Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **5129/22**

Paper 2 Theory **May/June 2024**

1 hour 45 minutes

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 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 **24** pages. Any blank pages are indicated.

[Turn over

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1 Fig. 1.1 shows a trolley travelling down a ramp.

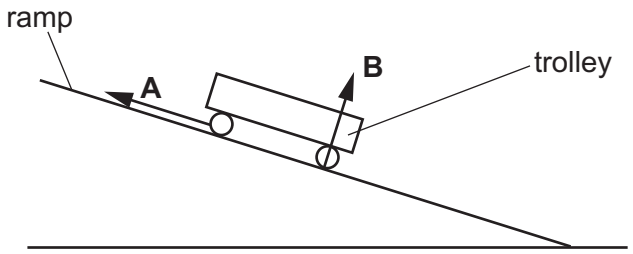

Fig. 1.1 (not to scale)

The arrows **A** and **B** show two of the forces acting on the trolley.

(a) State the name of the force shown by each arrow.

arrow **A** .....

arrow **B** .....
[2]

(b) Fig. 1.2 is the speed–time graph for the trolley as it travels down the ramp.

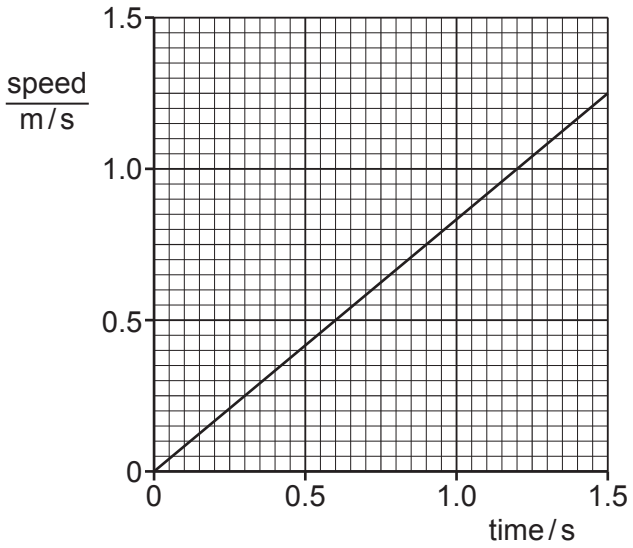

Fig. 1.2

(i) State how the graph shows that the trolley has a constant acceleration.

..... [1]

(ii) Calculate the acceleration of the trolley.

acceleration = ... m/s^2 [2]

[Total: 5]

2 Fig. 2.1 shows a plant cell after it has been immersed in distilled water for twenty minutes.

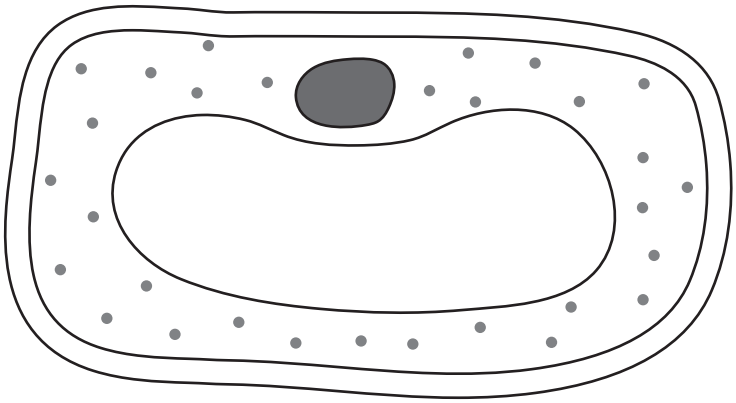

Fig. 2.1

(a) (i) On Fig. 2.1, draw a line to the vacuole.

Label the line **V**. [1]

(ii) The cell is then immersed in a concentrated sugar solution for twenty minutes. Fig. 2.2 shows the new appearance of the cell.

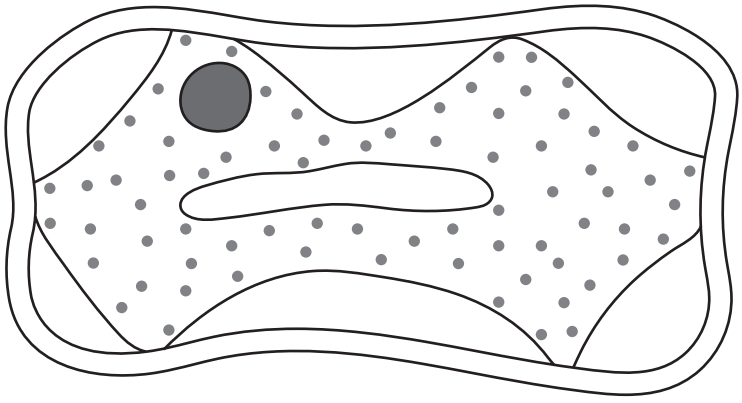

Fig. 2.2

On Fig. 2.2, draw a line to the cell membrane.

Label the line **M**. [1]

(iii) State **one** function of the nucleus in a cell.

.....

..... [1]

(b) The cell in Fig. 2.1 is described as ‘turgid’.

State the word that describes the cell in Fig. 2.2.

..... [1]

(c) Describe and explain the differences between the cell in Fig. 2.1 and the same cell in Fig. 2.2.

description .....

.....

.....

.....

explanation .....

.....

.....

.....

[3]

[Total: 7]

3 Bromine, Br_2, reacts with cold sodium hydroxide, NaOH, to form a mixture of sodium bromide, NaBr, sodium bromate(I), NaBrO, and water, H_2O.

The equation for the reaction is:

$$Br_2 + 2NaOH \rightarrow NaBr + NaBrO + H_2O$$

[A_r: Br, 80; H, 1; Na , 23; O, 16]

(a) (i) Calculate the relative molecular mass M_r of sodium bromate(I).

M_r = ... [1]

(ii) Complete the following sentence.

160 g of bromine produces .....g of sodium bromide. [1]

(b) State the colour of bromine liquid at room temperature and pressure.

..... [1]

(c) Describe a test and the result of the test that shows the presence of bromide ions in solution.

test .....

result .....
[2]

[Total: 5]

4 Fig. 4.1 shows a wheelbarrow full of sand.

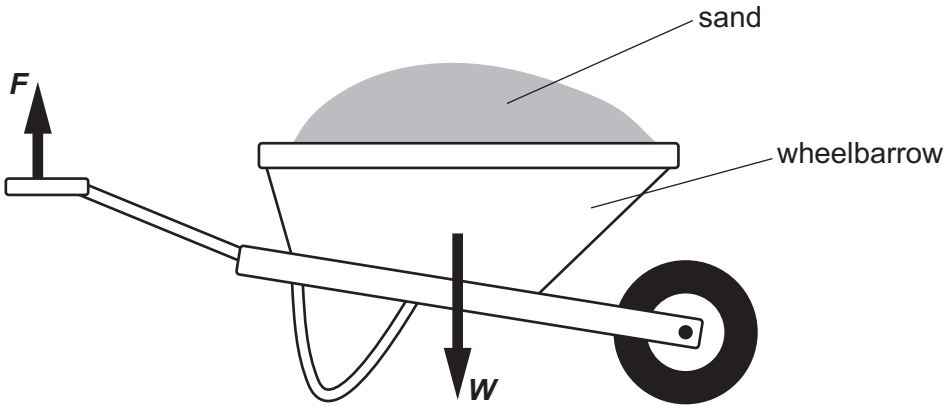

Fig. 4.1

The wheelbarrow full of sand has weight *W*.

A builder applies a force *F* at the handles of the wheelbarrow to lift the wheelbarrow.

(a) Complete the statement:

The moment of a force about a pivot is equal to force multiplied by

..... from the pivot. [1]

(b) On Fig. 4.1, draw a line to the position of the pivot.

Label the line **P**. [1]

(c) Explain why a small force *F* applied at the handle can lift a much larger weight *W*.

.....

..... [1]

(d) The builder applies a force *F* = 90 N to lift the handles of the wheelbarrow.

The work done in moving the handles upwards is 10 J.

Calculate the distance moved by the handles.

distance moved = ... m [1]

[Total: 4]

5 Draw **three** straight lines from the box on the left to **three** of the boxes on the right to make **three** correct sentences about the liver.

The liver …	… stores protein.
	… is damaged if excessive alcohol is drunk.
	… produces lipase.
	… produces urea.
	… sends blood back towards the heart along the hepatic portal vein.
	… stores glycogen.

[3]

6 The chemical formulae for some compounds and elements are shown.

CH_4 $CaCO_3$ Cu HNO_3 KOH NaCl

Use formulae from the list to answer the following questions.

Each formula can be used once, more than once or not at all.

State the formula of the compound or element that:

(a) is a gas at room temperature and pressure

..... [1]

(b) forms carbon dioxide when it reacts with acids

..... [1]

(c) is an alkane

..... [1]

(d) has a pH below 7 when dissolved in water

..... [1]

(e) is ductile.

..... [1]

[Total: 5]

7 At –79 °C, carbon dioxide is a solid.

At –78.5 °C, solid carbon dioxide changes directly into a gas.

(a) Complete the following sentences.

When carbon dioxide changes from a solid to a gas:

(i) the distance between the molecules ..... [1]

(ii) the movement of the molecules changes from

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

(iii) the forces between the molecules ..... . [1]

(b) Explain, in terms of molecules, why the increase in temperature from –79 °C to –78.5 °C causes the solid carbon dioxide to become a gas.

.....

.....

..... [2]

[Total: 5]

8 **(a)** **(i)** Table 8.1 compares the general structure of arteries and veins.

Complete Table 8.1 by writing the missing information, using words from the list.

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

large **no** **small**

thick **thin** **yes**

Table 8.1

type of blood vessel	diameter of lumen	thickness of wall	presence of valves
artery	.....	thick	.....
vein	.....	.....	.....

[3]

(ii) Explain why arteries have thick walls.

.....

..... [1]

(b) Describe the structure of a capillary.

.....

.....

.....

.....

..... [2]

[Total: 6]

9 Complete the sentences about the Periodic Table.

Elements in the Periodic Table are arranged in order of increasing number

of ..... .

Non-metals are on the ..... of the Periodic Table.

A period is a ..... in the Periodic Table.

Mass numbers given on the Periodic Table show the total number of .....

and ..... in an atom.

[4]

10 Fig. 10.1 shows an open fridge with a freezer compartment at the top.

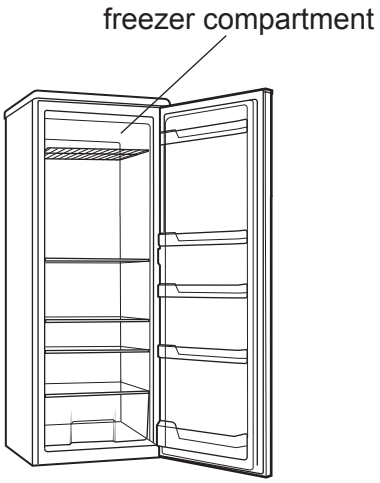

Fig. 10.1

The freezer compartment is the coldest part of this fridge. It is placed at the top so that all the air inside the fridge becomes cold when the air inside the freezer compartment is cooled.

(a) Use ideas about convection to explain why all the air in a fridge becomes cold when the freezer compartment is placed at the top.

.....

.....

..... [2]

(b) The fridge uses, on average, 133 kW h of energy per year.

The cost of 1 kilowatt-hour (kW h) is 15 cents.

Calculate the average cost, in cents, of using the fridge for one day.

There are 365 days in a year.

cost = ... cents per day [2]

(c) The walls and door of the fridge contain thermal insulation.

Explain why this keeps the cost of running a fridge low.

.....

..... [1]

[Total: 5]

11 **(a)** Carbohydrates, proteins and vitamins are important components of the human diet.

State **two** other components of the human diet.

1 .....

2 .....
[2]

(b) A vegan is a person who eats plant-based foods only.

Fig. 11.1 shows how the percentage of vegans in different age groups changed in one country between 2011 and 2015.

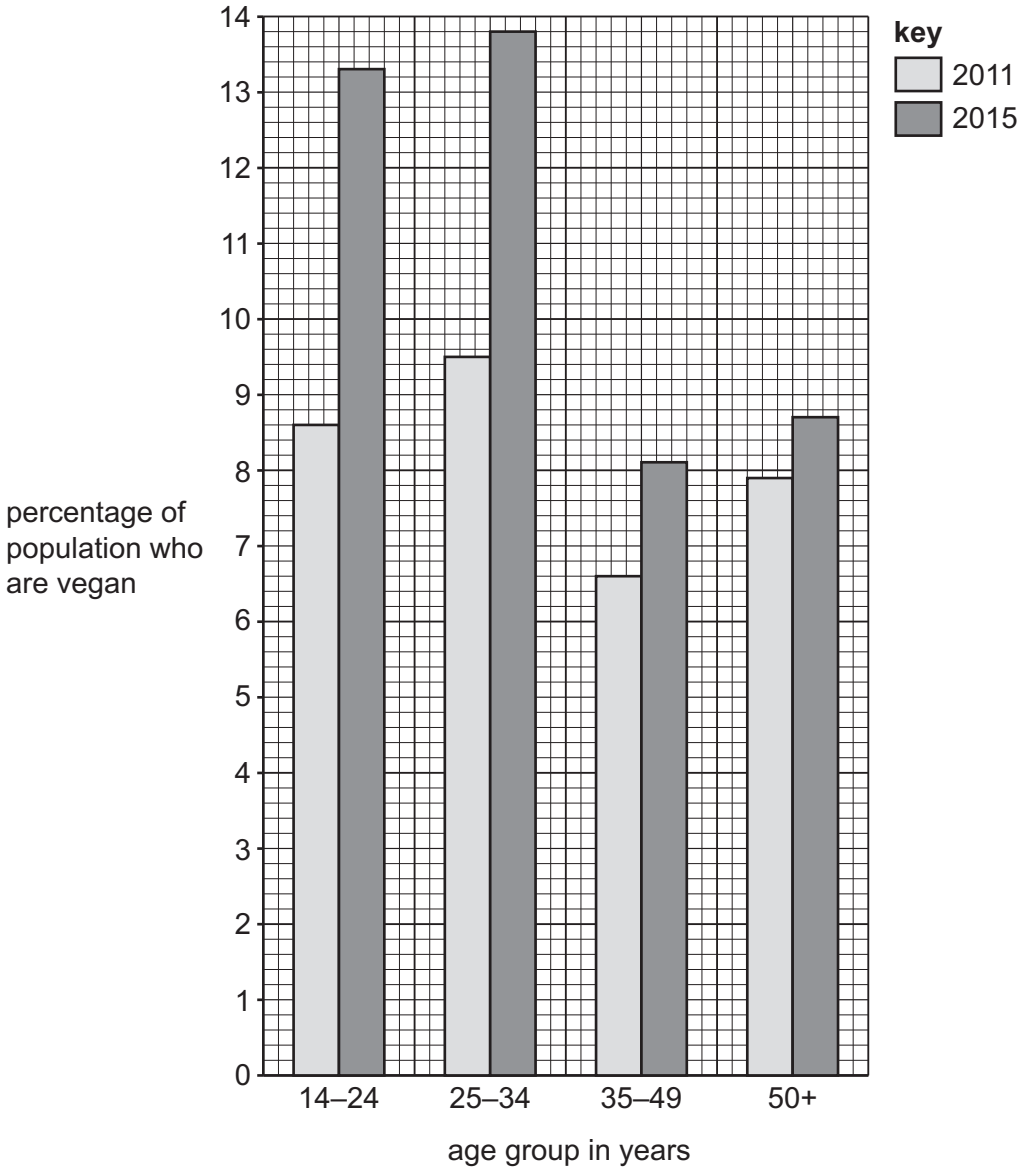

Fig 11.1

(i) State the percentage of the population who were vegan in 2015 in the 35–49 age group.

percentage of population = ... % [1]

(ii) State which age group had the largest increase in the percentage of vegans between 2011 and 2015.

age group = ... [1]

(c) Explain why it is more energy efficient for humans to eat crop plants than to eat livestock that have been fed on crop plants.

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

12 **(a)** Sea water can be purified by distillation.

Fig. 12.1 shows the apparatus used for the distillation of a sample of sea water.

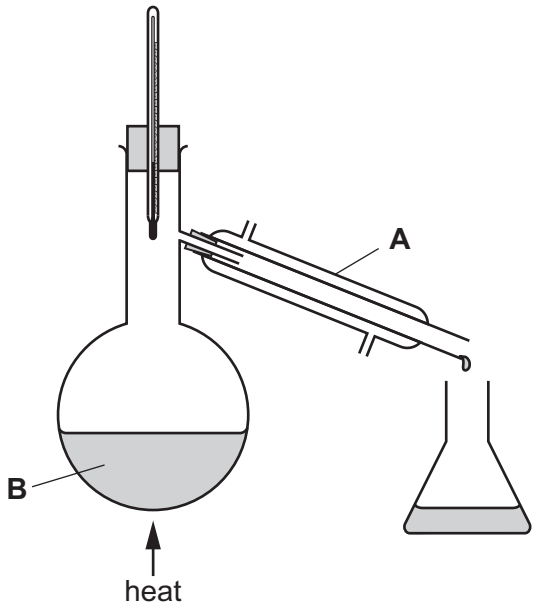

Fig. 12.1

(i) Name the piece of apparatus labelled **A** in Fig. 12.1.

..... [1]

(ii) Describe the change of state of water that takes place in **B**.

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

(b) Explain why chlorine is used in the treatment of domestic water supplies.

..... [1]

(c) Complete Fig. 12.2 to show the outer electrons in a molecule of chlorine, Cl_2.

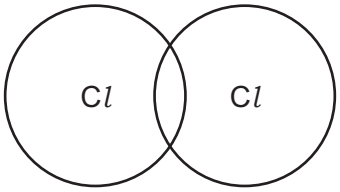

Fig. 12.2

[2]

(d) Chlorine is a gas at room temperature and pressure.

State how the volume of chlorine gas changes when:

(i) temperature is increased and pressure remains constant

..... [1]

(ii) pressure is increased and temperature remains constant.

..... [1]

[Total: 7]

13 In a demonstration of radioactivity, a Geiger-Müller (GM) tube is used to detect emissions from a radioactive source as shown in Fig. 13.1.

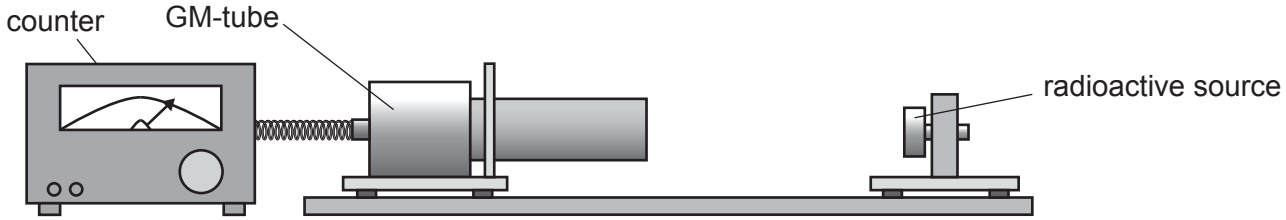

Fig. 13.1 (not to scale)

The GM-tube is connected to a counter.

The reading on the counter is recorded every 30 seconds.

Fig. 13.2 shows the graph drawn from the results when the background count rate is removed.

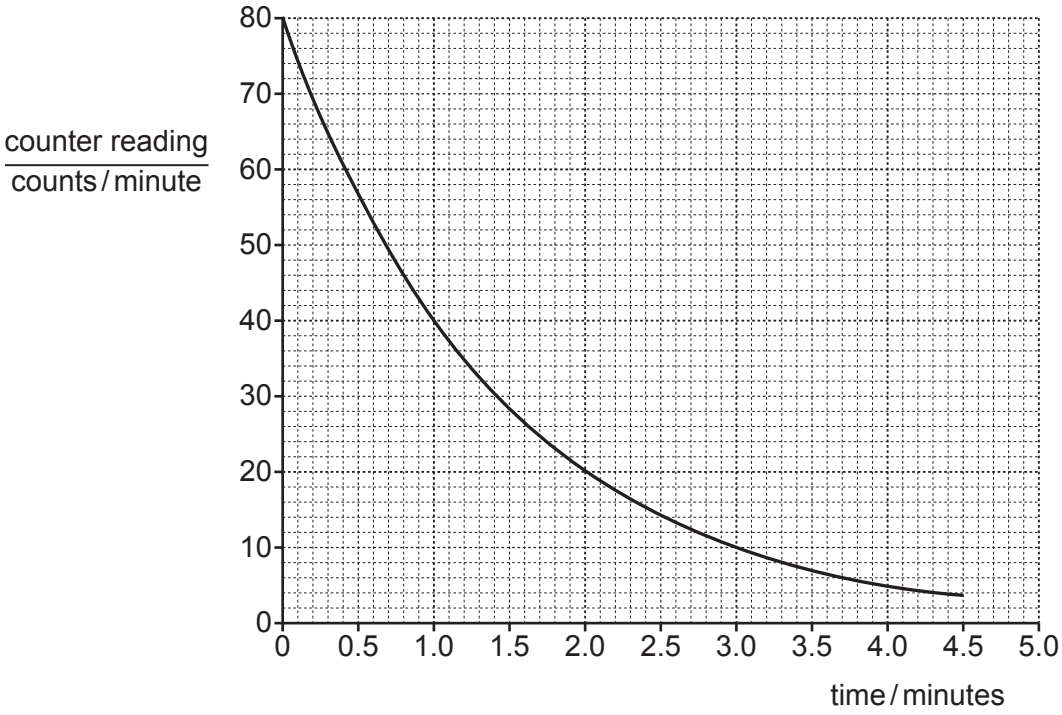

Fig. 13.2

(a) The time taken for the counter reading to halve is the half-life.

On Fig. 13.2 draw **one** horizontal line and **one** vertical line to show how the half-life of the radioactive source is determined from the graph.

Record the value of the half-life found using the lines that you have drawn.

half-life = ... minutes [2]

(b) Explain why the background count rate must be removed from the counter reading before determining the half-life of the source.

..... [1]

(c) At the start of the experiment, the teacher uses a pair of forceps with a long handle to move the radioactive source as shown in Fig. 13.3.

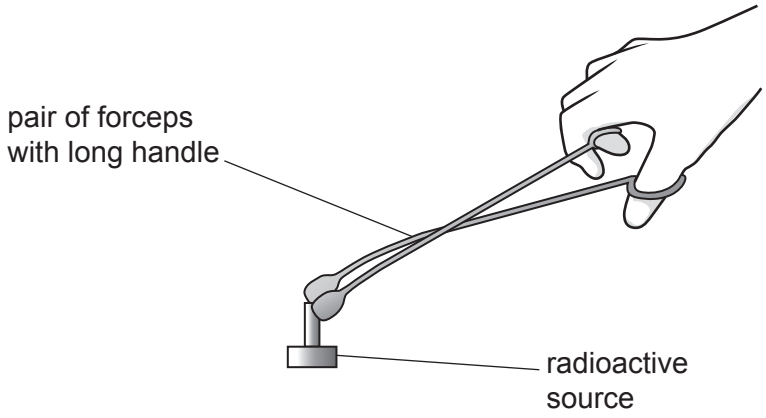

Fig. 13.3

Explain why the teacher needs to use a pair of forceps with a long handle.

.....

..... [1]

[Total: 4]

14 The boxes on the left contain descriptions of processes which occur in living organisms.

The boxes on the right contain the names of processes which occur in living organisms.

Draw **one** straight line from each box on the left to a box on the right to link the description to its name.

description of process	**name of process**
movement of particles from a region of their higher concentration to a region of their lower concentration	aerobic respiration
	absorption
movement of sucrose and amino acids in the phloem of a plant	meiosis
	translocation
nuclear division to produce cells with the same number of chromosomes as the original cell	mitosis
	diffusion
release of a large amount of energy from glucose in the presence of oxygen	transpiration

[4]

15 Sodium hydroxide is an alkali.

Aqueous solutions of ammonium bromide and sodium hydroxide react to form water and two other products.

(a) (i) Complete the word equation for the reaction.

ammonium bromide	+	sodium hydroxide	→	....	+	.....	+	water

[2]

(ii) Suggest the pH of aqueous sodium hydroxide.

..... [1]

(b) Ammonium bromide has the formula NH_4Br.

Deduce the total number of different elements in the compound ammonium bromide.

..... [1]

(c) Calculate the concentration of the solution formed when 40 g of ammonium bromide dissolves in 2000 cm^3 of distilled water.

[1 dm^3 = 1000 cm^3]

concentration = ... g/dm^3 [1]

[Total: 5]

16 A mobile (cell) phone camera passes a current through a lamp in a very short time. This produces a bright flash of light when taking a photograph.

(a) Complete the sentence:

Light from the lamp travels to an object and then .....

from the surface of the object back to the phone camera. [1]

(b) The total charge that passes through the lamp is 1.2×10^{-3} C.

(i) State the name of the unit of charge.

..... [1]

(ii) The current in the lamp is 0.8A.

Calculate the time taken for the flash of light.

time taken for the flash = ... s [2]

[Total: 4]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

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

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