ZHONGHUA SECONDARY SCHOOL
End-Of-Year Examination 2017

CANDIDATE NAME				( )
CLASS	2	E		

LOWER SECONDARY SCIENCE — 12 October, 2017

Secondary 2 Express — 2 hours

Set by: Mr Ong Kai Kun / Mrs Lin Jiaxuan

Vetted by: Ms Rozianna / Ms Ong Lay Hong / Mr Lawrence Tang

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

There are **thirty** questions on this paper. Answer all questions. For each question there are four possible answers A, B, C and D.

Choose the one you consider correct and record your choice in soft pencil on the separate OTAS Answer Sheet.

Section B

Answer **all** questions.

Write your answers in the spaces provided on the Question paper.

Section C

Answer **all** questions.

Write your answers in the spaces provided on the Question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

All essential working must be shown clearly.

A copy of the Periodic Table is printed on page 25.

For examiner's use	
Section A	/30
Section B	/30
Section C	/30
Total	

This document consists of **25** printed pages, including this cover page.

Section A

Answer **all** the questions.

1 The boiling points of some elements are given below.

element	boiling point/°C
nitrogen	-196
argon	-186
oxygen	-183

A mixture of liquids consisting of oxygen, nitrogen and argon at -200 °C is allowed to warm up gradually by 10 °C. Which of the substances will still be in the liquid state?

A argon only

B nitrogen only

C oxygen only

D argon and oxygen only

2 Why is it easy to compress air?

A The particles of air move in all directions.

B The particles in air move very quickly.

C There is a lot of empty space between the particles of air.

D There are no forces of attraction between the particles of air.

3 A substance is in a state in which its particles are widely spaced and able to move freely. It changes to a state in which its particles are in contact but still able to move freely. What is this change called?

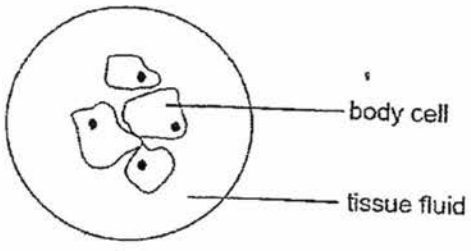
A condensation

B diffusion

C evaporation

D freezing

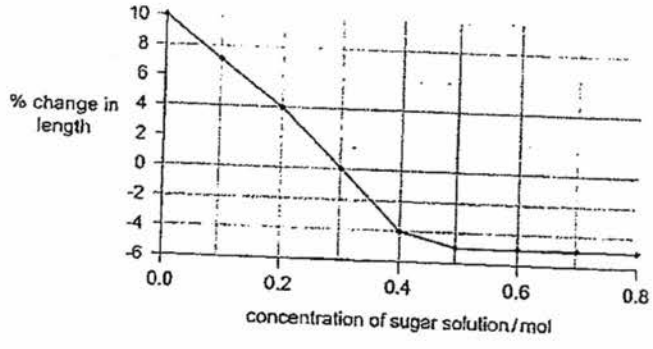
4 The diagram shows a group of body cells surrounded by tissue fluid.



Which conditions cause the body cells to take in water?

	water potential in the tissue fluid	water potential in the cytoplasm of body cells
A	high	high
B	high	low
C	low	high
D	low	low

5 Cylinders of potato tissue were placed in different concentrations of a sugar solution. The graph shows the percentage change in length of the cylinders of potato tissue.



Which sugar solution is isotonic to the potato tissue?

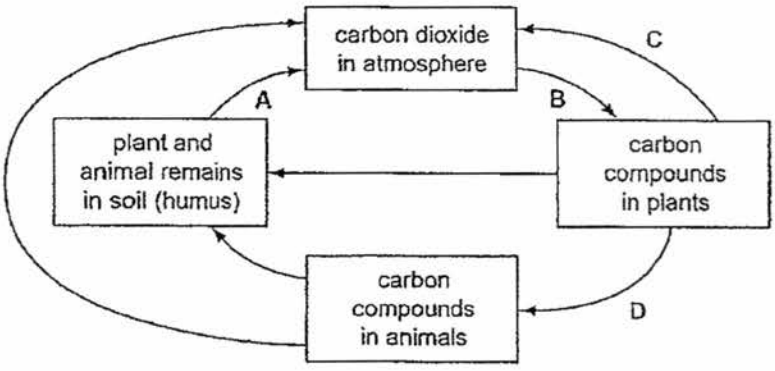
A 0.3 mol

B 0.4 mol

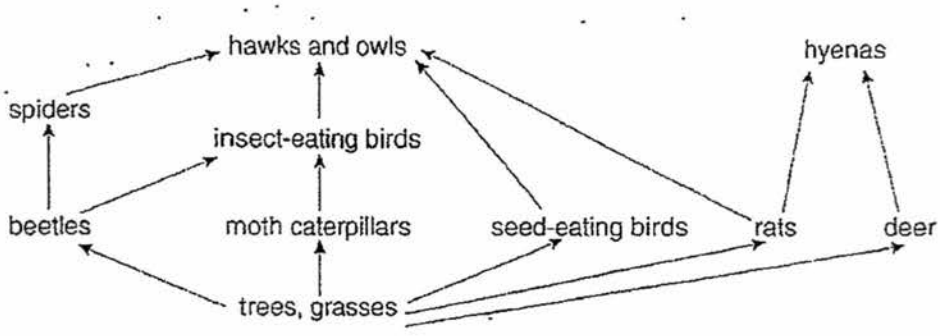
C 0.5 mol

D 0.8 mol

6 The diagram shows part of the carbon cycle.
Which arrow represents the process of photosynthesis?



7 The diagram shows part of a food web.



Which organisms represent the primary producer, secondary consumer and tertiary consumer?

	primary producer	secondary consumer	tertiary consumer
A	grasses	seed-eating birds	owls
B	grasses	insect-eating birds	hawks
C	trees	rats	hyenas
D	hyenas	deer	trees

8 Humans have a double circulatory system. The advantage of this mode of circulation is that _____.

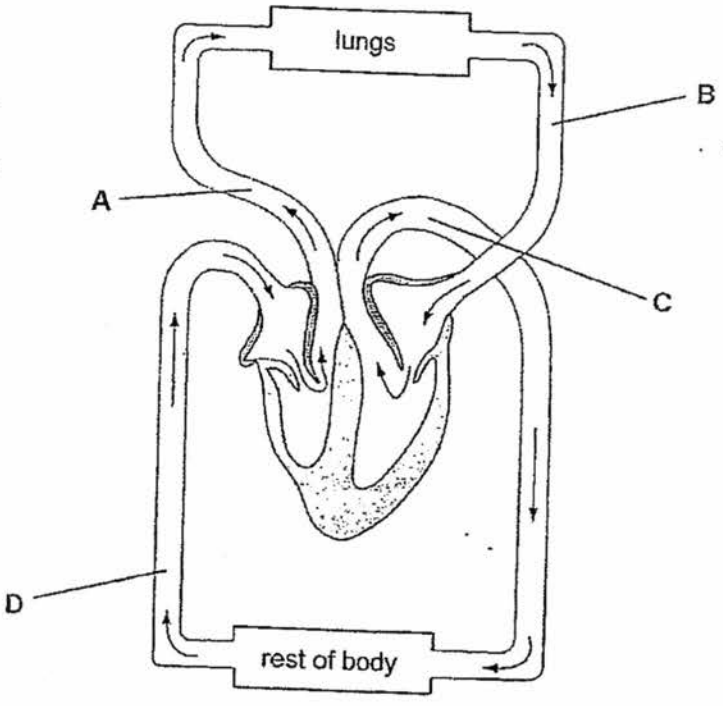
A it oxygenates blood

B it removes carbon dioxide easily

C it keeps blood leaving the heart at a high pressure

D It keeps the lung tissue living

9 The diagram shows the circulatory system.
In which vessel is the blood pressure highest?



10 What is the path taken by sperm cells during ejaculation from the male reproductive system?

A sperm duct → testis → urethra

B sperm duct → urethra → testis

C testis → sperm duct → urethra

D testis → urethra → sperm duct

11 A woman ovulates on 2nd March.
In which week will her next menstrual cycle begin?

	March						
week	Sun	Mon	Tue	Wed	Thu	Fri	Sat
	-	-	-	1	2	3	4
A	5	6	7	8	9	10	11
B	12	13	14	15	16	17	18
C	19	20	21	22	23	24	25
D	26	27	28	29	30	31	-

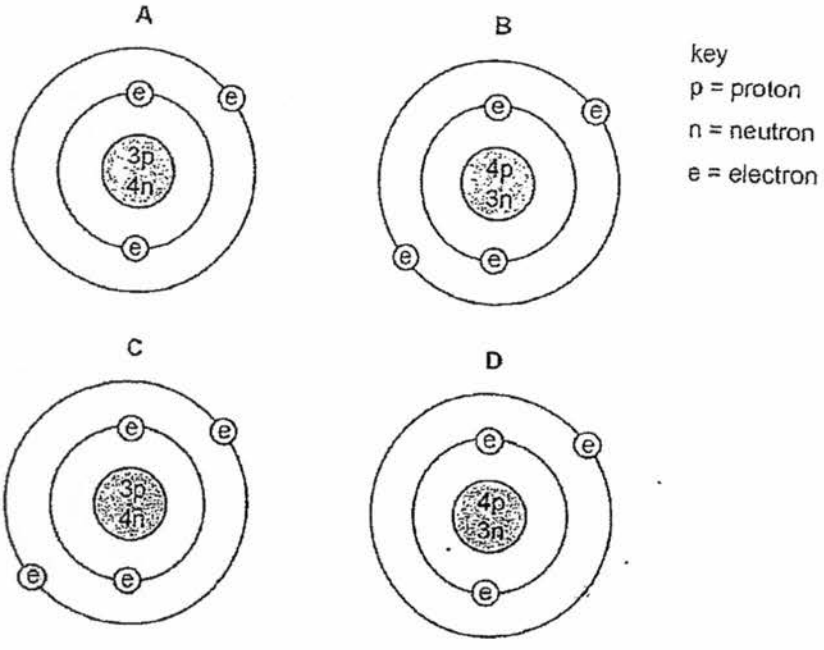
12 How many electrons and protons are in an ion of an element in Group VI of the Periodic Table?

	number of electrons	number of protons
A	8	6
B	8	8
C	18	16
D	18	20

13 Strontium has an isotope of nucleon number 90.
How many protons, neutrons and electrons are present in an atom of this isotope?

	protons	neutrons	electrons
A	38	52	38
B	38	50	40
C	40	52	38
D	40	50	40

14 Which diagram shows the structure of a $^{7}_{3}Li$ atom?



15 The element X and Y formed the compound X_2Y. What is the correct electron arrangement of the atoms of X and Y?

	atoms of X	atoms of Y
A	2.1	2.5
B	2.1	2.6
C	2.2	2.6
D	2.7	2.2

16 The formula of an oxide of uranium is UO_2.
What is the formula of the corresponding chloride?

A UCl

B UCl_2

C UCl_3

D UCl_4

17 Which statement about all alkali is not correct?

A They dissociate to give hydroxide ions

B They give ammonia with an ammonium salt.

C They consist of metal oxides and hydroxides.

D They have a pH value above 7.

18 Which word describes the reaction between hydrochloric acid and sodium hydroxide?

A decomposition

B elecrolysis

C neutralisation

D precipitation

19 Which of the following is not the appropriate substance for preparing zinc sulfate by reacting with dilute sulfuric acid?

A zinc carbonate

B zinc hydroxide

C zinc oxide

D zinc nitrate

20 When two solutions are mixed, a resulting solution with a pH value of 7 is formed. Which of the following are the pH values of the two solutions?

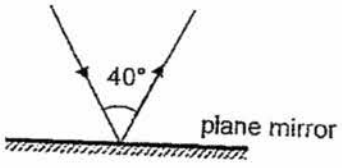
	first solution pH	second solution pH
A	2	5
B	5	12
C	1	6
D	8	13

21 Which of the following is a property of light?

1 It can be reflected.
2 It can be refracted.
3 It travels in straight lines.
4 It travels at a speed of 3.0×10^8 m/s in any medium.

A 1 and 2 only
B 1, 2 and 3 only
C 1, 2 and 4 only
D 1, 2, 3 and 4

22 A ray of light is reflected off the surface of a plane mirror.



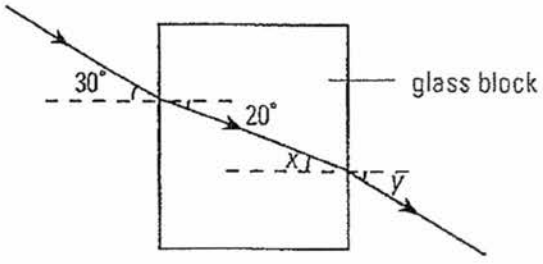
What are the angle of incidence and angle of reflection respectively?

	angle of incidence/°	angle of reflection/°
A	20	20
B	20	70
C	50	50
D	70	70

23 Which statement is correct about diffuse reflection?

A A parallel beam will reflect as a parallel beam.
B It occurs only in materials with high optical density.
C It is able to produce a sharp virtual image.
D The angle of incidence is equal to the angle of reflection.

24 A single ray of light travels through a rectangular glass block and emerges back into air as shown in the diagram below.



Which of the following statements is incorrect?

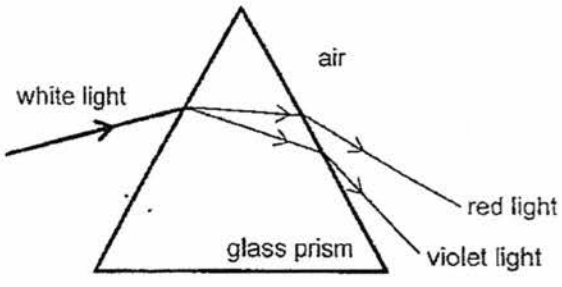
A The incident ray is parallel to the emergent ray.

B The refracted ray in the glass block bends towards the normal as light travels faster in glass than in air.

C The values of x and y are 20° and 30° respectively.

D When the ray emerges from the glass block; the angle of incidence is greater than the angle of refraction.

25 When white light is shone at a glass prism, it can disperse to show the spectrum of colours: red, orange, yellow, green, blue, indigo and violet. The diagram below show how the red light and violet light bends after the light dispersion.



Which statement is a correct comparison between the red light and the violet light?

A Red light has a larger angle of emergence than violet light.

B Red light has a smaller angle of incidence than violet light before it emerges from the glass prism.

C Red light refracts more than violet light as it emerges into the air.

D Red light slows down more than violet light as it enters the glass prism.

26 The units for current can be stated as _____.

A C/s

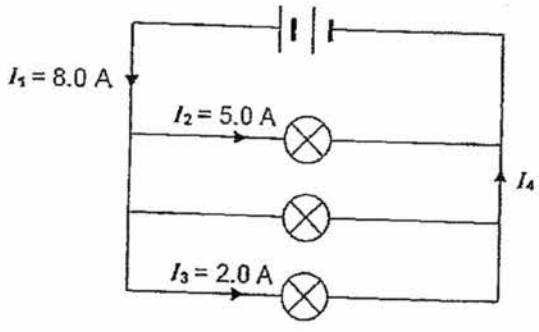
B J/C

C J/s

D Q/t

27 Three lamps are connected as shown in the diagram.

What is the value of the current I_4 ?



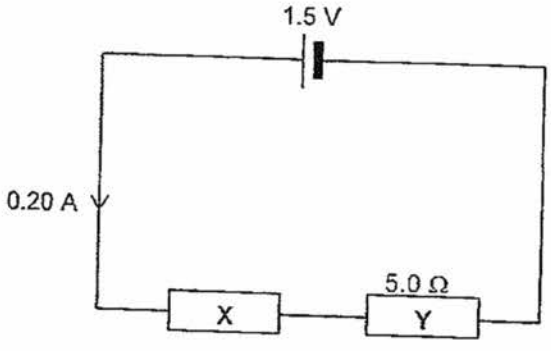
A 1.0 A

B 2.0 A

C 3.0 A

D 8.0 A

28 The diagram below shows two resistors X and Y connected in a circuit.



What is the resistance of X?

A 0 Ω

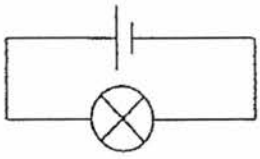
B 2.5 Ω

C 5.0 Ω

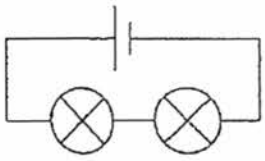
D 7.5 Ω

29 The following lamps and electrical cells are identical.
Which circuit, **A**, **B**, **C** or **D**, has the lowest effective resistance?

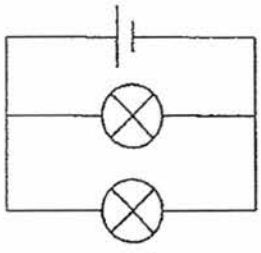
A



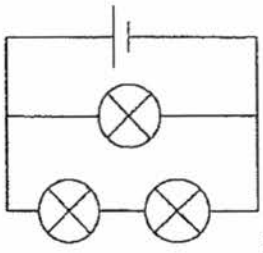
C



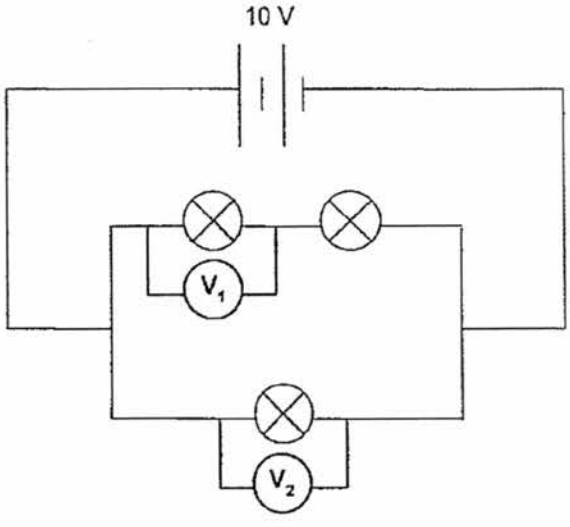
B



D



30 A student connects three identical lamps and two voltmeters V_1 and V_2 as shown in the circuit below.



The lamp which has the voltmeter V_2 connected across has a broken filament.
What will be the new voltmeter readings?

	reading on V_1 / V	reading on V_2 / V
A	0	0
B	0	10
C	5	10
D	10	10

Zhonghua Secondary School
End-Of-Year Examination 2017
Secondary 2 Express

NAME: _____ ( )

CLASS: 2 E

For Examiner's Use	
Section B	30
Section C	30
Total	

Section B

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

B1 In a light bulb, the tungsten wire may get so hot that it melts and breaks.
Fig. 1.1 shows the heating curve for tungsten.

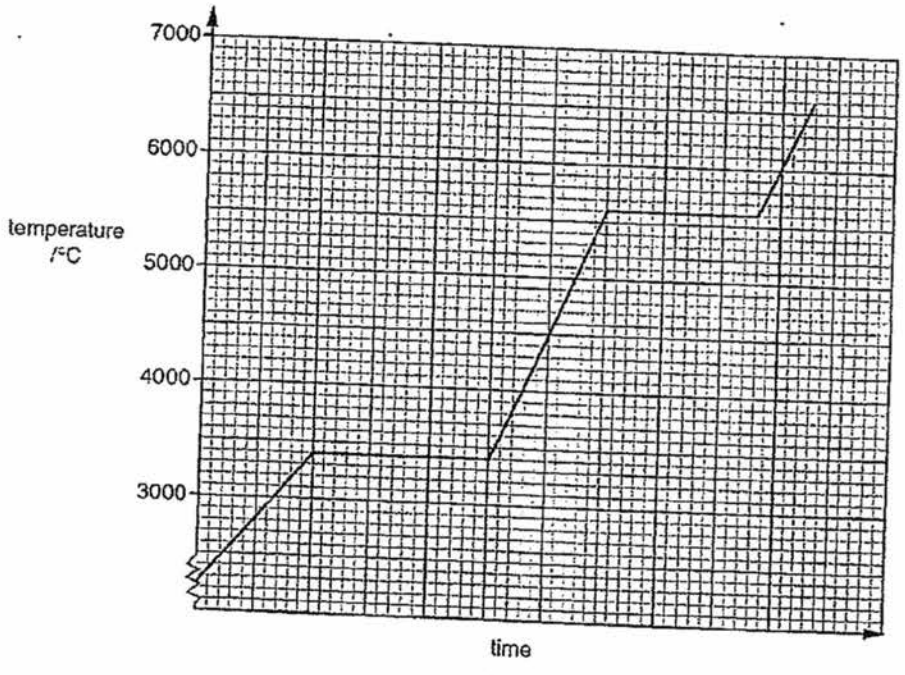


Fig 1.1

(a) Use the graph to predict the temperature when the tungsten wire breaks.

_____ [1]

(b) Describe the movement and arrangement of tungsten particles at 4500 °C.

_____

_____ [2]

B2 Fig. 2.1 shows a micrograph of a blood smear examined under a light microscope.

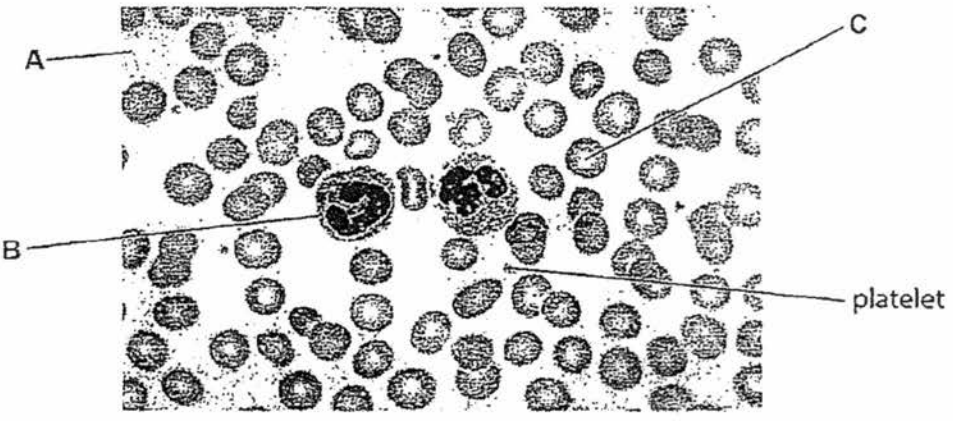


Fig. 2.1

(a) Name the blood components labelled A and B.

A _____ B _____ [2]

(b) Explain how the structure of component C allows it to be well-adapted to its function.

_____

_____

_____ [2]

(c) Fig. 2.3 shows the pressure of blood as it flows through arteries, capillaries and veins.

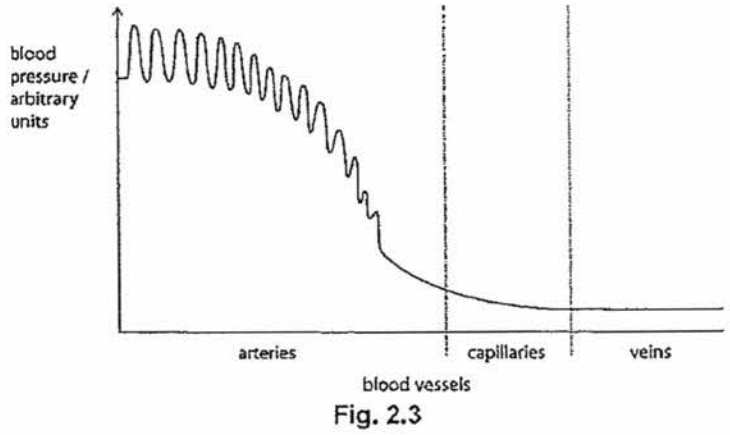


Fig. 2.3

With reference to the structure of blood vessels, describe and explain the blood pressure in arteries.

_____

_____

_____ [2]

B3 When rain water trickles through rocks, it dissolves some of the minerals present. This water, which is bottled for drinking, is called mineral water.
Table 3.1 shows the ions present in a litre of mineral water.

Table 3.1

name of ion	formula of ion	Mass of ion present in one litre of water / milligrams
calcium	Ca^{2+}	10
chloride	Cl^-	8
hydrogencarbonate	HCO_3^-	64
sodium	Na^+	8
sulfate	SO_4^{2-}	7

(a) Explain how a chloride ion is formed from its atom?

_____ [1]

(b) Which positive ion has the greatest mass of ion present in one litre of water in this sample of water?

_____ [1]

(c) When this sample of mineral water is evaporated to dryness, various compounds are formed. Two of these compounds is calcium hydrogencarbonate and calcium chloride.

(i) Give the formula of calcium hydrogencarbonate.

_____ [1]

(ii) Suggest the name of two other compounds which could be formed.

_____ [2]

(iii) Draw a dot-and-cross diagram to show the bonding in calcium chloride.
You only need to show outer shell electrons.

[2]

B4 Kathy is seated near the mirror **M** as shown in Fig. 4.1.

There are four seats (numbered **1**, **2**, **3** and **4**) in front of a plane mirror **M**. Lisa is asked to be seated at one of the four seats such that she can see the image of Kathy in the mirror **M**.

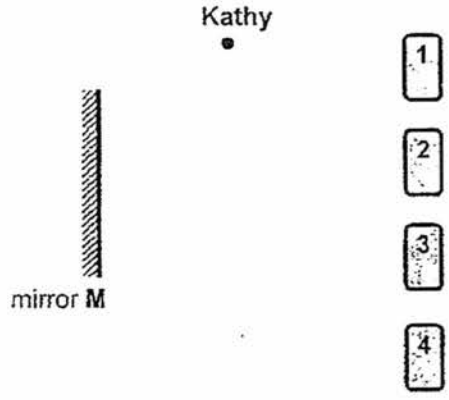


Fig. 4.1

(a) State **two** properties of the image of Kathy in the mirror.

1. _____

2. _____ [2]

(b) Locate the image of Kathy in the mirror. Label it as K'. [1]

(c) On Fig. 4.1, draw suitable rays to show the maximum field of view of the mirror **M**. [2]

(d) At which seat(s) will Lisa be able to see the image of Kathy? [1]

(e) Kathy is able to see the image of Lisa only if Lisa is seated at **two** of the seats. Predict which these two seats are.
(You are not required to draw any additional rays.)

Lisa's image can be seen if she is seated at seats _____ and _____ . [1]

B5 Jane conducts an experiment using the setup shown in Fig. 5.1. XY is a piece of conducting nichrome wire such that current flows through it when the switch is closed.

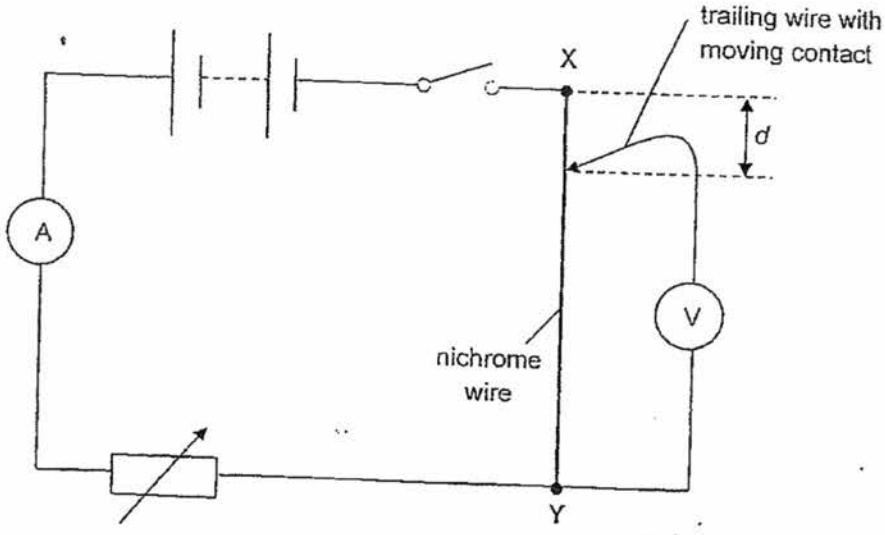


Fig. 5.1

d is the distance of the moving contact from X. The moving contact (with a voltmeter attached) is placed at different points along the wire XY to obtain different current readings, I.

The voltmeter reading V is maintained at 2.4 V throughout the experiment.

The values of $\frac{1}{I}$ are then calculated for graph plotting purpose.

Table 5.1 shows Jane's recorded data.

Table 5.1

distance d (in cm)	current (in A)	$\frac{1}{I}$ (in A^{-1})
40.0	0.3	3.33
35.0	0.27	3.7
30.0	0.24	4.17
25.0	0.22	4.55
20.0	0.2	5
15.0	0.19	5.26

Jane's teacher tells her that there are mistakes in the format of her data table.

(a) Using Table 5.2 below, show how Jane should have recorded her experimental data in the appropriate format.

Table 5.2

[2]

(b) On a piece of graph paper, plot the graph of $\frac{1}{I}$ against d. [4]

(c) Calculate the gradient of the graph.

gradient = _____ [2]

Section C

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

C6 A major use of ammonia is in the manufacture of fertilisers.
Some ammonia is first converted into nitric acid in the following steps.

1. Ammonia reacts with oxygen to form nitrogen monoxide and water
$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$
2. The nitrogen monoxide is then further oxidised to form nitrogen dioxide.
$$2NO + O_2 \rightarrow 2NO_2$$
3. The nitrogen dioxide is then dissolved into water in the presence of oxygen to form nitric acid.

(a) Draw a dot-and-cross diagram to show the bonding in a molecule of oxygen.
You only need to show outer shell electrons.

[2]

(b) Describe a test to identify ammonia gas.

_____

_____ [1]

(c) Write a balanced chemical equation for the reaction in step 3.

_____ [1]

(d) Many fertilisers are ammonium salts. They can be made by reacting nitric acid with ammonium hydroxide (aqueous ammonia) to produce the fertiliser, ammonium nitrate.

Write a balanced chemical equation for the reaction between nitric acid and ammonium hydroxide.

_____ [1]

(e) Some farmers use calcium hydroxide to improve crop growth. However, calcium hydroxide reacts with ammonium nitrate causing the soil to lose its nutrients.

(i) Explain how calcium hydroxide can help to improve crop yield.

_____

_____ [1]

(ii) Write a balanced chemical equation for the reaction between calcium hydroxide and ammonium nitrate.

_____ [1]

(f) Another type of fertilisers is known as potash fertilisers. It usually consists of potassium salts such as potassium sulfate and potassium chloride.

The potassium metal is a highly reactive metal which cannot be used to produce these salts as they can cause an explosive reaction.

(i) Suggest two suitable reactants which can be used to produce potassium sulfate.

_____ [2]

(ii) Write a balanced chemical equation for the reaction between the two reactants suggest in part (f)(i).

_____ [1]

C7 Two lamps and a fixed resistor are arranged as shown in Fig. 7.1.

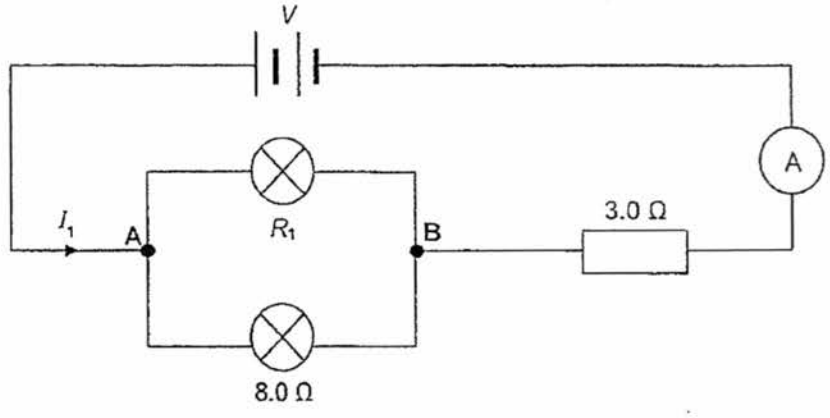


Fig. 7.1

The resistances of the lamps are R_1 and 8.0 Ω respectively. The fixed resistor has a resistance of 3.0 Ω.

(a) On Fig. 7.1, draw a circuit symbol of the instrument to show how the potential difference across the 3.0 Ω resistor can be measured. [1]

(b) The ammeter shows a reading of 0.24 A.

Calculate the potential difference across the 3.0 Ω resistor.

potential difference = _____ V [2]

(c) If the resistance R_1 of the lamp is 4.0 Ω, calculate the effective resistance of the two resistors in parallel.

resistance = _____ Ω [2]

(d) Hence or otherwise, determine the voltage of the battery.

voltage = _____ V [2]

(e) Explain how the value of the current I_1 changes if the resistance R_1 is increased.

_____

_____

_____ [2]

(f) Predict how the brightness of the lamps will change if the 3.0 Ω resistor is replaced with a 5.0 Ω resistor.

_____ [1]

C8 A ray of light is shone from the bottom of a rectangular plastic block as shown in Fig. 8.1.

A mirror is placed at the top of the plastic block.

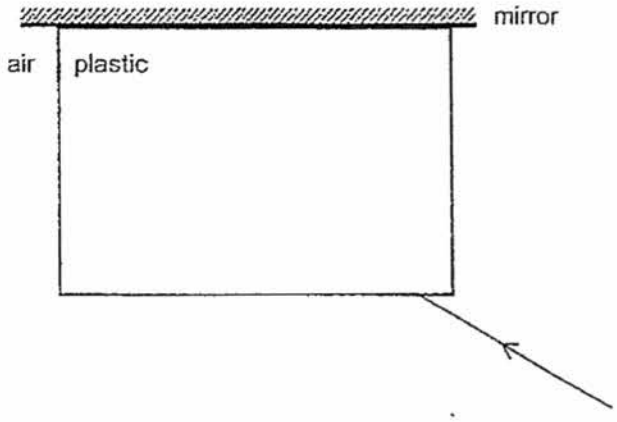


Fig. 8.1

(a) The *angle of refraction* at the air-plastic boundary (at the bottom of the block) is 30°. Explain what is meant by the term *angle of refraction.*

_____

_____ [1]

(b) Complete the ray diagram on Fig. 8.1 until the ray of light emerges. Include the normal at each of the boundaries. Measure and label the values of the relevant angles. [4]

(c) The plastic block is now submerged in a cup of water as shown in Fig. 8.2. A ray is again shone from the bottom of the block and at the same angle as in Fig. 8.1.

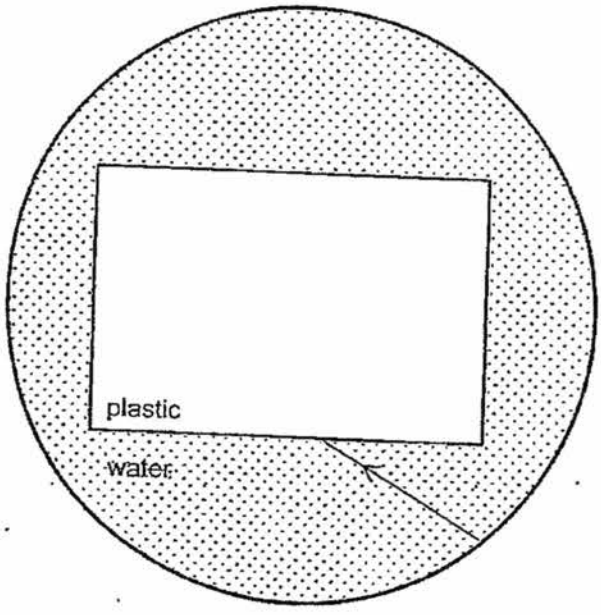


Fig. 8.2

The optical density of the plastic block is higher than that of water.

Describe how the ray will bend as it enters the plastic block from the water.
Explain your answer.

_____

_____

_____ [2]

(d) The same rectangular plastic block is machine-cut into a triangular block as shown in Fig. 8.3. A ray of light from source **L** is shone from the longest side of the block. An observer **E** is positioned as shown

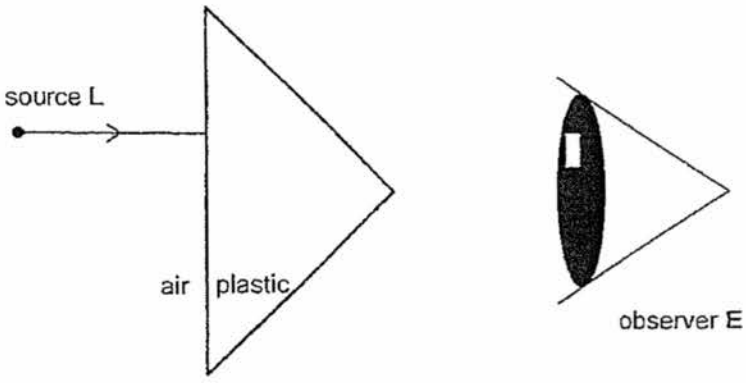


Fig. 8.3

(i) Complete the ray diagram on Fig. 8.3 to show how the ray of light reaches the observer E. [2]

(ii) On Fig. 8.3, draw the necessary line(s) or ray(s) to show how the observer E perceives where the light source is coming from. [1]

[Total marks: 10]

The Periodic Table of Elements

I	II											III	IV	V	VI	VII	0
							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: proton (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.).

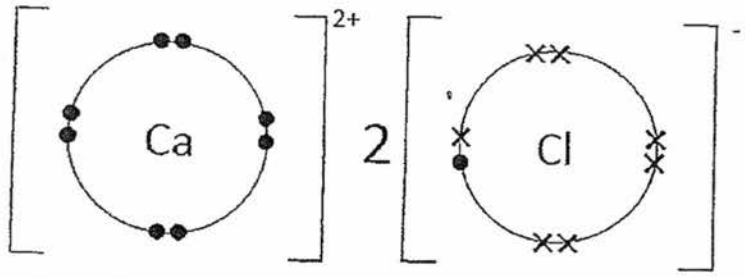
2017 Zhonghua Secondary School
2E Science EOY Answers

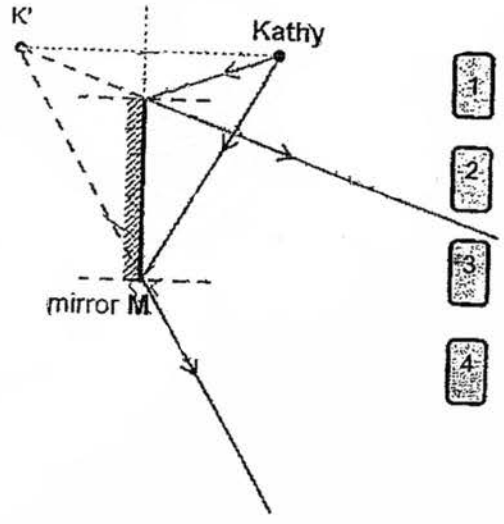
Section A

1	D	6	B	11	B	16	D	21	B	26	A
2	C	7	B	12	C	17	C	22	A	27	C
3	A	8	C	13	A	18	C	23	D	28	B
4	B	9	C	14	A	19	D	24	B	29	C
5	A	10	C	15	B	20	B	25	B	30	C

Section B

Qn	Answer	Marks
B1		
(a)	3400 °C	1
(b)	**Closely packed** in a **disorderly** arrangement. **Sliding over one another**	1 1
B2		
(a)	A – plasma B – phagocyte	1 1
(b)	Structure: Circular, biconcave shape — Explanation: To increase **surface area to volume ratio**, for **increased** rate of **diffusion/absorption** of oxygen Structure: Elastic cell membrane — Explanation: Able to **change shape** to squeeze through narrow blood capillaries Structure: Contains haemoglobin — Explanation: Able to bind with oxygen and transport oxygen around the body Structure: Absence of nucleus — Explanation: Able to store more haemoglobin and transport more oxygen around the body **0m if structure and explanation do not match**	2
(c)	The walls of the arteries are relatively **thicker and muscular** to withstand the **very high pressure (highest compared to veins and capillaries)** of blood flow.	1 1
B3		
(a)	The chlorine atom **gains** one (valance) **electron** to form a chloride ion	1
(b)	Calcium ion / Ca^{2+}	1
(c)	$Ca(HCO_3)_2$	1
(d)	calcium sulfate, sodium chloride, sodium hydrogencarbonate, sodium sulfate (any two)	2

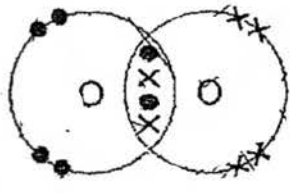
(e)	 1m for each correct structure	2

B4a	*Choose any two:* • Virtual • Upright • Laterally inverted • Object distance equals image distance. • Object size equals image size.	1m each [Total: 2m]
B4b, B4c		**B1b:** 1m (extend mirror, $d_{object} = d_{image}$, label K') **B1c:** 1m (correct virtual rays + reflected rays) 1m (correct incident rays) *[If student draws 1 correct set of virtual ray + reflected ray + incident ray, max 1 mark.]*
B4d	Seats 3 and 4	1m
B4e	Lisa's image can be seen if she is seated at seats 3 and 4.	1m

<table>
<tr><td>B5a</td><td>
<table>
<tr><th>d / cm</th><th>I / A</th><th>$\frac{1}{I}$ / A^{-1}</th></tr>
<tr><td>40.0</td><td><u>0.30</u></td><td>3.33</td></tr>
<tr><td>35.0</td><td>0.27</td><td><u>3.70</u></td></tr>
<tr><td>30.0</td><td>0.24</td><td>4.17</td></tr>
<tr><td>25.0</td><td>0.22</td><td>4.55</td></tr>
<tr><td>20.0</td><td><u>0.20</u></td><td><u>5.00</u></td></tr>
<tr><td>15.0</td><td>0.19</td><td>5.26</td></tr>
</table>
</td><td>1m (correct heading + units)

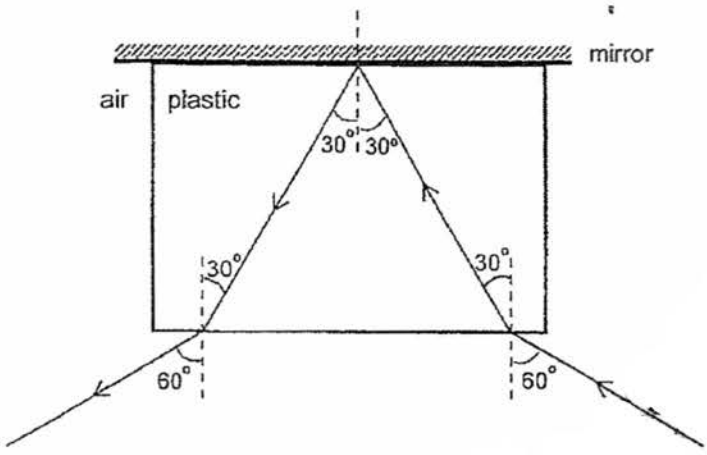
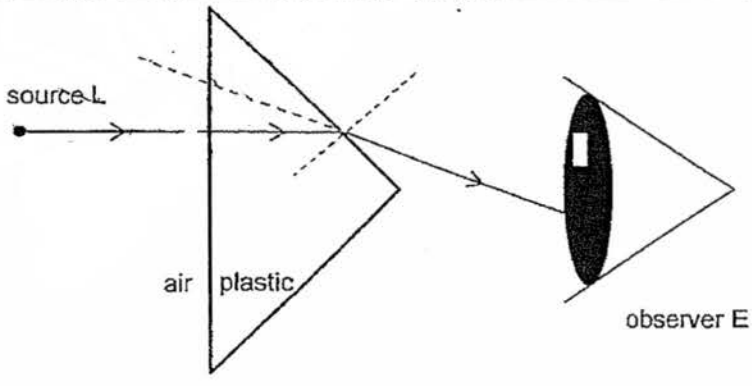
1m (2 d.p for I / A + 3 s.f. for $\frac{1}{I}$ / A^{-1})</td></tr>
<tr><td>B5b</td><td>[refer to graph on last page]</td><td>1m each for PSLB
[Total: 4m]</td></tr>
<tr><td>B5c</td><td>[refer to graph on last page]</td><td>1m (big gradient triangle + correctly labelled coordinates)

1m proper substitution + correctly calculated ans)</td></tr>
</table>

<table>
<tr><td>C6
(a)</td><td>  </td><td>2</td></tr>
<tr><td>(b)</td><td>Placed a moist red litmus paper near the gar, it will turned blue</td><td>1</td></tr>
<tr><td>(c)</td><td>$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$</td><td>1</td></tr>
<tr><td>(d)</td><td>$NH_4OH + HNO_3 \rightarrow NH_4NO_3 + H_2O$</td><td>1</td></tr>
</table>

(e)(i)	Calcium hydroxide can **neutralise the acidity** in soil / **increase the pH** of soil	1
(ii)	$2NH_4NO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2NH_3 + 2H_2O$	1
(f) (i)	Sulfuric acid and potassium hydroxide/carbonate	2
(ii)	$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ Or $H_2SO_4 + K_2CO_3 \rightarrow K_2SO_4 + CO_2 + H_2O$	1

C7a	***[Draw a voltmeter symbol across 3.0 Ω resistor.]***	1m
C7b	$V = I R$ $= 0.24 \times 3.0$ **[1]** $= 0.72$ V **[1]**	
C7c	$1/R_{AB} = 1/R_1 + 1/R_2$ $1/R_{AB} = 1/4 + 1/8$ $1/R_{AB} = 3/8$ **[1]** $R_{AB} = 8/3$ $= 2.666$ $= 2.67\ \Omega$ (correct to 3 s f.) **[1]**	
C7d	**Method #1** $R_{total} = R_{AB} + 3.0$ $= 2.666 + 3.0$ $= 5.666$ $= 5.67\ \Omega$ (correct to 3 s.f) **[1]** $V = I R_{total}$ $= 0.24 \times 5.666$ $= 1.36$ V (correct to 3 s.f.) **[1]** **Method #2** $V = V_{AB} + V_{resistor}$ $= I R_{AB} + V_{resistor}$ $= (0.24)(2.666) + 0.72$ **[1]** $= 1.35984$ $= 1.36$ V (correct to 3 s.f.) **[1]**	
C7e	The **effective/ total resistance** of the whole circuit will **increase**. Hence, the **total current** in the circuit, I , will **decrease**.	1m 1m
C7f	The brightness of the lamps will **decrease**.	1m

C8a	It is the <u>angle between the refracted ray and the normal</u> at the point of incidence.	1m
C8b		1m (1st refracted ray, bent towards normal) 1m (reflected ray at mirror, $i = r$) 1m (2nd refracted ray, bent away from normal at 60°) 1m (all 3 normal lines drawn + 3 pairs of relevant angles)
C8c	The ray will still **<u>bend towards the normal</u>**. Since plastic is optically denser than water **<u>speed of light decreases</u>** as the ray enters from water to plastic.	1m 1m
C8di C8dii		**<u>C6di:</u>** 1m (normally incident ray at 1st interface) 1m (emergent ray bent away from normal & to eye) **<u>C6di:</u>** 1m (virtual ray extended from behind emergent ray)

Suggested answer