Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0129921747

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **October/November 2021**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- 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.

INFORMATION

- The total mark for this paper is 120.
- 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 **28** pages. Any blank pages are indicated.

DC (CJ/FC) 211586/4

1 **(a)** A student measures their pulse rate at rest, during and after exercise.

Fig. 1.1 shows the results.

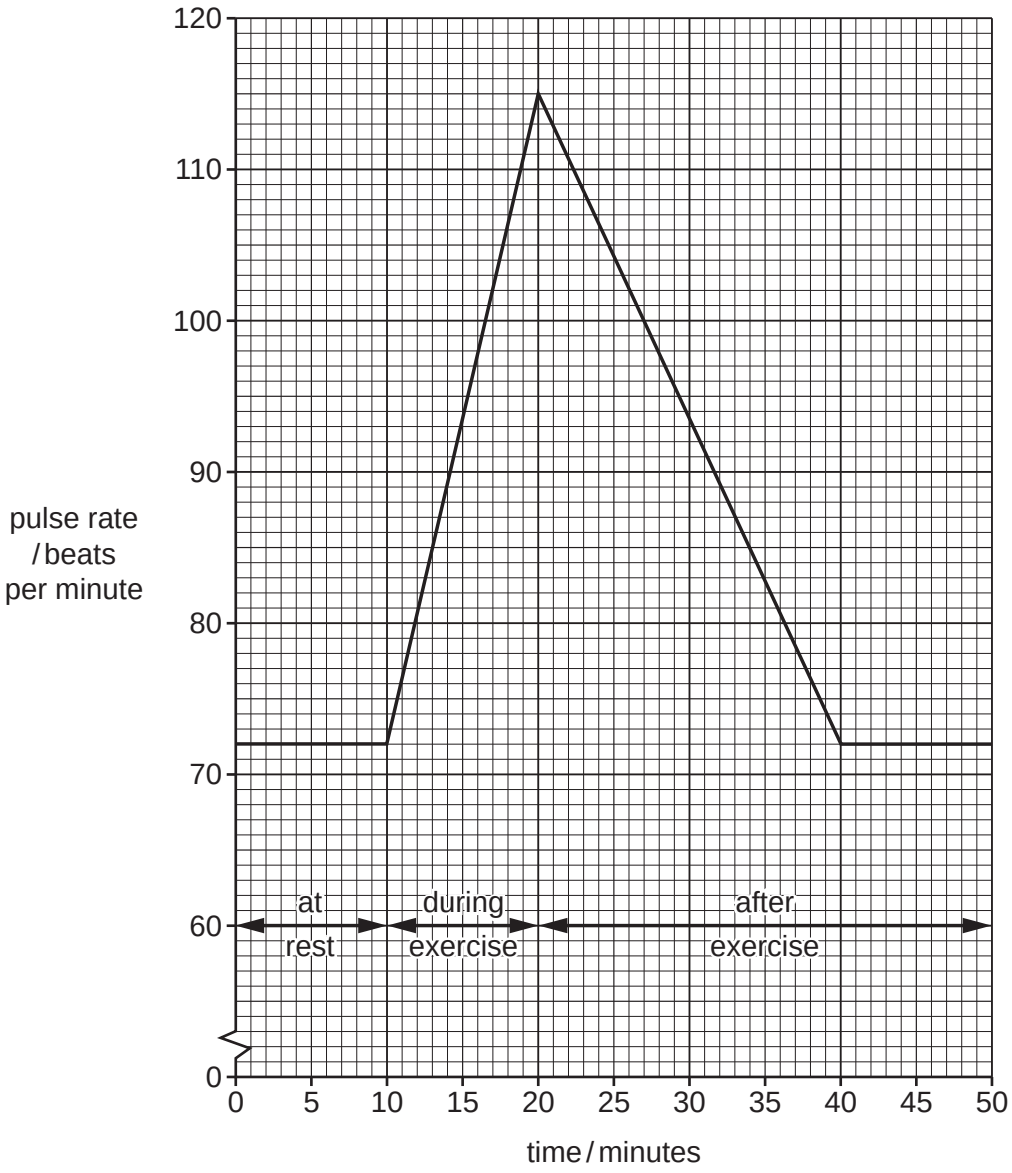

Fig. 1.1

(i) Calculate the difference in pulse rate between the pulse rate at rest and the maximum pulse rate of the student.

pulse rate at rest ..... beats per minute

maximum pulse rate ..... beats per minute

difference ..... beats per minute
[2]

(ii) Calculate the length of time taken for the student's pulse rate to return to the resting value once exercise had stopped.

..... min [1]

(b) Fig. 1.2 is a photomicrograph of a cross section of a human vein.

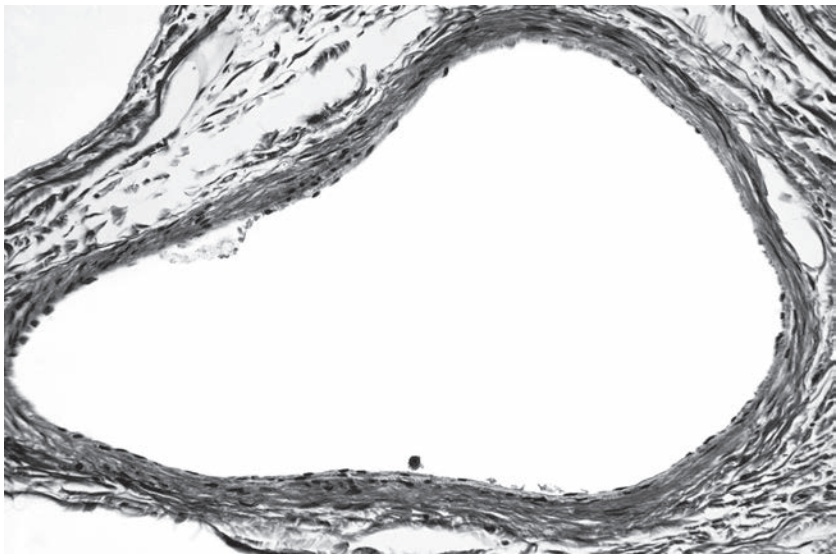

Fig. 1.2

(i) Name a structure present in veins but **not** visible in Fig. 1.2.

..... [1]

(ii) Describe **two** ways in which the structure of arteries is different from the vein shown in Fig. 1.2.

1 .....

.....

2 .....

.....

[2]

(iii) Describe the function of capillaries.

.....

..... [1]

(c) Table 1.1 shows some blood vessels and some organs.

Place ticks (✓) in the boxes to show which blood vessels transport blood **to** these organs.

One row has been done for you.

Table 1.1

	organ		
	heart	**kidney**	**lung**
coronary artery			
pulmonary artery			
renal artery			
vena cava	✓		

[3]

(d) List **two** of the main components of blood.

1 .....

2 .....

[2]

[Total: 12]

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2 **(a)** The formula of sulfuric acid is H_2SO_4.

(i) State the number of different elements shown in this formula.

..... [1]

(ii) State the total number of atoms shown in this formula.

..... [1]

(b) Fig. 2.1 shows the electrolysis of dilute sulfuric acid using carbon electrodes.

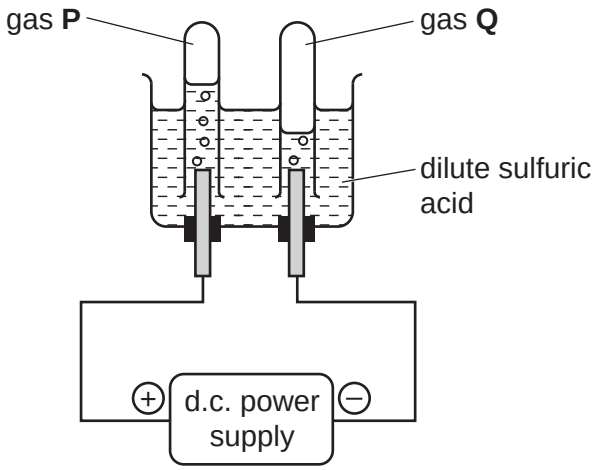

Fig. 2.1

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

gas **P** .....

gas **Q** .....
[2]

(ii) State the name of the positive electrode.

..... [1]

(c) Dilute sulfuric acid reacts with some metals.

(i) Suggest a pH for dilute sulfuric acid.

pH ..... [1]

(ii) State a metal element that does **not** react with dilute sulfuric acid.

..... [1]

(iii) Name the gas made when dilute sulfuric acid reacts with zinc.

..... [1]

(iv) When dilute sulfuric acid reacts with zinc, an aqueous solution of zinc sulfate is made.

State a method used to separate zinc sulfate from water.

..... [1]

[Total: 9]

3 **(a)** Fig. 3.1 shows water in a saucepan on an electric cooker.

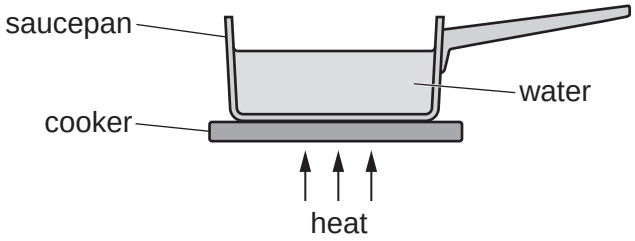

Fig. 3.1

State the process that transfers thermal energy through the base of the saucepan.

..... [1]

(b) The temperature of the water is recorded as the saucepan is heated.

Fig. 3.2 shows a graph of the results.

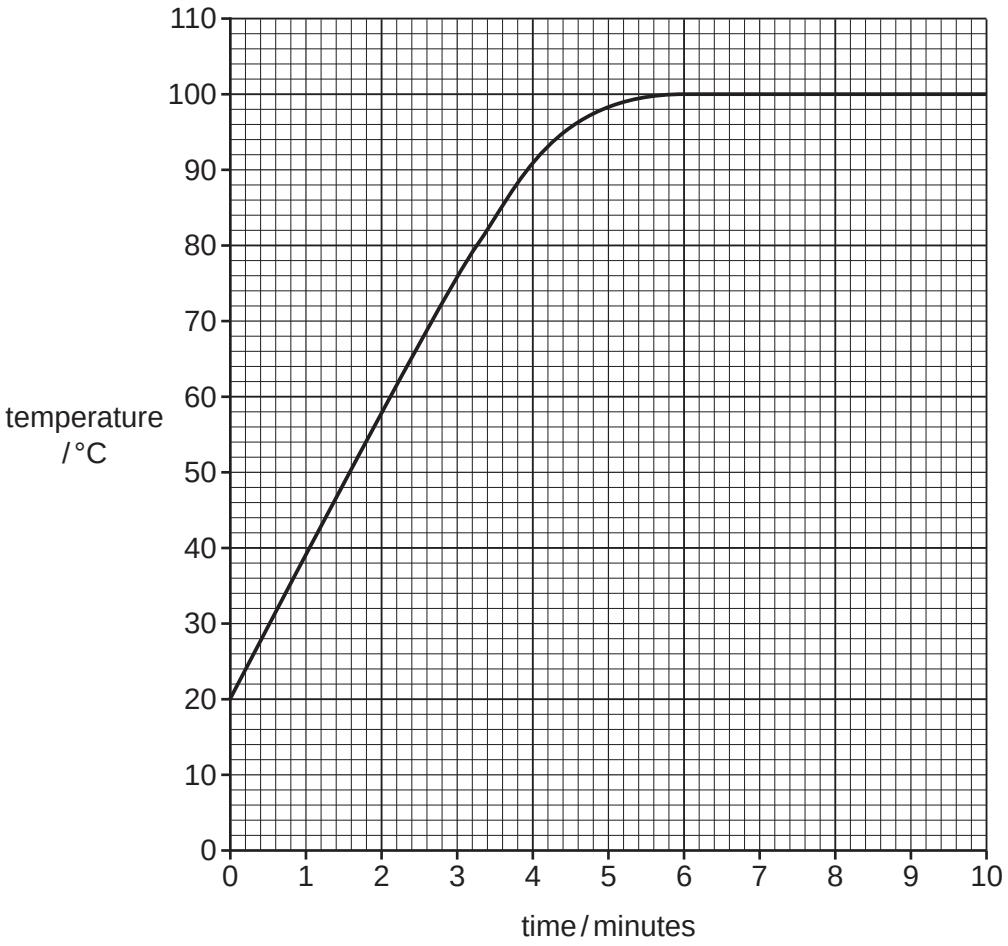

Fig. 3.2

(i) State the temperature rise over the first 2 minutes.

..... °C

[1]

(ii) State how the graph shows that the water boils at 100 °C.

.....

.....

..... [1]

(c) **(i)** The saucepan is made from steel.

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

.....

.....

..... [1]

(ii) The mass of steel used to make the saucepan is 900 g.

The volume of the steel is 115 cm^3.

Calculate the density of the steel used to make the saucepan.

State the units of your answer.

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

(d) When the base of the steel saucepan is heated, the steel expands.

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

.....

..... [1]

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

.....

..... [1]

[Total: 9]

4 **(a)** Fig. 4.1 shows part of a desert food web.

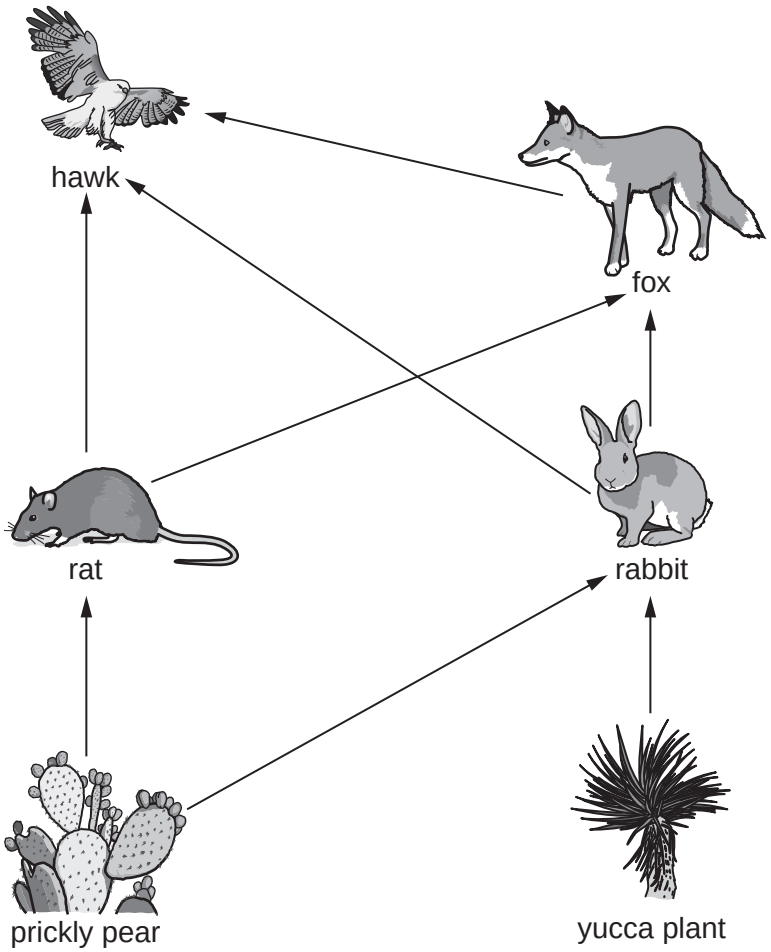

Fig. 4.1

(i) Identify the name of **one** producer in Fig. 4.1.

..... [1]

(ii) Identify the name of **one** herbivore in Fig. 4.1.

..... [1]

(iii) Identify the name of an organism that can be classified as both a secondary and tertiary consumer.

..... [1]

(iv) Use Fig. 4.1 to construct a food chain containing **four** organisms.

..... [2]

(b) A new species is introduced that eats yucca plants.

Explain the effect this has on the population of rabbits.

.....

.....

.....

..... [2]

(c) State the term used to describe organisms that get their energy from dead organic matter.

..... [1]

(d) State the principal source of energy for all food chains.

..... [1]

(e) Plants play an important role in the carbon cycle.

Describe how an increase in plant population affects the concentration of carbon dioxide in the atmosphere.

.....

.....

.....

..... [2]

[Total: 11]

5 **(a)** Petroleum is separated into useful fractions by fractional distillation.

Fig. 5.1 shows a simplified diagram for the fractional distillation of petroleum.

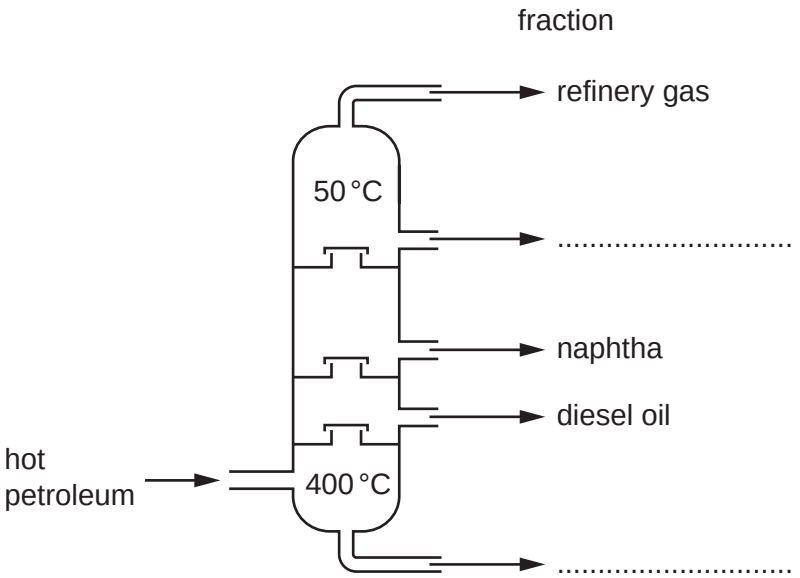

Fig. 5.1

(i) On Fig. 5.1 write the names of the missing fractions in their correct place. [2]

(ii) State **one** use for the refinery gas fraction.

..... [1]

(iii) State why the process of fractional distillation is a **physical change** and not a chemical change.

.....

..... [1]

(b) The diesel oil fraction is used as a fuel.

(i) Diesel oil is a mixture of hydrocarbons.

State what is meant by the term *hydrocarbon*.

.....

.....

..... [2]

(ii) State the two products of the **complete** combustion of a hydrocarbon.

1 .....

2 .....

[2]

(c) (i) Name the process that produces small alkene molecules from larger alkane molecules.

..... [1]

(ii) State how the molecular structure of an alkane molecule differs from the molecular structure of an alkene molecule.

.....

..... [1]

(iii) Aqueous bromine is used to test for an alkene.

State the colour change when aqueous bromine reacts with an alkene.

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

[Total: 12]

6 **(a)** The total current supplied to a television when in use is 3A.

(i) The fuse in the electrical supply to the television is replaced.

Several fuse ratings are available.

1A 3A 5A 13A 30A

State which fuse should be used.

Explain your answer.

fuse ..... A

explanation .....

.....

..... [2]

(ii) The electrical supply to the television is 120V.

Calculate the total resistance of the television.

resistance = ...Ω [2]

(b) The television is connected to a power socket which also supplies electricity to a kettle and an electric heater. The power socket is next to a kitchen sink.

Fig. 6.1 shows the power socket.

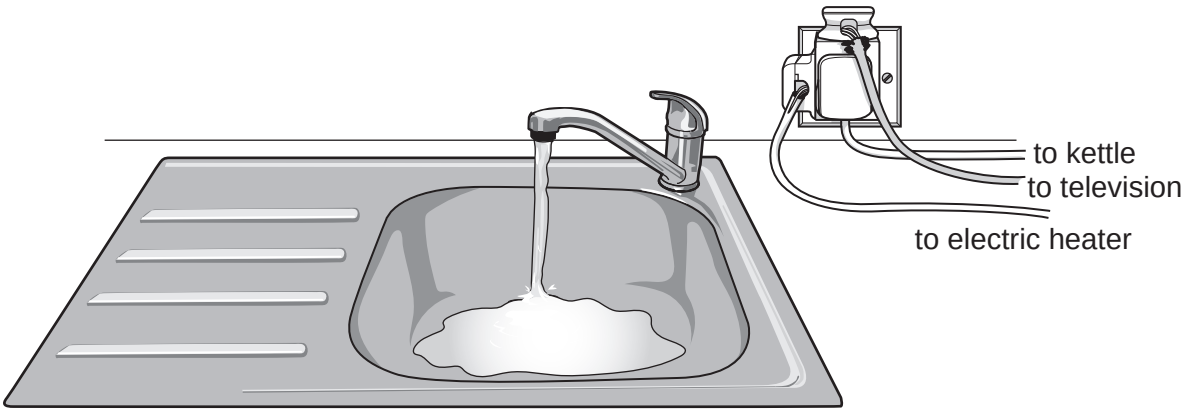

Fig. 6.1

State and explain **one** reason why this arrangement is **not** safe.

.....

.....

.....

..... [2]

(c) Television signals are carried by radio waves.

(i) On Fig. 6.2 write radio waves in the correct place in the incomplete electromagnetic spectrum.

	X-rays				**microwaves**	

Fig. 6.2

[1]

(ii) Fig. 6.3 represents an electromagnetic wave.

On Fig. 6.3 mark and label one wavelength. [1]

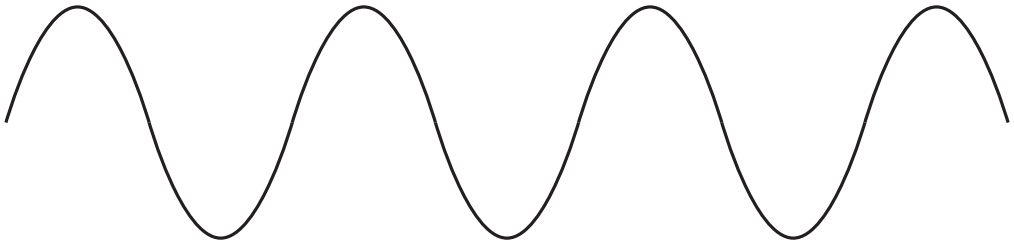

Fig. 6.3

(d) Fig. 6.4 shows a ray of light from the television reflecting at a plane mirror.

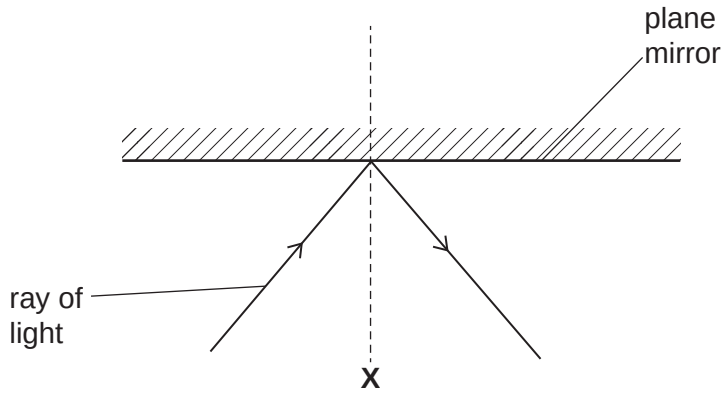

Fig. 6.4

(i) Identify the line labelled **X**.

..... [1]

(ii) Label the angle of reflection with the letter *r*. [1]

(iii) The angle of reflection is 30°.

State the angle of incidence.

angle = ... ° [1]

[Total: 11]

7 **(a)** A student puts potato cubes in sugar solutions of different concentrations.

The student records the mass of the potato cubes before and after immersion.

The results are shown in Table 7.1.

Table 7.1

sugar solution	starting mass / g	final mass / g	difference in mass / g
A	5.2	5.4	+0.2
B	5.2	5.2	0.0
C	5.3	4.2	–1.1
D	5.1	3.8	–1.3
E	5.0	2.4	–2.6

(i) Identify **all** the sugar solutions where the potato cubes lose mass.

..... [1]

(ii) Describe how water is lost from the cells of the potato cubes.

.....

.....

.....

..... [2]

(iii) Suggest which sugar solution has the same concentration as the cells inside the potato.

..... [1]

(b) When an animal cell is placed in a very dilute sugar solution it will burst.

Name the structure that stops plant cells bursting in very dilute sugar solutions.

..... [1]

(c) Place ticks (✓) in **two** boxes to show two uses of water in a plant.

as a solvent	
as a material for photosynthesis	
as a material for respiration	
for transfer of electrical impulses	
for muscle contraction	
for breathing	

[2]

(d) The list shows the parts involved in the pathway of water through a plant.

Write numbers next to each part to show the correct order **1–4**.

Number **1** has been done for you.

mesophyll cells .....

root cortex cells .....

root hair cells .....**1**.....

xylem .....

[1]

[Total: 8]

8 **(a)** Two isotopes of iron are iron-54 and iron-56.

Both isotopes have a proton number of 26.

Iron-54 has a nucleon number of 54 and iron-56 has a nucleon number of 56.

(i) State the number of electrons in one atom of iron-54.

..... [1]

(ii) Determine the **difference** in the number of neutrons between an atom of iron-54 and an atom of iron-56.

..... [1]

(b) Iron is extracted from iron oxide using carbon monoxide. Carbon dioxide is also made.

(i) Write the word equation for this reaction.

[1]

(ii) State the substance that is oxidised in this reaction.

..... [1]

(c) Iron reacts with two other substances to make rust.

(i) Name the element and the compound that react with iron when it rusts.

element .....

compound .....
[2]

(ii) Iron is coated with a material to prevent rusting.

Suggest **one** suitable material to use.

..... [1]

[Total: 7]

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9 **(a)** Describe two advantages of generating electricity using nuclear fission compared to generating electricity using fossil fuels.

1 .....

.....

2 .....

.....
[2]

(b) One disadvantage of nuclear power is that nuclear waste is made.

A sample of nuclear waste contains 2.00 g of nickel-63.

(i) The half-life of nickel-63 is 100 years.

Calculate the mass of nickel-63 remaining in the sample after 300 years.

mass = ... g [2]

(ii) Suggest a safe way of storing this sample of nuclear waste at a nuclear power station.

.....

..... [1]

(iii) Nuclear waste emits ionising radiation.

Fig. 9.1 shows three types of ionising radiation and their descriptions.

Draw lines to link each type of ionising radiation to its correct description.

type of radiation	**description**
α-particle	electromagnetic wave
β-particle	electron
γ-ray	helium nucleus

Fig. 9.1 [2]

(c) In most power stations thermal energy is released and used to heat water. The water is turned into steam.

Fig. 9.2 shows the arrangement of particles in a gas, a liquid and a solid.

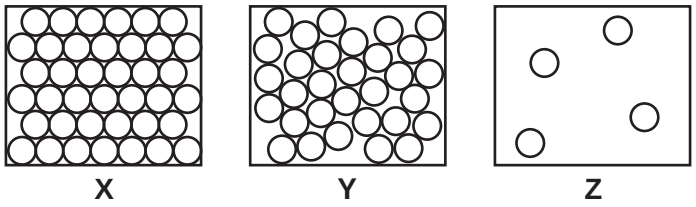


Fig. 9.2

State and explain why diagram **Y** represents a liquid and diagram **Z** represents a gas.

Diagram **Y** represents a liquid because .....

.....

.....

Diagram **Z** represents a gas because .....

.....

.....

[2]

[Total: 9]

10 (a) Use words from the list to complete the sentences about adrenaline.

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

breathing **exercise** **fight**

narrow **rest** **widen**

Adrenaline is the hormone secreted in '..... or flight' situations.

Adrenaline increases pulse rate and ..... rate.

Adrenaline also causes pupils in the eye to ..... .

[3]

(b) The boxes on the left show some sentence beginnings.

The boxes on the right show some sentence endings.

Draw **one** line to link one box on the left to one box on the right to define the term *hormone*.

A hormone is a chemical substance, produced by a gland,	carried by cells, which alters the activity of target organs.
A hormone is a chemical substance, produced by respiration,	carried by cells, which alters the activity of target organisms.
A hormone is an enzyme, produced by a gland,	carried by the blood, which alters the activity of target organisms.
A hormone is an enzyme, produced by respiration,	carried by the blood, which alters the activity of target organs.

[2]

(c) State the **two** parts of the central nervous system (CNS).

1 .....

2 .....

[2]

(d) A student describes a nerve impulse.

The description is **not** correct.

'A nerve impulse is a chemical signal that passes along nerve cells called connectors.'

Circle the **two** words in the student's description that are **not** correct. [2]

[Total: 9]

11 **(a)** Table 11.1 contains data for some elements in Group VII of the Periodic Table.

Table 11.1

element	formula	physical state at room temperature
chlorine	Cl_2	
bromine	Br_2	liquid
iodine		solid

(i) State the formula of iodine.

..... [1]

(ii) Explain why a chlorine molecule is described as *diatomic*.

..... [1]

(iii) Predict the physical state of chlorine.

..... [1]

(iv) State the name given to the elements in Group VII of the Periodic Table.

..... [1]

(b) **(i)** Explain why the drinking water supply for a large town is treated with chlorine.

.....

..... [1]

(ii) Describe the chemical test for chlorine and give the positive result.

test .....

result .....

.....
[2]

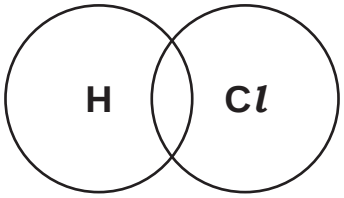
(c) Hydrogen and chlorine combine to produce hydrogen chloride (HCl).

(i) Balance the symbol equation for this reaction.

$$H_2 + Cl_2 \rightarrow \ldots\ldots HCl$$ [1]

(ii) Complete the dot and cross diagram to show the bonding in a molecule of hydrogen chloride, HC*l*.

You only need to show the outer shell electrons.



[3]

(iii) State why hydrogen chloride is a covalent compound and not an ionic compound.

.....

..... [1]

[Total: 12]

12 **(a)** Fig. 12.1 is a speed-time graph for an aircraft taking off.

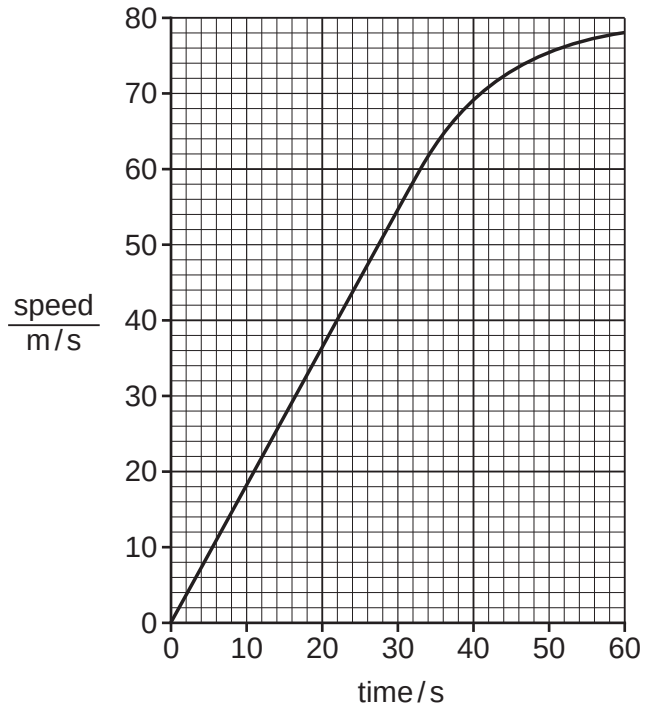


Fig. 12.1

(i) Calculate the distance travelled between t = 0 s and t = 25 s.

distance = ... m [2]

(ii) On Fig. 12.1, identify a time when the aircraft has the greatest acceleration.

Explain your answer.

time = ... s

explanation .....

.....

[2]

(iii) State two types of energy gained by the aircraft as it accelerates and gains height after take-off.

1 ..... energy

2 ..... energy

[2]

(b) Fig. 12.2 shows the four forces, **A**, **B**, **C** and **D**, acting on the aircraft flying at a constant height and constant speed.

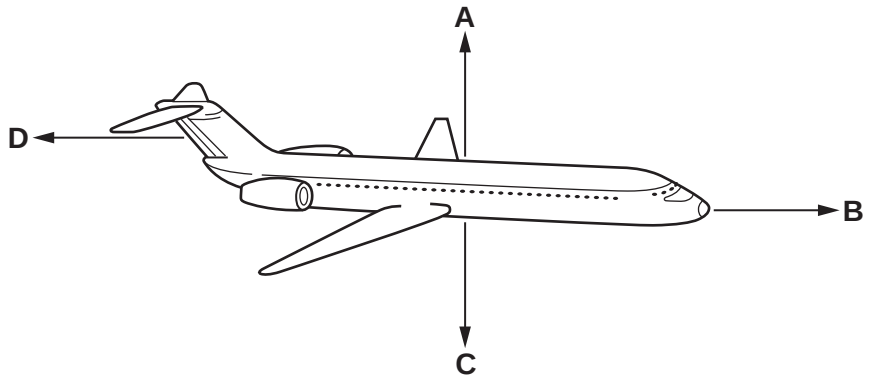


Fig. 12.2

(i) Compare the forces **B** and **D**.

Explain your answer.

.....

.....

.....

..... [2]

(ii) State which force, **A**, **B**, **C** or **D**, shows the weight of the aircraft.

force ..... [1]

(iii) The weight of the aircraft is 1×10^6 N.

Calculate the mass of the aircraft in kg.

The gravitational field strength g is 10 N / kg.

mass = ... kg [2]

[Total: 11]

The Periodic Table of Elements

Key: atomic number / atomic symbol / name / relative atomic mass

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 –		

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.).