

CANDIDATE
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CENTRE
NUMBER

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CO-ORDINATED SCIENCES

0654/33

Paper 3 (Core)

May/June 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 soft 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 32.

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 **30** printed pages and **2** blank pages.

1 Fig. 1.1 shows the human gas exchange system.

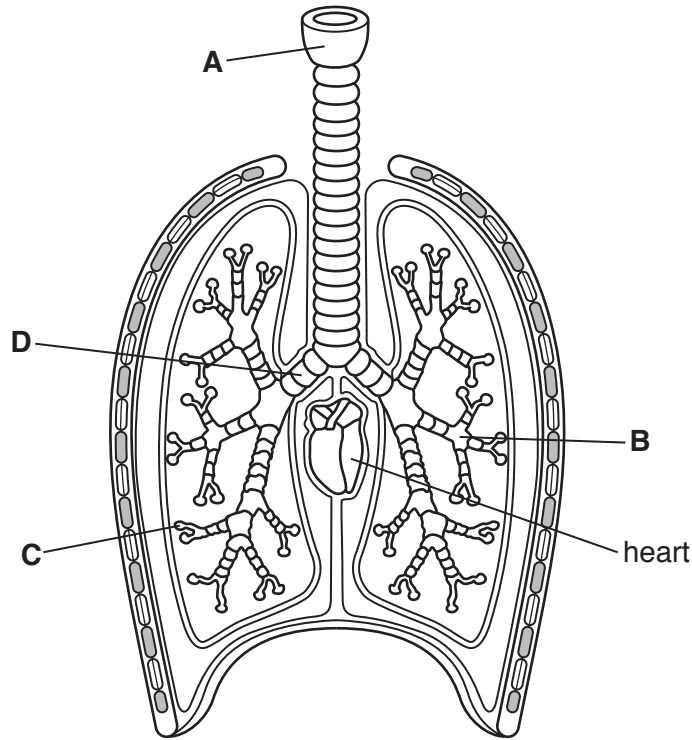


Fig. 1.1

(a) (i) Identify which letter in Fig. 1.1 represents the following parts.

- alveoli
- bronchiole
- larynx

[3]

(ii) Add a label line to identify and name the trachea.

[1]

(b) Air enters the lungs, and gases are exchanged at the alveoli by diffusion.

Use the words in the list to fill in the blanks to describe the process of diffusion.

- | | | | |
|---------------|---------------|---------------|--------------|
| across | dilute | down | equal |
| higher | lower | random | up |

Diffusion is the net movement of molecules from a region of their
 concentration to a region of their concentration
 a concentration gradient.

[3]

(c) Carbon dioxide diffuses from the blood into the lungs and leaves the body during exhalation.

Expired air contains more carbon dioxide than inspired air.

(i) Describe **two** other ways in which expired air differs from inspired air.

1

2

[2]

(ii) Describe **two** ways in which the pattern of a person's breathing changes during vigorous exercise.

1

2

[2]

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

(a) (i) Define the term *atomic number*.

.....
[2]

(ii) Explain why water does **not** have a place in the Periodic Table.

.....
[1]

(iii) Table 2.1 contains some information about the structure of one atom of argon.

Complete Table 2.1.

Table 2.1

element	atomic number	mass number	number of neutrons	number of electrons
argon	18	40

[2]

(iv) Large amounts of argon are produced every day industrially.

State the source of argon.

.....[1]

(v) In the steel industry, argon is bubbled through molten steel at about 1500 °C to keep the steel mixed.

Suggest why argon is a suitable gas for this process.

.....[1]

- (b) The maximum mass of potassium nitrate that dissolves in 100 cm^3 of water is called the solubility of potassium nitrate.

Fig. 2.1 shows the solubility of potassium nitrate at different temperatures.

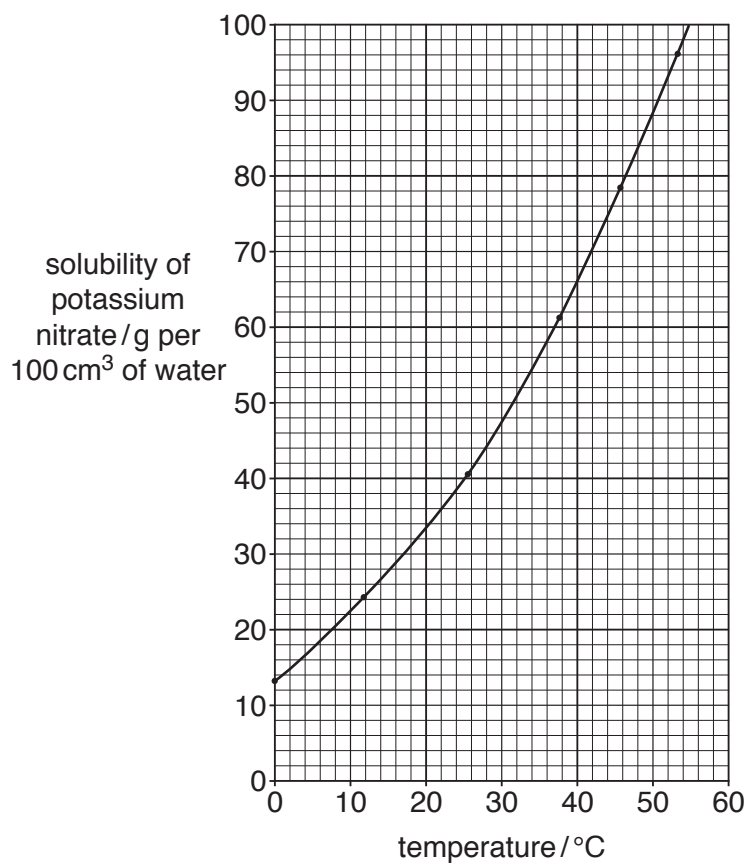


Fig. 2.1

- (i) Describe the trend shown in Fig. 2.1.

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

- (ii) Two students make predictions, **A** and **B**, about what happens when 60 g of potassium nitrate is stirred into 100 cm³ of water at a temperature of 30 °C.

Fig. 2.2 shows their predictions.

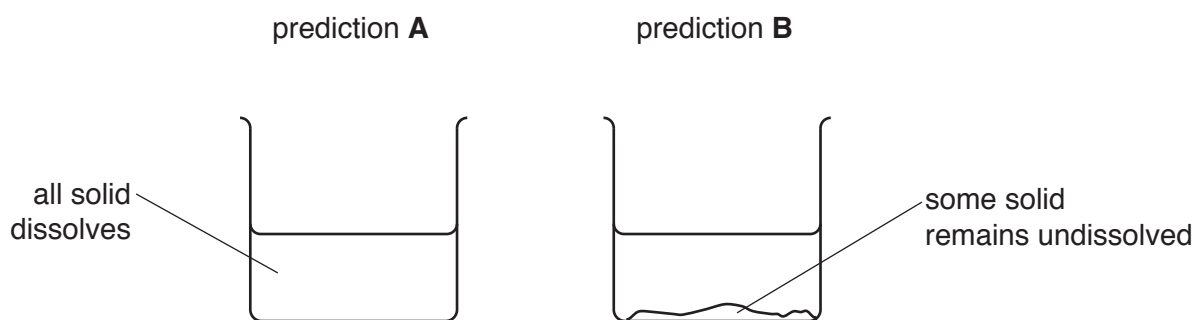


Fig. 2.2

Use the information in Fig. 2.1 to explain why prediction **B** is correct.

.....

.....

..... [2]

3 (a) Fig. 3.1 is a diagram of the male reproductive system.

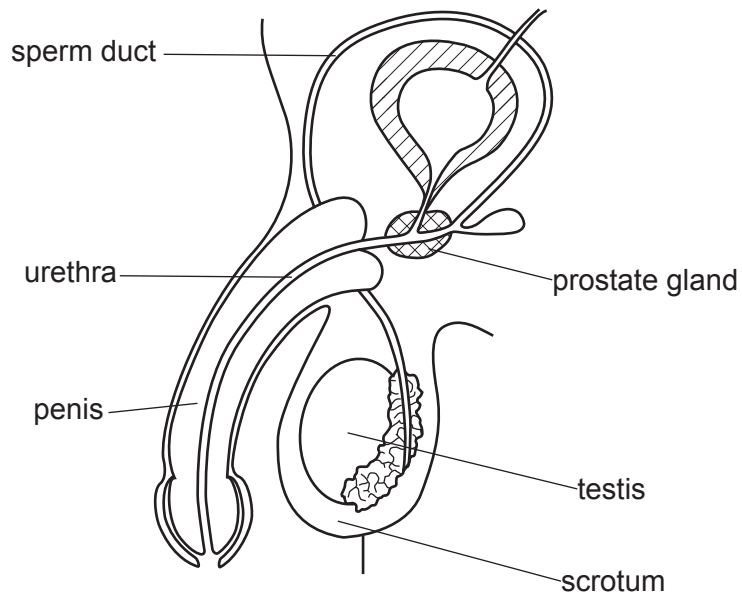


Fig. 3.1

(i) Draw **one** line from each part of the male reproductive system to its function.

part of the male reproductive system	function
scrotum	secretes fluid to make semen
prostate gland	carries sperm
sperm duct	organ from which semen and urine leave the body
penis	holds the testes

[3]

(ii) Add the letter **X** to Fig. 3.1 to show where the sperm are made.

[1]

(b) The male gamete is a sperm.

(i) Name the female gamete.

..... [1]

(ii) State the name of the process when the nuclei of the male and female gametes fuse.

.....[1]

(iii) State the name of the cell that is produced by the process you have named in **(b)(ii)**.

.....[1]

- 4 (a) A polar bear swims 687 km in 9 days without stopping.

Complete the following steps to calculate the average speed of the polar bear.

Show your working in each step.

Step 1

Calculate the distance in metres travelled by the polar bear.

distance = m

Step 2

Calculate the time in seconds taken by the polar bear for this journey.

time = s

Step 3

Use your answers to Steps 1 and 2 to calculate the average speed, in metres per second, of the polar bear for this journey.

average speed = m/s
[3]

- (b) Polar bears spend a lot of time on floating ice.

A polar bear must exert as small a pressure as possible when standing on the ice.

State the **two** quantities that are needed to calculate the pressure exerted by the polar bear on the ice.

..... and [2]

(c) Recent research suggests that the audible frequency range for polar bears is between 50Hz and 35000Hz.

(i) State the audible frequency range for a human.

from Hz to Hz [1]

(ii) Ultrasound waves have a very high frequency that cannot be heard by humans.

Devices which emit ultrasound waves have been tested to see if they can keep polar bears away from people.

Suggest a suitable frequency for the waves emitted by such a device.

..... Hz [1]

(d) Scientists use thermal imaging cameras to detect polar bears travelling on the ice.

Thermal imaging cameras use infra-red radiation.

Infra-red radiation is part of the electromagnetic spectrum.

Name **one** other part of the electromagnetic spectrum and give a use for that radiation.

radiation

use

..... [2]

5 Human activities and natural events cause air pollution.

Fig. 5.1 shows some of the gases that pass into the air during a volcanic eruption.

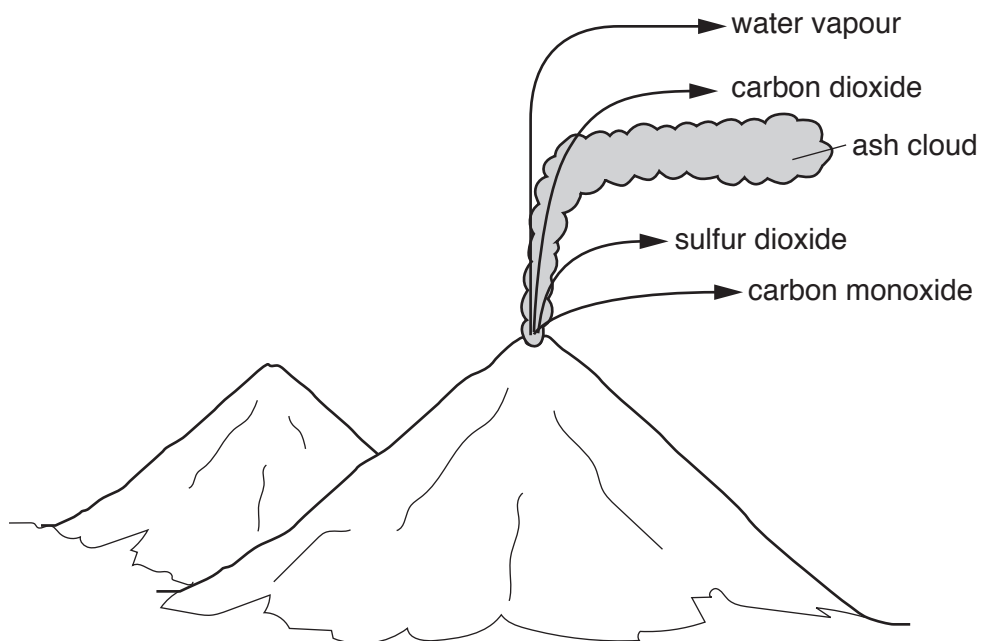


Fig. 5.1

- (a) (i) State and explain which gas shown in Fig. 5.1 is responsible for increasing the acidity of rain.

name

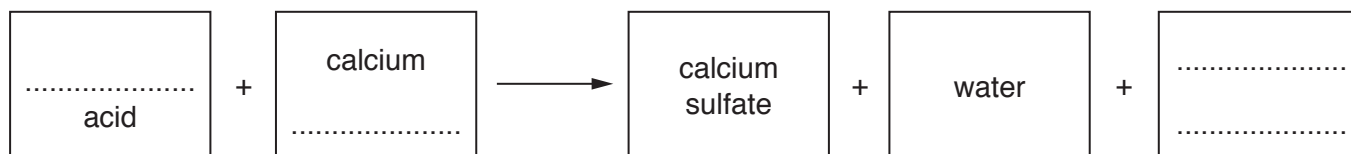
explanation

.....

[2]

- (ii) Acid rain reacts with limestone.

Complete the **word** equation for the reaction between the acid in acid rain and the main compound in limestone.



[3]

(b) Table 5.1 shows the pH values of three colourless liquids, **D**, **E** and **F**.

Table 5.1

liquid	description	pH
D	acid rain	4
E	pure water
F	dilute hydrochloric acid	1

(i) Complete Table 5.1. [1]

(ii) A student compares the rate of reaction of these three liquids with magnesium.

Fig. 5.2 shows what the student observes.

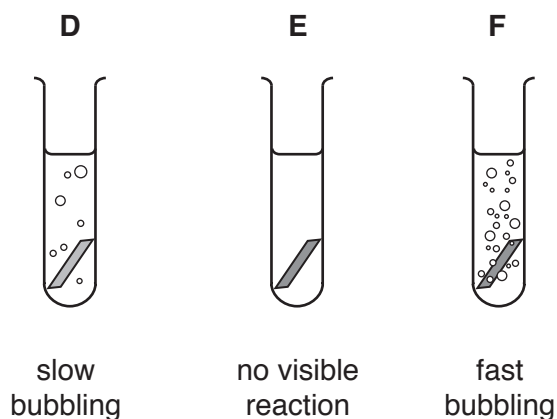


Fig. 5.2

Use the information in Table 5.1 to explain the observations for liquids **D** and **F**.

.....

 [2]

(iii) Explain why the student must make sure that the temperature of the three liquids is the same.

.....
 [1]

6 Fig. 6.1 is a graph that shows the rate of water loss from a plant during a 24-hour period.

The rate of water loss is equivalent to the rate of transpiration.

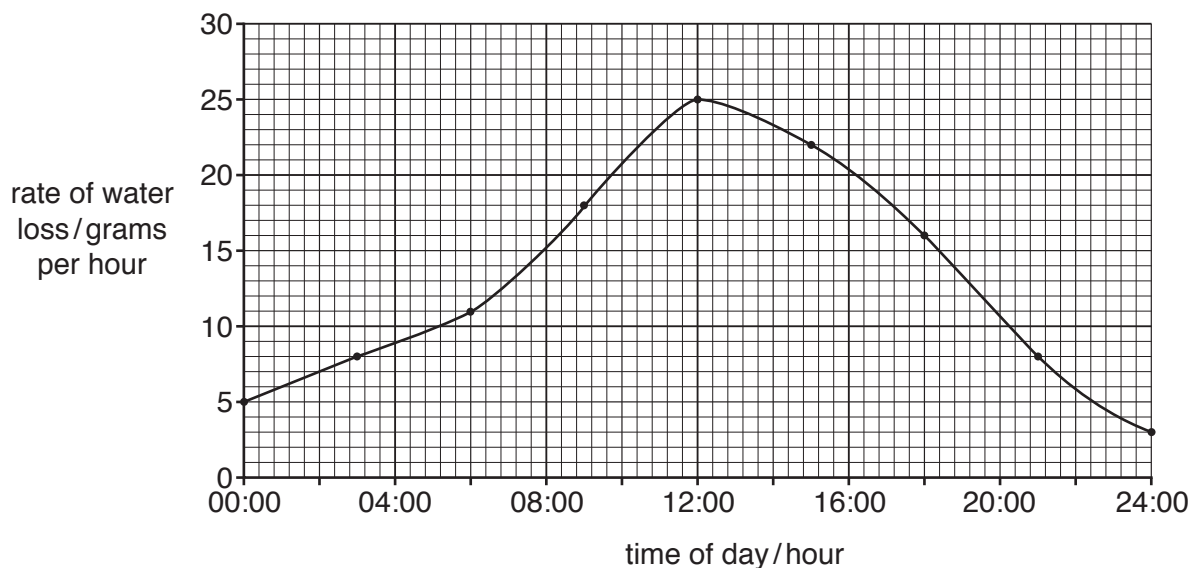


Fig. 6.1

(a) (i) Use Fig. 6.1 to describe how the rate of water loss changes during a 24-hour period.

.....

 [2]

(ii) Suggest reasons why the rate of water loss is lowest at 24:00 hours.

.....

 [2]

(iii) Calculate the difference in rate of water loss between 12:00 and 24:00 hours.

..... grams per hour [1]

(b) Water enters the plant through the root hair cells and is lost by transpiration.

(i) Put the letters in the correct order to show the pathway of water through the plant.

Two have been done for you.

- mesophyll cells **A**
- root cortex cells **B**
- root hair cell **C**
- stomata **D**
- xylem **E**

C		E		
----------	--	----------	--	--

[1]

(ii) State **one** function of root hair cells apart from absorption of water.

.....[1]

(iii) Suggest **one** use of water absorbed by the plant.

.....[1]

7 (a) Fig. 7.1 shows the speed-time graph for a truck.

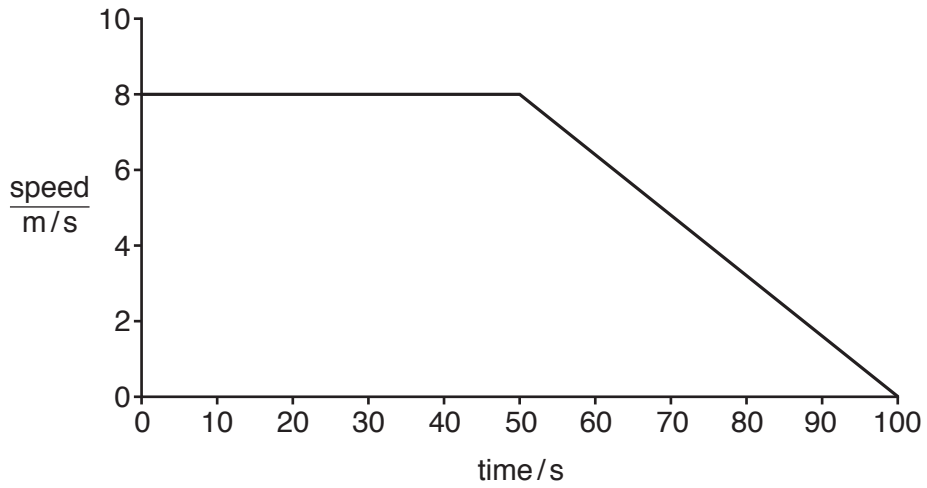


Fig. 7.1

(i) State the maximum speed of the truck.

..... m/s [1]

(ii) On Fig. 7.1, mark with an **X** the point when the truck has stopped moving. [1]

(b) Fig. 7.2 shows four forces, **P**, **Q**, **R** and **S**, acting on the truck.

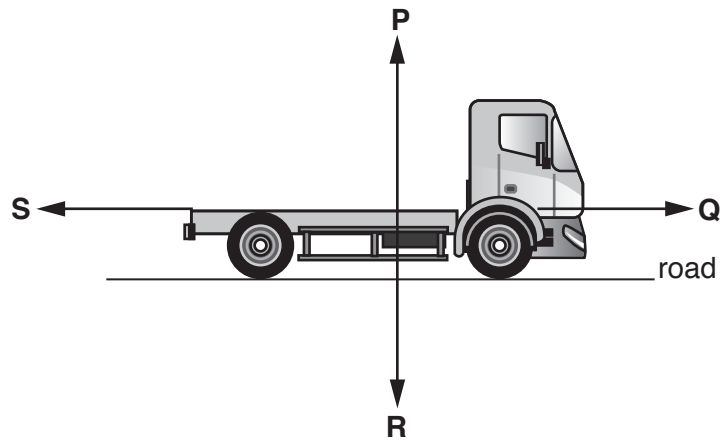


Fig. 7.2

Compare the size and direction of forces **Q** and **S** when the truck is slowing down.

size

direction

[2]

(c) The air in the tyres of the truck is warmed during its journey.

(i) Describe what happens to the motion of the air particles as the air warms up.

.....
[1]

(ii) When the temperature of the air in the tyres increases, the pressure in the tyres increases.

Explain, in terms of the motion of the air particles, why the pressure increases.

.....

[2]

(d) A reflector on the rear of the truck is made from many small red plastic prisms.

One prism is shown in Fig. 7.3.

Light from the headlight of a following car enters the prism.

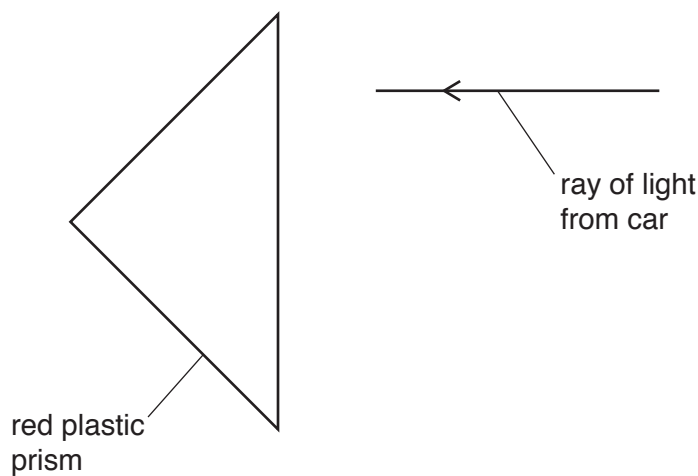


Fig. 7.3

Total internal reflection occurs within the prism.

On Fig. 7.3, complete the path taken by the ray of light.

[2]

- (e) The truck has two headlights.

The lamp inside one headlight is connected in parallel with the lamp in the other headlight across a 24 V battery.

- (i) The resistance of each lamp is 5.6Ω .

Calculate the current passing through each lamp.

State the formula you use and show your working.

formula

working

current = A [2]

- (ii) Suggest **one** important reason why the lamps in the headlights are connected in parallel rather than in series.

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

- 8 (a) Black ink in marker pens is a mixture of several dyes (coloured compounds).

Fig. 8.1 shows an experiment being used to find out how many dyes are contained in a sample of black ink.

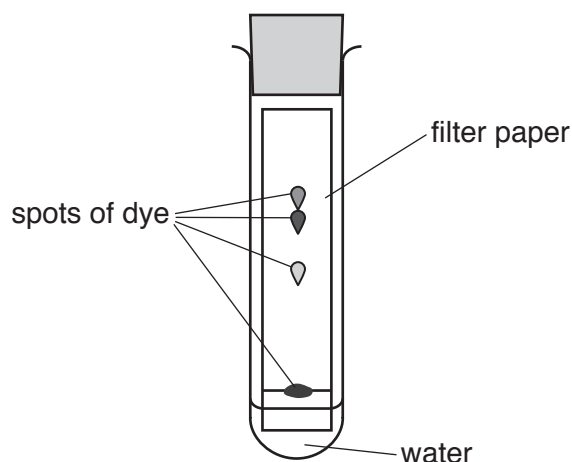


Fig. 8.1

- (i) Name the process shown in Fig. 8.1.

.....[1]

- (ii) Explain why the separation of the dyes in the black ink is a physical change and **not** a chemical change.

.....

.....[1]

- (b) Table 8.1 shows descriptions of four types of chemical reaction.

Complete the right hand column of Table 8.1. The first type of reaction is shown.

Table 8.1

description	type of reaction
acid reacting with a base	neutralisation
molecules joining together into long chains	
oxygen being removed from a compound	
alkenes being produced by heating alkanes with a catalyst	

[3]

(c) Fig. 8.2 shows the electrolysis of dilute sulfuric acid using inert electrodes.

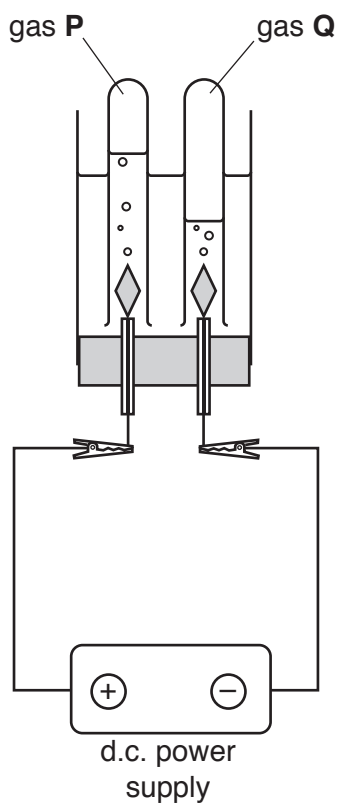


Fig. 8.2

(i) On Fig. 8.2, use label lines to label the cathode and the electrolyte. [2]

(ii) Name gas **P** and gas **Q**.

P

Q [2]

(d) A student adds a solution of barium nitrate to dilute sulfuric acid.

She observes a white precipitate.

Name the ion in dilute sulfuric acid that this test identifies.

..... [1]

9 Fig. 9.1 shows a list of items bought from a food shop.

- | |
|--|
| <p style="text-align: center;"><u>Shopping list</u></p> <ul style="list-style-type: none">• bananas• bread• butter• milk• orange juice• tuna fish• water (bottled) |
|--|

Fig. 9.1

(a) Name one item on the shopping list in Fig. 9.1 that is the best source of

calcium,

fat,

protein. [3]

(b) (i) State **one** reason why fat is needed in our diet.

..... [1]

(ii) State the **three** chemical elements contained in fat.

1

2

3 [1]

(iii) State the **two** basic units that result from the digestion of fats and oils.

1

2 [1]

(c) Nutrition is the taking in of materials for energy, growth and development. Nutrition is one of the characteristics of living organisms.

List **two** other characteristics of living organisms.

1

2 [2]

10 Fig. 10.1 shows a diagram of the carbon cycle.

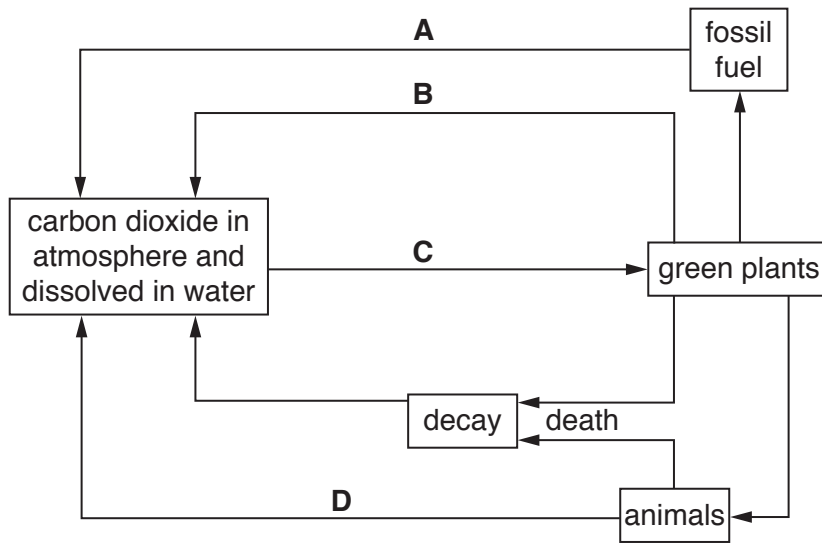


Fig. 10.1

(a) Identify one letter in Fig. 10.1 that represents the following processes.

- combustion
- photosynthesis
- respiration

[3]

(b) Atmospheric carbon dioxide concentrations are increasing.

(i) Using the information in Fig. 10.1, suggest **two** ways in which humans can reduce the increase of atmospheric carbon dioxide.

- 1
-
- 2
-

[2]

(ii) Name the process that increased atmospheric carbon dioxide is contributing to.

.....[1]

11 (a) A house has solar panels fitted on the roof.

State **one** disadvantage of generating electricity from solar energy.

.....
[1]

(b) Fig. 11.1 shows a hot water storage tank in the house.

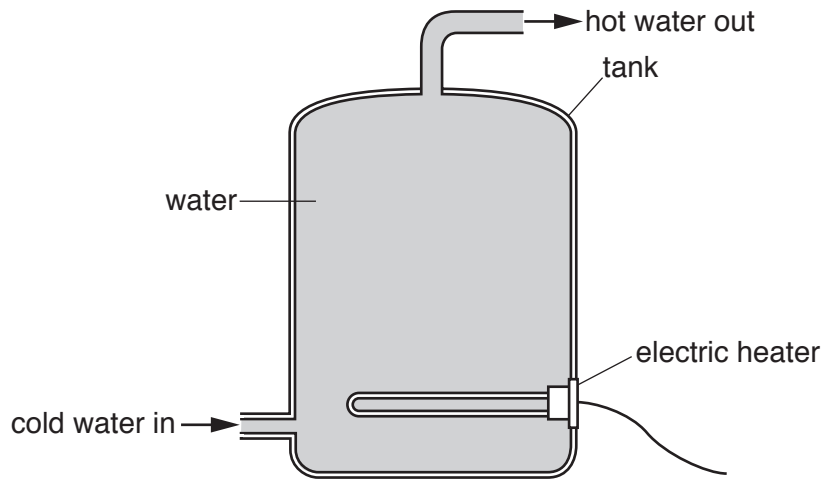


Fig. 11.1

Complete the sentence below.

The electric heater is placed near the bottom of the tank so that all the water can be heated by the process of [1]

(c) The house is fitted with a smoke detector. The smoke detector contains a radioactive isotope of americium-241, which emits α -particles.

(i) State the meaning of the term *isotope*.

.....

[1]

(ii) State the composition of α -particles.

.....
[1]

(iii) α -particles are ionising radiation. Explain why ionising radiation is hazardous.

.....

[2]

(iv) Suggest why the α -particle source poses little or no danger to people passing by the smoke detector.

.....
[1]

(d) Fig. 11.2 shows a woman standing in front of a mirror mounted on a wall in the house.

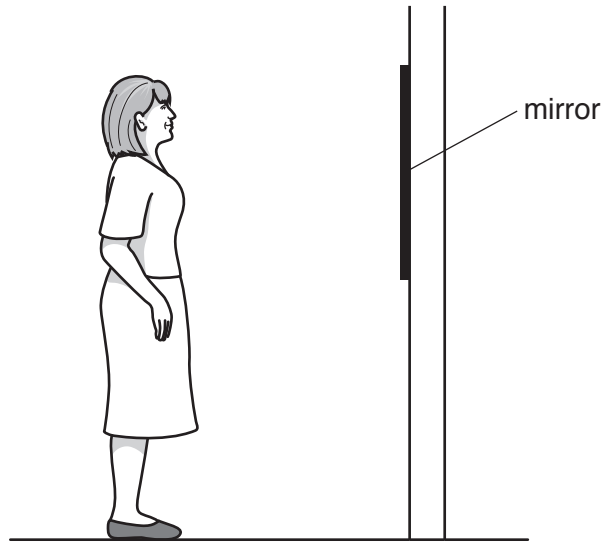


Fig. 11.2

Describe the image formed in the mirror by choosing three words or phrases from the list below.

- | | | | |
|---------------------------|------------------|------------------------|----------------|
| laterally inverted | magnified | not upside down | real |
| same size | smaller | upside down | virtual |

1
 2
 3
 [2]

12 Fig. 12.1 shows part of a wave-powered electrical generator.

At the bottom, the sea water is able to flow in and out.

At the top, air is either pushed out or drawn in.

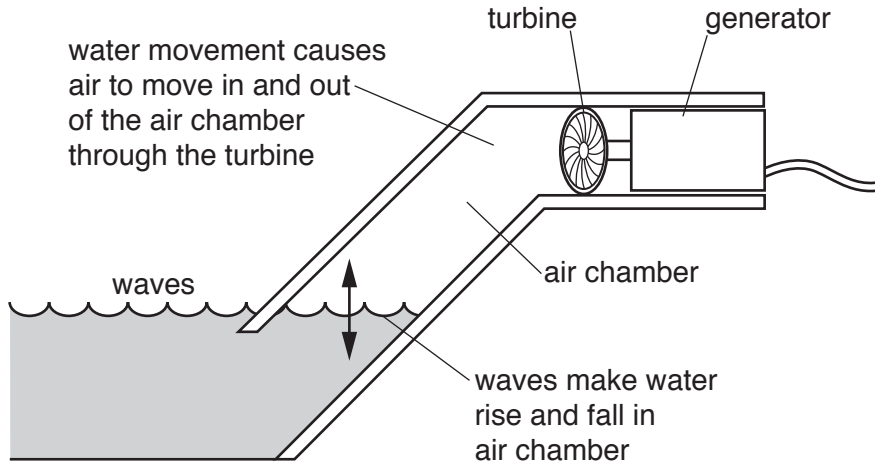


Fig. 12.1

(a) Using the information in Fig. 12.1, describe how the kinetic energy of the waves is transferred into electrical energy from the generator.

.....

.....

.....

.....

.....

..... [2]

(b) Wave energy is an example of a renewable energy resource.

State **two** advantages of using renewable energy resources.

1

.....

2

.....

[2]

(c) Fig. 12.2 represents a water wave on the ocean.

displacement (m)

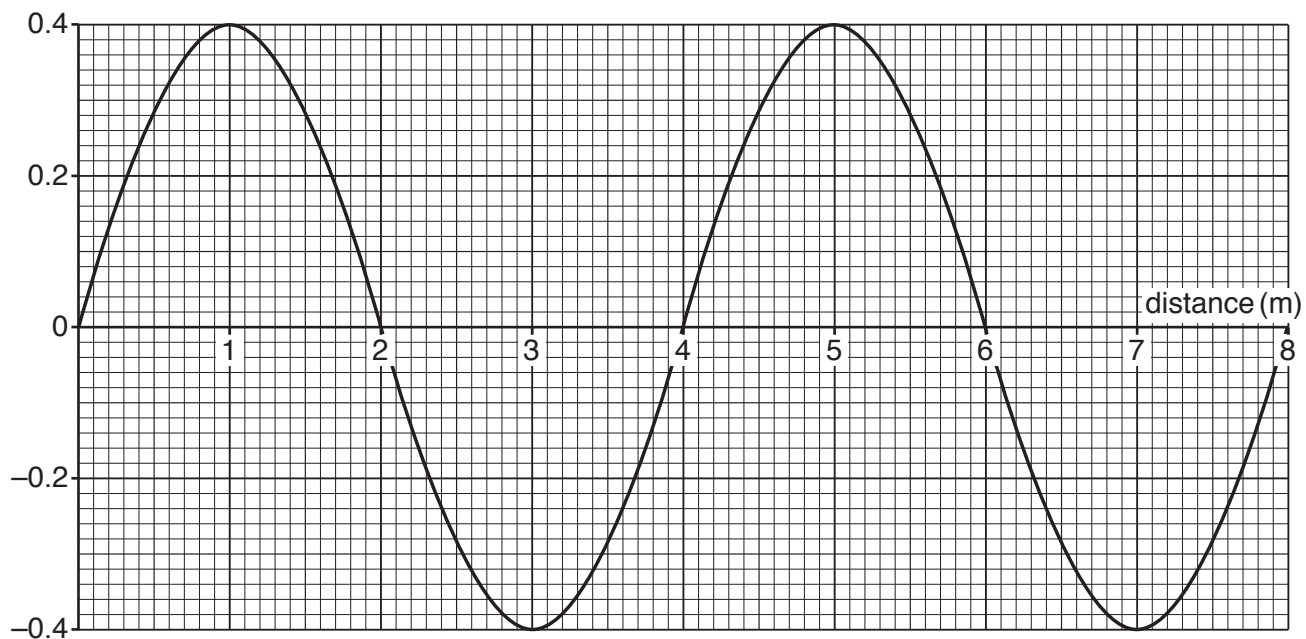


Fig. 12.2

Determine

- (i) the amplitude of the wave m [1]
- (ii) the wavelength of the wave m [1]

(d) Fig. 12.3 shows an iceberg floating in the sea.

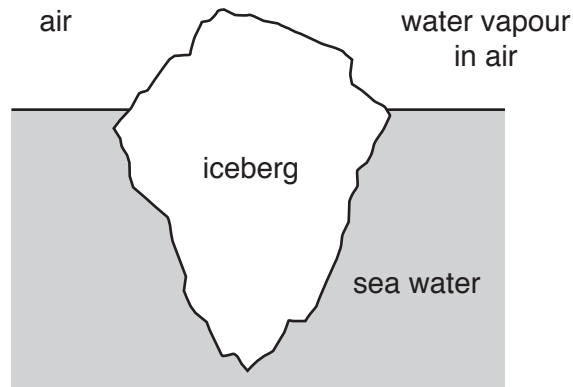


Fig. 12.3

(i) Name the process by which water molecules in the sea become water molecules in the air.

.....[1]

(ii) Name the process by which water changes to ice.

.....[1]

(iii) The density of ice is 0.93 g/cm^3 .

Calculate the volume of 500g of ice.

State the formula you use and show your working

formula

working

volume = cm^3 [2]

13 Ethanol is a colourless liquid compound that contains the elements carbon, hydrogen and oxygen.

(a) Complete Fig. 13.1 to show the structure of **one** molecule of ethanol.

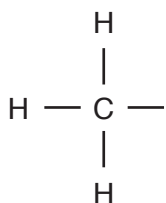


Fig. 13.1

[2]

(b) A mixture of ethanol and water is separated using the apparatus shown in Fig. 13.2.

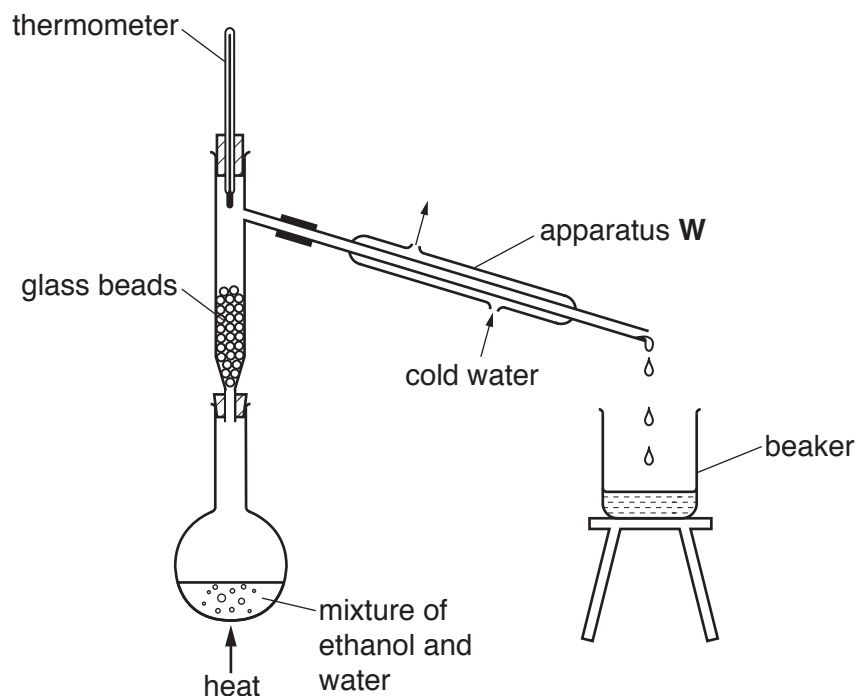


Fig. 13.2

The mixture of ethanol and water is heated and liquid collects in the beaker.

(i) Name the process in Fig. 13.2.

.....[1]

(ii) State the purpose of apparatus W.

.....
[1]

- (iii) The boiling point of water is 100 °C.

Suggest why the liquid that collects first in the beaker contains mainly ethanol.

.....
[1]

- (c) Sodium reacts slowly with ethanol, and hydrogen is given off as shown in Fig. 13.3.

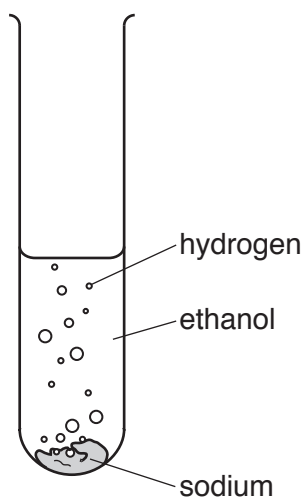


Fig. 13.3

- (i) Describe the test and the positive result for hydrogen.

test

result [2]

- (ii) Describe **one** similarity between the reactions of sodium with ethanol and sodium with water.

.....
 [1]

- (iii) Describe **one** difference between the reactions of sodium with ethanol and sodium with water.

.....
 [1]

(d) Some cars use a mixture of ethanol and gasoline for fuel.

Fig. 13.4 shows apparatus a student uses to investigate the combustion of ethanol.

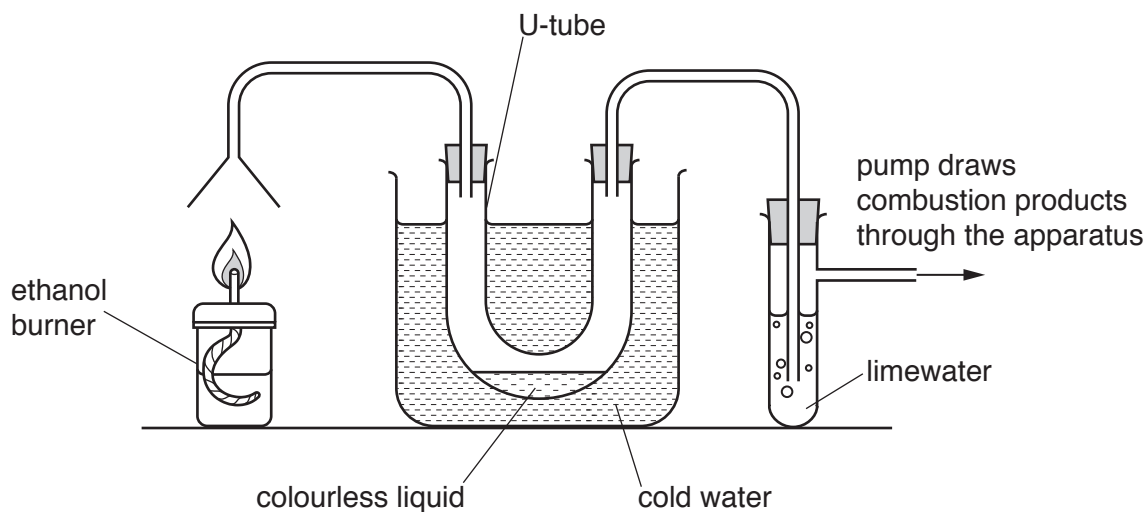


Fig. 13.4

Shortly after the ethanol burner is lit, the following observations are made.

- A colourless liquid collects inside the U-tube.
- The liquid inside the U-tube changes cobalt chloride paper from blue to pink.
- The limewater becomes milky.

Use the information in Fig. 13.4 and the observations to deduce the names of the **two** compounds that are produced when ethanol completely burns in air.

Explain your answers.

1 compound

explanation

.....

2 compound

explanation

.....

[2]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	1 H hydrogen 1	2 He helium 4	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 —			

Key

atomic number
atomic symbol
name
relative atomic mass

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)