



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/31

October/November 2023

1 hour 15 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **20** pages.

- 1 (a) Fig. 1.1 shows the female reproductive system in humans.

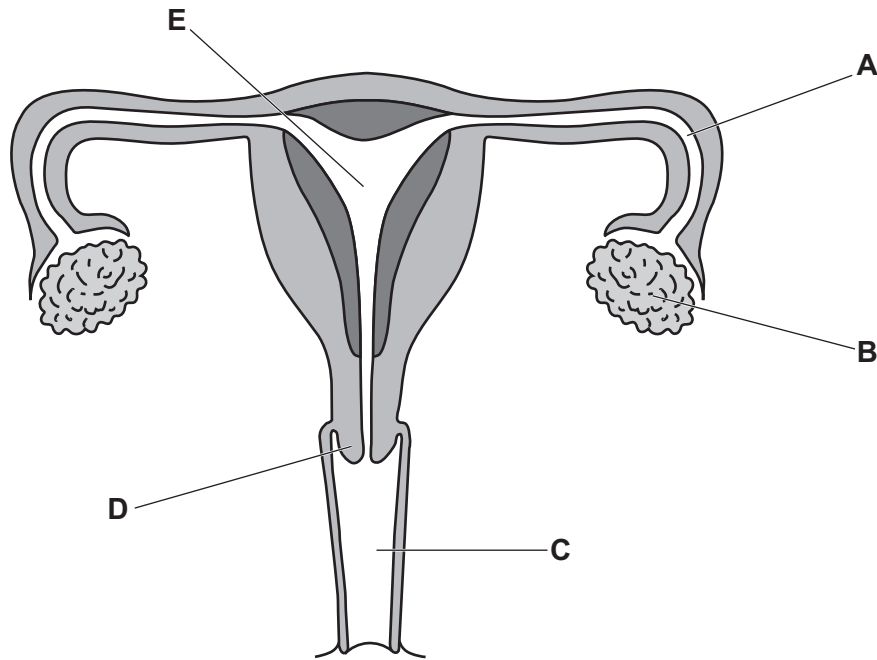


Fig. 1.1

State the letter in Fig. 1.1 that identifies:

- the cervix
- where eggs are released from
- where fertilisation takes place.

[3]

- (b) (i) Complete the definition of fertilisation in humans.

Fertilisation is the fusion of the from a male gamete and a female gamete to form a zygote. [1]

- (ii) Describe the early development of a zygote.

.....

 [2]

- (c) A study records the number of new human immunodeficiency virus (HIV) infections each year in people from one region of a country.

Fig. 1.2 shows a chart of the results.

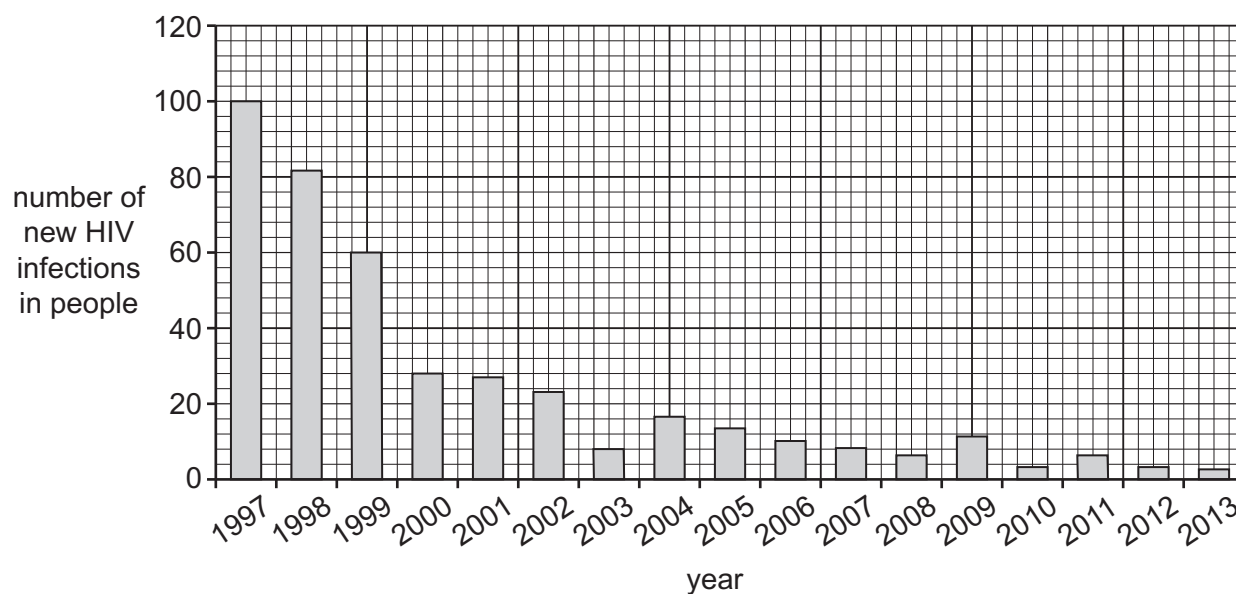


Fig. 1.2

- (i) Identify the year in Fig. 1.2 with a total of 60 new HIV infections in people.

..... [1]

- (ii) Describe the trend shown in Fig. 1.2 between 1997 and 2013.

.....
 [1]

- (iii) Describe **two** ways that HIV is transmitted from person to person.

1

2

[2]

[Total: 10]

2 A student dissolves sodium carbonate, Na_2CO_3 , in water to form aqueous sodium carbonate.

(a) (i) State a chemical test for water and the observation for a positive result.

test

observation

[2]

(ii) Complete Fig. 2.1 to show the dot-and-cross diagram of a molecule of water.

Show all of the outer shell electrons.

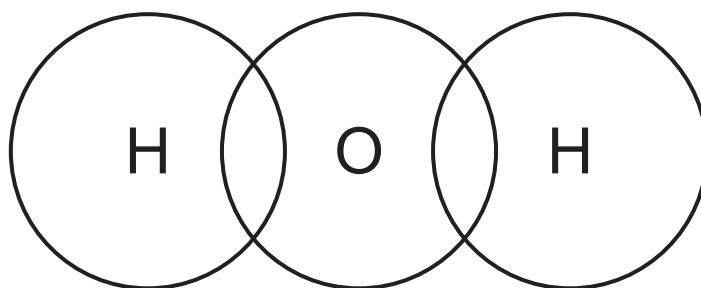


Fig. 2.1

[2]

(b) The student measures the boiling point of the aqueous sodium carbonate.

(i) State the piece of apparatus used to measure the temperature of the boiling point of the aqueous sodium carbonate.

..... [1]

(ii) State whether boiling is a chemical or a physical change.

Give a reason for your answer.

change

reason

[1]

(iii) During boiling, thermal energy (heat) is taken in.

State the name for the type of process that takes in thermal energy.

..... [1]

(c) The student adds dilute hydrochloric acid to a sample of aqueous sodium carbonate.

Complete the word equation for the reaction.



[2]

[Total: 9]

- 3 Fig. 3.1 shows the forces acting on an aircraft in flight.

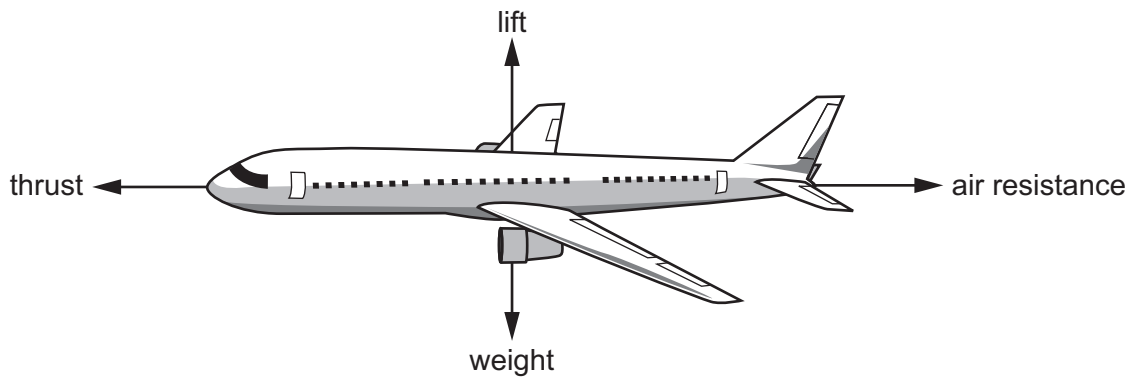


Fig. 3.1

- (a) The aircraft has a mass of 190 000 kg.

- (i) Calculate the weight of the aircraft.

The gravitational force on unit mass g is 10 N/kg.

weight = ... N [2]

- (ii) Complete the sentences about air resistance.

Air resistance is a force that acts on an object moving through air. Air resistance is a form of [1]

- (iii) The body of the aircraft is made of an aluminium alloy with a density of 2800 kg/m³.

The mass of the aluminium alloy is 120 000 kg.

Calculate the volume of the aluminium alloy.

volume = ... m³ [2]

- (b) Complete the sentences about energy transfers.

The aircraft uses fuel for combustion. When the aircraft climbs higher at a constant speed, energy is transferred from energy to energy.

[2]

- (c) The aircraft travels a distance of 1950 km in a time of 4 h 15 min.

Calculate the average speed for this journey in km/h.

speed = ... km/h [3]

[Total: 10]

4 (a) Transpiration is loss of water vapour from plant leaves.

(i) Describe the effect of temperature on transpiration.

.....
 [1]

(ii) Plants take in more water than is lost from the leaves.

State **one** use of water in plants.

..... [1]

(b) Fig. 4.1 is a photomicrograph of some of the cells in a plant root.

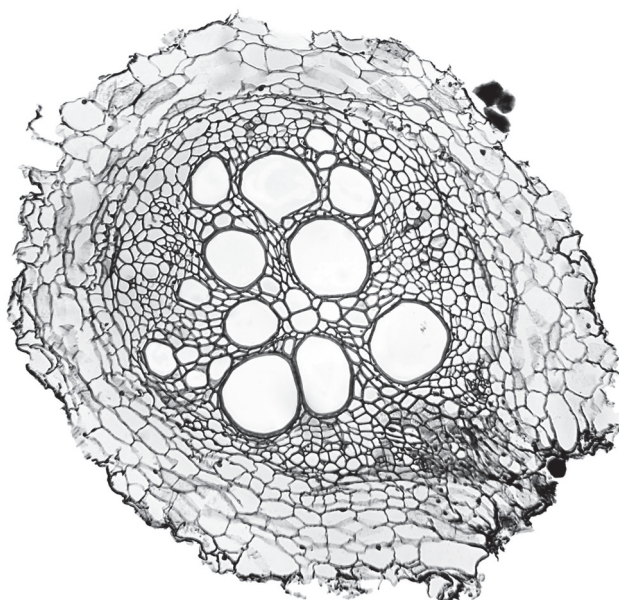


Fig. 4.1

(i) Draw a label line and the letter **X** on Fig. 4.1 to identify a xylem vessel. [1]

(ii) Water is transported from the soil to the xylem vessels through two types of cell.

State the names of the **two** types of cell.

1
 2 [2]

- (c) Plants and animals are both sources of food for humans.

A balanced diet needs to contain fibre and starch.

- (i) State the dietary importance of fibre.

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

- (ii) Circle the food that is a principal source of fibre.

chicken

eggs

milk

potatoes

[1]

- (iii) State the name of the smaller molecules that starch is made from.

..... [1]

[Total: 8]

- 5 Copper is a transition element.

Aluminium is a metal in Group III of the Periodic Table.

- (a) State **one** general physical property of metals.

..... [1]

- (b) Copper is extracted from copper oxide in a process that uses carbon.

Aluminium is extracted from its ore by a different process.

- (i) Describe **one** condition required for the extraction of copper from copper oxide using carbon.

..... [1]

- (ii) Suggest why aluminium **cannot** be extracted from its ore using carbon.

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

- (iii) State the name of an ore of aluminium.

..... [1]

- (iv) Recycling metals uses less energy and costs less than extracting metals from their ores.

Suggest **one** other reason why metals are recycled.

..... [1]

- (c) Aluminium alloys are used to make aircraft bodies.

- (i) State what is meant by the term alloy.

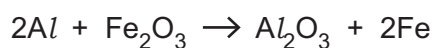
.....
..... [1]

- (ii) Suggest **one** reason why aluminium alloys, rather than pure aluminium, are used to make aircraft bodies.

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

- (d) Aluminium reacts with iron(III) oxide, Fe_2O_3 , at high temperatures.

The equation for this reaction is shown.



Identify **one** substance that is oxidised and **one** substance that is reduced during this reaction.

oxidised

reduced

[1]

[Total: 8]

- 6 A student determines the resistance of resistor **R**.

Fig. 6.1 shows resistor **R** connected in series with a battery and an ammeter.

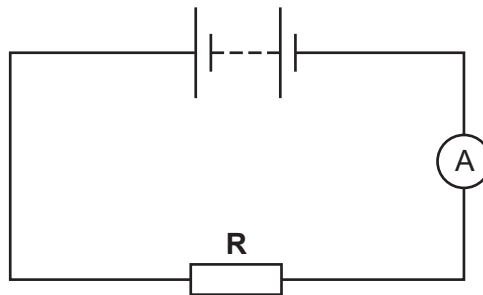


Fig. 6.1

- (a) The reading on the ammeter is 0.24A.

- (i) State the name of the **quantity** measured by the ammeter.

..... [1]

- (ii) The student connects a voltmeter to measure the potential difference (p.d.) across resistor **R**.

On Fig. 6.1, draw a voltmeter symbol and show how the student connects the voltmeter to take this measurement. [2]

- (iii) The potential difference across resistor **R** is 3.6V.

Calculate the resistance of resistor **R**.

Give the unit of your answer.

resistance = ... unit [3]

(b) Resistor **S** has the same resistance as resistor **R**.

(i) The student connects resistor **S** in series with resistor **R**.

Fig. 6.2 shows the circuit.

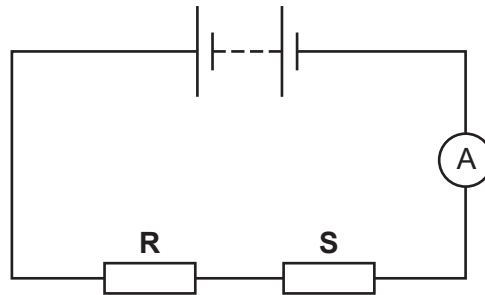


Fig. 6.2

State the reading on the ammeter.

reading = ...A [1]

(ii) The student connects resistor **S** in parallel with resistor **R**.

Fig. 6.3 shows the circuit.

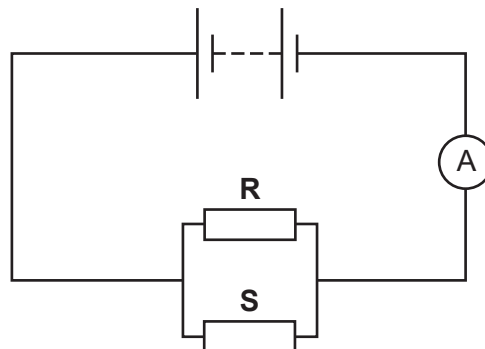


Fig. 6.3

Describe how the reading on the ammeter compares to the reading in (a).

Give a reason for your answer.

description

reason

.....

.....

[2]

[Total: 9]

7 (a) Fig. 7.1 shows a food web.

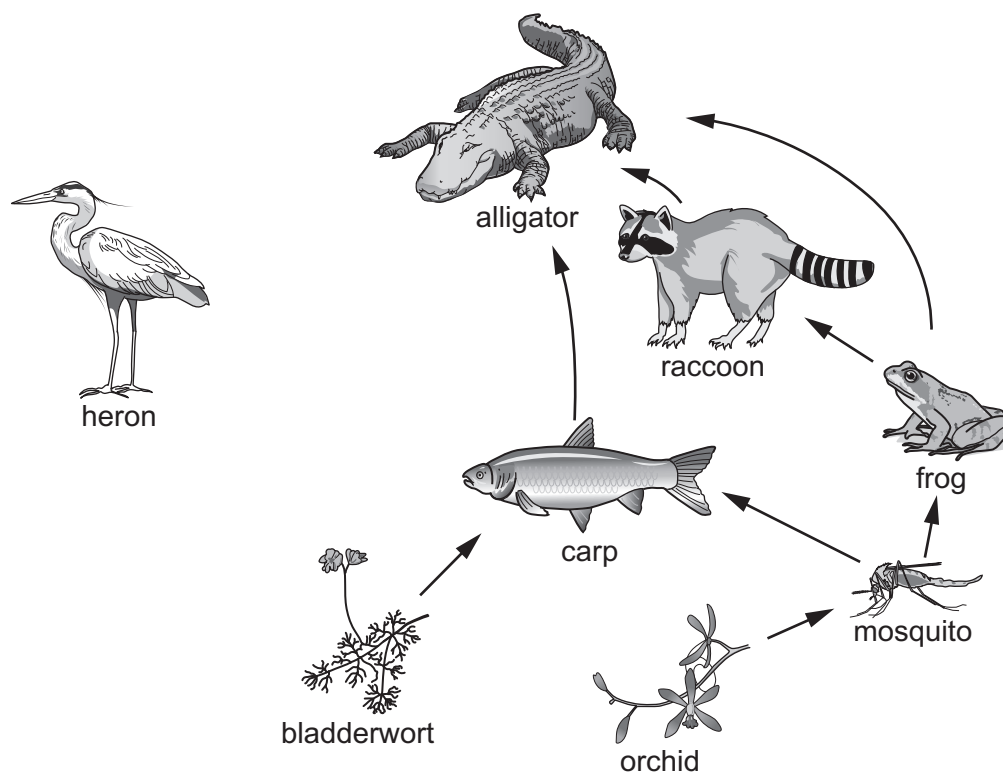


Fig. 7.1

(i) The food web is **not** complete.

The heron eats the carp. The alligator eats the heron.

Draw **two** arrows on Fig. 7.1 to show these feeding relationships.

[1]

(ii) State the name of **one** producer shown in Fig. 7.1.

..... [1]

(iii) Complete the sentences about the food web in Fig. 7.1.

The mosquito eats the orchid. The mosquito is a consumer.

The frog eats the mosquito. The frog is a secondary consumer.

The raccoon eats the frog. The raccoon is a consumer.

[2]

(b) All living organisms respire.

State the **word** equation for aerobic respiration.

..... [2]

- (c) (i) Fig. 7.2 shows some of the pathway taken by food in the human alimentary canal.

Complete Fig. 7.2.

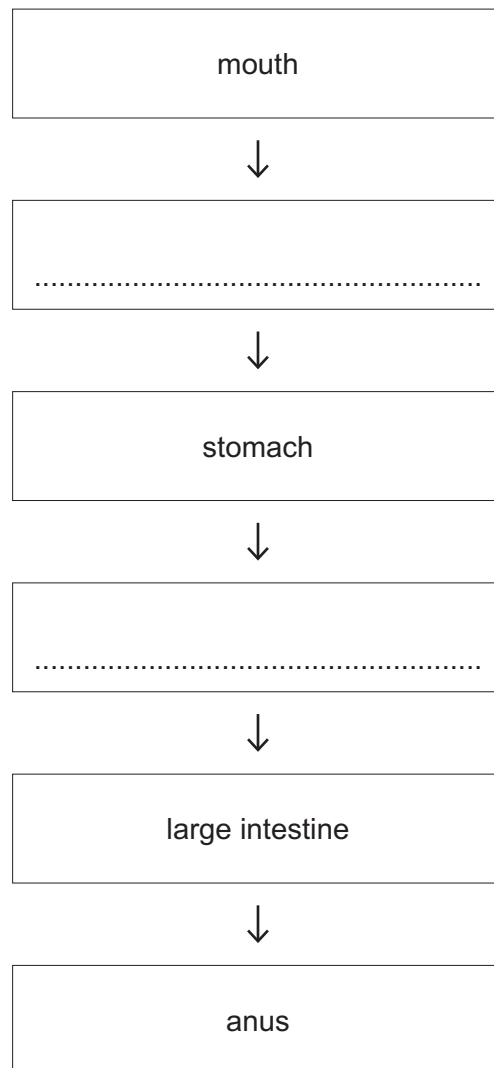


Fig. 7.2

[2]

- (ii) Circle the function of the anus.

absorption

digestion

egestion

ingestion

[1]

[Total: 9]

8 Chlorine is in Group VII of the Periodic Table.

(a) A chlorine atom has 17 electrons and nucleon number 35.

(i) Complete Fig. 8.1 to show the electrons in this chlorine atom.

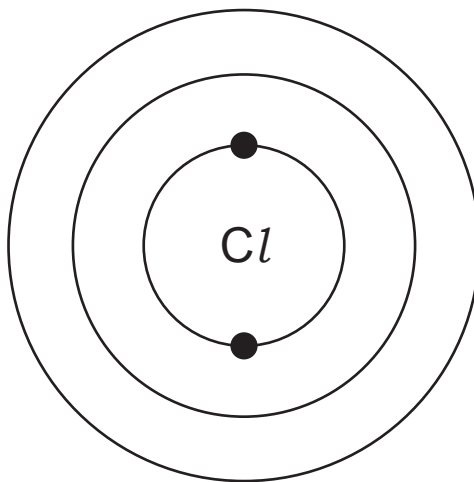


Fig. 8.1

[1]

(ii) Deduce the number of neutrons in this chlorine atom.

..... [1]

(b) Chlorine gas and aqueous sodium hydroxide are made when an electric current is passed through solution **X**.

(i) State the name of the process that breaks down compounds by passing an electric current through them.

..... [1]

(ii) Identify solution **X**.

..... [1]

(c) The elements in Group VII exist as diatomic molecules.

(i) State what is meant by the term diatomic.

.....

..... [1]

(ii) Describe **two** trends in the properties of elements in Group VII, going down the group.

1

2

[2]

(d) Complete the sentences about the treatment of the water supply.

Use **one** word in each gap.

The process of is used to remove insoluble particles from the water.

The process of chlorination is used to kill in the water.

[2]

[Total: 9]

- 9 Many security measures are used in airports, including security scans of baggage, intruder alarms and video cameras.

(a) There are seven regions of the electromagnetic spectrum.

Fig. 9.1 shows an incomplete electromagnetic spectrum.

← increasing frequency						
gamma radiation	X-rays	ultraviolet	visible light	infrared		

Fig. 9.1

(i) Complete Fig. 9.1. [2]

(ii) State which region of the electromagnetic spectrum is used for:

security scans of baggage

intruder alarms.

[2]

(b) An intruder alarm emits sound waves.

Fig. 9.2 represents two sound waves, **A** and **B**, shown to the same scale.

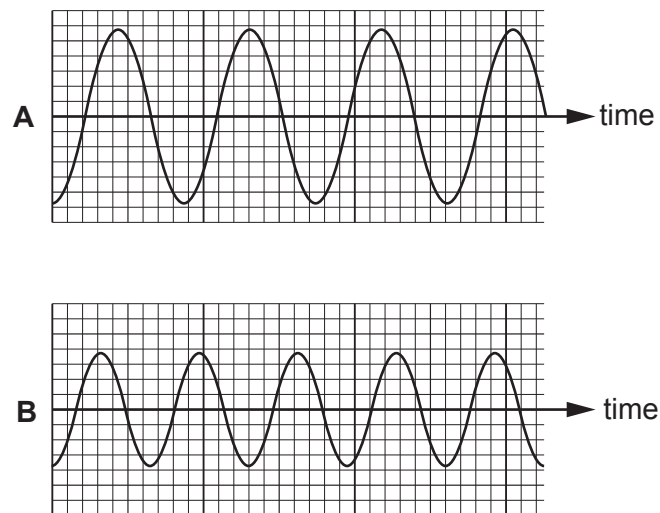


Fig. 9.2

State which sound wave is:

• lower pitch

• louder.

[1]

- (c) Video cameras use thin converging lenses.

Fig. 9.3 shows a thin converging lens forming the real image of an object on a screen.

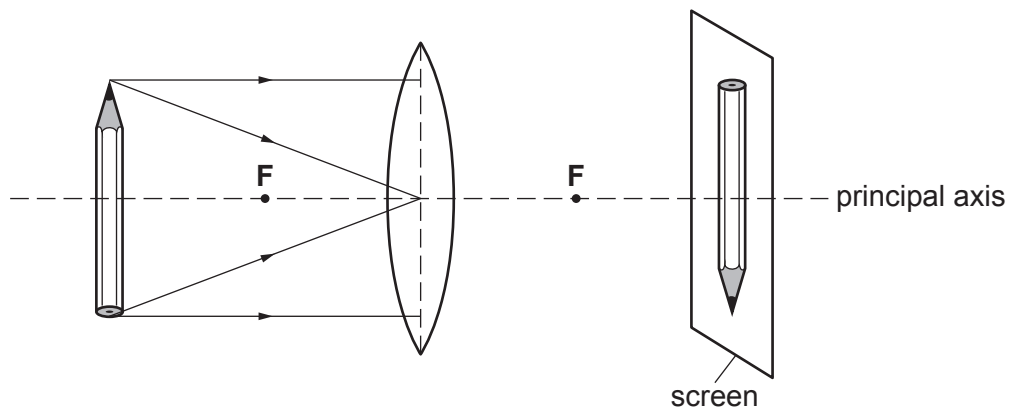


Fig. 9.3

- (i) On Fig. 9.3, use a double-headed arrow ($\leftrightarrow$ or $\updownarrow$) to show the focal length of the lens. [1]
- (ii) On Fig. 9.3, complete the ray diagram to show the formation of the image on the screen. [2]

[Total: 8]

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The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
												1 H hydrogen 1							
												Key atomic number atomic symbol name relative atomic mass							
3 Li lithium 7	4 Be beryllium 9																		
11 Na sodium 23	12 Mg magnesium 24																		
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 —	118 Ts tennessine —	119 Og oganeson —	120 Nh nihonium —	121 Lr lawrencium —	

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
	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 dm³ at room temperature and pressure (r.t.p.).



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1 hour 15 minutes

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- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

- 1 (a) Fig. 1.1 is a diagram of the human gas exchange system.

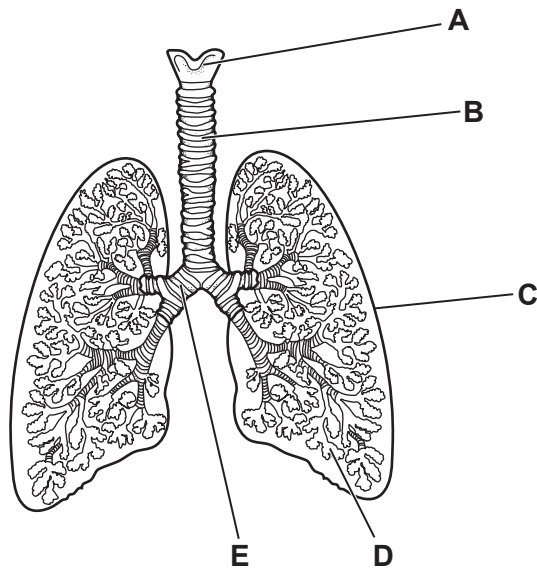


Fig. 1.1

- (i) State the letter in Fig. 1.1 that identifies:

one of the bronchi

the trachea.

[2]

- (ii) Circle the name of the blood vessel that takes blood from the lungs to the heart.

aorta

pulmonary artery

pulmonary vein

vena cava

[1]

- (b) Table 1.1 shows the composition of inspired air and expired air.

Table 1.1

gas	percentage in inspired air	percentage in expired air
nitrogen	79	79
oxygen	21	16
gas X	0.04	4
water vapour	variable	saturated

- (i) State the name of gas **X** in Table 1.1.

..... [1]

- (ii) Calculate the difference between the percentage of oxygen in inspired and expired air.

..... % [1]

- (iii) State the name of **one** process in the body that uses oxygen.

..... [1]

- (c) Gas exchange takes place through stomata in the leaves of a plant.

Stomata are also involved in water loss.

- (i) Complete the sentences to describe how water is lost from the leaves.

The water evaporates from the surfaces of the cells.

The water vapour then exits the leaf by through the stomata.

This process of water loss is called

[3]

- (ii) Suggest why stomata may close on very hot dry days.

..... [1]

[Total: 10]

2 A student investigates the reactions of four metals with dilute hydrochloric acid, HCl .

- (a) In the first experiment, the student adds a piece of each metal to separate test-tubes of dilute hydrochloric acid.

The concentration and temperature of the acid are the same in each test-tube. The size of each piece of metal is the same, and the pieces of metal are added to the acid at the same time.

The student observes bubbles of gas being produced in three of the test-tubes, as shown in Fig. 2.1.

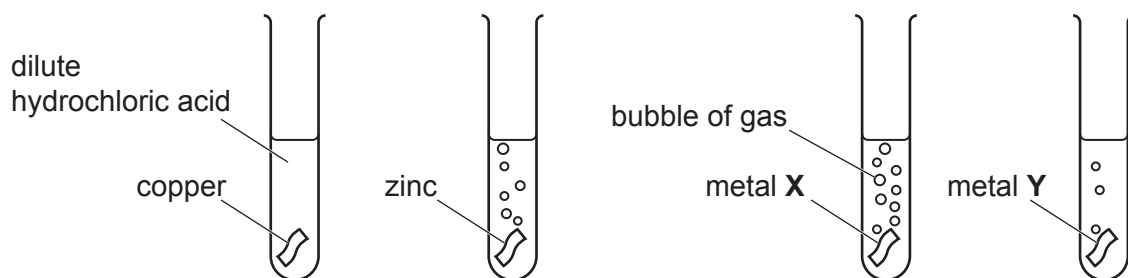


Fig. 2.1

- (i) State the name of the gas produced in this investigation.

..... [1]

- (ii) State the name of the salt made in the reaction between zinc and dilute hydrochloric acid.

..... [1]

- (iii) Explain why bubbles of gas are produced in the test-tube containing zinc, but no bubbles of gas are produced in the test-tube containing copper.

.....
 [1]

- (iv) Suggest the identities of metal X and metal Y.

Choose from the list of metals.

aluminium

calcium

iron

magnesium

metal X

metal Y

[1]

- (b) In the second experiment, the student uses the apparatus shown in Fig. 2.2 to investigate the rate of reaction of zinc with dilute hydrochloric acid.

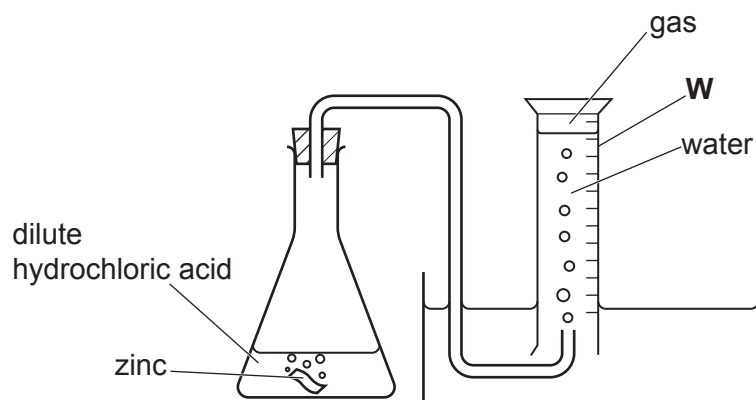


Fig. 2.2

- (i) State the name of the piece of apparatus labelled **W**.
 [1]
- (ii) State **one** other piece of apparatus, not shown in Fig. 2.2, that the student uses to investigate the rate of this reaction.
 [1]
- (iii) Suggest **one** way the student can increase the rate of this reaction.

 [1]
- (iv) When zinc reacts with dilute hydrochloric acid, an aqueous zinc salt is formed.
 This salt contains zinc ions, Zn^{2+} .
 State a chemical test for zinc ions, Zn^{2+} , and give the observation for a positive result.
 test

 observation
 [2]

[Total: 9]

- 3 Fig. 3.1 shows a truck carrying a load moving horizontally along a flat level road.

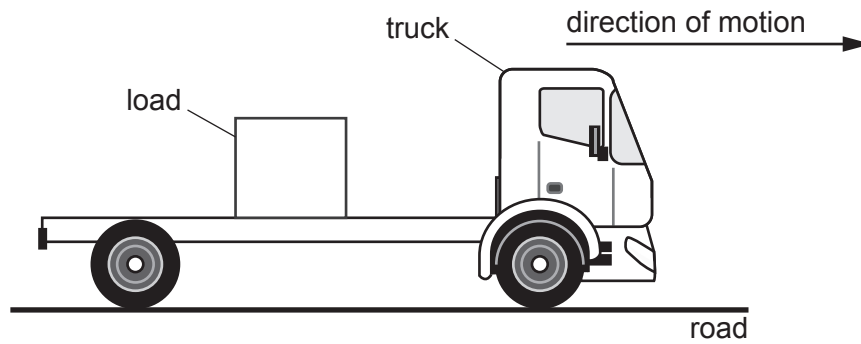


Fig. 3.1

- (a) The load has a mass of 2500 kg.

- (i) Calculate the weight of the load.

The gravitational force on unit mass g is 10 N/kg.

weight = ... N [2]

- (ii) Draw an arrow on Fig. 3.1 to show the weight of the load. [1]

- (iii) The load on the truck is made of solid gold.

The volume of the load is $1.3 \times 10^5 \text{ cm}^3$.

Calculate the density of gold in kg/m^3 .

density = ... kg/m^3 [3]

(b) Fig. 3.2 shows the speed–time graph for the motion of the truck on a journey.

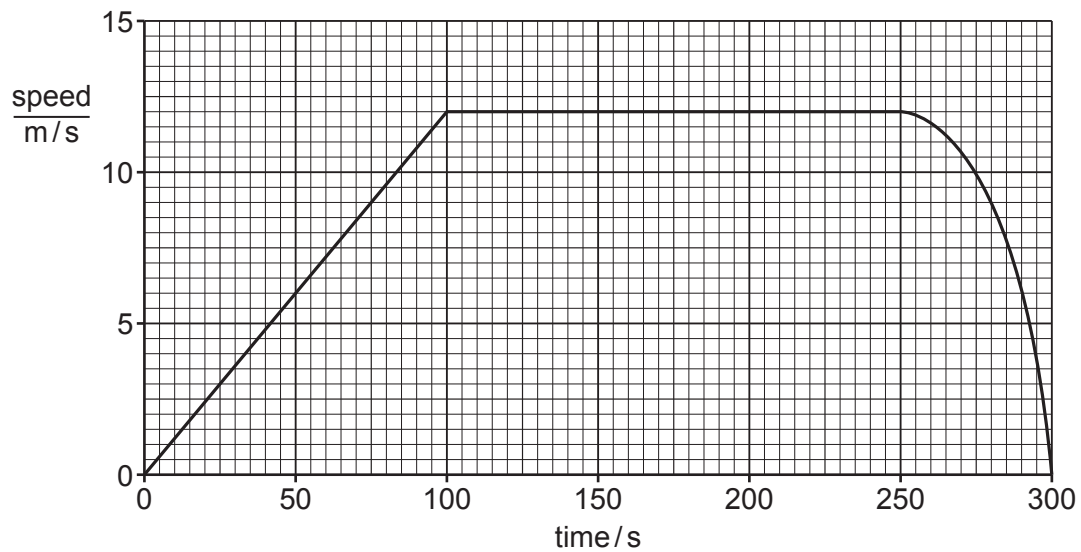


Fig. 3.2

(i) State the maximum speed of the truck on this journey.

maximum speed = ... m/s [1]

(ii) State the time taken by the truck to reach the maximum speed.

time = ... s [1]

(iii) Describe the motion of the truck between 250 s and 300 s.

.....
 [1]

(c) On a different journey, the truck is moving along a flat level road at a constant speed of 5 m/s.

The engine of the truck provides a constant driving force.

Explain why this constant driving force does **not** change the speed of the truck.

.....

 [2]

[Total: 11]

- 4 (a) Fig. 4.1 shows a food web for one ecosystem.

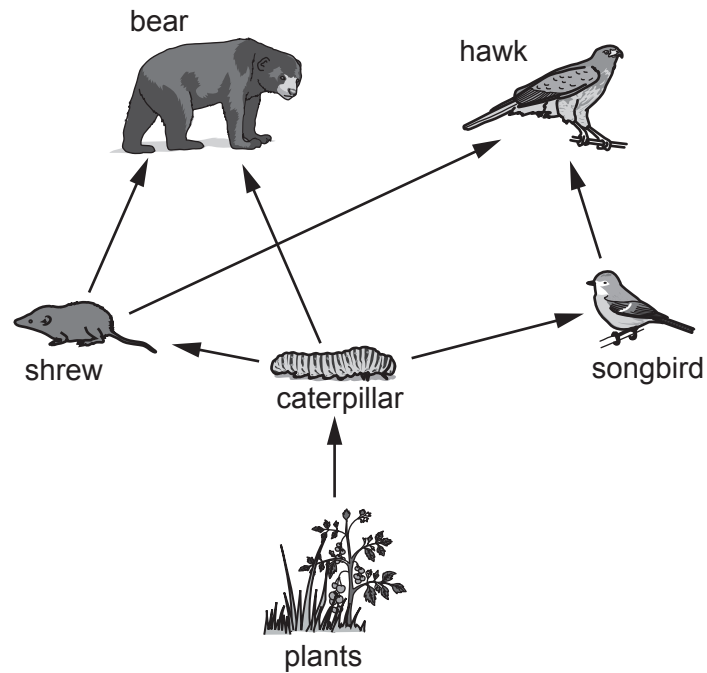


Fig. 4.1

- (i) Identify the herbivore in Fig. 4.1.

..... [1]

- (ii) Complete the sentences to explain why the hawk is a tertiary consumer.

Use **one** word in each gap.

The hawk eats an organism called a

This organism is a consumer.

[2]

- (iii) Rabbits are also found in the ecosystem.

Rabbits feed on plants.

Bears eat rabbits.

Construct a food chain to show this feeding relationship.

..... [2]

(b) Some plants are pollinated by insects.

(i) Define the term pollination.

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

(ii) State the function of petals in pollination.

..... [1]

(c) Complete the sentences about fertilisation in humans.

Choose words from the list.

gamete

ovary

oviduct

ovum

uterus

zygote

Fertilisation in humans takes place in the of the female.

After fertilisation, the fertilised egg is called the

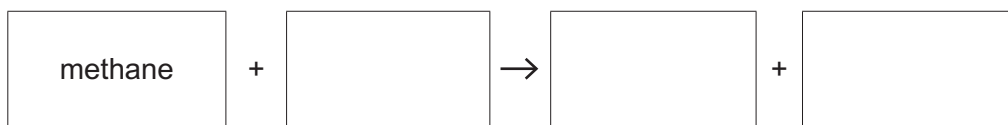
[2]

[Total: 10]

5 Natural gas and petroleum are fossil fuels.

(a) Methane is the main constituent of natural gas.

Complete the word equation for the complete combustion of methane.



[1]

(b) Petroleum is a mixture of saturated hydrocarbon molecules.

It is separated by the process shown in Fig. 5.1.

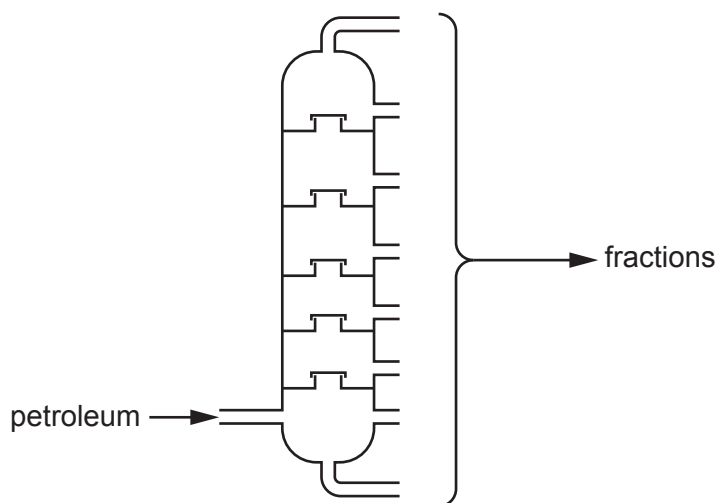


Fig. 5.1

(i) State the name of this process.

..... [1]

(ii) State the name of the fraction used for bottled gas for heating and cooking.

..... [1]

(c) Naphtha from petroleum is used to produce alkenes.

(i) State the name of the process that is used to produce alkenes.

..... [1]

(ii) Describe the colour change when aqueous bromine is added to an alkene.

from to [1]

(iii) Alkenes form addition polymers.

Name **one** alkene and the addition polymer that it forms.

alkene

addition polymer [1]

[Total: 6]

- 6 Fig. 6.1 shows a wind turbine used to generate electricity for the electrical system of a house.

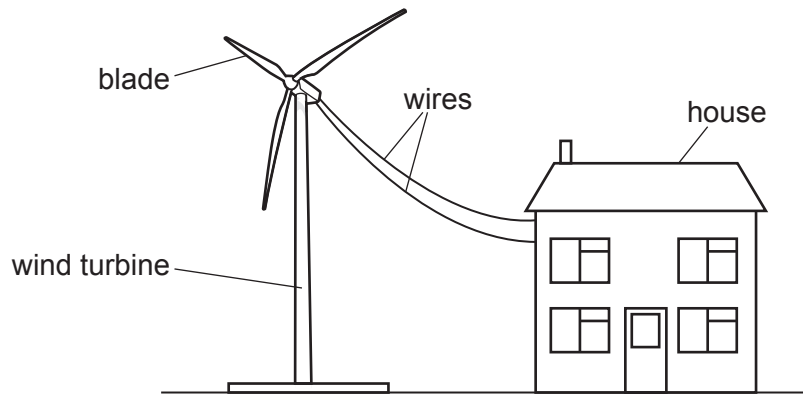


Fig. 6.1

- (a) Complete the sentences to describe the energy transfers for the wind turbine.

The energy of the wind rotates the blades of the turbine.

The generator in the wind turbine uses the energy of the rotating blades to generate energy.

[3]

- (b) The electromotive force (e.m.f.) produced by the wind turbine is 230 V.

There is a current of 9.2 A in each wire connected to the house.

- (i) State the name of a suitable metal for the wires.

..... [1]

- (ii) Complete the sentence:

The current in the metal wires is due to a flow of [1]

- (iii) Calculate the resistance of the electrical system of the house.

Give the unit of your answer.

resistance = ... unit [3]

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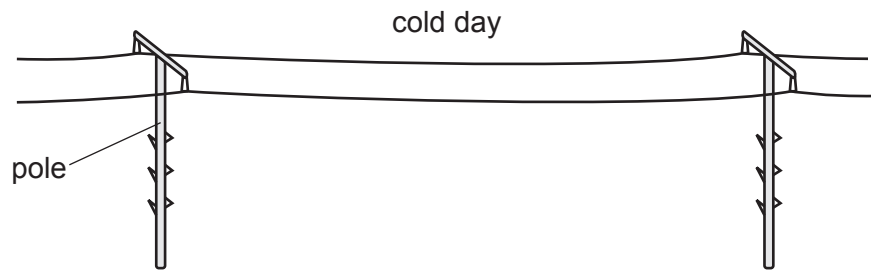


Fig. 6.2

Fig. 6.3 shows the same electricity wires on a hot day.

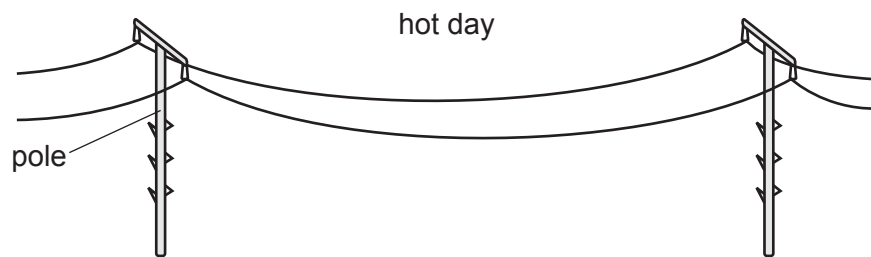


Fig. 6.3

Explain why the wires hang differently on the hot day.

.....
 [1]

[Total: 9]

- 7 (a) Carbohydrates are part of a balanced diet for humans.

Large carbohydrates are digested by enzymes in the alimentary canal.

The graph in Fig. 7.1 shows the effect of pH on the activity of one enzyme.

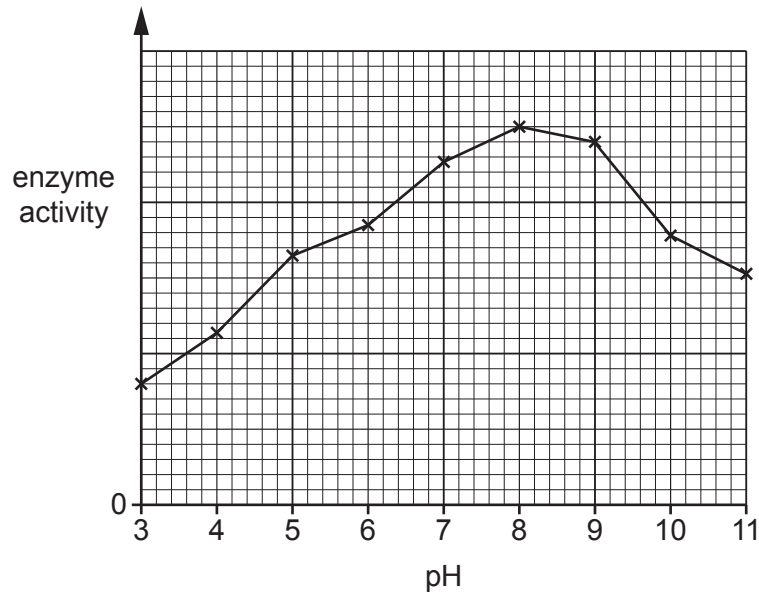


Fig. 7.1

- (i) Describe the effect of pH on the enzyme activity.

Include data from Fig. 7.1 in your answer.

.....

.....

..... [2]

- (ii) State the **three** chemical elements that make up carbohydrates.

1

2

3 [1]

- (iii) State the dietary importance of carbohydrates.

..... [1]

- (b) Digested food is transported in the blood.

State the name of the component of blood that transports digested food.

..... [1]

- (c) Blood can be tested for the presence of human immunodeficiency virus (HIV) in the body.

State **two** ways that the spread of HIV is controlled.

1

2 [2]

[Total: 7]

8 (a) Chlorine exists as diatomic molecules.

(i) State what is meant by the term molecule.

.....
 [1]

(ii) State what is meant by the term diatomic.

.....
 [1]

(iii) Chlorine is dissolved in a solvent to form aqueous chlorine.

State the formula of the solvent and the formula of the solute in aqueous chlorine.

solvent

solute [2]

(iv) State why chlorine is used in the treatment of the water supply.

.....
 [1]

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

One atom of chlorine is represented as shown.



(i) Deduce the number of protons and neutrons in the nucleus of this atom.

protons

neutrons [2]

(ii) State the number of electrons in the outer shell of a chlorine atom and in the outer shell of a chloride ion, Cl^- .

Cl atom

Cl^- ion [2]

- (c) State why chlorine does **not** react with neon, a Group VIII element.

Use ideas about electronic structure in your answer.

.....

.....

..... [2]

[Total: 11]

- 9 Fig. 9.1 shows a lighthouse used at night to warn ships of dangerous rocks in the water.

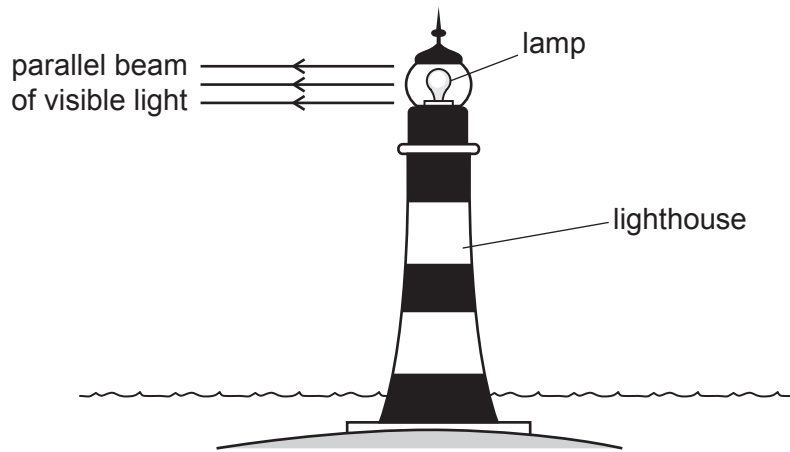


Fig. 9.1

- (a) A thin converging lens is used to form a parallel beam of visible light.

Fig. 9.2 shows the lens placed in front of the lamp.

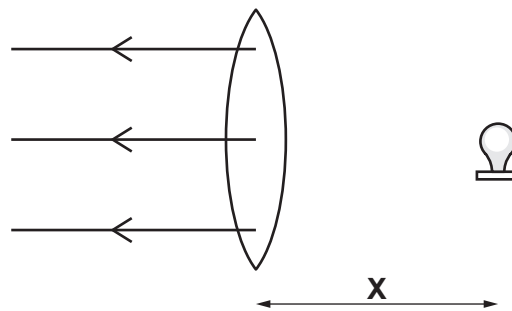


Fig. 9.2

- (i) Complete Fig. 9.2 to show how three rays from the lamp form the beam from the lens. [1]

- (ii) State the name of the distance labelled **X** in Fig. 9.2.

..... [1]

- (iii) Fig. 9.3 shows an incomplete electromagnetic spectrum.

Write visible light on Fig. 9.3 in the correct position.

← increasing frequency						
	X-rays					radio waves

Fig. 9.3

[1]

- (b) In fog, the beam from the lighthouse cannot be seen easily.

Therefore, the lighthouse also uses a foghorn to make a loud sound.

Fig. 9.4 shows a foghorn.

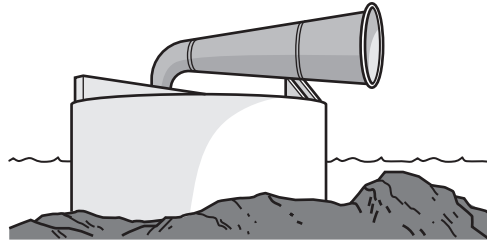


Fig. 9.4

- (i) The foghorn emits a loud sound.

Describe the amplitude of a loud sound.

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- (ii) The sound from the foghorn has a low pitch.

Suggest a suitable frequency for the foghorn that can be heard by humans with healthy ears.

Give a reason for your answer.

frequency Hz

reason

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- (iii) The foghorn is heard on a ship at a distance of 2100 m from the lighthouse.

The speed of sound in air is 330 m/s.

Calculate the time taken for sound from the foghorn to travel to the ship.

time = ... s [2]

[Total: 7]

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The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										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 —		

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 dm³ at room temperature and pressure (r.t.p.).



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/33

October/November 2023

1 hour 15 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

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[Turn over

- 1 (a) Fig. 1.1 is a diagram of the human gas exchange system.

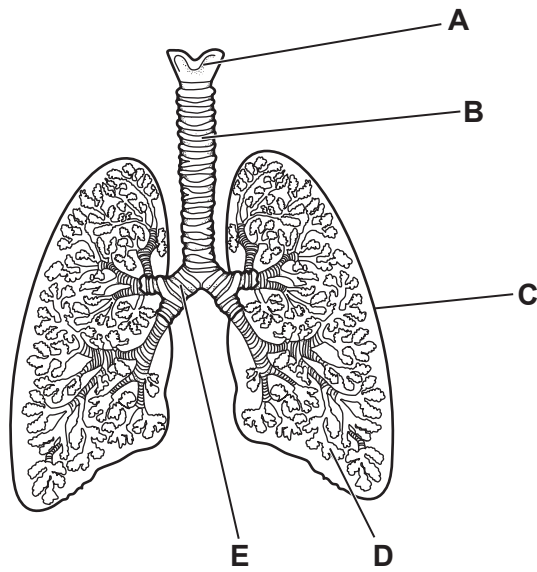


Fig. 1.1

- (i) State the letter in Fig. 1.1 that identifies:

one of the bronchi

the trachea.

[2]

- (ii) Circle the name of the blood vessel that takes blood from the lungs to the heart.

aorta

pulmonary artery

pulmonary vein

vena cava

[1]

- (b) Table 1.1 shows the composition of inspired air and expired air.

Table 1.1

gas	percentage in inspired air	percentage in expired air
nitrogen	79	79
oxygen	21	16
gas X	0.04	4
water vapour	variable	saturated

- (i) State the name of gas **X** in Table 1.1.

..... [1]

- (ii) Calculate the difference between the percentage of oxygen in inspired and expired air.

..... % [1]

- (iii) State the name of **one** process in the body that uses oxygen.

..... [1]

- (c) Gas exchange takes place through stomata in the leaves of a plant.

Stomata are also involved in water loss.

- (i) Complete the sentences to describe how water is lost from the leaves.

The water evaporates from the surfaces of the cells.

The water vapour then exits the leaf by through the stomata.

This process of water loss is called

[3]

- (ii) Suggest why stomata may close on very hot dry days.

..... [1]

[Total: 10]

2 A student investigates the reactions of four metals with dilute hydrochloric acid, HCl .

- (a) In the first experiment, the student adds a piece of each metal to separate test-tubes of dilute hydrochloric acid.

The concentration and temperature of the acid are the same in each test-tube. The size of each piece of metal is the same, and the pieces of metal are added to the acid at the same time.

The student observes bubbles of gas being produced in three of the test-tubes, as shown in Fig. 2.1.

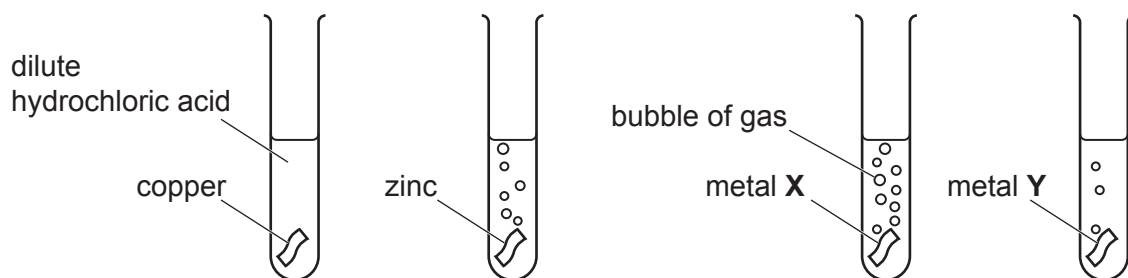


Fig. 2.1

- (i) State the name of the gas produced in this investigation.

..... [1]

- (ii) State the name of the salt made in the reaction between zinc and dilute hydrochloric acid.

..... [1]

- (iii) Explain why bubbles of gas are produced in the test-tube containing zinc, but no bubbles of gas are produced in the test-tube containing copper.

.....
 [1]

- (iv) Suggest the identities of metal X and metal Y.

Choose from the list of metals.

aluminium

calcium

iron

magnesium

metal X

metal Y

[1]

- (b) In the second experiment, the student uses the apparatus shown in Fig. 2.2 to investigate the rate of reaction of zinc with dilute hydrochloric acid.

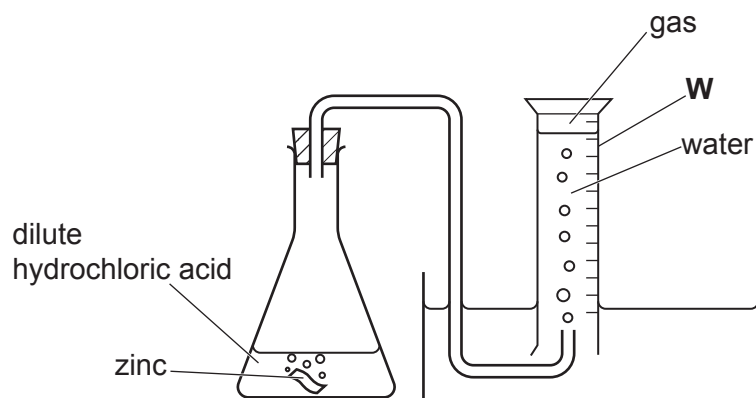


Fig. 2.2

- (i) State the name of the piece of apparatus labelled **W**.
 [1]
- (ii) State **one** other piece of apparatus, not shown in Fig. 2.2, that the student uses to investigate the rate of this reaction.
 [1]
- (iii) Suggest **one** way the student can increase the rate of this reaction.

 [1]
- (iv) When zinc reacts with dilute hydrochloric acid, an aqueous zinc salt is formed.
 This salt contains zinc ions, Zn^{2+} .
 State a chemical test for zinc ions, Zn^{2+} , and give the observation for a positive result.
 test

 observation
 [2]

[Total: 9]

- 3 Fig. 3.1 shows a truck carrying a load moving horizontally along a flat level road.

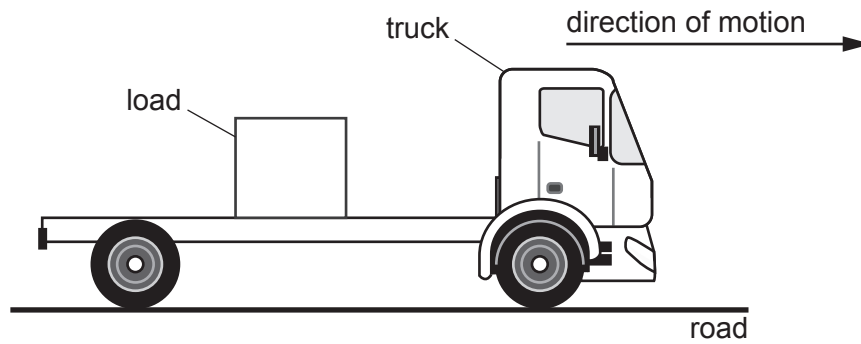


Fig. 3.1

- (a) The load has a mass of 2500 kg.

- (i) Calculate the weight of the load.

The gravitational force on unit mass g is 10 N/kg.

weight = ... N [2]

- (ii) Draw an arrow on Fig. 3.1 to show the weight of the load. [1]

- (iii) The load on the truck is made of solid gold.

The volume of the load is $1.3 \times 10^5 \text{ cm}^3$.

Calculate the density of gold in kg/m^3 .

density = ... kg/m^3 [3]

(b) Fig. 3.2 shows the speed–time graph for the motion of the truck on a journey.

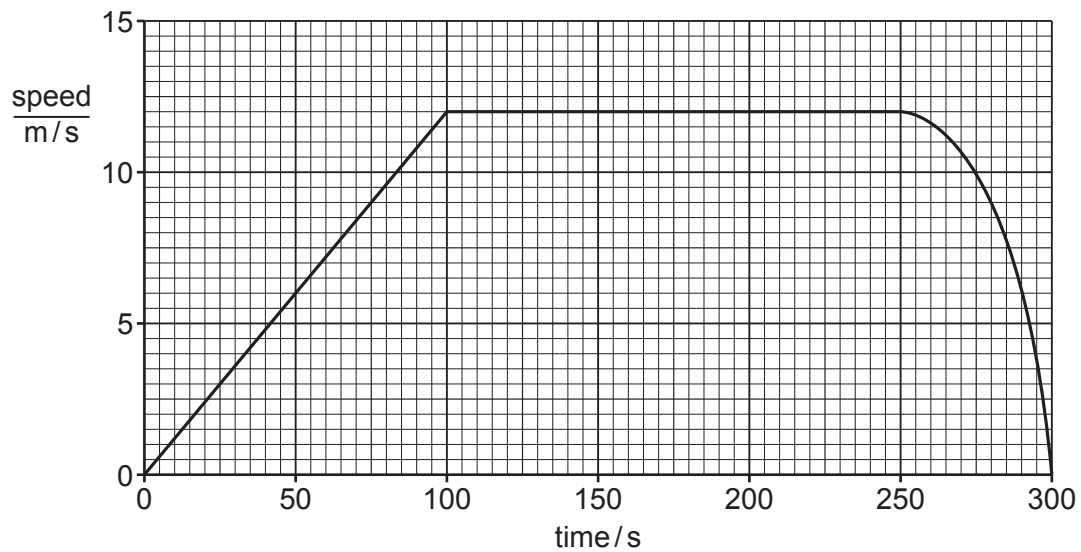


Fig. 3.2

(i) State the maximum speed of the truck on this journey.

maximum speed = ... m/s [1]

(ii) State the time taken by the truck to reach the maximum speed.

time = ... s [1]

(iii) Describe the motion of the truck between 250 s and 300 s.

.....
 [1]

(c) On a different journey, the truck is moving along a flat level road at a constant speed of 5 m/s.

The engine of the truck provides a constant driving force.

Explain why this constant driving force does **not** change the speed of the truck.

.....

 [2]

[Total: 11]

- 4 (a) Fig. 4.1 shows a food web for one ecosystem.

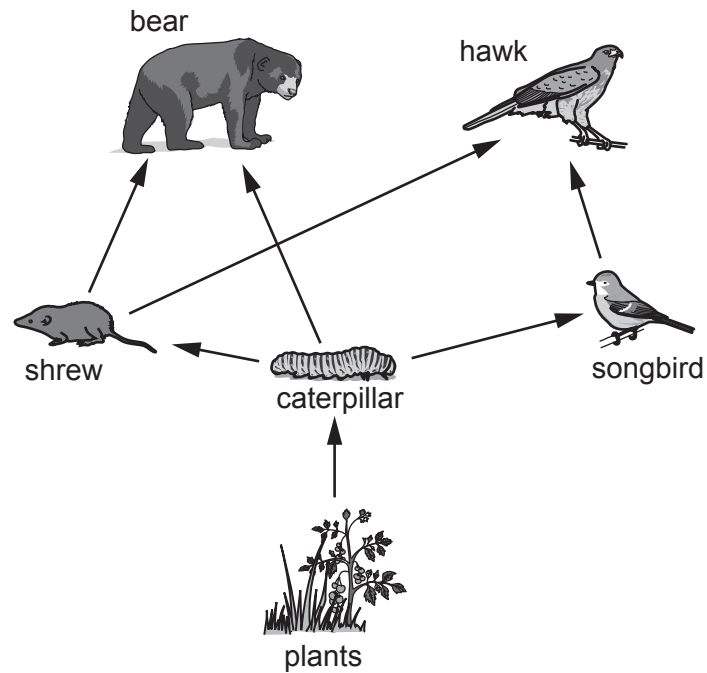


Fig. 4.1

- (i) Identify the herbivore in Fig. 4.1.

..... [1]

- (ii) Complete the sentences to explain why the hawk is a tertiary consumer.

Use **one** word in each gap.

The hawk eats an organism called a

This organism is a consumer.

[2]

- (iii) Rabbits are also found in the ecosystem.

Rabbits feed on plants.

Bears eat rabbits.

Construct a food chain to show this feeding relationship.

..... [2]

(b) Some plants are pollinated by insects.

(i) Define the term pollination.

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

(ii) State the function of petals in pollination.

..... [1]

(c) Complete the sentences about fertilisation in humans.

Choose words from the list.

gamete

ovary

oviduct

ovum

uterus

zygote

Fertilisation in humans takes place in the of the female.

After fertilisation, the fertilised egg is called the

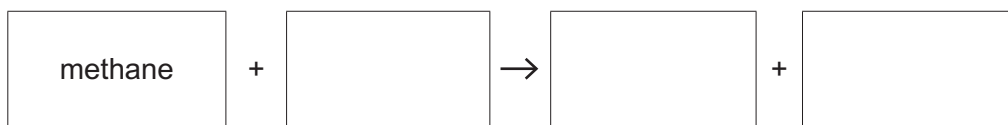
[2]

[Total: 10]

5 Natural gas and petroleum are fossil fuels.

(a) Methane is the main constituent of natural gas.

Complete the word equation for the complete combustion of methane.



[1]

(b) Petroleum is a mixture of saturated hydrocarbon molecules.

It is separated by the process shown in Fig. 5.1.

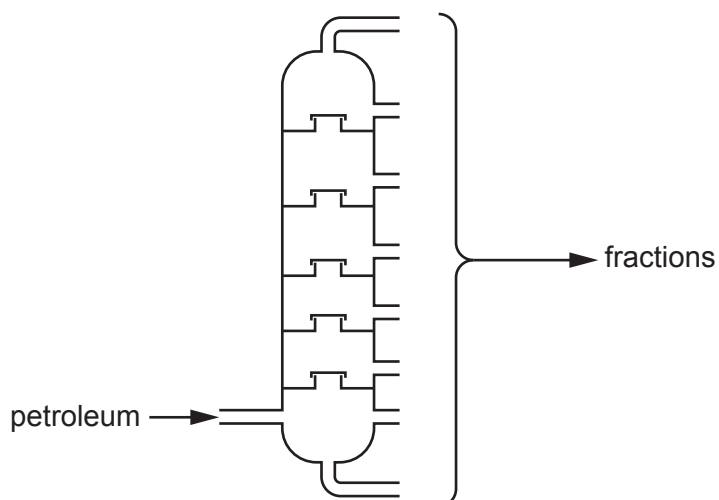


Fig. 5.1

(i) State the name of this process.

..... [1]

(ii) State the name of the fraction used for bottled gas for heating and cooking.

..... [1]

(c) Naphtha from petroleum is used to produce alkenes.

(i) State the name of the process that is used to produce alkenes.

..... [1]

(ii) Describe the colour change when aqueous bromine is added to an alkene.

from to [1]

(iii) Alkenes form addition polymers.

Name **one** alkene and the addition polymer that it forms.

alkene

addition polymer [1]

[Total: 6]

- 6 Fig. 6.1 shows a wind turbine used to generate electricity for the electrical system of a house.

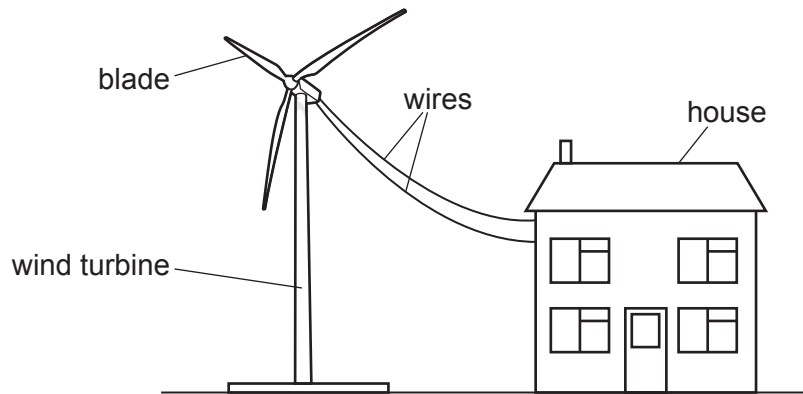


Fig. 6.1

- (a) Complete the sentences to describe the energy transfers for the wind turbine.

The energy of the wind rotates the blades of the turbine.

The generator in the wind turbine uses the energy of the rotating blades to generate energy.

[3]

- (b) The electromotive force (e.m.f.) produced by the wind turbine is 230 V.

There is a current of 9.2 A in each wire connected to the house.

- (i) State the name of a suitable metal for the wires.

..... [1]

- (ii) Complete the sentence:

The current in the metal wires is due to a flow of [1]

- (iii) Calculate the resistance of the electrical system of the house.

Give the unit of your answer.

resistance = ... unit [3]

(c) Fig. 6.2 shows electricity wires hanging between poles on a cold day.

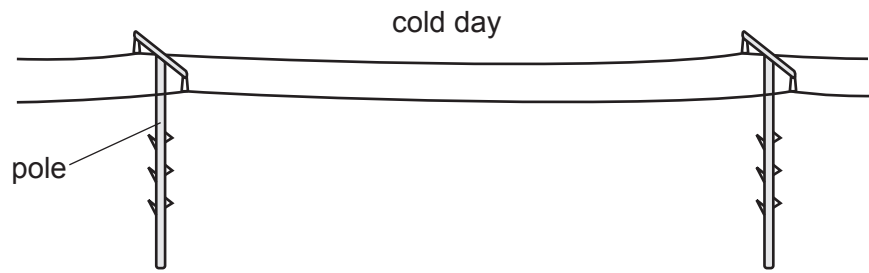


Fig. 6.2

Fig. 6.3 shows the same electricity wires on a hot day.

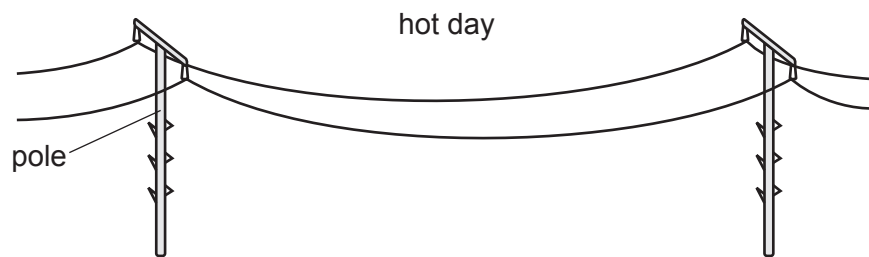


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Explain why the wires hang differently on the hot day.

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[Total: 9]

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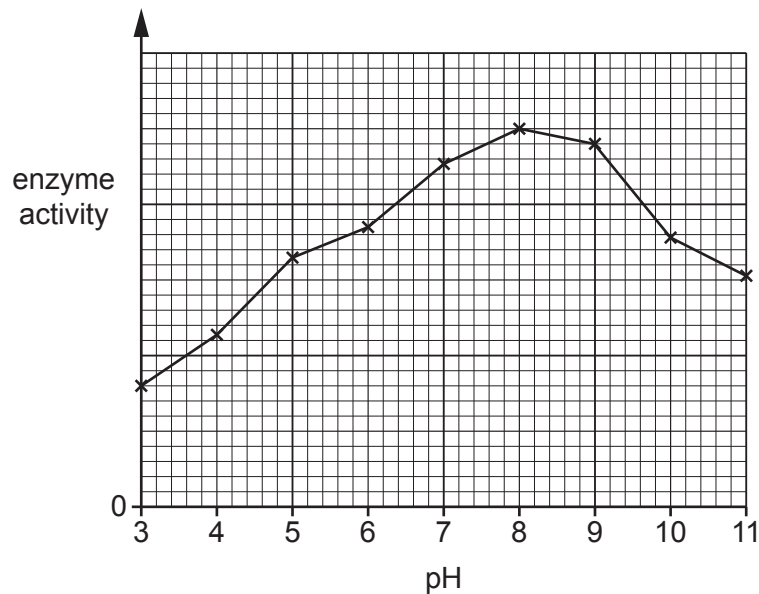


Fig. 7.1

- (i) Describe the effect of pH on the enzyme activity.

Include data from Fig. 7.1 in your answer.

.....

.....

..... [2]

- (ii) State the **three** chemical elements that make up carbohydrates.

1

2

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- (b) Digested food is transported in the blood.

State the name of the component of blood that transports digested food.

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State **two** ways that the spread of HIV is controlled.

1

2 [2]

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(i) State what is meant by the term molecule.

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(iii) Chlorine is dissolved in a solvent to form aqueous chlorine.

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

One atom of chlorine is represented as shown.



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protons

neutrons [2]

(ii) State the number of electrons in the outer shell of a chlorine atom and in the outer shell of a chloride ion, Cl^- .

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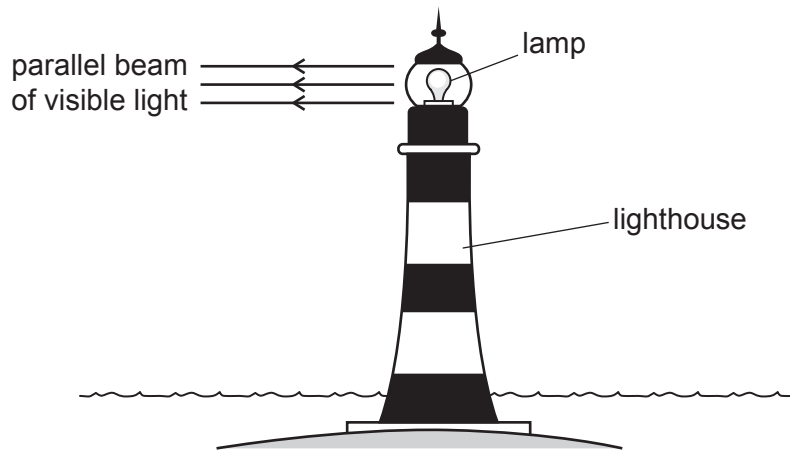


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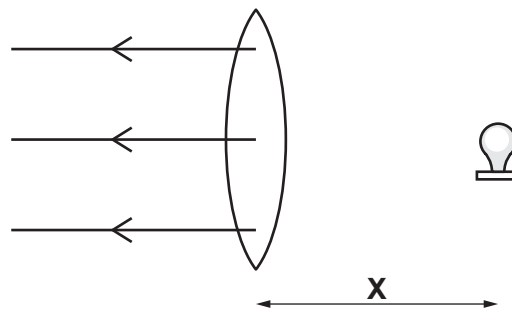


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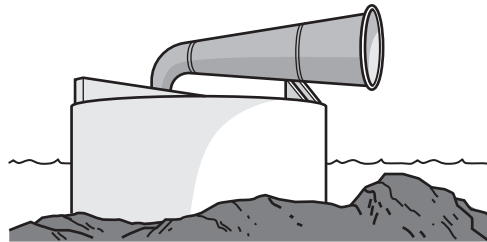


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19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
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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 —		

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 dm³ at room temperature and pressure (r.t.p.).