OCR

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Monday 16 June 2014 – Morning

GCSE GATEWAY SCIENCE
FURTHER ADDITIONAL SCIENCE B

B761/02 Further Additional Science 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

* B 7 6 1 0 2 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- The number of marks 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 **24** pages. Any blank pages are indicated.

EQUATIONS

$$\text{energy} = \text{mass} \times \begin{matrix}\text{specific}\\ \text{heat}\\ \text{capacity}\end{matrix} \times \begin{matrix}\text{temperature}\\ \text{change}\end{matrix}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

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

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{energy supplied} = \text{power} \times \text{time}$$

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

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

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

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

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

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

$$\text{power} = \text{force} \times \text{speed}$$

$$KE = \frac{1}{2}mv^2$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

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

$$GPE = mgh$$

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

$$v = u + at$$

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

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

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

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

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

$$I_e = I_b + I_c$$

$$\frac{\begin{matrix}\text{voltage across}\\ \text{primary coil}\end{matrix}}{\begin{matrix}\text{voltage across}\\ \text{secondary coil}\end{matrix}} = \frac{\begin{matrix}\text{number of}\\ \text{primary turns}\end{matrix}}{\begin{matrix}\text{number of}\\ \text{secondary turns}\end{matrix}}$$

$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

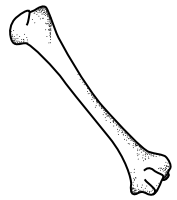
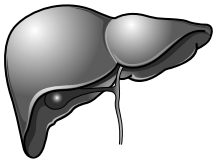
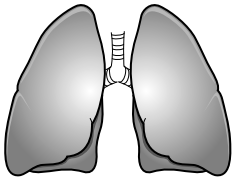
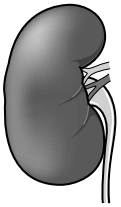
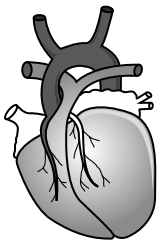
$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module B5

1 The body contains different organs.

Five of these are shown in the pictures.

				
a bone	liver	lungs	kidney	heart

(a) Answer these questions by choosing from the five organs.

(i) Which organ can be damaged by osteoporosis?

..... **[1]**

(ii) Which organ contains the AVN (atrioventricular node)?

..... **[1]**

(b) The table shows the urea concentration in the blood entering and leaving three of the organs in the pictures.

	Blood urea concentration in mg/100 ml of blood	
Organ	**Blood entering**	**Blood leaving**
liver	16	29
lungs	29	29
kidneys	29	16

Which organ makes urea and what happens to urea in the other two organs?

You must use the data in your answer.

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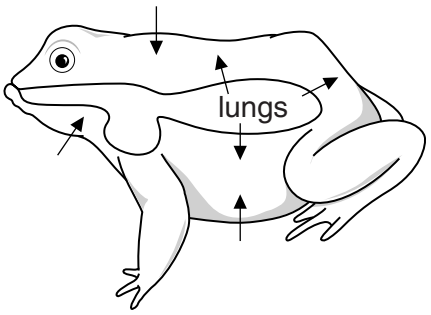
..... **[3]**

[Total: 5]

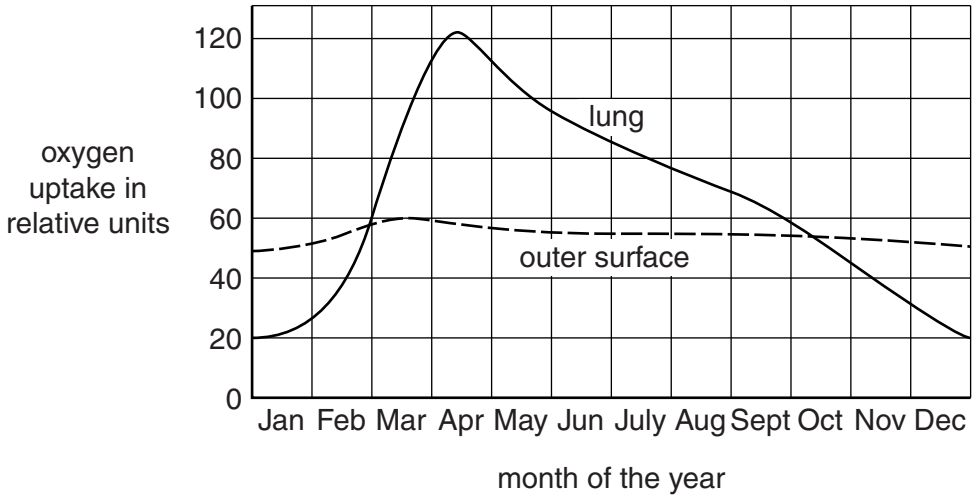
2 This question is about gaseous exchange.

A frog can take in oxygen through its skin and lungs.



(a) Look at the graph.

It shows the amount of oxygen taken up by a frog at different times of the year.



Describe **two** patterns shown in the graph.

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..... **[2]**

(b) Frogs can only live in certain habitats.

Their skin is adapted to take in oxygen from its surroundings.

Explain why this restricts where they can live.

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..... **[2]**

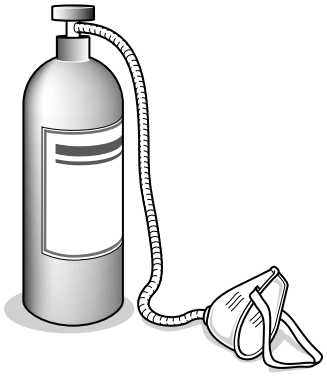
(c) Gaseous exchange in humans only happens in the lungs.

This is speeded up by breathing.

If the trachea is blocked, a person may stop breathing.

To treat this, doctors would first remove the blockage.

The patient may then breathe from a gas cylinder to get their breathing back to normal.



The gas used contains oxygen and 5% carbon dioxide.

This is a higher percentage of carbon dioxide than in air.

Suggest why this high percentage of carbon dioxide is used to help get their breathing back to normal.

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..... **[2]**

[Total: 6]

3 This question is about digestion.

(a) Food molecules need to be digested.

Explain why.

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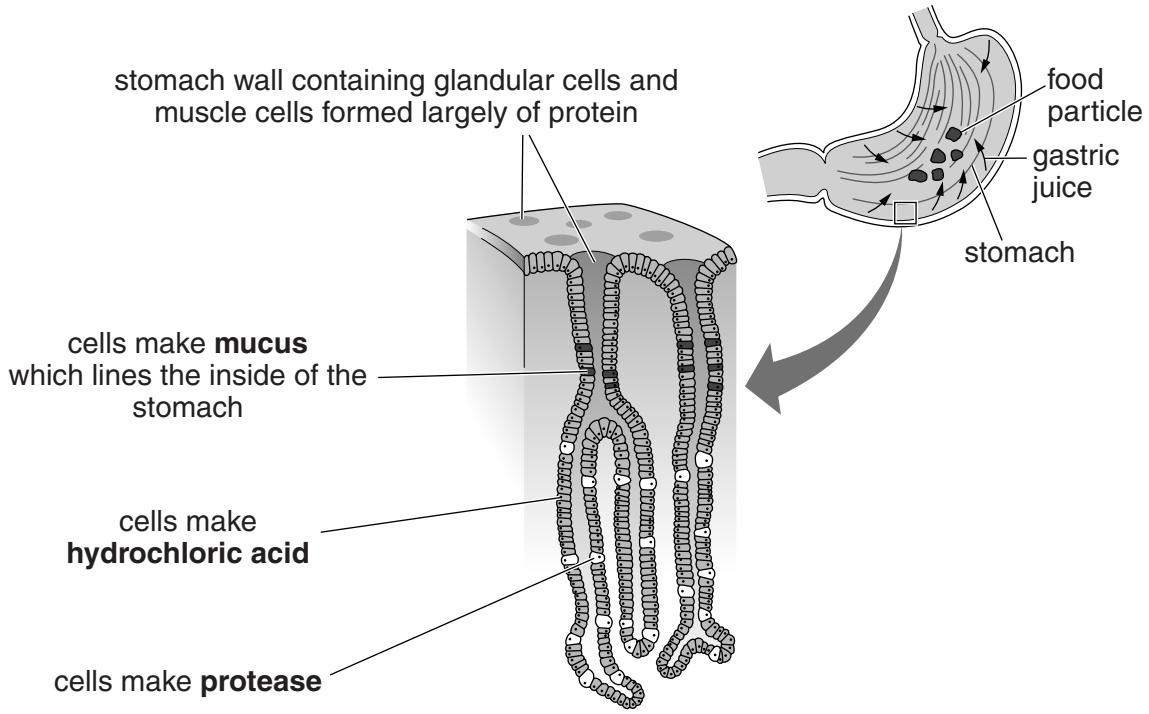
..... **[2]**

(b) The lining of the stomach makes a liquid called gastric juice.

This contains protease, hydrochloric acid and mucus.



7

Write about the function of protease and hydrochloric acid in digestion, and suggest what might happen if too little mucus is made.

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

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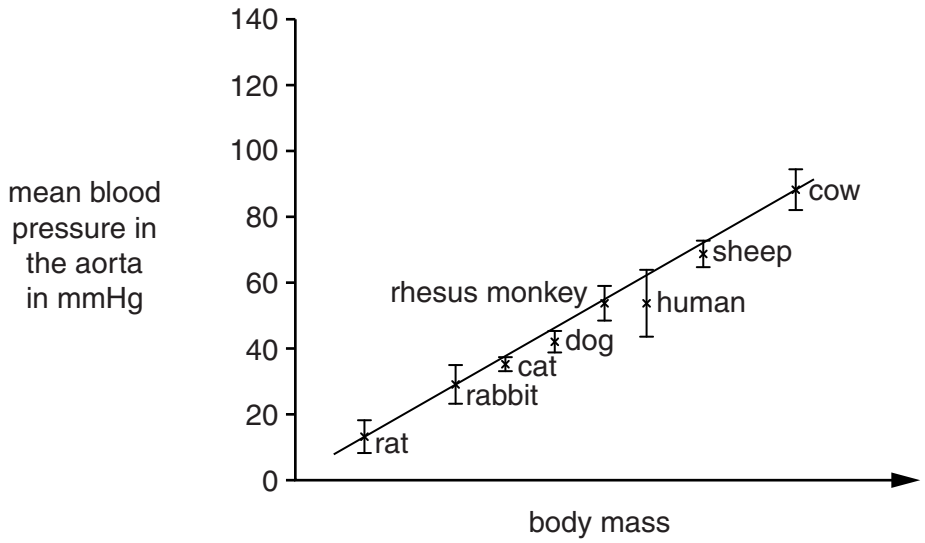
..... **[6]**

[Total: 8]

4 The graph shows the mean (average) blood pressure in the aorta (main artery) of different sized newborn mammals.



(a) (i) Suggest a reason for the pattern shown in the graph.

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..... **[1]**

(ii) Newborn humans have a mean pressure of 55 mmHg in the aorta.

What else can be concluded from the graph about the blood pressure of newborn humans?

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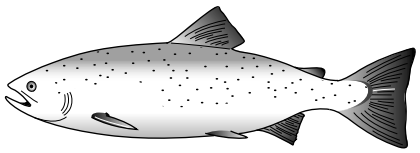
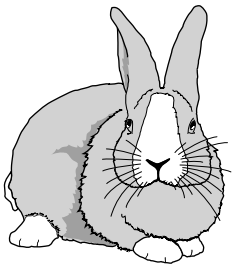
..... **[1]**

(b) Scientists compare the blood pressure of a fish with a mammal.

They measure the blood pressure leaving and entering the heart in a trout and in a rabbit.

Here are their results.





Trout	
Mean blood pressure leaving heart (aorta)	= 40 mmHg
Mean blood pressure entering heart (vena cava)	= 2 mmHg

Rabbit	
Mean blood pressure leaving heart (aorta)	= 36 mmHg
Mean blood pressure entering heart (vena cava)	= 6 mmHg

(i) The blood pressure in the rabbit drops by 83.3% between the aorta and the vena cava.

The percentage drop in blood pressure in the trout is greater.

Calculate the percentage drop in blood pressure in the trout.

..... % **[2]**

(ii) The trout and the rabbit are the same mass.

Explain why the pressure drop is greater in the trout (fish) than in the rabbit (mammal).

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..... **[2]**

[Total: 6]

SECTION B – Module C5

5 Sodium carbonate, Na_2CO_3, reacts with hydrochloric acid, HC*l*.

Look at the balanced symbol equation for this reaction.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$$

(a) Sarah neutralises 0.2 moles of hydrochloric acid with sodium carbonate.

(i) How many moles of carbon dioxide are made?

..... **[1]**

(ii) Calculate the volume of carbon dioxide made at room temperature and pressure.

One mole of carbon dioxide has a volume of 24 dm^3 at room temperature and pressure.

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volume of carbon dioxide ..... dm^3 **[1]**

(b) David dissolves 53 g of sodium carbonate, Na_2CO_3, in water to make 2000 cm^3 of solution.

Show that the concentration of sodium carbonate solution is 0.25 mol/dm^3.

The relative atomic mass, A_r, of Na = 23, of C = 12 and of O = 16.

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..... **[2]**

(c) Calcium carbonate also reacts with dilute hydrochloric acid.

What is the formula for calcium carbonate?

..... **[1]**

[Total: 5]

6 This question is about acids.

(a) Sulfuric acid, H_2SO_4, ionises in water.

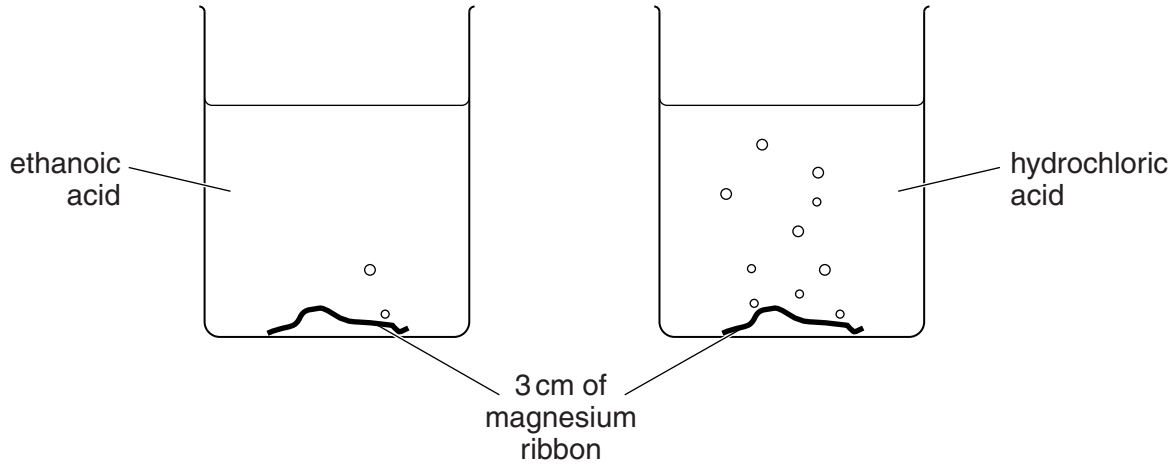
Write down the formula of one ion made when sulfuric acid ionises in water.

..... **[1]**

(b) Julie puts a 3 cm length of magnesium into dilute ethanoic acid.

She puts another 3 cm length of magnesium into dilute hydrochloric acid.

She uses the same volume and concentration of both acids.



(i) Both acids make the same volume of hydrogen gas.

Explain why.

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..... **[1]**

(ii) Ethanoic acid reacts much more slowly than hydrochloric acid.

Explain why using the reacting particle model.

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..... **[3]**

[Total: 5]

7 Sulfuric acid is made by the Contact Process.

One of the reactions used in the Contact Process is reversible.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

A catalyst, vanadium(V) oxide, is used in this reaction.

(a) Write down **two other** conditions used for this reversible reaction in the Contact Process.

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..... **[2]**

(b) What effect does using a catalyst have on the **rate of reaction** and on the **position of equilibrium** in this reversible reaction?

rate of reaction .....

.....

position of equilibrium .....

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[2]

[Total: 4]

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Question 8 begins on page 14

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8 Phil is a research chemist.

He lives near to a river. He thinks the river water is polluted.

Phil uses **precipitation** reactions to test the river water.

He adds barium chloride solution to a test tube containing some of the river water.

He adds lead nitrate solution to another sample of river water.

Look at his results.

Test	Result with river water
barium chloride solution	white precipitate
lead nitrate solution	cream precipitate

Barium chloride solution contains $Ba^{2+}(aq)$ and lead nitrate solution contains $Pb^{2+}(aq)$.

(a) Phil thinks that these precipitation reactions show that both iodide ions, $I^{-}(aq)$, and sulfate ions, $SO_4^{2-}(aq)$, are in the river water.

Explain whether Phil's results support his conclusion and write a **balanced ionic** equation, with **state symbols**, for one of the reactions that takes place.

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

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..... **[6]**

(b) A precipitate is formed immediately when barium chloride solution is added to the river water.

This is because precipitation reactions are extremely fast.

Explain why precipitation reactions are extremely fast.

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..... **[2]**

[Total: 8]

9 Nick is eating a potato snack.

He looks at the label on the packet.

The label shows Guideline Daily Amounts, GDA, and some other nutritional information.

	Amount in 100 g of snack	**Adult GDA value**	**Percentage of GDA in 100 g of snack (%)**
energy	1910 kJ	8300 kJ	23
protein	4.5 g	45 g	10
carbohydrate	61.8 g	230 g	27
fat	14.0 g	70 g	20
fibre	3.2 g	24 g	13
sodium	1.27 g	2.4 g	53

(a) Nick eats 400 g of the potato snack in one day.

Which of the following will be over the GDA?

Choose from

energy

protein

carbohydrate

fat

fibre

sodium

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

(b) All the sodium in the potato snack comes from salt.

Salt is sodium chloride, NaC*l*.

What is the mass of salt in 100 g of the potato snack?

The relative atomic mass, A_r, of Na = 23 and of C*l* = 35.5.

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mass of salt = ... g **[2]**

[Total: 3]

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Question 10 begins on page 18

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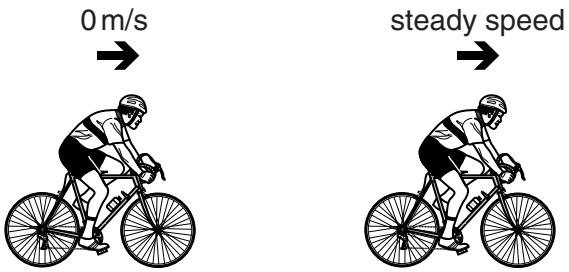
SECTION C – Module P5

10 Bradley trains on his bike. His sports coach takes measurements of his performance.

(a) Bradley starts from rest and accelerates at 0.25 m/s^2 for 52 s to reach a steady speed.



Calculate this steady speed.

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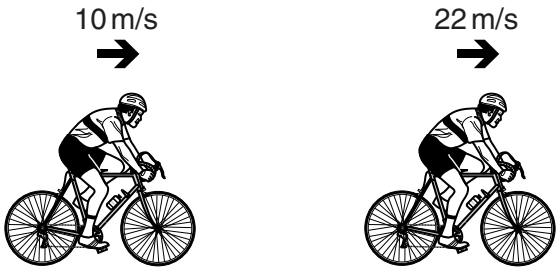
answer ..... m/s **[2]**

(b) Bradley reaches the top of a hill. His speed at the top of the hill is 10 m/s.

He accelerates steadily down the hill for 320 m and increases his speed to 22 m/s.



Calculate the time it takes to travel the 320 m.

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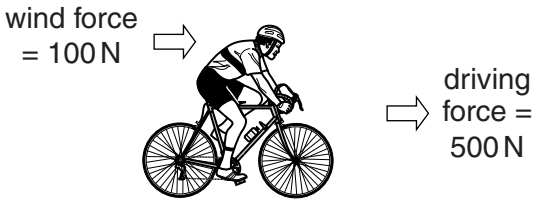
answer ..... s **[2]**

(c) In time trials, cyclists try to cover a route as fast as possible.

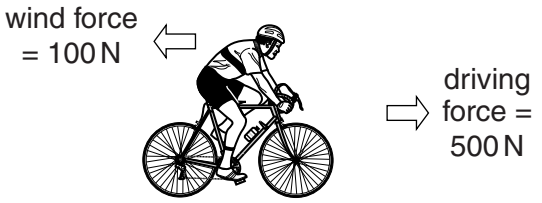
The speed at which they cycle can depend on the wind speed and the force the wind produces.

Look at the diagrams.

Trial A



Trial B



Calculate the vector sum of forces for each trial and explain why the cyclists take different times to complete each trial.

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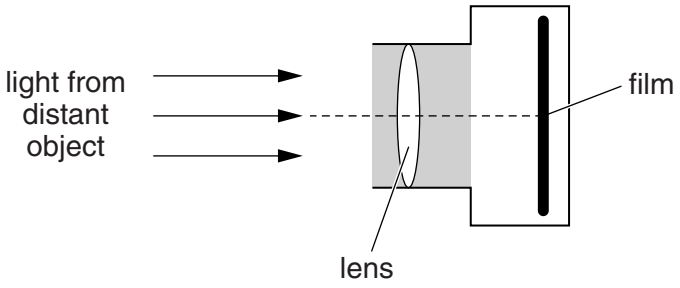
..... **[4]**

[Total: 8]

11 Ellie's camera uses a convex lens to focus an image onto a film.

Look at the diagram of her simple camera with a single lens.



(a) Complete the diagram to show how an image is produced on the film. **[1]**

(b) Ellie's camera produces an image on the film.

What **type** of image does the camera produce on the film?

..... **[1]**

(c) Ellie points the camera at a **nearby** insect.

The image of the insect is not in focus.

Describe what must happen to the lens in the camera to focus the image of the insect.

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..... **[1]**

(d) Ellie takes a picture of the insect.

The insect is 5 mm long.

The image produced on the film is 12.5 mm long.

Calculate the image **magnification**.

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.....

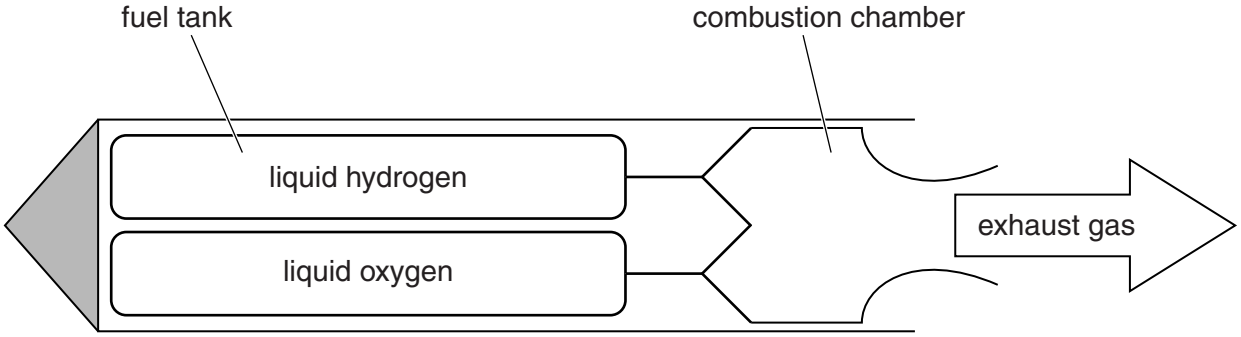
magnification = ... **[2]**

[Total: 5]

12 Rockets are used for space travel.

They use hydrogen fuel which reacts with oxygen in a combustion chamber.

Look at the simple diagram of a rocket.



The hydrogen particles react violently with the oxygen particles in the combustion chamber.

This produces the exhaust gas particles.

Explain how the particles make the rocket accelerate forwards.

Use ideas about momentum and force in your answer.

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

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..... **[6]**

[Total: 6]

13 This question is about refractive index and using gemstones to make jewellery.

Look at the table about the refractive index for different materials.

Sample	Substance	State	Refractive Index
A	vacuum	space	1.00
B	ice	solid	1.31
C	fluorite	solid	1.43
D	quartz	solid	1.54
E	tourmaline	solid	1.62
F	cubic zirconia	solid	2.18
G	diamond	solid	2.42

(a) In a vacuum, light travels at 3.00×10^8 m/s. Calculate the speed of light in ice.

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answer ..... m/s **[2]**

(b) When making jewellery the refractive index of a gemstone is important.

Inside a gemstone the light hitting a surface can be:
- totally internally reflected
- refracted to the outside.

Substances **F** and **G** are used to make gemstones.

The light entering the gemstones tends to be 'trapped' inside the stone for many reflections before being refracted to the outside. This makes the gemstone sparkle.

The refractive index of **F** and the refractive index of **G** are both suitable for making jewellery.

Use the data to suggest why.

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..... **[2]**

(c) When white light leaves a gemstone it disperses into many colours.

The amount of dispersion depends on the material used.

Look at the information in the table for two different materials used to make gemstones.

Colour of light	Refractive index for the gemstone	
	Diamond	Quartz
Red	2.40735	1.524312
Yellow	2.41734	1.527982
Green	2.42694	1.531372
Violet	2.46476	1.544684

The 'dispersion coefficient' is a measure of how much light disperses in a gemstone and therefore how much it sparkles with different colours.

Look at the equation for dispersion coefficient.

Dispersion coefficient = refractive index in violet light – refractive index in red light

A jeweller thinks that diamonds disperse light by nearly three times that of quartz.

Use the information in the table to show the jeweller is correct.

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..... **[2]**

[Total: 6]

END OF QUESTION PAPER

The Periodic Table of the Elements

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 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** 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 **Tl** 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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.