OCR
Oxford Cambridge and RSA

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Monday 20 June 2016 – 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 *

* 4 4 0 0 2 3 9 5 1 5 *

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 **32** pages. Any blank pages are indicated.

EQUATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$GPE = mgh$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

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

$$V_pI_p = V_sI_s$$

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Question 1 begins on page 4

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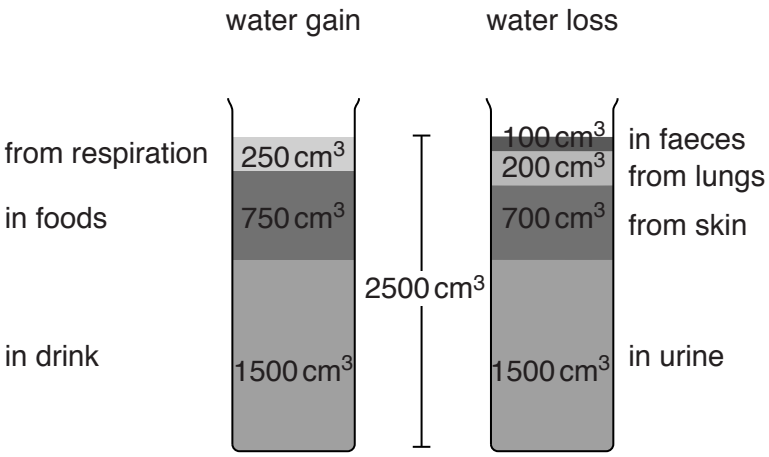
Answer **all** the questions.

SECTION A – Module B5

1 This question is about water loss from the body.

Look at the diagram.

It shows the amount of water the body gains and loses in one day.



(a) (i) Calculate the **percentage** of water loss that is excreted by the kidneys.

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

(ii) The percentage loss of water calculated in part **(i)** is an average daily amount.

This value will change if the person drinks more water.

Describe what will happen to this value and explain how ADH causes this change.

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

(b) Sometimes kidneys can stop working and need replacing with a donated organ.

Describe ethical arguments **for** and **against** organ donations.

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

[Total: 7]

2 This question is about blood.

Look at the bar charts.

Chart **A** shows how many days supply of blood there was in the UK blood banks on 29th July 2013. This is an estimate of how long the actual volume of blood will last if no more blood of that type was collected.

Chart **B** shows the actual volume of blood held in the UK blood banks on the 29th July 2013.

Chart A

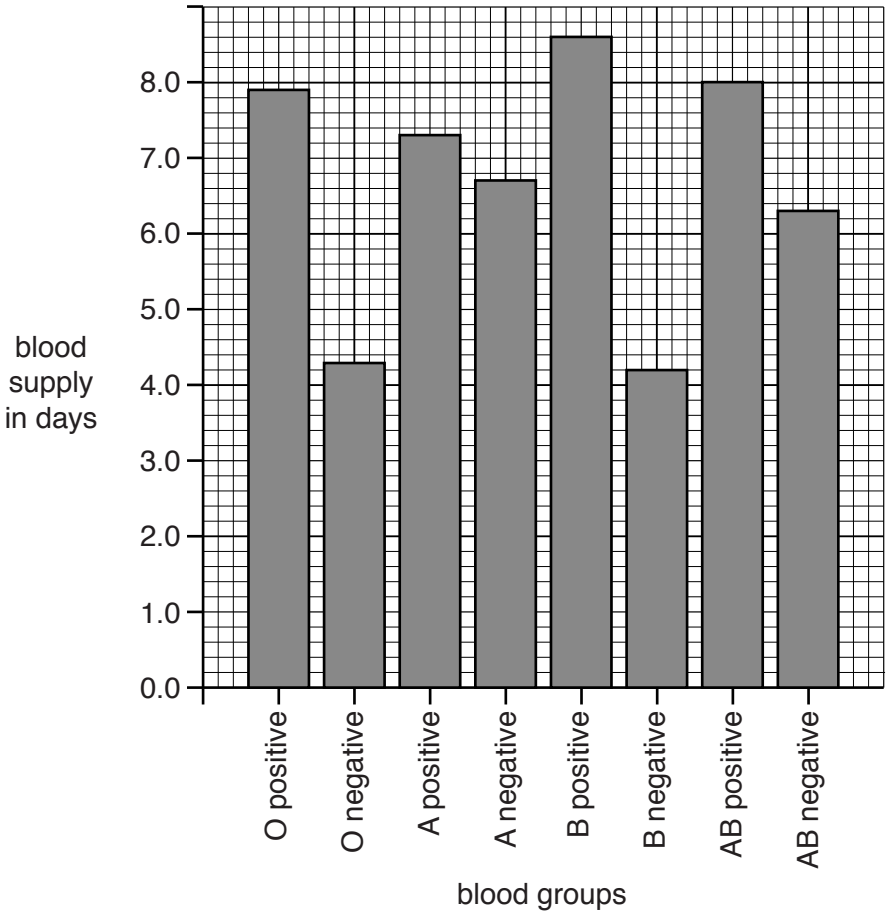
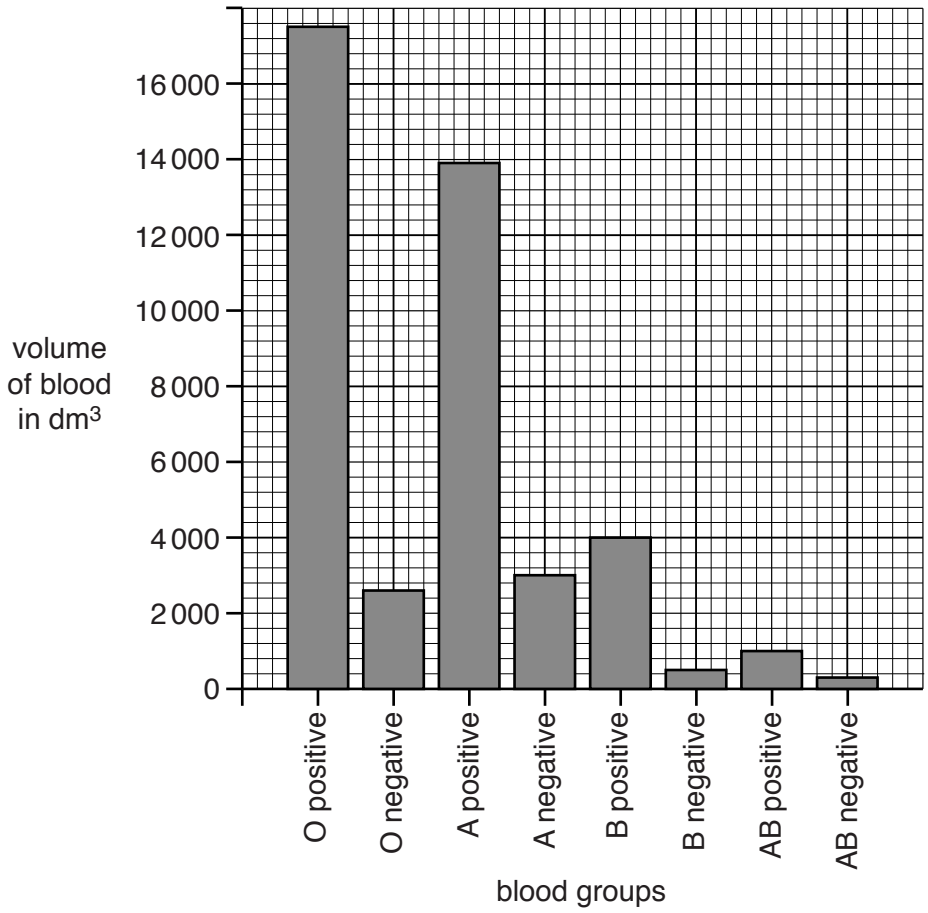


Chart B



(a) Put a tick (✓) next to **one correct** conclusion that can be made from the two charts.

The demand for AB negative blood was greater than the demand for B positive blood. ☐

The demand for A positive blood was greater than A negative blood. ☐

The demand for B negative blood was greater than O positive. ☐

The demand for AB blood of either type was greater than either type of O blood. ☐

[1]

(b) Blood donor organisations need more people with O negative to donate blood.

Explain why more O negative donors are needed and why O negative donors are so important.

Use the data in your answer.

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

[Total: 4]

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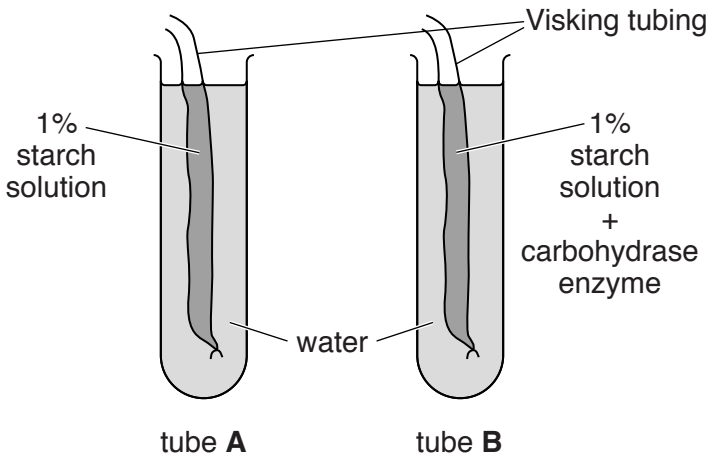
3 Benazir and Toby investigate digestion.

They use Visking tubing as a model gut.

Visking tubing has tiny holes in its membrane that only let very small molecules pass through.

Look at the apparatus they use.



Benazir and Toby leave the apparatus set up for 30 minutes.

They then test the water for starch and sugar.

The table shows their results.

Test	Tube A	Tube B
starch	no starch	no starch
sugar	no sugar	contains sugar

(a) The Visking tubing in **B** contains only **one** type of carbohydrase enzyme.

What is the name of the sugar they find in tube **B**?

Explain your answer.

.....

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

(b) Benazir wants to extend their investigation.

She suggests they set up tube **A** in the same way but add starch and lipase to the Visking tubing in **B**.

Toby tells her that they would just get the same result.

Is Toby correct? .....

Explain your answer.

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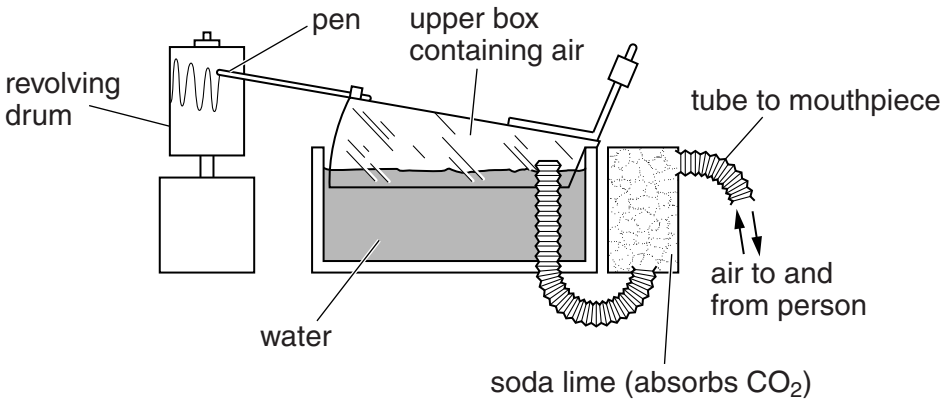
..... **[2]**

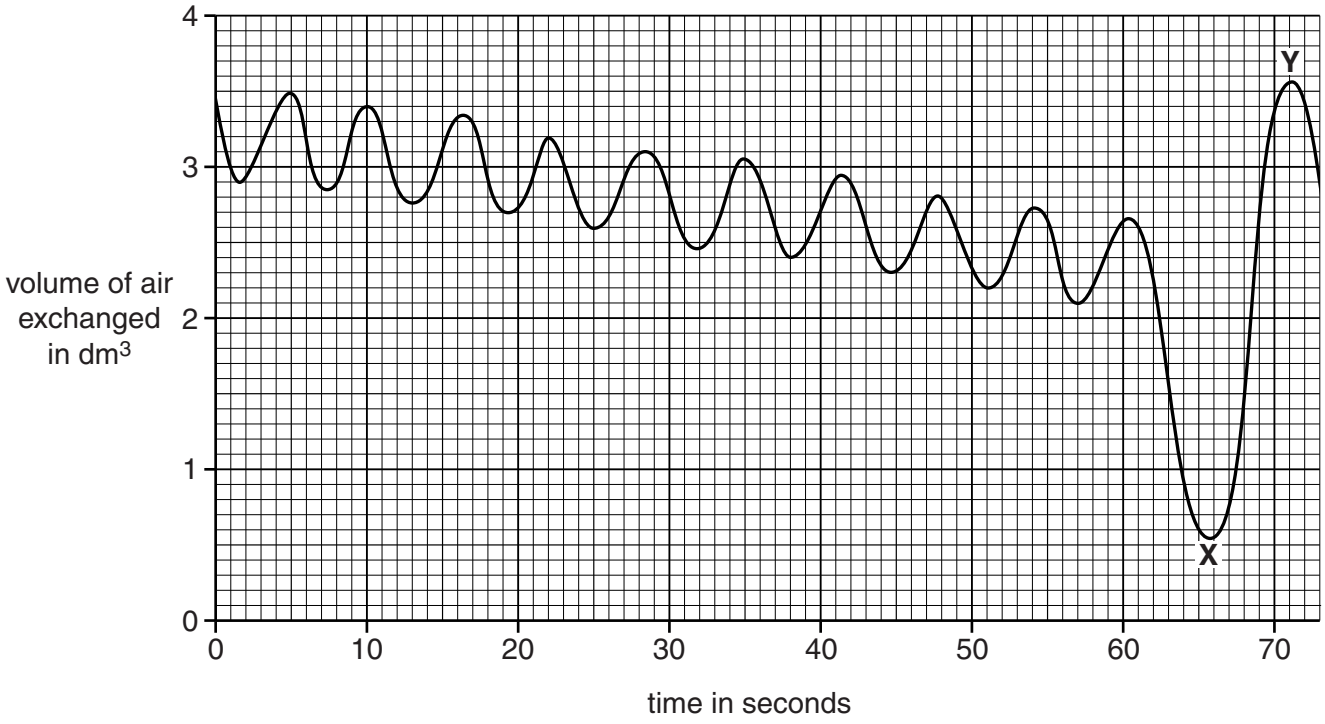
[Total: 4]

4 Jerry uses a spirometer to measure the volume of air he breathes in and breathes out.



Jerry breathes normally for the first 60 seconds, he then breathes in and out as deeply as he can.

Look at Jerry's spirometer trace.



(a) Use the trace to estimate Jerry's tidal volume.

.....dm^3 **[1]**

(b) (i) What name is used to describe the volume of gas between **X** and **Y**?

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

(ii) Describe what is happening to the volume of air in Jerry's lungs between **X** and **Y** and explain how the diaphragm and intercostal muscles cause these changes.

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

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

(c) Human lungs are protected by part of our internal skeleton.

Internal skeletons have advantages over external skeletons.

Explain **two** of these advantages.

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

[Total: 10]

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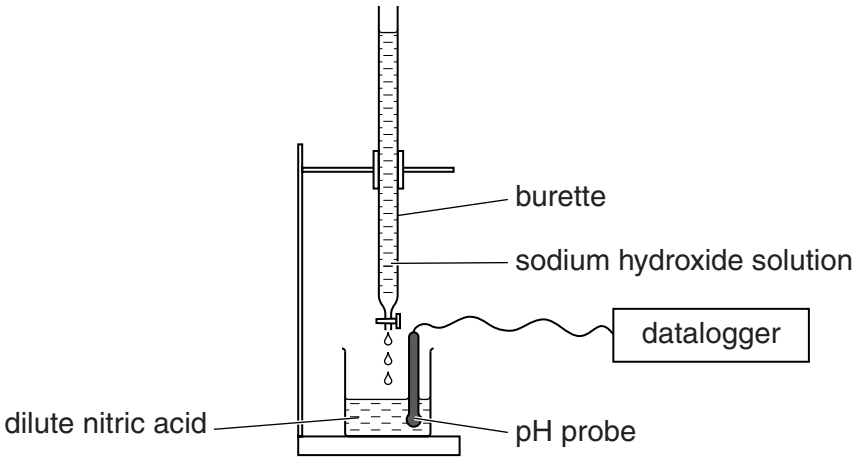
Section B starts on the next page

SECTION B – Module C5

5 This question is about acid-base titrations.

Terry is neutralising dilute nitric acid with sodium hydroxide solution.

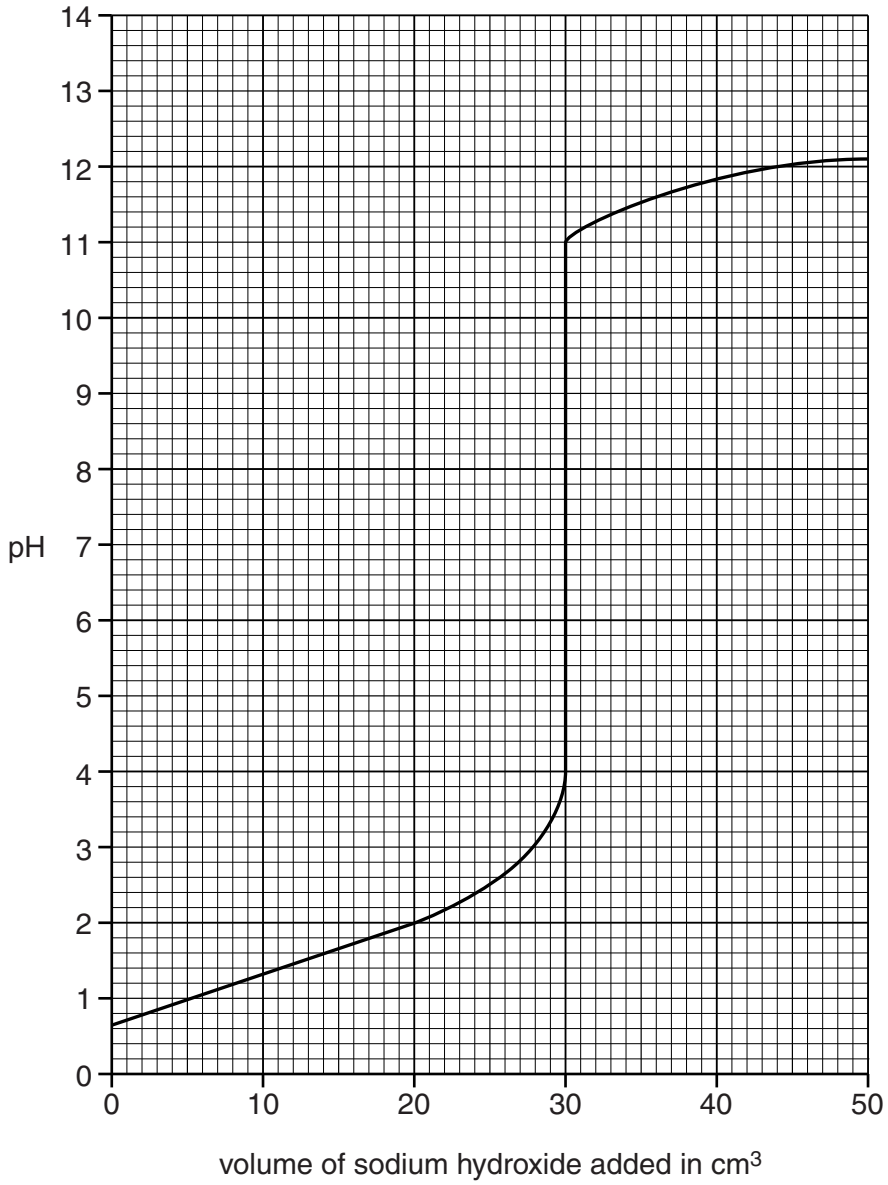
Look at the diagram. It shows the apparatus he uses.



Terry slowly adds 50 cm^3 of sodium hydroxide solution to 25 cm^3 of dilute nitric acid.

He measures the pH of the solution in the flask.

Look at the graph of his results on the next page.



(a) What is the pH after 25 cm^3 of sodium hydroxide solution are added?

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

(b) **(i)** What volume of sodium hydroxide solution is needed to exactly **neutralise** the nitric acid?

answer ..... cm^3 **[1]**

(ii) The concentration of the nitric acid is 0.20 mol/dm^3.

Show that 25 cm^3 of this solution contains 0.005 moles of nitric acid.

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

(iii) The equations for this neutralisation reaction are:

nitric acid + sodium hydroxide ⟶ sodium nitrate + water

HNO_3 + NaOH ⟶ $NaNO_3$ + H_2O

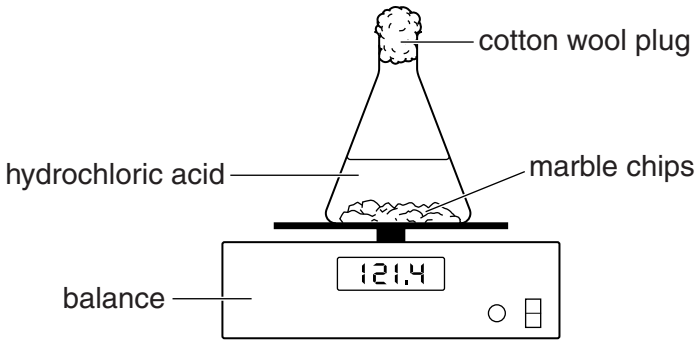
Use the answers to parts **(i)** and **(ii)** to calculate the concentration of the sodium hydroxide solution.

concentration of sodium hydroxide solution = ...mol/dm^3 **[2]**

[Total: 5]

6 Sue and Steve investigate the reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Look at the diagram. It shows the apparatus they use.



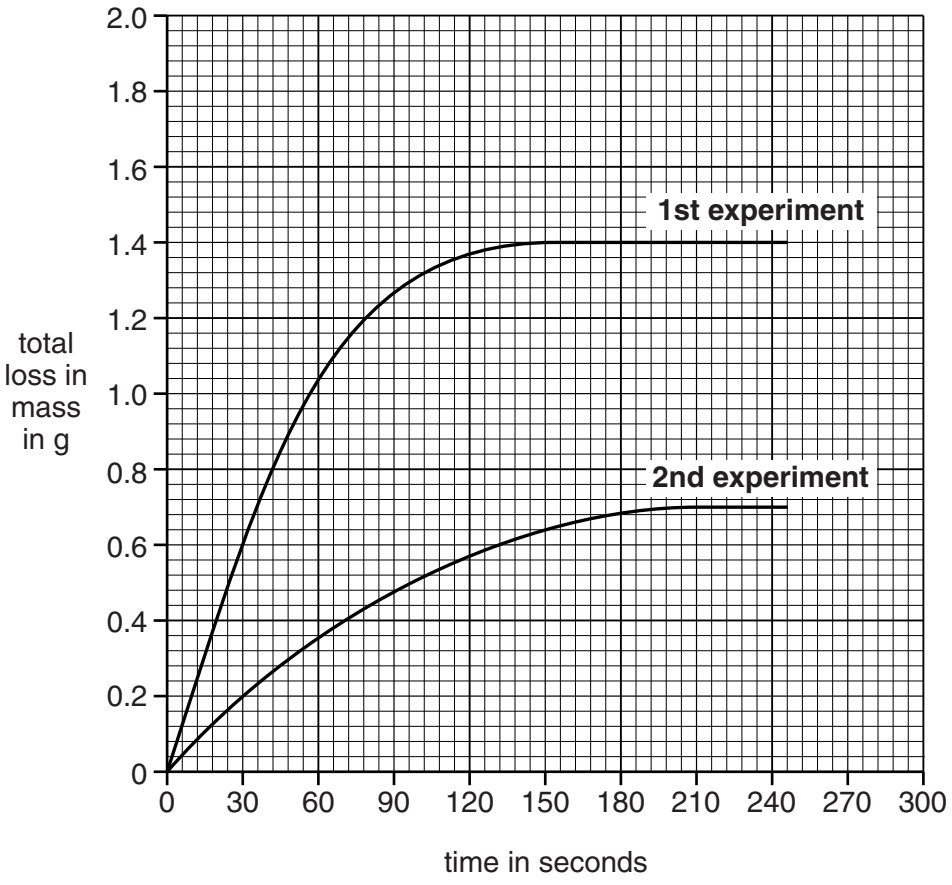
They add 50 cm^3 of dilute hydrochloric acid to 20.0 g of marble chips.

They measure the total loss in mass of the flask and its contents every 30 seconds for 5 minutes.

They do the experiment again.

They change something for the second experiment.

The graph shows their results.



(a) Hydrochloric acid is the **limiting reactant** in this reaction.

What is meant by the limiting reactant?

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

(b) The lines on the graph for the first and second experiments are different.
Suggest what Sue and Steve changed to give different results in experiment 2.
Give a reason for your answer.

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

(c) In this reaction, calcium carbonate, $CaCO_3$, reacts with hydrochloric acid, HCl.

Calcium chloride, $CaCl_2$, carbon dioxide, CO_2, and water, H_2O, are made.

Write a **balanced symbol** equation for this reaction.

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

(d) Sue and Steve work as part of a team of scientists.

Explain why it is an advantage for scientists to work in teams to investigate scientific problems.

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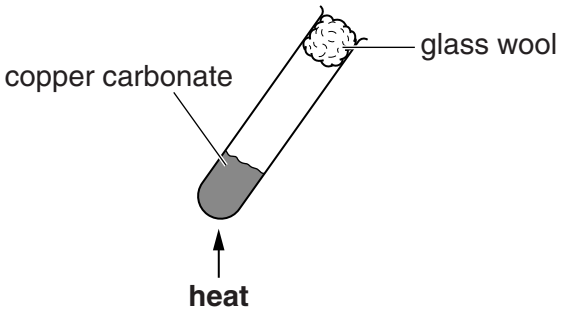
..... **[2]**

[Total: 7]

7 Zach is heating copper carbonate.



Zach finds the mass of the tube and its contents before and after heating.

Look at the equations for this reaction.

copper carbonate ⟶ copper oxide + carbon dioxide

$CuCO_3$ ⟶ CuO + CO_2

(a) Zach heats 2.48 g of copper carbonate.

Calculate how much **copper oxide** he should make.

The relative atomic mass, A_r, of Cu is 64, of C is 12 and of O is 16.

Mass of copper oxide made = ... **[2]**

(b) Calculate the percentage by mass of **copper** in copper carbonate.

The relative atomic mass, A_r, of Cu is 64, of C is 12 and of O is 16.

Percentage by mass of copper = ... % **[2]**

[Total: 4]

8 This question is about strong and weak acids.

Hydrochloric acid, HC*l*, is a **strong** acid.

Ethanoic acid, CH_3COOH, is a **weak** acid.

Hydrochloric acid with a concentration of $0.10\,mol/dm^3$ has a pH of 1.

Ethanoic acid with a concentration of $0.10\,mol/dm^3$ has a pH of 3.

Both acids react with a 3 cm length of magnesium ribbon.

Ethanoic acid reacts more slowly than hydrochloric acid.

Explain the difference in pH of the two acids and explain the difference in the rate of the reactions with magnesium.

Include an equation for the ionisation of at least one of the acids.

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

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

[Total: 6]

9 Ethanol is made in an industrial process.

Ethene reacts with steam to make ethanol.

$$\text{ethene} + \text{steam} \rightleftharpoons \text{ethanol}$$

The reaction is reversible and can reach an equilibrium.

Look at the table.

It shows the percentage of ethanol in the equilibrium mixture at
- 100 atmospheres pressure
- different **temperatures**.

Temperature in °C	**Percentage (%) of ethanol at 100 atmospheres**
100	78
200	54
300	22
400	17

(a) How does **increasing** the temperature affect the percentage of ethanol in the equilibrium mixture?

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

(b) When the reaction is at equilibrium, what can you say about
- the rates of the forward and back reactions
- the concentration of ethene in the mixture?

Rates of forward and back reactions .....

.....

Concentration of ethene .....

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

[Total: 3]

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Question 10 begins on page 24

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Section C – Module P5

10 Jenny rides her bike and takes some measurements.

(a) Jenny accelerates steadily at $0.4\,m/s^2$ for 12 s. After 12 s she reaches a speed of 4.8 m/s.

Initial speed

4.8 m/s

Use this information to find her initial speed.

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.....

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

(b) Jenny continues to travel at a steady speed of 4.8 m/s but then brakes steadily and stops.

It takes her 3 s to stop.

Calculate her braking distance.

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.....

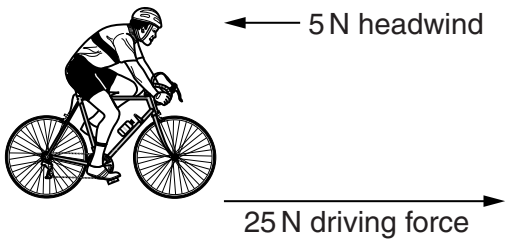
answer ..... m **[2]**

(c) Jenny then rides her bike with a driving force of 25 N.

She rides into a headwind.

This provides a resistance force of 5 N.

Look at the diagram.



Calculate the resultant force.

Choose from: **5 N** **20 N** **25 N** **30 N** **125 N**

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

(d) Velocity is a vector quantity.

Speed is a scalar quantity.

Explain the difference between vector and scalar quantities.

.....

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

[Total: 6]

11 Samuel sees an interference pattern on a pond.

He decides to make an interference pattern in the lab.

He uses a screen, a point red light source and a barrier.

The barrier has two very small gaps (slits) which allow light to pass through them.

Look at the diagram.

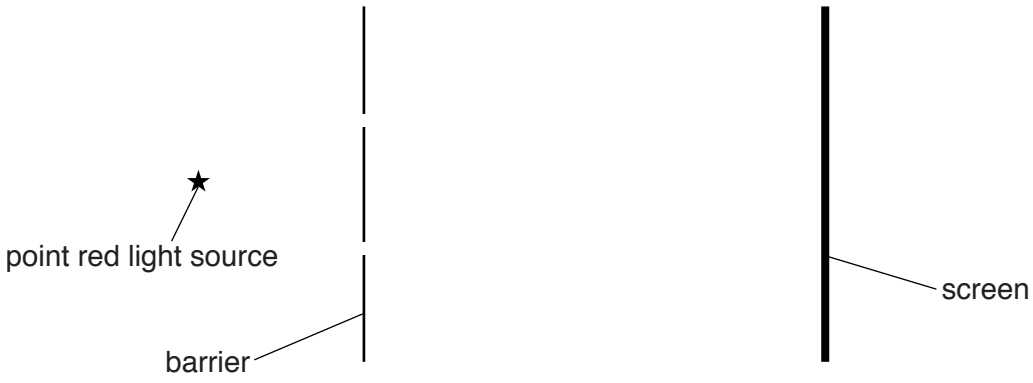


diagram not to scale

(a) The light from both gaps (slits) produces an interference pattern of dark and light bands on the screen.

(i) What happens to the light as it passes through each of the gaps (slits)?

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

(ii) What properties must the light from each gap (slit) have to produce this interference pattern?

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

(iii) Explain how the **dark** bands are produced.

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

(b) How does Samuel's experiment provide evidence for the nature of light?

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

[Total: 5]

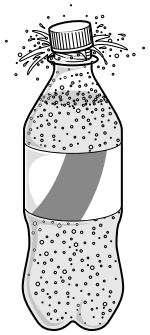
12 George takes a bottle of cold fizzy lemonade from his fridge.

He opens the bottle and a few bubbles of gas are released.

George thinks this is because of the pressure of the gas inside the bottle.

He closes the bottle and leaves it in a warm room for a few hours.

When he opens the bottle again the lemonade sprays out rapidly.



Explain, using ideas about momentum, how the gas particles in the warm bottle of lemonade create a pressure that causes the lemonade to spray out rapidly.

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

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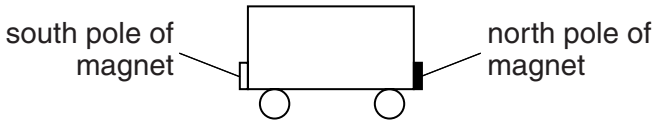
..... **[6]**

[Total: 6]

13 Ronnie plays with some magnetic toy train trucks.

Look at the diagram.



(a) Two **identical** trucks move towards each other, repel, and then move apart.

Look at the diagram.

Look at the two trucks **after** they repel.

Suggest why both trucks move apart at the same speed as each other after they repel.

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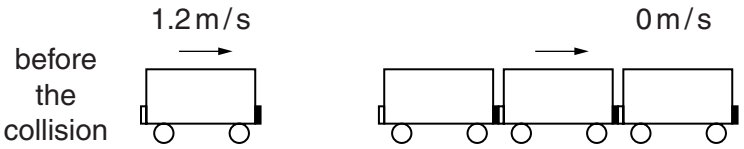
..... **[2]**

(b) Ronnie turns one truck round so the magnets can now attract each other.

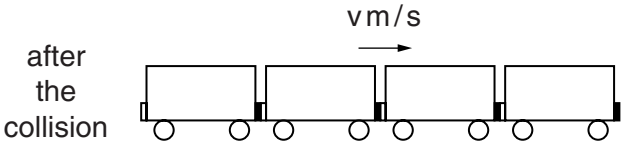
He pushes one truck into 3 other identical stationary trucks joined together.

Look at the diagram.



After the collision all four trucks move off together.

Look at the diagram.



Use momentum to calculate the speed, **v**, of the trucks after the collision.

Show how you work out your answer.

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Speed, v = ... m/s. **[3]**

[Total: 5]

14 Satellites orbit the Earth at different heights.

(a) Satellites in lower orbits travel faster than those in higher orbits.

Explain why.

.....

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

(b) Look at the data for orbits of satellites at different heights.

Height above surface of Earth in km	**Speed of satellite in km/h**	**Time for one orbit in minutes**
10 000	17 748	347
20 000	14 004	710
30 000	11 916	1150
40 000	10 548	1656
50 000	9576	2220

Geostationary satellites orbit the Earth once every 24 hours.

Use the data to estimate the height of a geostationary satellite.

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

[Total: 3]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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.