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GENERAL CERTIFICATE OF SECONDARY EDUCATION

B761/02

FURTHER ADDITIONAL SCIENCE B

Unit B761/02: modules B5, C5, P5 (Higher Tier)

Candidates answer on the question paper. A calculator may be used for this paper. **OCR Supplied Materials:** None **Other Materials Required:** • Pencil • Ruler (cm/mm)	**Duration**: 1 hour 15 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number					

INSTRUCTIONS TO CANDIDATES

• Write your name clearly in capital letters, your centre number and candidate number in the boxes above.
• Use black ink. Pencil may be used for graphs and diagrams only.
• Read each question carefully and make sure that you know what you have to do before starting your answer.
• Answer **all** the questions.
• Write your answer to each question in the space provided; however, additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

• Your quality of written communication is assessed in questions marked with a pencil [✐].
• The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
• The total number of marks for this paper is **75**.
• This document consists of **28** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8		16	
Total			

OCR is an exempt Charity   **Turn over**

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output} (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \tfrac{1}{2}\, mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \tfrac{1}{2}\, mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$v = u + at$

$v^2 = u^2 + 2as$

$$s = ut + \tfrac{1}{2}\, at^2$$

$m_1 u_1 + m_2 u_2 = (m_1 + m_2)v$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$I_e = I_b + I_c$

$$\frac{\text{voltage across primary coil}}{\text{voltage across seconday coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

power loss = (current)^2 × resistance

$V_p I_p = V_s I_s$

Answer **all** the questions.

Section A – Module B5

1 (a) John goes to the doctor.

His doctor uses a spirometer to measure the volume of air John breathes out in a single deep breath.

The graph shows the results for John and for a person of John's size and age who does **not** have asthma.
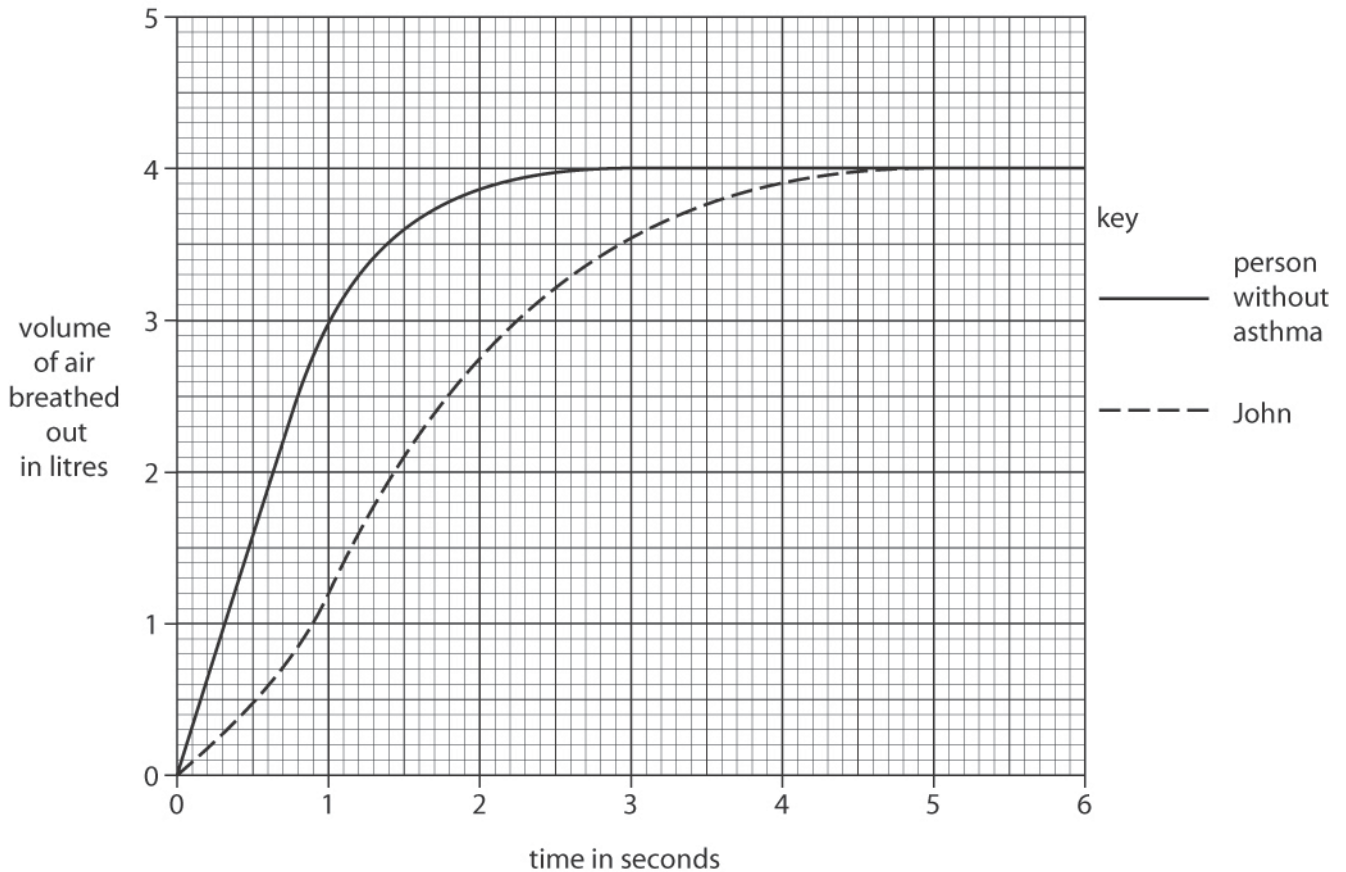
(i) John and the other person have the same vital capacity.

Look at the graph.

What is their **vital capacity**?

answer .... litres **[1]**

(ii) The doctor thinks John has asthma.

He can decide how severe John's asthma is from the graph.

He reads off the volumes of air breathed out **after one second** and does this calculation.

asthma value = $\dfrac{\text{volume of air breathed out after one second by John}}{\text{volume of air breathed out after one second by person without asthma}}$

He looks up John's level of asthma in this table.

asthma value	level of asthma
more than 0.80	none
0.80 – 0.55	mild
0.55 – 0.30	moderate
less than 0.30	severe

Use the graph to calculate John's asthma value.

....

....

....

asthma value..

Use the table to work out what level of asthma John has.

level of asthma ....**[1]**

(iii) What type of treatment could the doctor prescribe based on the results of the calculation?

.... **[1]**

(b) Describe what happens inside the lungs during an asthma attack.

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.... **[3]**

(c) John's doctor is concerned that John could be suffering from a different condition called chronic obstructive pulmonary disease (COPD).

COPD causes progressive and permanent damage to the lung tissue.

Some people with COPD have low oxygen levels in their blood.

Suggest why.

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....

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.... **[2]**

[Total: 8]

2 Astronauts sometimes spend long periods of time in space.

When astronauts return to Earth a number of changes may have happened to their bodies.

These include:

- weakening of the muscles
- increased risk of blood clots
- decreased amount of haemoglobin
- weaker bones
- lower heart rate and blood pressure.

(a) Which **one** of these changes could be treated with heparin?

.... **[1]**

(b) Scientists have used studies on astronauts to learn more about the disease osteoporosis.

How can studying astronauts help them learn more about osteoporosis?

....

.... **[1]**

(c) Returning astronauts may develop kidney problems.

Explain how one of the changes can lead to astronauts developing kidney problems.

....

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.... **[2]**

(d) Suggest why astronauts in space have a lower heart rate than they normally do on Earth.

....

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.... **[2]**

[Total: 6]

3 There are many reasons why some couples have difficulties conceiving babies.

One possible treatment for infertility is IVF.

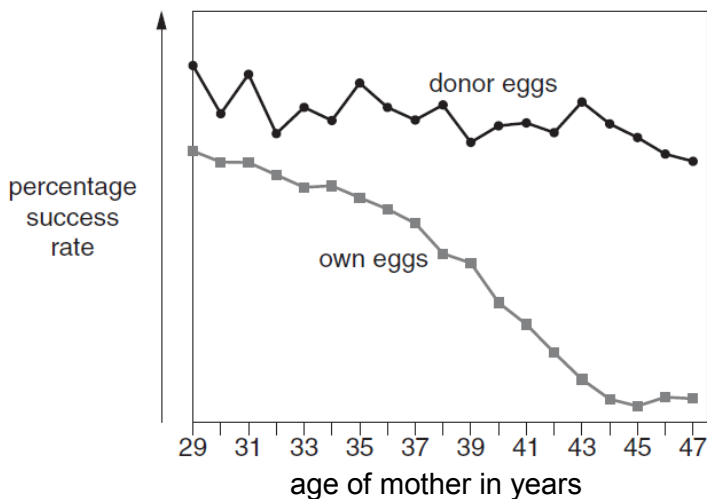(a) (i) How does fertilisation in IVF differ from normal fertilisation?

.... [1]

(ii) Before IVF with their own eggs, women are usually treated with FSH (follicle-stimulating hormone).

Explain why.

....

.... [2]

(b) The graph shows the percentage success rate of IVF for women of different ages.

It shows the success rate using their own eggs or eggs from a donor.

Discuss the issues that parents have to consider when deciding which type of eggs to use for IVF.

Use the information in the graph and your own knowledge.

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.... [2]

[Total: 5]

4   Anya is investigating the effect of bile salts on the digestion of fats by lipase.

She sets up tubes containing the same amount of fat and pH indicator.

She changes the amounts of lipase and bile salts.

She then adds distilled water to make the volume the same in each tube.

Anya times how long it takes for the indicator to change colour in each tube after all the solutions have been added.

The colour change happens when the pH goes from pH8 to pH6.

She records the **time in minutes** in a table.

		amount of lipase solution in cm^3				
		0.0	**0.4**	**0.8**	**1.2**	**1.6**
amount of bile salt solution in cm^3	**0.0**	*	*	12	4	4
	0.4	*	21	8	2	2
	0.8	*	15	5	1	1
	1.2	*	9	3	0.5	0.5
	1.6	*	7	2	0.4	0.4

* = no change after 30 minutes

Explain why the indicator changes colour and what conclusions Anya can draw about the factors affecting the digestion of fats.

✐ *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

[Total: 6]

Section B – Module C5

5 Josh is worried about the amount of salt he eats.

Josh looks at this label on his packet of cornflakes.

It gives information about the mass of sodium and of salt in 100 g of cornflakes.

	mass in grams
sodium	0.7
salt	1.8

Josh wants to know if all the sodium in his cornflakes comes from salt.

Show by calculation that all of the sodium in cornflakes comes from salt, NaCl.

The relative atomic mass of Na is 23 and of Cl is 35.5.

....

....

.... **[2]**

[Total: 2]

6 Methanol, CH_3OH, can be made from carbon dioxide.

Look at the symbol equation for the reaction used to make methanol.

$$CO_2(g) \quad + \quad 3H_2(g) \quad \rightleftharpoons \quad CH_3OH(g) + H_2O(g)$$

The reaction is exothermic.

The conditions used for this reaction are:

- a temperature of 250°C

- a pressure of 70 atmospheres

- a catalyst containing copper.

Explain, using ideas about rate of reaction and position of equilibrium, the choice of the three conditions used in this reaction.

✎ *The quality of written communication will be assessed in your answer to this question.*

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....**[6]**

[Total: 6]

7 This question is about acid-base titrations.

Issy wants to find out the concentration of a sample of dilute nitric acid.

Look at the apparatus she uses.
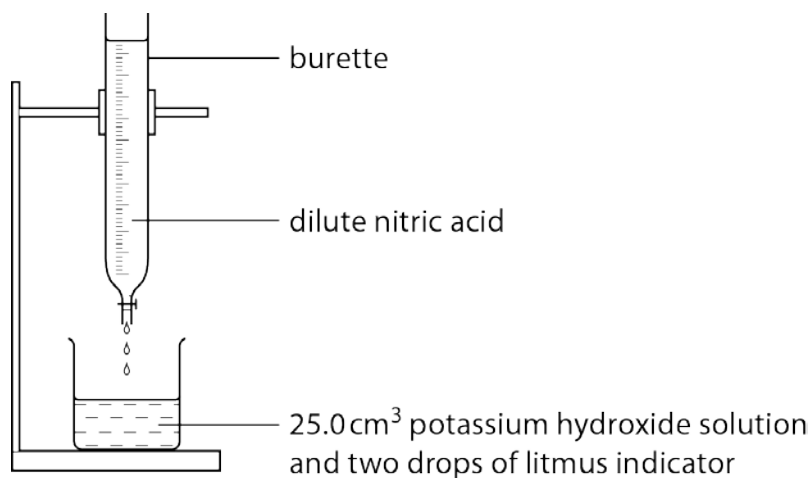
She adds dilute nitric acid slowly until the litmus suddenly changes colour.

She repeats the experiment two more times.

Look at Issy's results table.

titration number	1	2	3
final burette reading in cm^3	29.7	27.0	34.8
initial burette reading in cm^3	8.5	6.9	24.9
volume of acid used (titre) in cm^3	21.2	20.1	19.9

(a) Issy does two experiments (**1** and **2**) and looks at her results.

She decides that she needs to do a third experiment (**3**).

Explain why she needs to do **three** experiments.

....

....

.... **[2]**

(b) Litmus is a single indicator but universal is a mixed indicator.

If Issy uses universal indicator instead of litmus how, would the colour change be different?

.... **[1]**

(c) Look at the balanced symbol equation for the reaction between potassium hydroxide and nitric acid.

$$KOH + HNO_3 \rightarrow KNO_3 + H_2O$$
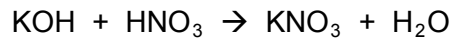
Issy uses 25.0 cm^3 of potassium hydroxide solution.

The concentration of the potassium hydroxide is 0.100 mol/dm^3.

Use the mean titre to calculate the concentration, in mol/dm^3, of the nitric acid.

Give your answer to **three** significant figures.

....

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concentration of nitric acid = ... mol/dm^3 **[4]**

[Total: 7]

8 Silicon dioxide and iron (III) hydroxide have been discovered on the planet Mars.

(a) Silicon dioxide, SiO_2, has a molar mass of 60 g/mol.

Calculate the molar mass of iron (III) hydroxide, $Fe(OH)_3$.

The relative atomic mass of H is 1, of O is 16, of Si is 28 and of Fe is 56.

....

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....

molar mass = ...g/mol **[1]**

(b) Compound **X** has been discovered on the planet Mars.

Compound **X** has the empirical formula CH.

Which formula could be the formula of compound **X**?

CH_4	C_2H_6
C_4H_4	C_4H_8
C_6H_{12}	$C_{10}H_{22}$
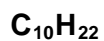
answer .... **[1]**

[Total: 2]

9 Sulfamic acid reacts with calcium carbonate as shown in the equation.

sulfamic acid + calcium carbonate → calcium sulfamate + carbon dioxide + water
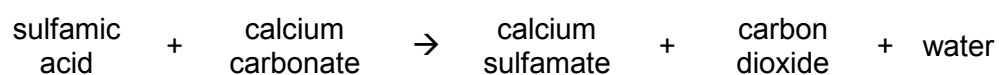
Hayley investigates the reaction between sulfamic acid and calcium carbonate.

She adds 0.20 g of calcium carbonate powder to 100 cm^3 of sulfamic acid solution.

Hayley measures the total volume of carbon dioxide formed every minute.

Look at the table of her results.

time in minutes	total volume of carbon dioxide in cm^3
0	0
1	24
2	38
3	44
4	47
5	48
6	48
7	48

(a) Draw a labelled diagram to show the apparatus Hayley uses to collect these results.

[2]

(b) What is the amount, in moles, of carbon dioxide made at the end of the experiment?

One mole of any gas occupies 24 dm^3 at room temperature and pressure.

....

....

amount =...mol **[1]**

(c) Hayley repeats the experiment with 100 cm^3 of hydrochloric acid.

She uses the same concentration of hydrochloric acid as sulfamic acid.

She finds the rate of reaction is much higher because hydrochloric acid is a strong acid and sulfamic acid is a weak acid.

Why does a strong acid react faster than a weak acid?

....

....

.... **[2]**

[Total: 5]

10 Emma wants to prepare a pure dry sample of lead iodide by a precipitation reaction.

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$
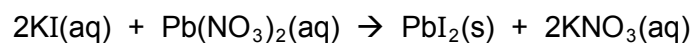
She starts with potassium iodide solution and lead nitrate solution.

Describe the steps Emma must do to get a **pure dry** sample of lead iodide.

....

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.... **[3]**

[Total: 3]

Section C – Module P5

11 This question is about satellites.

(a) Look at the diagram.
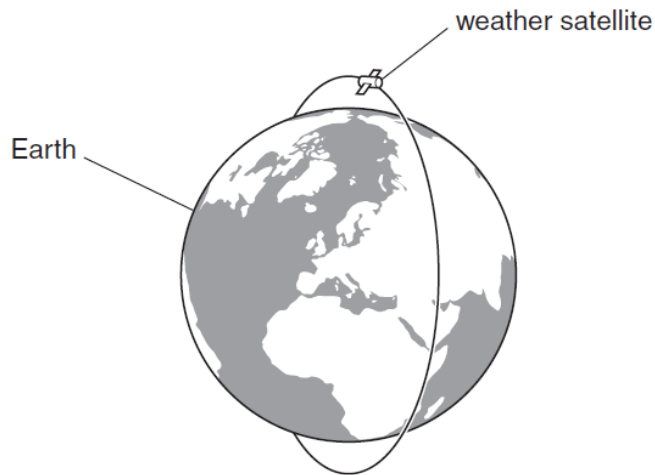
This type of satellite is used for weather forecasting.

Explain why the orbit of this satellite makes it suitable for imaging the Earth.

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....**[3]**

(b) Another type of artificial satellite is a **geostationary** satellite.

Why do geostationary satellites have higher orbits than satellites used for imaging the Earth?

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....**[1]**

(c) (i) What happens to the gravitational force when the distance between a satellite and the Earth doubles?

.... **[1]**

(ii) Explain why the speed of a comet changes as it approaches the Sun.

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....

....

.... **[2]**

[Total: 7]

12 William is a search and rescue pilot in a helicopter.

He is trying to help some walkers on a mountain by dropping them some supplies from his helicopter.

The supplies have a small parachute so they fall with a steady vertical velocity of 12 m/s.

Look at the diagram.
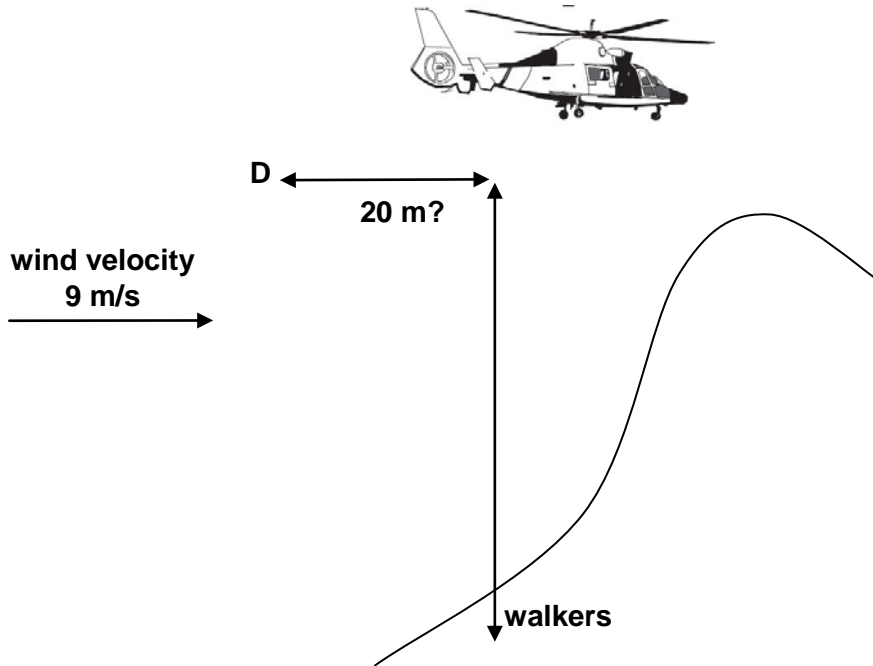
(a) What is the size of the resultant velocity of the supplies as they fall?

....

....

....**[2]**

(b) It takes 5 seconds for the supplies to fall to the walkers.

William's co-pilot realises the supplies need to be dropped before the helicopter is vertically above the walkers.

He says the supplies should be dropped from **D**, 20 m before being vertically above.

Is William's co-pilot correct?

Show any working you use to draw your conclusion.

....

....

.... **[2]**

[Total: 4]

13 James kicks a football in the air.

It travels in a curve. This is an example of a **projectile**.

Look at the diagram.
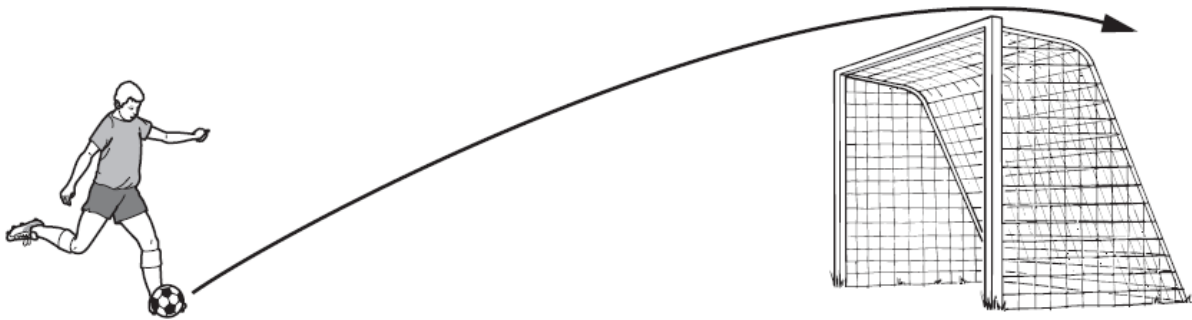
The football travels in a curved path.

Explain why the path of the football is curved.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

[Total: 6]

14 (a) Danny shines a ray of light from a ray box through a glass block.

He looks at the path of the light **leaving** the block.
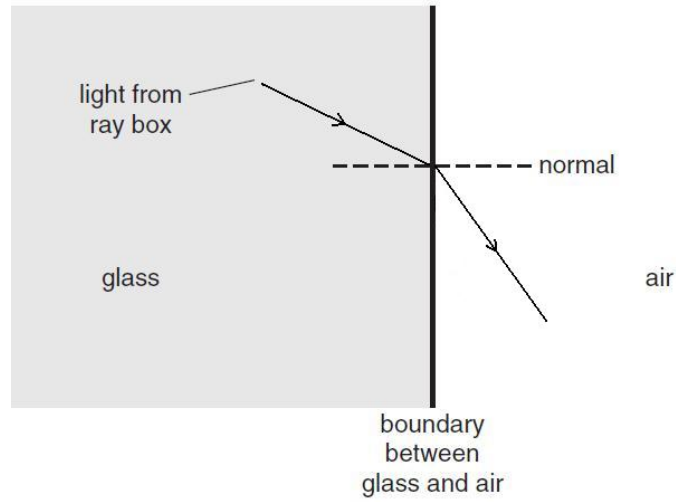
Explain what causes the ray of light to be refracted in this way at the boundary.

....

....

.... **[2]**

(b) In addition to refraction, light is dispersed when it travels from one medium to another.
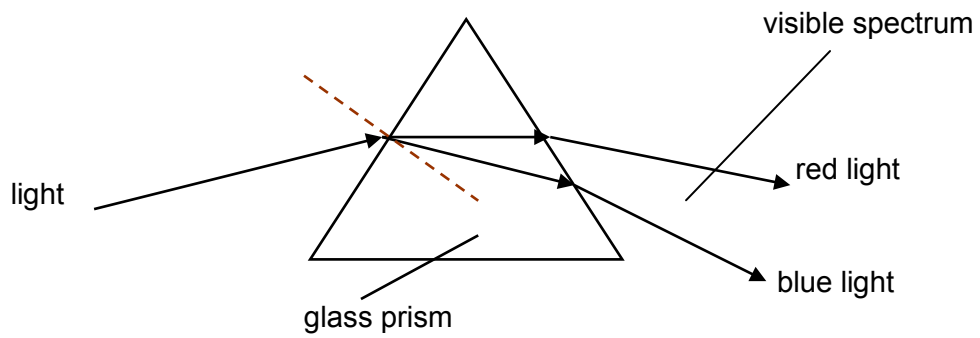
Look at the table.

colour of light	wavelength (m)	refractive index
blue	4.34×10^{-7}	1.528
red	7.00×10^{-7}	1.510

The diagram shows that different colours refract by different amounts.

Use the information in the table to explain why.

....

....

....

.... **[2]**

[Total: 4]

15 Bharat's teacher shows his class an experiment with light passing through a double slit.

When the experiment was first performed many years ago it altered scientists' views about the properties of light.

His teacher draws a diagram to explain the experiment.

Look at the diagram.

light travelling towards a double slit

barrier with double slit

screen with light and dark bands
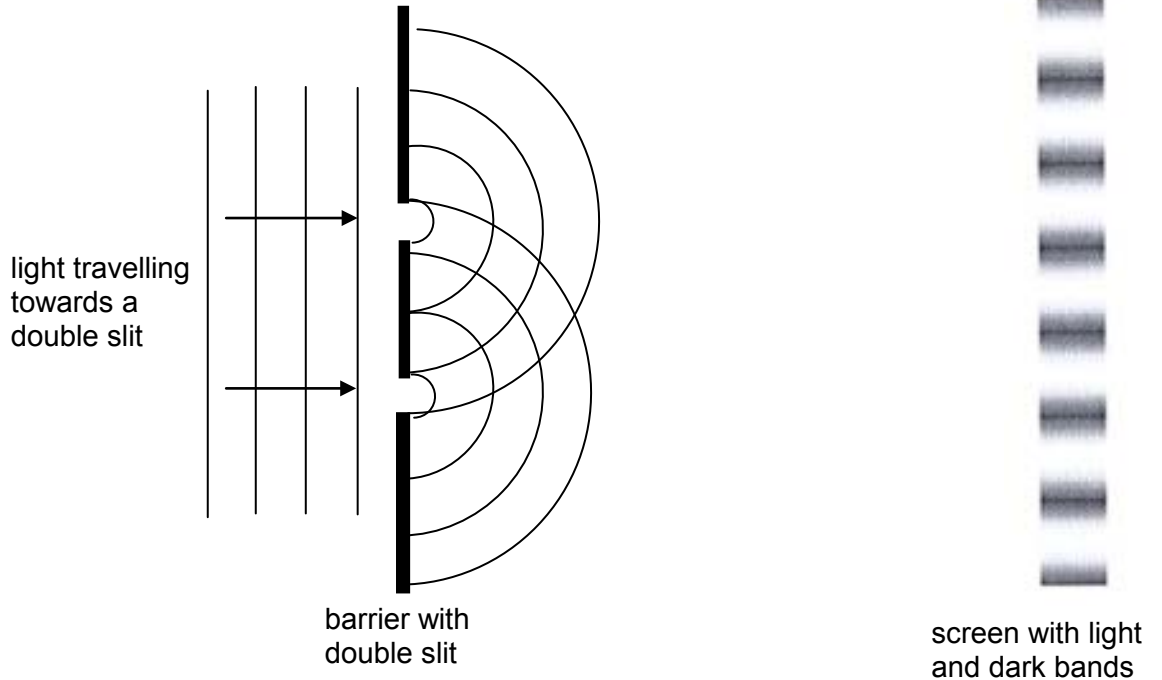
Scientists made a conclusion about the nature of light from this experiment.

What was this conclusion and what evidence in the diagram supported it?

....

....

.... **[2]**

[Total: 2]

16 This question is about waves.

Look at the sentences about waves.

Put a tick (✓) if the sentence is **true**.

Put a cross (✘) if the sentence is **false**.

sentence	**✓ or ✘**
Greatest diffraction happens when the gap size equals the wavelength of the wave.	
Radio frequencies between 30MHz and 30GHz are stopped by the Earth's atmosphere.	
Microwaves are used in satellite broadcasting because the dish aerial produces a lot of diffraction.	
Coherent waves have the same frequency with different amplitudes and are out of phase.	

[2]

[Total: 2]

[Paper Total 75]

END OF QUESTION PAPER

PERIODIC TABLE

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
						1 **H** hydrogen 1											4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **A*l*** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C*l*** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **T*l*** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111		Elements with atomic numbers 112-116 have been reported but not fully authenticated					

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

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SPECIMEN

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SPECIMEN **H**

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GENERAL CERTIFICATE OF SECONDARY EDUCATION

B761/02

FURTHER ADDITIONAL SCIENCE B

Unit B761/02: modules B5, C5, P5 (Higher Tier)

MARK SCHEME

Duration: 1 hour 15 minutes

MAXIMUM MARK   75

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, e.g. mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   e.g. mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)	(i)	4 (litres) (1)	1	
		(ii)	(1.2 / 3 =) 0.4 moderate (1)	1	both answers for 1 mark
		(iii)	prescribe an inhaler (1)	1	
	(b)		**any three from:** lining (of airways) becomes inflamed (1) fluid builds up (in airways) (1) muscles (around bronchioles) contract (1) airways constrict (1)	3	
	(c)		because the alveoli/gaseous exchange surface is damaged reducing diffusion of oxygen into the blood (1) diffusion is reduced because of a reduced surface area of the lungs (1)	2	**allow** build up of mucus increasing diffusion distance / scarring causing thickening of alveoli reducing diffusion (1)
			Total	8	

Question			Expected answers	Marks	Additional guidance
2	(a)		increased risk of blood clots (1)	1	
	(b)		astronauts have weak(er) bones so can model / mimic the effect of osteoporosis (1)	1	**ignore** references to weak muscles
	(c)		pressure is needed to filter the blood (1) astronauts have lower blood pressure so filtering may not be so effective (1)	2	**answer must link pressure needed for filtering to low blood pressure in astronaut to gain full credit** **allow** blood clotting in kidneys blocking flow (1) reduces filtration (1)
	(d)		less activity / AW (1) not working against gravity / easier to move / AW (1)	2	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	it happens outside the body (1)	1	**allow** it happens in a dish / test tube **ignore** it happens in a lab / outside the womb
		(ii)	because FSH stimulates/increases egg production (1) which will increase chances of successful harvest / fertilisation / implantation (1)	2	**answer must link increase egg production to increased chance of success to gain full credit**
	(b)		success rate is higher using donor eggs making this a better option / ORA (1) but using donor eggs baby not genetically the mother's / AW (1)	2	**allow** the difference in success rates increases with the age of the mother (1) **allow** uncertainty over the egg donor's genes / AW (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
4	✎		**Level 3** Applies understanding of lipase action to explain how it lowers pH, applies understanding of enzyme and bile action to thoroughly explain the results in terms of how varying the quantity affects rates of reaction. Complete conclusion linked to both lipase and bile. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **Level 2** Applies understanding of lipase action to identify that fatty acids are made, applies understanding of enzyme or bile action to explain some results. Limited conclusion linked to lipase or bile. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **Level 1** Applies understanding of enzyme or bile action to identify conditions for digestion of fats linking fat digestion to presence / absence of bile and lipase. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • indicator changes colour because fatty acids made during breakdown of fats • fatty acids will lower the pH of the solution to an acidic pH results show • there is no digestion in the absence of lipase • increasing amount of lipase increases the rate of digestion • increasing amount of lipase has no effect at high concentrations • digestion occurs in the absence of bile salts • increasing amount of bile salts increases the rate of digestion • effect of bile salts is less than effect of lipase conclusions • lipase required for digestion of fats • reaction rate increased by presence of bile because bile emulsifies the fats • highest reaction rate at high concentrations of lipase and bile salts • at high concentrations, lipase is not the limiting factor for the reaction
			Total	**6**	
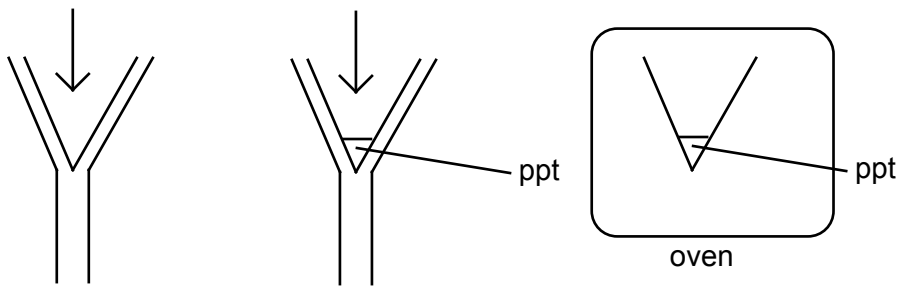
Question			Expected answers	Marks	Additional guidance
5			**use of %** % Na in NaCl is 39.3 / 39% (1) and working to show that 0.7 is 39% of 1.8 / working to show that 39.3% of 1.8 is 0.7 (1) **or** use of moles moles of sodium chloride = 1.8/58.5 (1) so mass of sodium = (1.8/58.5) x 23 = 0.7 (1) **or** ratios Na Cl NaCl 23 35.5 58.5 1 35.5/23 58.5/23 (1) 0.7 (35.5/23) x 0.7 = 1.1 (58.5/23) x 0.7 = 1.8 (1)	2	there are three main ways in which candidates may express their answer use of % of sodium use of moles of sodium use of ratios
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
6	✎		**Level 3** Applies understanding of equilibria to give a detailed explanation of all the conditions chosen in terms of the rate and position of equilibrium. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **Level 2** Applies understanding of equilibria to show that the conditions chosen give both a high rate of reaction and force position of equilibrium to the right with one condition explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **Level 1** Idea that the presence of the catalyst, temperature chosen and/or pressure chosen will increase the rate of reaction. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • high temperature forces position of equilibrium to the left since the reaction is exothermic • so a relatively low temperature is used but it is high enough to increase rate of reaction • high pressure to make position of equilibrium move to the right because there are fewer gas molecules on the right • high pressure will also increase rate of reaction • if too high a pressure it will increase safety risks to workers and the plant costs will be too high • catalyst does not change the position of equilibrium (1) • catalyst increases the rate of reaction
Total				**6**	

Question			Expected answers	Marks	Additional guidance
7	(a)		results **1** and **2** are inconsistent / 1.1 cm^3 apart so she needed to do a third experiment (1) however, results **2** and **3** are consistent / within 0.2 cm^3 so she doesn't need to do any more (1)	2	**evidence from table must be linked to the need for repeats to gain credit for each marking point** **allow** cannot tell which titration was wrong so needed to do a third experiment (1) **not** to get a better mean titre marking points in either order can gain credit
	(b)		(with universal indicator) there is a continuous colour change / no sudden change / no sharp end-point / AW (1)	1	**allow** (universal indicator) has many colours
	(c)		mean titre is 20 (cm^3) or 0.020 dm^3 (1) moles of KOH = 0.0025 (1) moles of HNO$_3$ = 0.0025 (1) concentration = 0.125 (mol/dm^3) (1)	4	mean titre must be from readings **2** and **3** **allow** answers in standard form, i.e. 2.5 x 10^{-3} **allow** ecf from moles of KOH, i.e. moles of KOH = moles of HNO$_3$ **allow** ecf from moles of HNO$_3$ and from mean titre answer must be to three significant figures
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
8	(a)		107 (1)	1	
	(b)		C$_4$H$_4$ (1)	1	**both** needed
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
9	(a)		correct apparatus to collect gas, e.g. gas syringe / measuring cylinder / upturned burette (1) will it work – is it gas tight? / is there water to be displaced? (1)	2	**allow** all marks from a diagram **allow** apparatus if not labelled providing it has clear graduations or is obviously a gas syringe **allow** 'solid' bungs / 'solid' ends of tubes if gas is not collected, e.g. lime-water test is shown award no marks
	(b)		0.002 (1)	1	
	(c)		strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions this results in more collisions with hydrogen ions per second (2) **OR** strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions / there are more collisions in strong acid (1)	2	**more collisions must be linked to more/greater concentration of hydrogen ions to gain 2 marks** **allow** strong acid has more crowded hydrogen ions
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
10			add two solutions and filter (1)	3	**ignore** sieving filtering stage must be before the washing and drying stage
			wash the residue with water (1)		washing stage must be before the drying stage
			dry the residue in an oven / leave in air to evaporate (1)		drying stage must be the last stage **allow** let it dry in air **ignore** dry it / let it dry **ignore** heat it **not** use of a Bunsen burner to dry the residue **allow** marks from a diagram reaction mixture　　　　water
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
11	**(a)**		because a polar orbit covers the whole of the Earth's surface over time (1) low orbit gives shorter orbital period (1) therefore idea that it can monitor changing weather patterns / can give early warning of potential dangerous weather situations (1)	3	**third marking point must be linked to either of the first two to gain credit** **allow** idea that low orbit allows higher resolution images (1)
	(b)		(geostationary satellites) need a longer orbital period (than imaging satellites) (1)	1	**ignore** just need 24 hours **but allow** comparison, e.g. geostationary needs 24 hours but imaging needs 1 hour / much less time to orbit (1)
	(c)	**(i)**	idea that force falls by a factor of 4 (1)	1	**allow** it is inversely proportional so falls by factor of 4 (1)
		(ii)	because the force increases as the comet approaches the Sun (1) this will cause the comet to accelerate/speed to increase (1)	2	**allow** answers in either order but must link increased force to increased speed to gain full credit
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
12	**(a)**		15 (m/s) (2) BUT evidence of use of Pythagoras / scale drawing (1)	2	
	(b)		no (no mark) drop should be 45 m away (1) because the wind has a larger effect / 9x5 (1)	2	
			Total	**4**	

| Question			Expected answers	Marks	Additional guidance
13	✐		**Level 3** Answer thoroughly explains the path of the ball taking account of all forces, both horizontal and vertical effects and applies understanding of vector addition to explain the resultant velocity. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **Level 2** Answer partially explains the path using some appreciation of the force of gravity acting to change the velocity. The explanation should include application of vector addition in terms of the resulting path as a combination of horizontal and vertical velocities. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **Level 1** An incomplete explanation that may only mention one of the velocities in relation to gravity. Some appreciation that the direction of the velocities is important. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • horizontal velocity constant • vertical velocity increasing (in the downward direction) due to gravitational force • gravity is the only force (neglecting air resistance) once 'kicking' force no longer acting on the ball • no horizontal acceleration • constant vertical acceleration then • idea of vector addition for resultant velocity • resultant is the ever increasing downward velocity • mention of the fact that if air resistance were not ignored, horizontal velocity would decrease **allow** diagrams when answering the vector sum part of the answer **allow** correct reference to the equations of motion
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
14	(a)		speed is greater in air compared to glass causing the bending away from the normal (2) **OR** speed changes / wavelength changes / AW (1)	2	**answer must identify where speed is greater to gain full credit**
	(b)		refractive index shows that blue light is travelling faster than red light in the glass (1) idea that amount/angle of refraction is higher for faster light / amount/angle of refraction is higher for higher refractive index / ora (1)	2	marking points may be in either order candidate must link refractive index to speed of light and significance of speed difference to gain full credit
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
15			(scientists concluded) that light travels as waves (1) waves produce (an interference) pattern (1)	2	**allow** higher level answers in terms of constructive and destructive interference
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
16			✓ ✗ ✗ ✗	2	4 correct = (2) 2/3 correct = (1) 1 correct = (0)
			Total	**2**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)(i)		1		1
1(a)(ii)		1		1
1(a)(iii)	1			1
1(b)	3			3
1(c)		2		2
2(a)	1			1
2(b)		1		1
2(c)	1	1		2
2(d)		2		2
3(a)(i)	1			1
3(a)(ii)	2			2
3(b)	1	1		2
4 ✎		4	2	6
5		2		2
6 ✎	2	4		6
7(a)			2	2
7(b)	1			1
7(c)	1	3		4
8(a)		1		1
8(b)		1		1
9(a)	2			2
9(b)		1		1
9(c)	2			2
10	3			3
11(a)	1	2		3
11(b)		1		1
11(c)(i)		1		1
11(c)(ii)		2		2
12(a)		2		2
12(b)			2	2
13 ✎	5	1		6
14(a)	1	1		2
14(b)	1	1		2
15	1	1		2
16	2			2
Totals	**32**	**37**	**6**	**75**