Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7501484811

COMBINED SCIENCE **0653/43**

Paper 4 Theory (Extended) **October/November 2023**

1 hour 15 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.

1 **(a)** Fig. 1.1 shows part of the breathing system in humans.

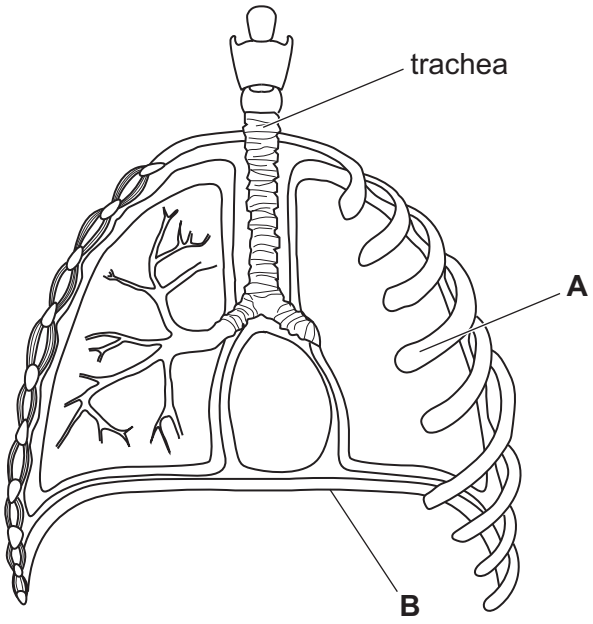

Fig. 1.1

(i) State the names of the parts labelled **A** and **B** in Fig. 1.1.

A .....

B .....
[2]

(ii) Describe how goblet cells protect the lining of the trachea.

.....

.....

..... [2]

(b) The breathing rate of four students is measured before and during physical activity.

Table 1.1 shows the results.

Table 1.1

student	breathing rate / breaths per minute		
	before physical activity	during physical activity	difference
1	18	33	15
2	14	32	18
3	16	35	19
4	17	38	21

(i) Identify the student in Table 1.1 with the lowest breathing rate **before** physical activity.

..... [1]

(ii) Calculate the average difference in breathing rate.

Give your answer to the nearest whole number.

average difference = ... breaths per minute [2]

(iii) Explain the effect of physical activity on breathing rate shown in Table 1.1.

Include ideas about carbon dioxide in your answer.

.....

.....

.....

..... [3]

[Total: 10]

2 Fig. 2.1 shows the electrolysis of concentrated aqueous sodium chloride using platinum electrodes.

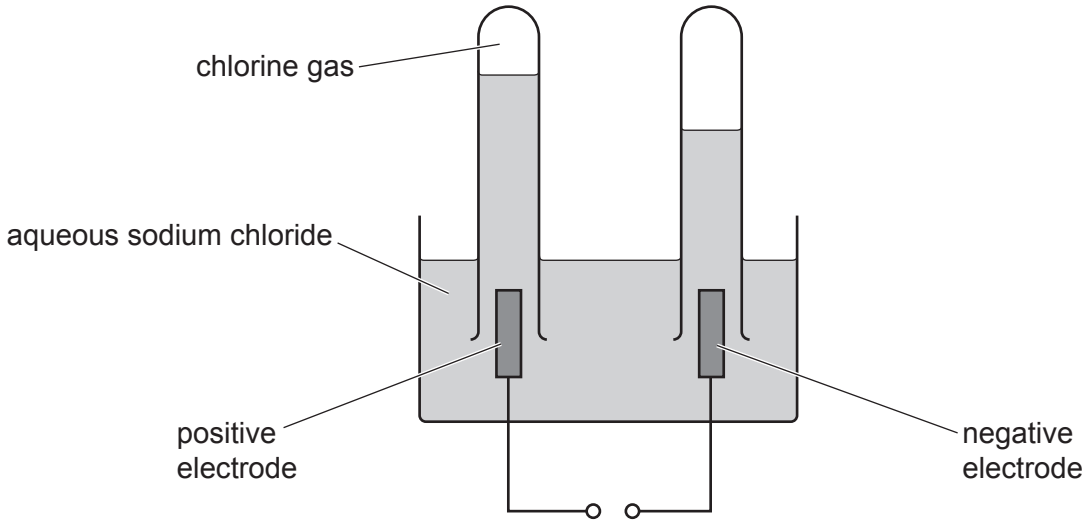

Fig. 2.1

(a) Some information about ions in the solution is shown in Table 2.1.

Table 2.1

name of ion	formula of ion	source of ion	concentration of ion during the electrolysis
chloride	Cl^-	sodium chloride	decreases
hydrogen		water	
hydroxide	OH^-		stays the same
sodium		sodium chloride	

(i) Complete Table 2.1. [3]

(ii) Describe what happens to the chloride ions at the positive electrode during the electrolysis.

Use ideas about ions, electrons, atoms and molecules in your answer.

.....

.....

.....

..... [3]

(b) Platinum is a transition element.

(i) State **one** property of platinum that makes it suitable to use as an electrode.

..... [1]

(ii) State **two** other properties of transition elements that are **not** properties of Group I elements.

1 .....

2 .....
[2]

[Total: 9]

3 Fig. 3.1 shows a firefighter standing next to a fire engine.

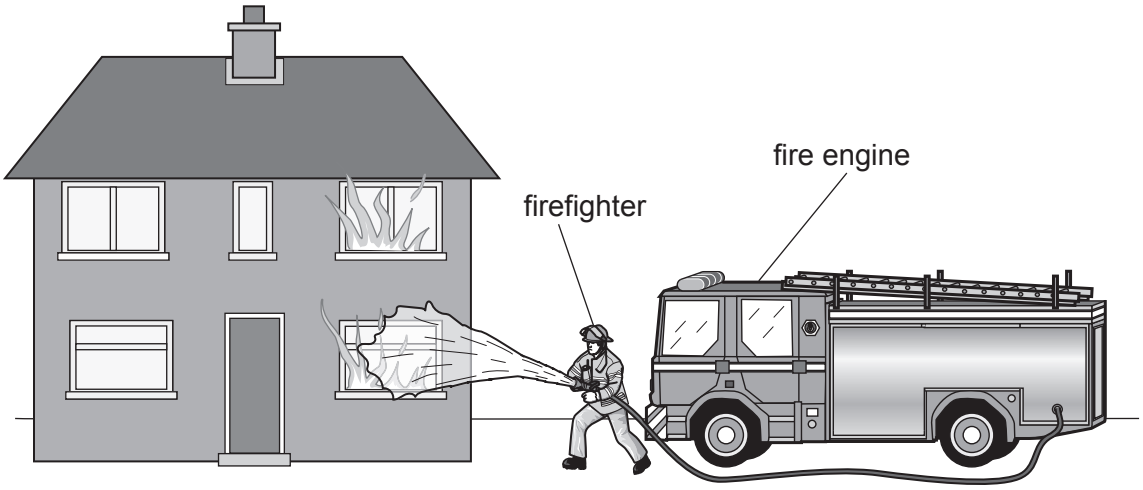

Fig. 3.1

(a) The firefighter sprays water onto the fire.

The temperature of the fire is 600 °C.

(i) The firefighter is heated by the fire.

State the main method of energy transfer from the fire to the firefighter.

..... [1]

(ii) The temperature of the water is 15 °C.

State what happens to the water when it is heated from 15 °C to 600 °C.

..... [1]

(iii) The fire engine has a tank containing a volume of 1800 dm^3 of water.

Calculate the mass of water in the tank.

The density of water is 1000 kg/m^3.

mass = ... kg [3]

(b) The fire engine has a weight of 140 000 N.

(i) Calculate the mass of the fire engine.

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

mass = ... kg [2]

(ii) The fire engine has a total area of 0.56 m^2 in contact with the ground.

Calculate the pressure exerted by the fire engine on the ground.

Give the unit of your answer.

pressure = ... unit ..... [3]

[Total: 10]

4 **(a)** Fig. 4.1 shows part of the human alimentary canal and associated organs.

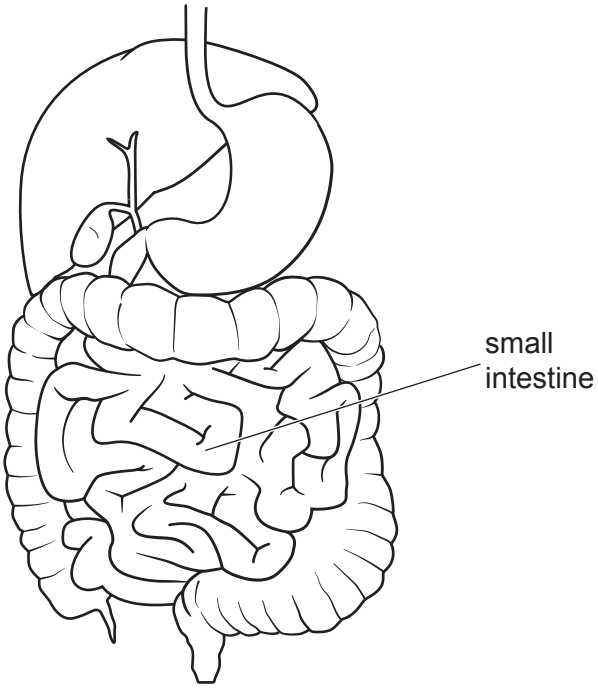

Fig. 4.1

(i) Draw a label line and the letter **G** on Fig. 4.1 to identify the gall bladder. [1]

(ii) Starch is digested by an enzyme in the alimentary canal.

State the name of the enzyme and of the product of this digestion.

enzyme .....

product .....
[2]

(iii) Describe how soluble food molecules are absorbed into the blood from the small intestine.

.....

.....

..... [2]

(b) Fig. 4.2 shows the effect of temperature on the activity of an enzyme that is **not** found in humans.

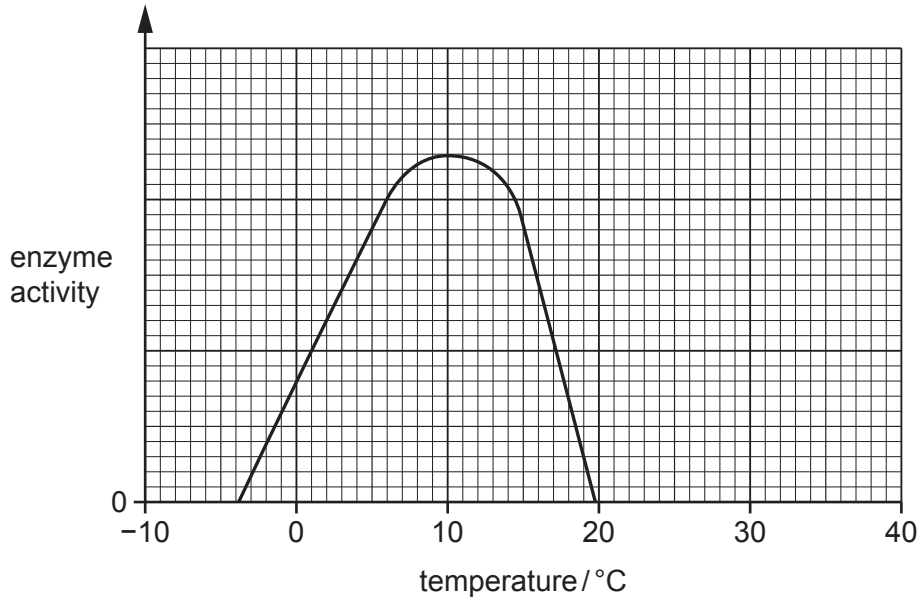

Fig. 4.2

(i) Identify the temperature at which the enzyme is the most active.

temperature = ... °C [1]

(ii) Explain the effect of a temperature of 20 °C on the activity of the enzyme.

.....

.....

.....

..... [3]

[Total: 9]

5 Table 5.1 gives information on the percentage composition of the atmosphere of the planet Mars.

Table 5.1

gas	percentage composition of the atmosphere of Mars
carbon dioxide	95.0
nitrogen	1.9
argon	1.9

(a) (i) The atmosphere of Mars contains other gases not shown in Table 5.1.

Use Table 5.1 to calculate the percentage of other gases in the atmosphere of Mars.

other gases = ...% [1]

(ii) More than 20% of the Earth's atmosphere is gas **X**.

Gas **X** is not shown in Table 5.1.

State the name of gas **X**.

..... [1]

(b) The electronic structure of argon is shown in Fig. 5.1.

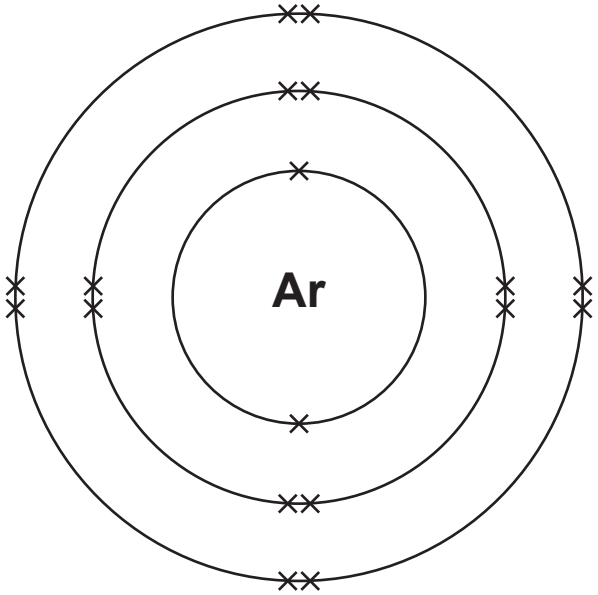

Fig. 5.1

Argon is a noble gas.

Describe how the position of argon in the Periodic Table is related to its electronic structure.

Use ideas about period number and group number in your answer.

.....

.....

.....

..... [3]

(c) The structure of carbon dioxide is shown in Fig. 5.2.

Fig. 5.2

State the number of electrons that are shared between the carbon atom and one oxygen atom in a molecule of carbon dioxide.

Give a reason for your answer.

number of electrons .....

reason .....

.....

[2]

(d) Complete Fig. 5.3 to show the dot-and-cross diagram of a molecule of nitrogen.

Show all of the outer shell electrons.

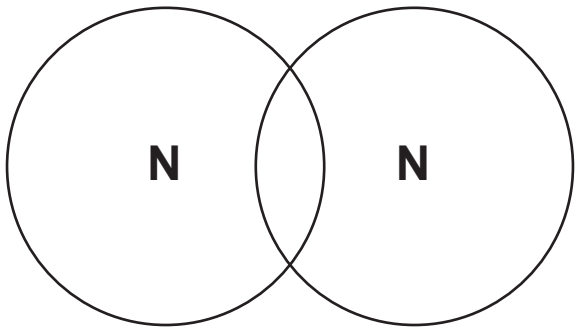

Fig. 5.3

[2]

[Total: 9]

6 A spring has an original length of 10.0 cm.

An object is suspended from the spring, and the spring extends to a length of 12.0 cm, as shown in Fig. 6.1.

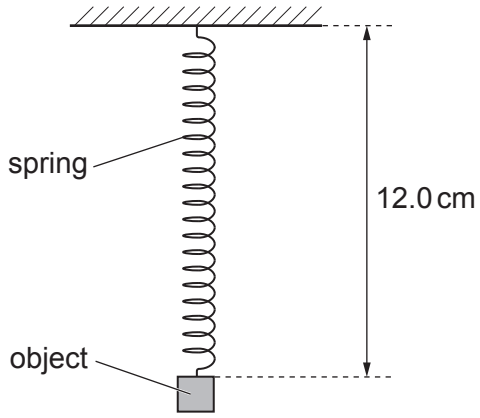

Fig. 6.1

(a) (i) Determine the extension of the spring.

extension = ... cm [1]

(ii) The weight of the object is 1.5 N.

Calculate the spring constant *k* of the spring.

k = ... N / cm [2]

(iii) State the name of the energy stored in the extended spring.

..... [1]

[Turn over

(b) The object is pulled down and held at a vertical distance of 3.0 cm from its rest position, as shown in Fig. 6.2.

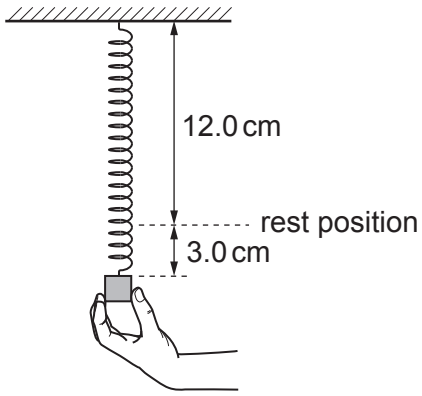

Fig. 6.2

The object is released, and the object oscillates up and down.

The period of an oscillation is the time taken for one complete oscillation.

Fig. 6.3 shows a distance–time graph for the vertical motion of the object after release.

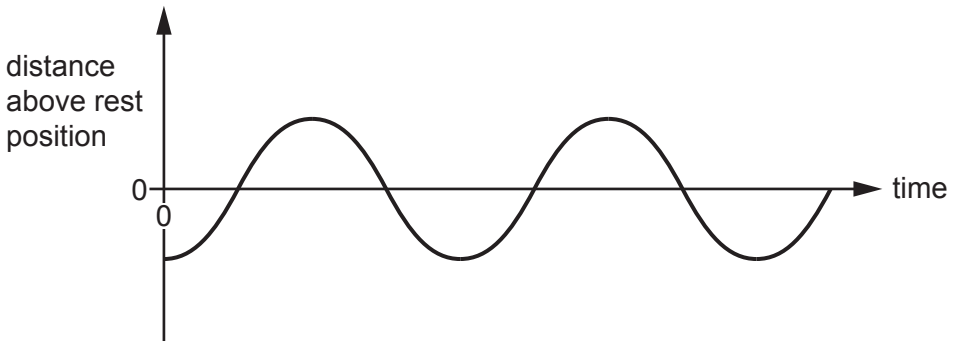

Fig. 6.3

(i) On Fig. 6.3, use a double-headed arrow (↕ or ↔) to show:

- the period of the oscillation and label this **T**
- the amplitude of the oscillation and label this **A**.

[2]

(ii) The mass of the object is 0.15 kg.

During oscillation, the object has a maximum speed of 0.012 m / s.

Calculate the kinetic energy of the object at its maximum speed.

kinetic energy = ... J [2]

(iii) A student suggests that the energy stored in the spring in Fig. 6.2 before the object is released is the same value as the kinetic energy calculated in **(b)(ii)**.

State whether you think the student is correct or incorrect.

Give a reason for your answer.

student is .....

reason .....

.....

[1]

[Total: 9]

7 **(a)** Fig. 7.1 shows the drawing of a cross-section through a root.

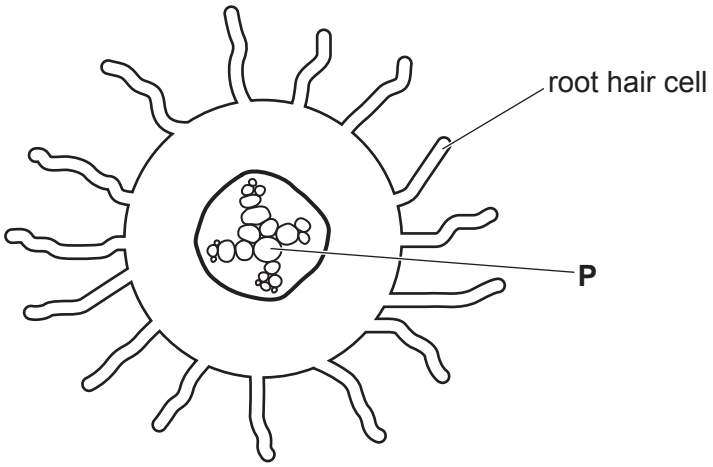

Fig. 7.1

(i) State **two** functions of the part labelled **P** in Fig. 7.1.

1 .....

2 .....
[2]

(ii) Describe **one** way the root hair cell is adapted for absorption.

.....

..... [1]

(b) Scientists measure the concentration of dissolved oxygen in pond **A** and in pond **B** for 24 hours.

Fig. 7.2 is a graph of the results.

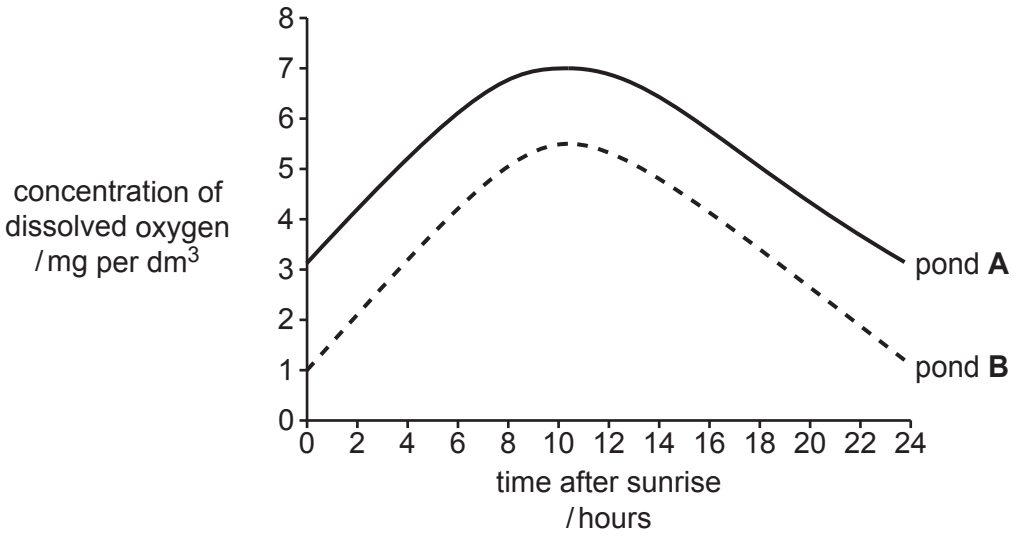

Fig. 7.2

(i) Complete the sentences about aquatic plants that are growing in pond **A**.

During daylight hours, chlorophyll in aquatic plants in the pond transfers light into

..... energy.

This is part of the process of ..... in the aquatic plants.

[2]

(ii) Pond **B** is polluted with nitrate fertiliser, which increases the availability of nitrates in pond **B**.

Explain the difference in concentration of dissolved oxygen between pond **A** and pond **B**.

.....

.....

.....

..... [3]

[Total: 8]

8 Table 8.1 shows some information about some alkanes and alkenes.

Table 8.1

number of carbon atoms in one molecule	alkane		alkene	
	name	formula	name	formula
2	ethane	C_2H_6	ethene	
3	propane	C_3H_8	propene	C_3H_6
4		C_4H_{10}	butene	C_4H_8
8	octane		octene	C_8H_{16}

(a) The general formula for the alkenes is C_nH_{2n}.

(i) Deduce the general formula for the **alkanes**.

..... [1]

(ii) Complete Table 8.1. [3]

(b) The structure of propane is shown in Fig. 8.1.

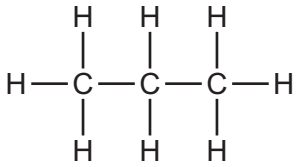

Fig. 8.1

(i) Describe how Fig. 8.1 shows that propane is a saturated hydrocarbon.

.....

.....

..... [2]

(ii) Draw a diagram, similar to Fig. 8.1, to show the structure of **propene**.

[2]

[Total: 8]

9 **(a)** Fig. 9.1 shows an ultraviolet torch used to kill bacteria and viruses on surfaces.

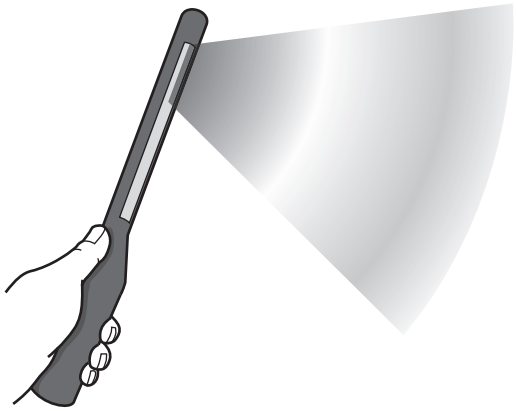

Fig. 9.1

When switched on, the torch emits both ultraviolet radiation and visible light.

(i) Fig. 9.2 shows an incomplete electromagnetic spectrum.

On Fig. 9.2, write ultraviolet and visible light in their correct places.

← increasing frequency						
	X-rays					radio waves

Fig. 9.2

[2]

(ii) State **one** danger of ultraviolet radiation.

..... [1]

(iii) The torch uses a 3.7 V battery.

The power rating of the torch is 3.0 W.

Calculate the current in the torch.

current = ... A [2]

(b) A student has a box of 10 Ω, 15 Ω and 22 Ω resistors. There are at least three resistors of each value in the box.

The student takes three resistors and connects them together as shown in Fig. 9.3.

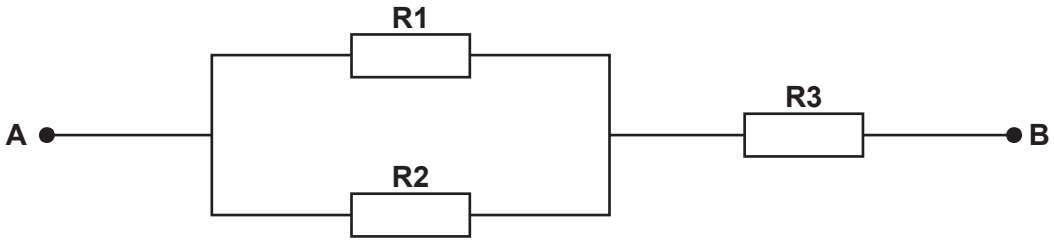

Fig. 9.3

The total resistance between points **A** and **B** is 28 Ω.

Find values for **R1**, **R2** and **R3** that give a total resistance of 28 Ω.

Show calculations to support your values.

R1 = ... Ω **R2** = ... Ω **R3** = ... Ω [3]

[Total: 8]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –		

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.).