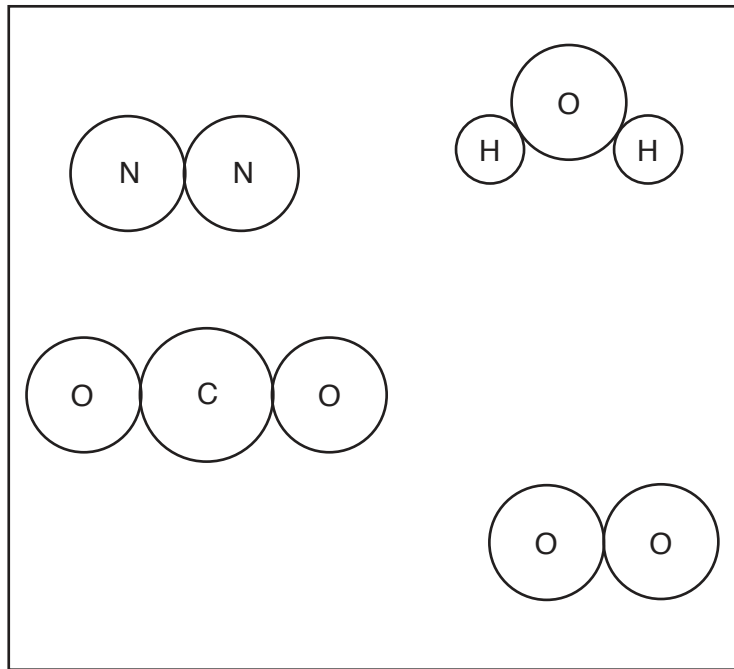


Fig. 2.2

(i) On Fig. 2.2, draw a label line to a molecule of an element and label it **E**.

Explain your answer.

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

(ii) On Fig. 2.2, draw a label line to the molecule of water and label it **W**.

Explain your answer.

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

(iii) Describe a chemical test and its result to show that the air contains water.

test .....

result .....

[2]

3 Doctors use X-rays,  $\gamma$ -rays and ultrasound waves in a hospital.

(a) State **one** medical use for X-rays in a hospital.

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

(b) Ultrasound waves are used by doctors to scan unborn babies.

Suggest **and** explain why it is **not** safe to scan unborn babies with X-rays or  $\gamma$ -rays.

.....  
.....  
.....[2]

(c) Ultrasound waves have a very high frequency which humans cannot hear.

(i) State, in terms of waves, what is meant by the term *frequency*.

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

(ii) Using your knowledge of the range of audible frequencies for humans, suggest a frequency for these ultrasound waves.

Explain your answer.

frequency = ..... Hz

explanation .....  
.....  
[2]

- 4 (a) An athlete runs in a race. Her pulse rate is measured before, during and after the race.

Fig. 4.1 shows the changes to her pulse rate.

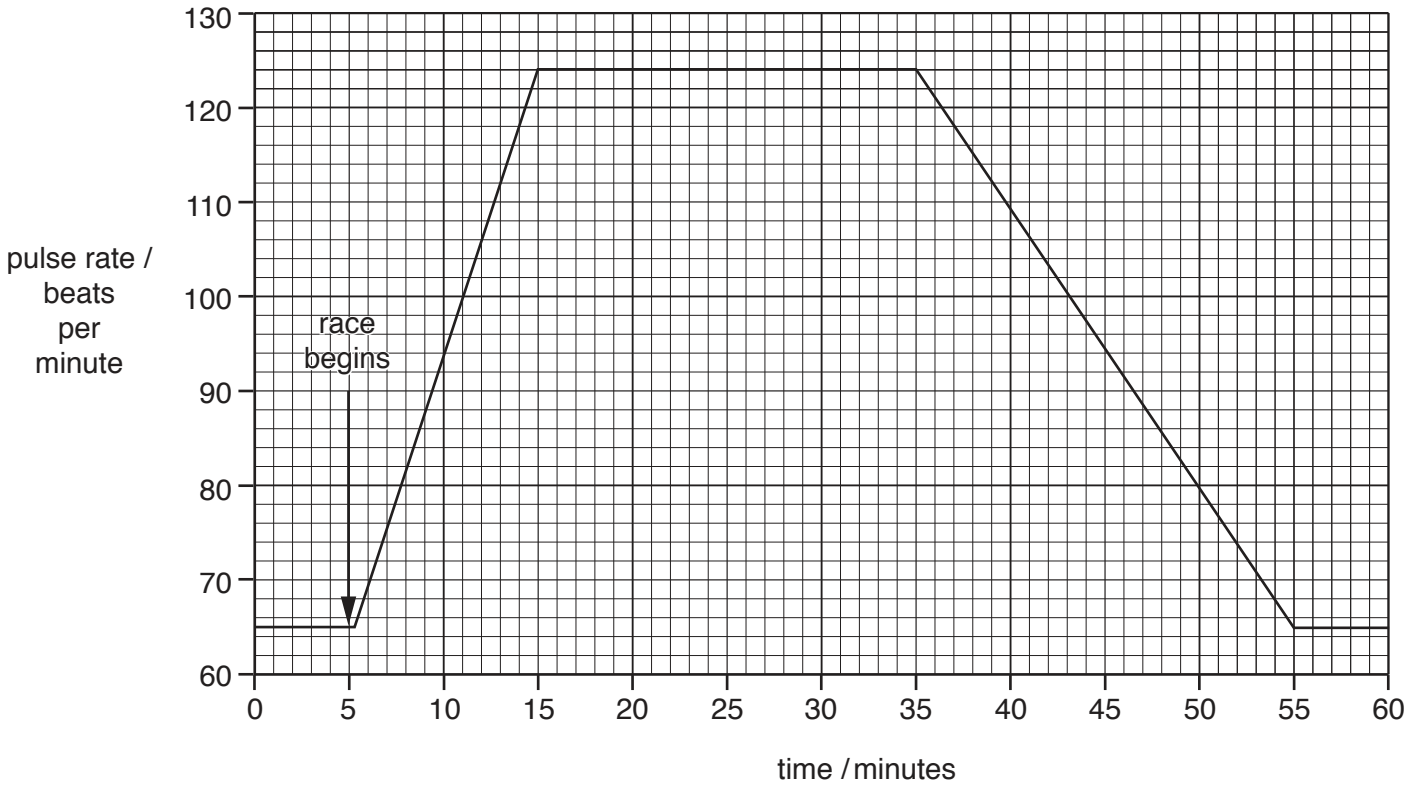


Fig. 4.1

- (i) Determine the athlete's pulse rate before the race begins.

.....beats per minute [1]

- (ii) Determine how long after the start of the race the athlete's pulse rate reaches its maximum.

..... minutes [1]

- (iii) Mark with an X the point on the graph when the athlete finishes her race. [1]

- (b) Describe how the action of the heart causes an increase in pulse rate during exercise.

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

- (c) Name the main blood vessel that transports blood from the heart to the body.

.....[1]

- (d) The blood brings oxygen to the respiring muscles.

Draw a circle around the component of blood that is responsible for the transport of oxygen.

platelets                      plasma                      red blood cells                      white blood cells

[1]

5 Copper and potassium are metallic elements in the fourth period of the Periodic Table.

(a) (i) Using the Periodic Table on page 28, state:

- the chemical symbols of copper and potassium

copper .....

potassium .....

- the proton numbers of copper and potassium.

copper .....

potassium .....

[2]

(ii) State whether an atom of copper or an atom of potassium contains the greater number of electrons.

Explain your answer.

atom .....

explanation .....

..... [1]

(iii) An atom of copper and an atom of potassium have different mass numbers.

Define the term *mass number*.

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

(b) State **two** reasons, other than cost, why potassium is **not** used to make water pipes.

1 .....

2 .....

[2]



- (c) A student uses the apparatus shown in Fig. 5.1 to investigate what happens when copper carbonate, a green solid, is heated strongly.

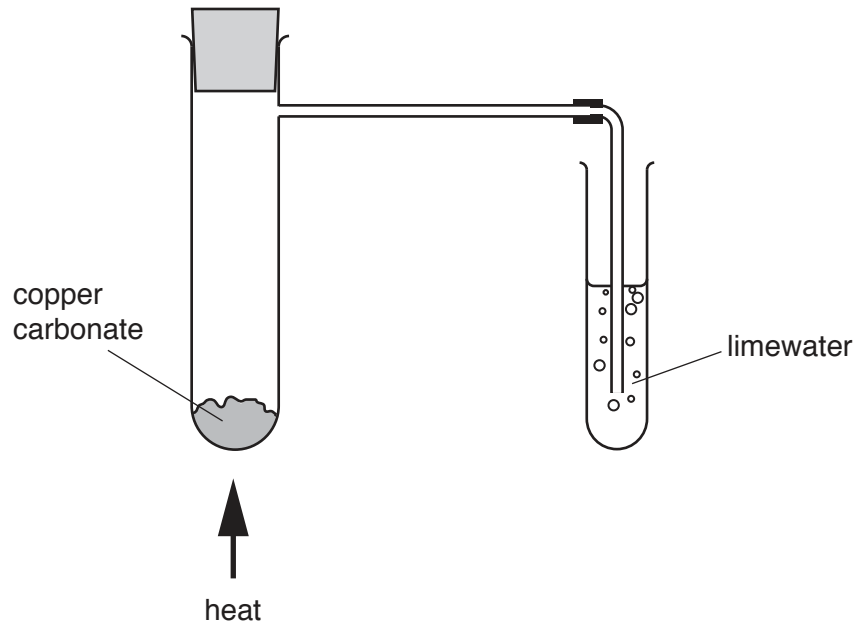


Fig. 5.1

During heating, green copper carbonate changes to black copper oxide, and carbon dioxide bubbles through the limewater.

- (i) Construct the **word** equation for this reaction.



[1]

- (ii) Identify the type of chemical reaction that occurs when copper carbonate is heated.

.....[1]

- (iii) Describe the change in appearance of the limewater during the investigation.

.....[1]

- (iv) State **one** property of copper carbonate that is typical of a **transition** metal compound.

.....[1]

6 Two headlamps on a truck are connected in parallel with a battery.

(a) The circuit also contains:

- one switch that controls both headlamps
- one fuse that protects both headlamps.

Draw a circuit diagram for this circuit using electrical circuit symbols.

[4]

(b) The battery has a voltage of 12V and supplies a current of 16A to each lamp.

Calculate the resistance in each lamp when lit.

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

formula

working

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

(c) The truck accelerates up a hill.

Apart from thermal energy, state **two** forms of energy gained by the truck as it accelerates up the hill.

1 .....energy

2 .....energy

[2]

(d) The truck has rear view mirrors to help the driver see behind the truck.

The truck driver sees a taxi in his mirror as shown in Fig. 6.1.



Fig. 6.1

Use Fig. 6.1 to describe **two** characteristics of an image seen in a plane mirror apart from size.

1 .....

.....

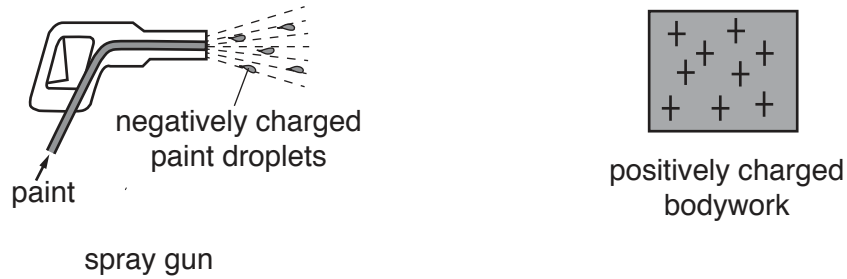
2 .....

.....

[2]

- (e) The bodywork of the truck is painted using an electrostatic paint spray gun. The paint droplets leave the spray gun with a negative electric charge. The bodywork is given a positive electric charge.

Fig. 6.2 shows part of the process.



**Fig. 6.2**

- (i) Explain why the negative charges on the paint droplets and positive charges on the bodywork ensure that most of the paint reaches the bodywork.

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

- (ii) Explain why the negative charges on the paint droplets ensure that the paint is spread evenly.

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



7 Polydactyly is an inherited condition which results in the growth of extra fingers or toes.

Fig. 7.1 is a drawing of the foot of a baby with polydactyly.



Fig. 7.1

- The allele for polydactyly is **D**.
- The allele for non-polydactyly is **d**.

(a) (i) State the terms that can be used to describe the genotype **DD**.

..... and ..... [2]

(ii) State the genotype of a person that does **not** have polydactyly.

..... [1]

(b) A couple have a child.

Complete the genetic diagram to show the possible genotypes of the offspring.

		mother's alleles	
		<b>D</b>	<b>d</b>
father's alleles	<b>D</b>	.....	.....
	<b>d</b>	.....	.....

[1]

(c) Identical twins have identical genotypes, but often have different phenotypes.

Explain what causes their phenotypes to be different from each other, and give an example of a possible difference.

.....  
 .....  
 ..... [2]

(d) Humans have 46 chromosomes. Half are inherited from the mother and half from the father during fertilisation.

(i) Use words from the list to complete the description of the term *fertilisation*.

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

**alleles**      **cell**      **DNA**      **eggs**      **genes**  
**nuclei**      **sperm**      **zygotes**

Fertilisation is described as the joining of the ..... of male gametes called ..... and female gametes called

..... [2]

(ii) State the chromosome pairs in the sex chromosomes of a human male and the sex chromosomes of a human female.

male sex chromosomes .....

female sex chromosomes .....

[1]

- 8 (a) Limestone is a useful material obtained from the Earth's crust.

The main compound in limestone is calcium carbonate,  $\text{CaCO}_3$ .

- (i) State **two** uses of limestone.

1 .....

2 .....

[2]

- (ii) Calcium carbonate contains positive calcium ions and **not** calcium atoms.

Describe, in terms of the number of protons and of electrons, the difference between an atom and a positive ion.

.....

.....

.....[2]

- (b) Fig. 8.1 shows apparatus a student uses to investigate the rate of reaction between calcium carbonate and dilute hydrochloric acid.

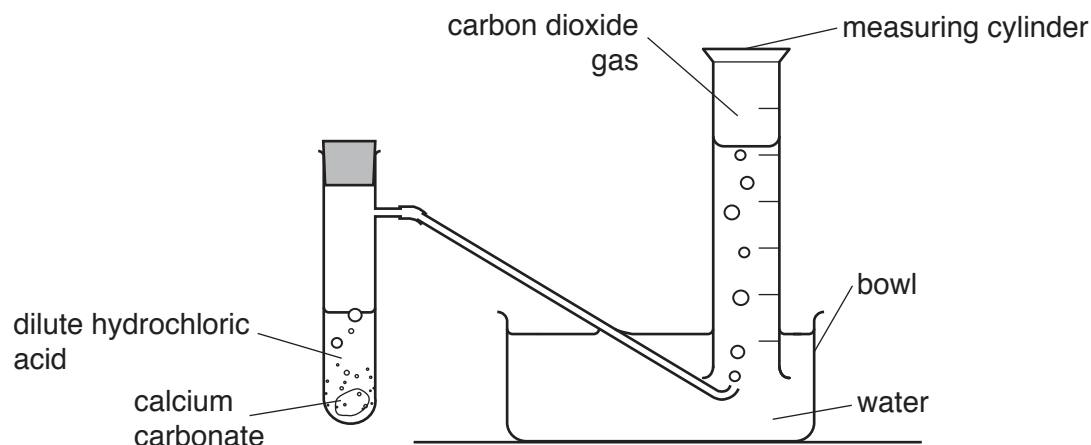


Fig. 8.1

The student adds a single piece of calcium carbonate to dilute hydrochloric acid.

A salt solution and carbon dioxide are produced.

- (i) Name the salt that is produced.

.....[1]



- (ii) Some of the carbon dioxide dissolves into the water in the bowl, and the pH changes.

Predict whether the pH increases or decreases.

Explain your answer.

pH change .....

explanation .....

.....

.....

[2]

- (iii) The student repeats the investigation using the same mass of calcium carbonate and the same volume of dilute hydrochloric acid.

Suggest **two** changes to the reaction conditions that would cause the rate of this reaction to increase.

1 .....

2 .....

[2]

9 (a) Fig. 9.1 shows the speed-time graph for a journey made by a train.

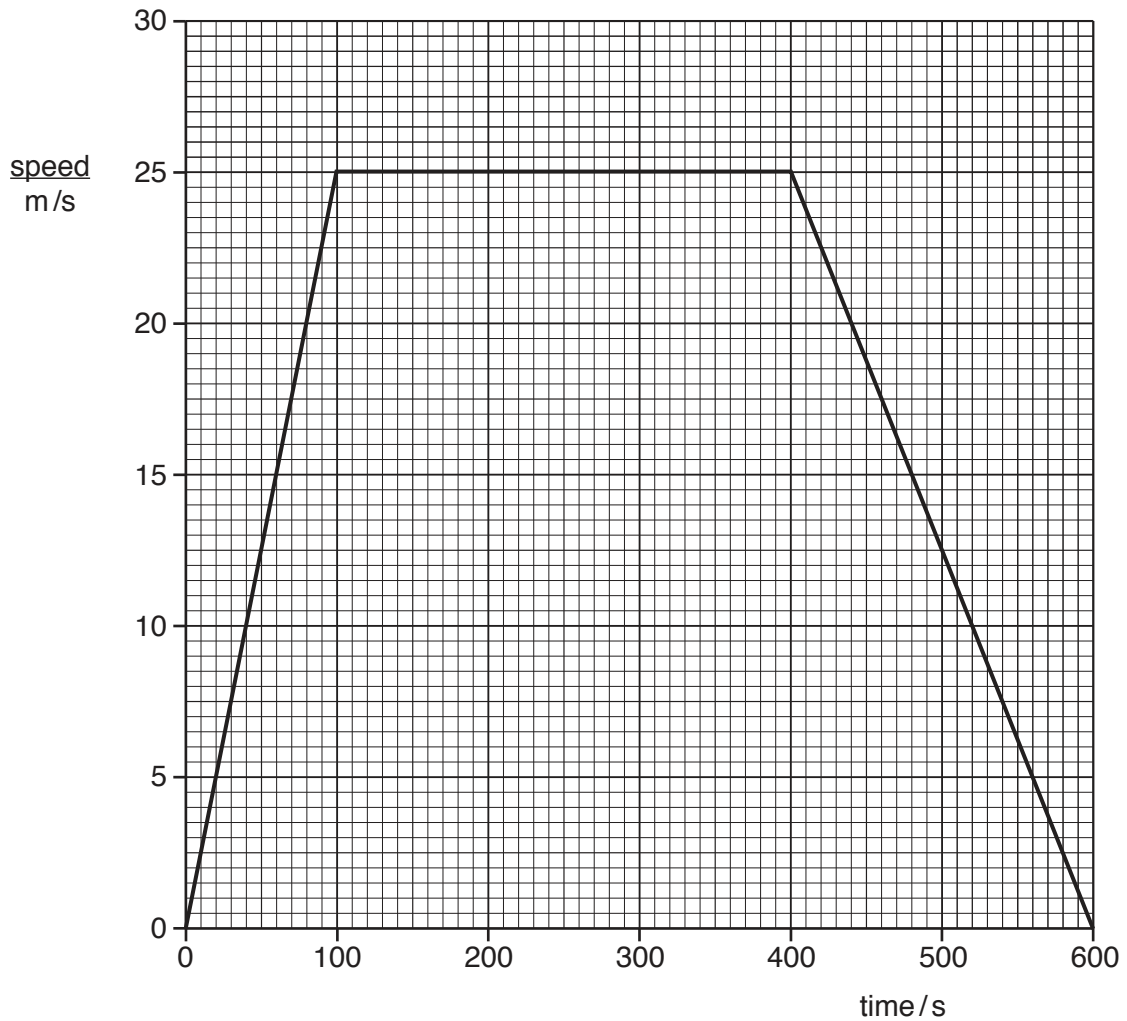


Fig. 9.1

(i) State the time taken by the train for this journey.

..... s [1]

(ii) The train travels a total distance of 11 250 metres in this journey. Using your answer to (i), calculate the average speed of the train for this journey. State the formula that you use and show your working.

formula

working

..... m/s [2]

(b) The engine of the train is powered by diesel fuel. The combustion of diesel fuel produces thermal energy, which is transformed into kinetic energy.

State the form of energy stored in diesel fuel.

..... [1]

(c) Diesel fuel is made from petroleum (crude oil). Petroleum is a non-renewable energy source.

(i) State **one other** non-renewable energy source.

.....[1]

(ii) State **one** renewable energy source.

.....[1]

(d) Fig. 9.2 shows the forces acting on the train engine when it accelerates.

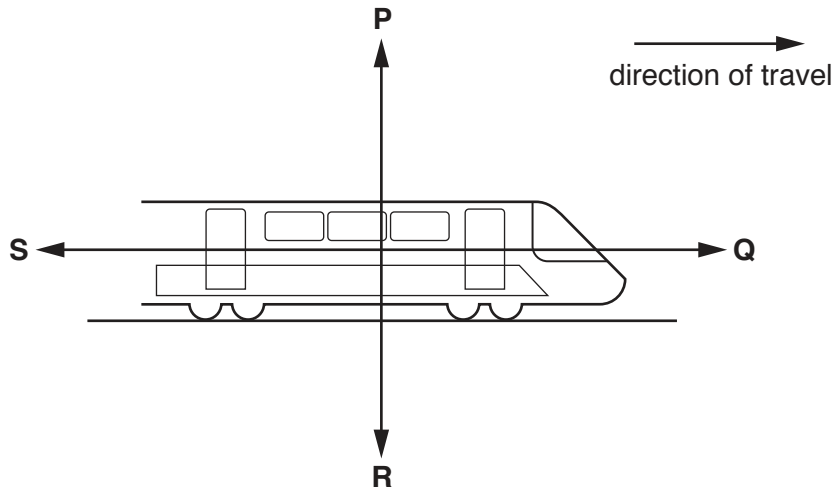


Fig. 9.2

Four forces **P**, **Q**, **R** and **S** are shown.

The force arrows do not indicate the size of the forces.

(i) State which force, **P**, **Q**, **R** or **S**, is the driving force of the train engine.

..... [1]

(ii) State which force, **P**, **Q**, **R** or **S**, is the weight of the train engine.

..... [1]

(iii) Compare the size **and** direction of forces **Q** and **S** when the train is accelerating.

.....  
 .....  
 ..... [2]

10 Fig. 10.1 shows a diagram of a cross-section of the skin.

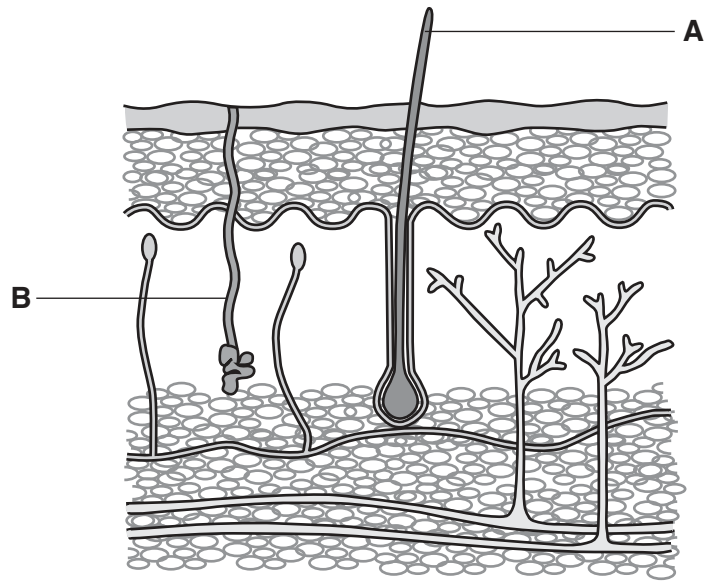


Fig. 10.1

(a) Use Fig. 10.1 to name the parts labelled **A** and **B**.

**A** .....

**B** .....

[2]

(b) An athlete is running a marathon in a hot country.

(i) Describe the changes that happen to the skin of this athlete in response to the heat.

.....  
 .....  
 .....  
 ..... [3]

(ii) Define the term *homeostasis*.

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

- (c) The body responds to painful stimuli such as stepping on a pin. The stimulus is detected by receptor cells in the skin which causes a response to occur. This is a reflex action.

Describe the pathway the information takes from receptor cells to a response in a reflex action.

.....

.....

.....

.....[3]

11 (a) Natural gas is used as a fuel.

When natural gas burns, the temperature increases.

(i) State the main constituent of natural gas.

.....[1]

(ii) Name the compound that is formed in addition to carbon dioxide when natural gas is burned completely.

.....[1]

(iii) State the term used for all chemical reactions that cause an increase in temperature.

.....[1]

(b) Petroleum is a mixture of hydrocarbons.

Table 11.1 shows information about six hydrocarbons **A** to **F** at standard temperature and pressure.

**Table 11.1**

hydrocarbon	formula	boiling point/°C
<b>A</b>	$C_2H_6$	-86
<b>B</b>	$C_3H_8$	-42
<b>C</b>	$C_4H_{10}$	-1
<b>D</b>	$C_5H_{12}$	36
<b>E</b>	$C_6H_{14}$	69
<b>F</b>	$C_7H_{16}$	99

(i) Using Table 11.1, describe the effect of the size of molecules on the boiling point of a hydrocarbon at standard temperature and pressure.

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

(ii) Predict **and** explain which of the hydrocarbons **A** to **F** are gases at 20°C.

hydrocarbons .....

explanation .....

.....[2]

(c) Complete the diagrams in Fig. 11.1 to show the structures of ethane and of ethene.

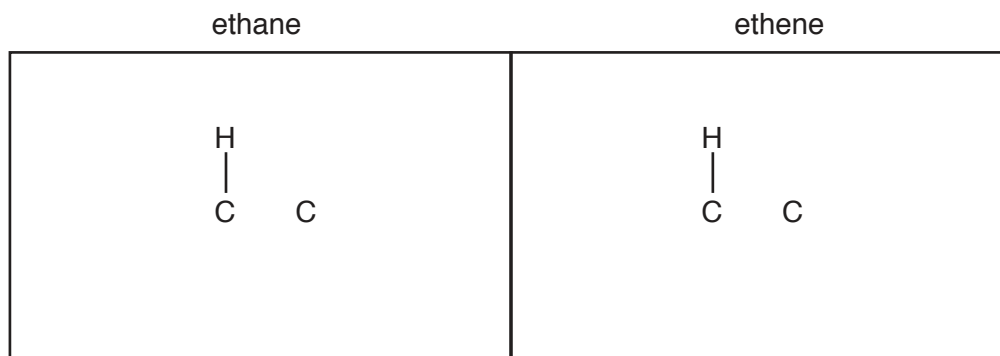


Fig. 11.1

[3]

(d) Fig. 11.2 shows apparatus a teacher uses to pass a gaseous hydrocarbon through bromine solution.

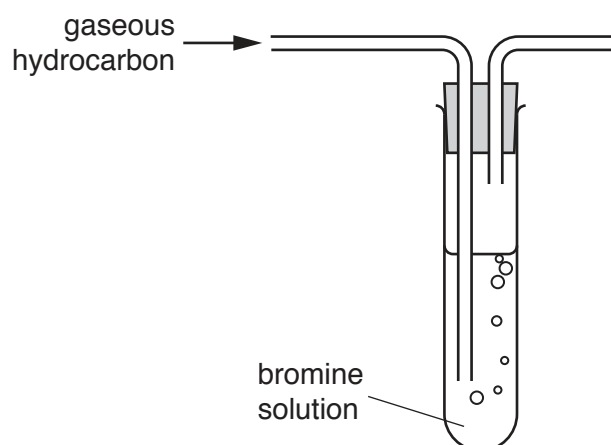


Fig. 11.2

(i) State the colour of the bromine solution before any gas passes through it.

.....[1]

(ii) The gas causes the solution to become colourless.

State what this observation shows about the structure of the hydrocarbon molecules.

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

12 A metal saucepan containing water is placed onto the hot-plate of an electric cooker.

Fig. 12.1 shows the water being heated in the saucepan.

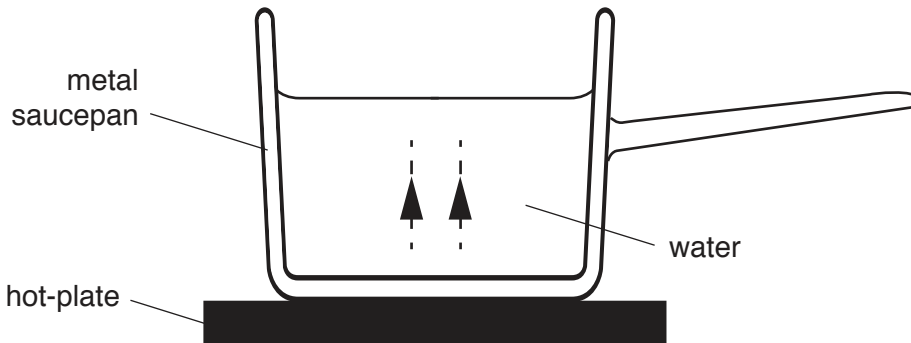


Fig. 12.1

(a) (i) Name the main method of energy transfer involved in transferring thermal energy through the base of the saucepan.

.....[1]

(ii) The water at the bottom of the saucepan is heated.

On Fig. 12.1, draw arrows to show how the warmed water circulates around the saucepan.

Two arrows have been drawn for you. [1]

(iii) Name the method of thermal energy transfer you have shown in (a)(ii).

.....[1]

(b) When the base of the metal saucepan is heated, the metal expands.

(i) Suggest **one** example where the thermal expansion of a metal is a problem.

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

(ii) Suggest **one** example where the thermal expansion of a metal is useful.

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



(c) Some of the water in the saucepan is evaporating.

Complete the following sentences to describe this evaporation.

Choose words from the list.

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

**bottom      fall      least      most      rise      surface      whole**

Evaporation occurs from the ..... of the liquid.

Only molecules with the ..... energy escape.

This causes the temperature of the remaining liquid to ..... [2]

(d) The water in the saucepan boils at 100 °C.

State what is meant by the term *boiling point*.

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

(e) The saucepan is made from steel.

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

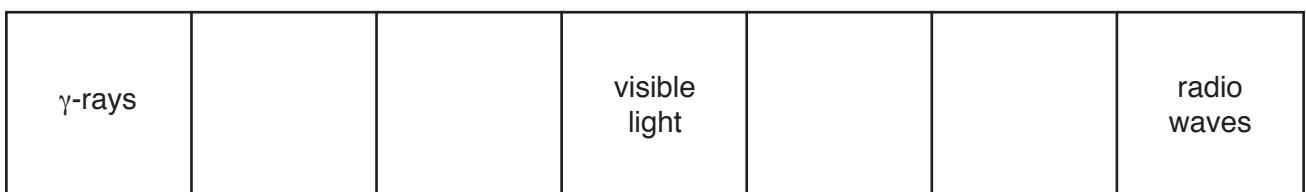
.....  
 ..... [1]

(f) Water can also be heated in a microwave oven.

Microwaves are part of the electromagnetic spectrum.

(i) Fig. 12.2 shows an incomplete electromagnetic spectrum.

On Fig. 12.2, place microwaves in the correct position.



**Fig. 12.2** [1]

(ii) State the part of the electromagnetic spectrum shown in Fig. 12.2 that has the lowest frequency.

..... [1]

13 (a) In the human body digestion is required to break down large, insoluble food molecules into small, water-soluble molecules that can be absorbed.

(i) Complete Table 13.1 to describe the two types of digestion process that take place in the human body.

**Table 13.1**

digestion process	example of this process in the human body
.....	enzymes in the stomach breaking food down
mechanical digestion	.....

[2]

(ii) Describe the movement of the digested food molecules during absorption.

.....  
 .....[2]

(b) (i) The boxes on the left show some nutrients.

The boxes on the right contain the smaller units from which they are made.

Draw a line from each nutrient to their correct smaller units.

nutrient	smaller units
fats and oils	amino acids
proteins	glucose
starch	glycerol and fatty acids

[2]

(ii) Draw a circle around **all** the elements that are present in fats.

calcium	carbon	hydrogen
magnesium	oxygen	sulfur

[1]

(c) Define the term *balanced diet*.

.....

.....

.....

.....[2]

## The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	<b>Key</b> atomic number atomic symbol name relative atomic mass										5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24											13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40
19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	86 <b>Rn</b> radon —
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	89–103 actinoids	104 <b>Rf</b> rutherfordium —	105 <b>Db</b> dubnium —	106 <b>Sg</b> seaborgium —	107 <b>Bh</b> bohrium —	108 <b>Hs</b> hassium —	109 <b>Mt</b> meitnerium —	110 <b>Ds</b> darmstadtium —	111 <b>Rg</b> roentgenium —	112 <b>Cn</b> copernicium —	114 <b>Fl</b> flerovium —	116 <b>Lv</b> livermorium —	—	—	—	—

57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	59 <b>Pr</b> praseodymium 141	60 <b>Nd</b> neodymium 144	61 <b>Pm</b> promethium —	62 <b>Sm</b> samarium 150	63 <b>Eu</b> europium 152	64 <b>Gd</b> gadolinium 157	65 <b>Tb</b> terbium 159	66 <b>Dy</b> dysprosium 163	67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175
89 <b>Ac</b> actinium —	90 <b>Th</b> thorium 232	91 <b>Pa</b> protactinium 231	92 <b>U</b> uranium 238	93 <b>Np</b> neptunium —	94 <b>Pu</b> plutonium —	95 <b>Am</b> americium —	96 <b>Cm</b> curium —	97 <b>Bk</b> berkelium —	98 <b>Cf</b> californium —	99 <b>Es</b> einsteinium —	100 <b>Fm</b> fermium —	101 <b>Md</b> mendelevium —	102 <b>No</b> nobelium —	103 <b>Lr</b> lawrencium —

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).