OCR
Oxford Cambridge and RSA

H

Monday 15 June 2015 – 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 8 5 8 1 8 2 8 4 1 *

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 **28** pages. Any blank pages are indicated.

EQUATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$GPE = mgh$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

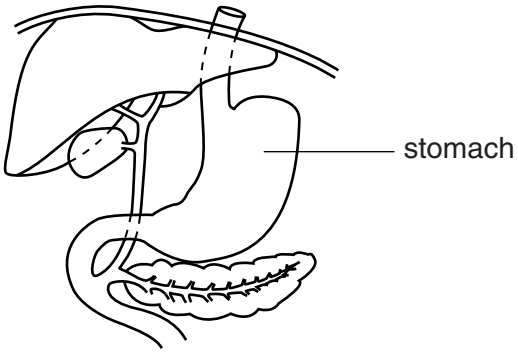
$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module B5

1 Look at the diagram. It shows part of the digestive system.



(a) **(i)** Which enzyme in the stomach breaks down protein?

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

(ii) Which type of substance is made when proteins are digested?

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

(b) Some elderly people produce very little acid in their stomach.

Explain why this would slow down digestion in the stomach.

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

(c) The contents of the stomach then enter the small intestine.

Explain **two** ways the small intestine is adapted for efficient absorption of digested food.

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

2 This question is about tests on the circulatory system.

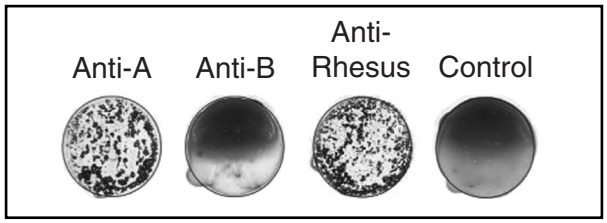
(a) A simple test can be done to find out which blood type a person has.

A drop of blood is added to antibodies.

There is also a control that contains no antibodies.

If blood clots in the control the test is invalid.

Look at the picture. It shows the result of a valid test.



(i) What is the blood type of the individual taking the test? Explain your answer.

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

(ii) Explain what would happen if this person received blood from a donor who was AB positive.

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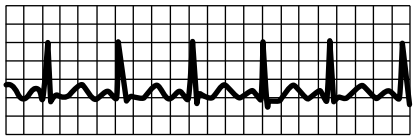
..... **[1]**

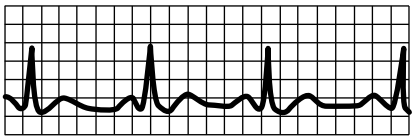
(b) Look at the diagram. It shows an ECG trace of a normal heartbeat and three ECG traces that show heart problems.

normal heartbeat

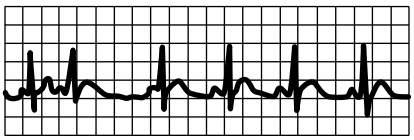


A

B



C



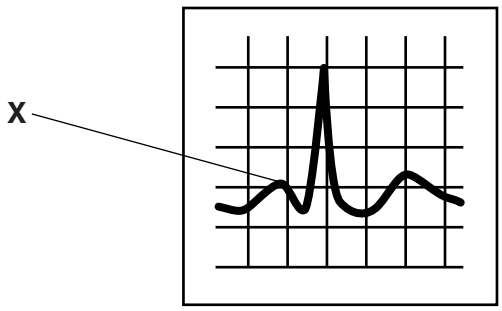
(i) Match the letter of each ECG to its correct description.

irregular heartbeat .....

fast heartbeat .....

slow heartbeat ..... **[1]**

(ii) Look at an enlarged image of part of the ECG trace.



Describe what is happening inside the heart at point X.

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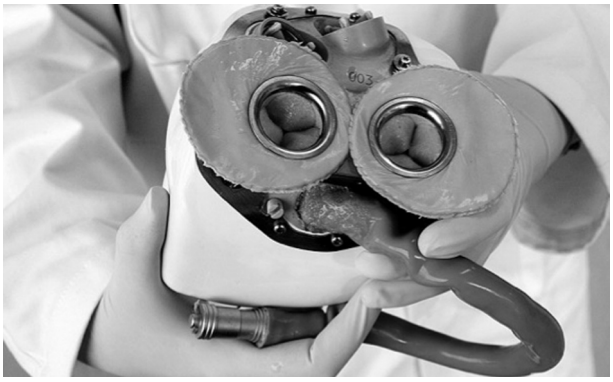
..... **[1]**

3 Read the article about a new type of artificial heart.

Artificial hearts



Scientists have made a new artificial heart that can replace the human heart.

The heart is made of plastic and lined with animal tissue. The animal tissue should reduce the chance of rejection compared to a completely plastic heart.

Batteries kept on the outside of the body power the heart.

The scientists hope this new type of heart can keep someone alive for at least five years. This would mean that more patients would survive while they waited for a donor human heart. At the moment, if their hearts fail completely, they have to be kept alive on a heart–lung machine.

Compare the use of this new artificial heart to other artificial hearts and to a transplant of a donor human heart.

Use information from the article and your own knowledge to answer the question.

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

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

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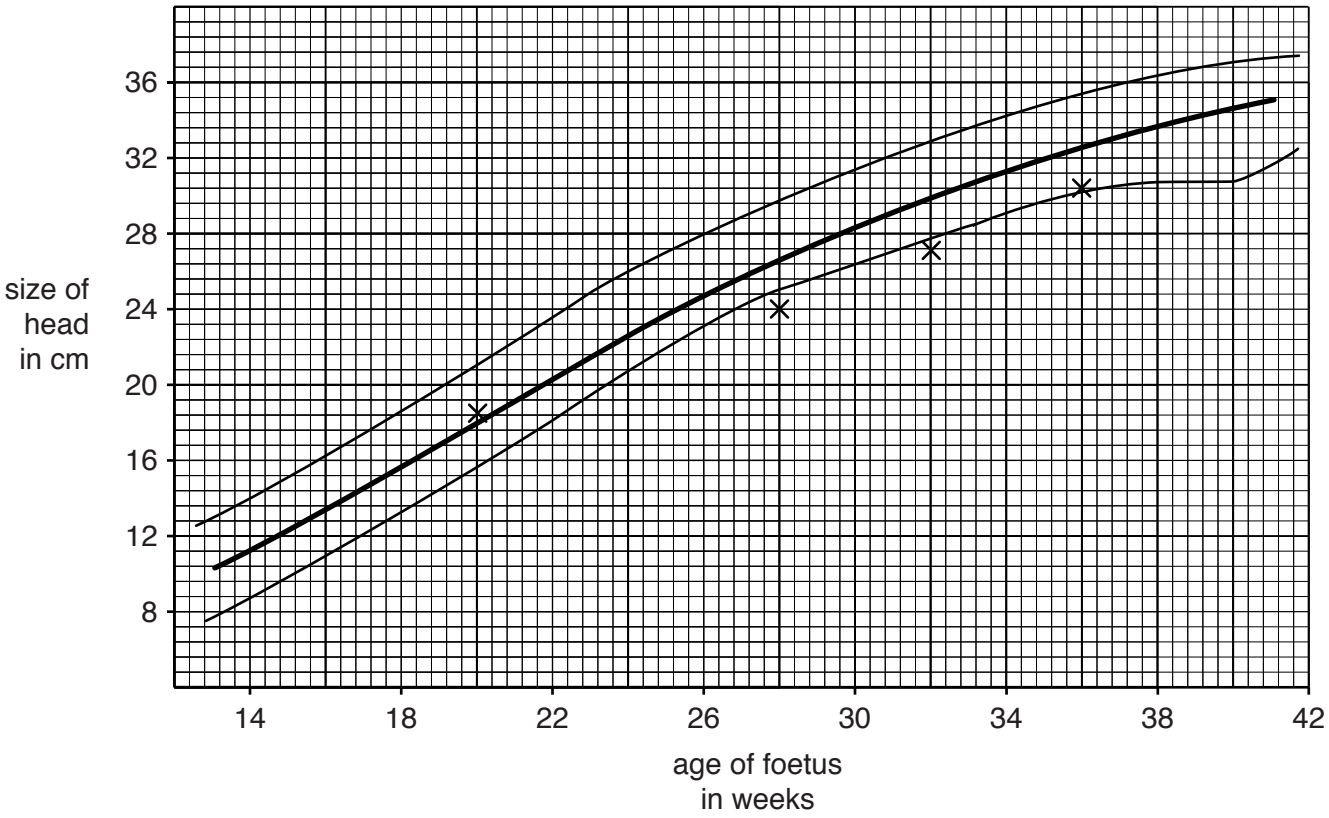
4 During pregnancy the development of the foetus is monitored.

One way to monitor development is to measure the size of the head.

Look at the graph.

The dark line in the middle shows the average head size for a foetus of that age.

The other two lines show the healthy range for the head size of a foetus.



(a) Claire is pregnant.

The head size of her foetus is measured four times.

The results are plotted on the graph.

(i) What is the rate of growth of the head size between 28 and 36 weeks?

Write your answer to 2 decimal places.

..... cm per week **[1]**

(ii) Why is it important to consider the overall rate of growth of the head size rather than the head size measurement from one day?

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

(b) (i) A foetus can be tested for conditions such as Down's syndrome.

Describe how a foetus can be tested for Down's syndrome.

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

(ii) People have different opinions about foetal testing.

Describe the ethical arguments **for** and **against** foetal testing.

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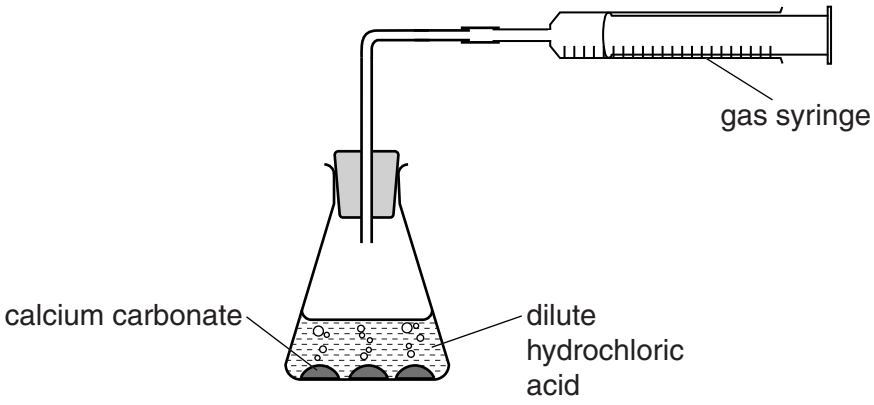
..... **[2]**

SECTION B – Module C5

5 Greg and Steph investigate the reaction between calcium carbonate and hydrochloric acid.

$$\text{calcium carbonate} + \text{hydrochloric acid} \rightarrow \text{calcium chloride} + \text{carbon dioxide} + \text{water}$$

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



Greg and Steph do the experiment several times.

Each time they use a different mass of calcium carbonate.

They measure the volume of carbon dioxide made at the end of the reaction.

In each experiment the hydrochloric acid is **in excess**.

(a) Explain why each reaction stops.

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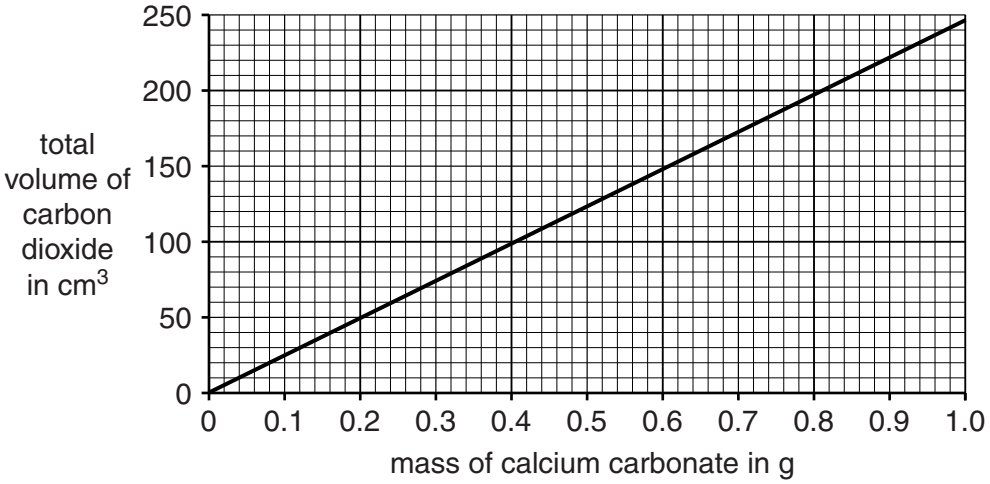
..... **[2]**

(b) Look at the graph. It shows their results.



Greg and Steph want to make exactly 90 cm^3 of carbon dioxide at the end of the reaction.

What mass of calcium carbonate should they use?

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

(c) 120 cm^3 of carbon dioxide, at room temperature and pressure, is made when 0.48 g of calcium carbonate react.

Calculate the number of moles of carbon dioxide in 120 cm^3 of gas at room temperature and pressure.

(1 mole of any gas occupies 24 000 cm^3 at room temperature and pressure.)

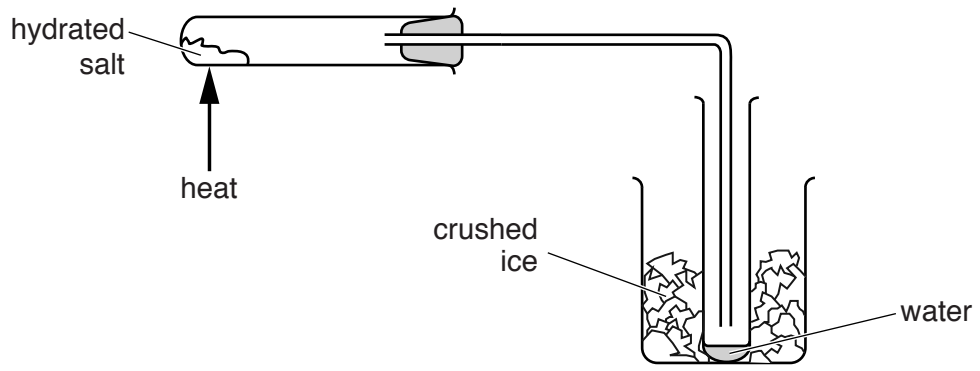
answer ..... moles **[2]**

6 Peter is heating two hydrated salts.

These are

- hydrated sodium carbonate, $Na_2CO_3.10H_2O$
- hydrated copper(II) sulfate, $CuSO_4.5H_2O$.

Look at the apparatus he uses.



When each hydrated salt is heated, the water in the hydrated salt is given off as steam.

The steam is condensed and collected in the test tube placed in crushed ice.

(a) When hydrated copper(II) sulfate, $CuSO_4.5H_2O$, is heated, anhydrous copper(II) sulfate, $CuSO_4$, and water are made.

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

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

(b) Look at Peter's results for hydrated copper(II) sulfate.

Complete the table.

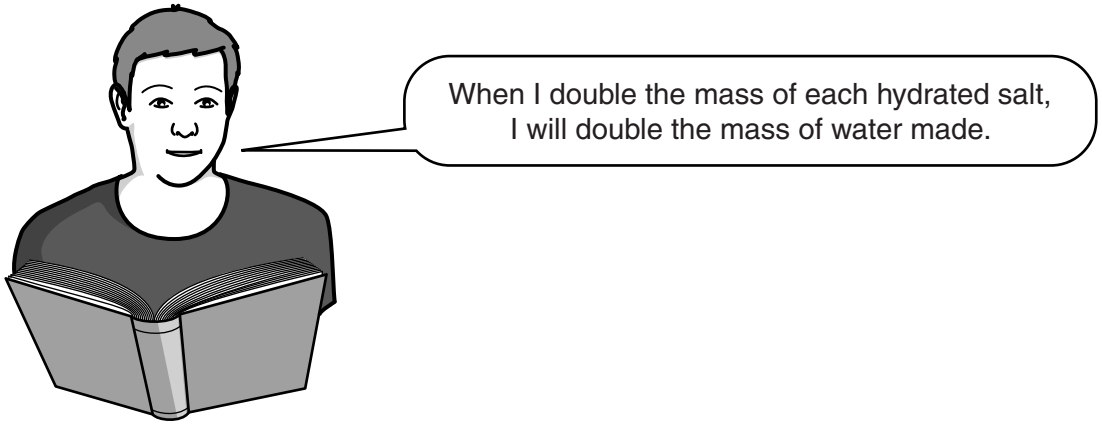
Mass of hydrated copper(II) sulfate in g	**Mass of anhydrous copper(II) sulfate in g**	**Mass of water in g**
0.50	0.32	0.18
1.00	0.64	0.36
1.50	.....	.....
2.00	1.28	0.72
2.50	1.60	0.90

[2]

(c) Look at Peter's results for hydrated sodium carbonate.

Mass of hydrated sodium carbonate in g	Mass of anhydrous sodium carbonate in g	Mass of water in g
1.00	0.37	0.63
1.50	0.70	0.80
2.00	1.00	1.00

Before he starts the experiment, Peter makes a prediction for **both** hydrated salts.



Do Peter's results support his prediction about **both** hydrated salts?

Explain your answer quoting information from **both** tables.

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

7 **(a)** Benzene is a hydrocarbon.

The molecular formula of benzene is C_6H_6.

What is the **empirical** formula of benzene?

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

(b) Look at the table. It shows the percentage composition of compound **A**.

Element	Percentage by mass (%)
carbon	38.7
hydrogen	9.7
oxygen	51.6

(i) Calculate the empirical formula of compound **A**.

(The relative atomic mass, A_r, of carbon is 12, of hydrogen is 1 and of oxygen is 16.)

empirical formula ..... **[2]**

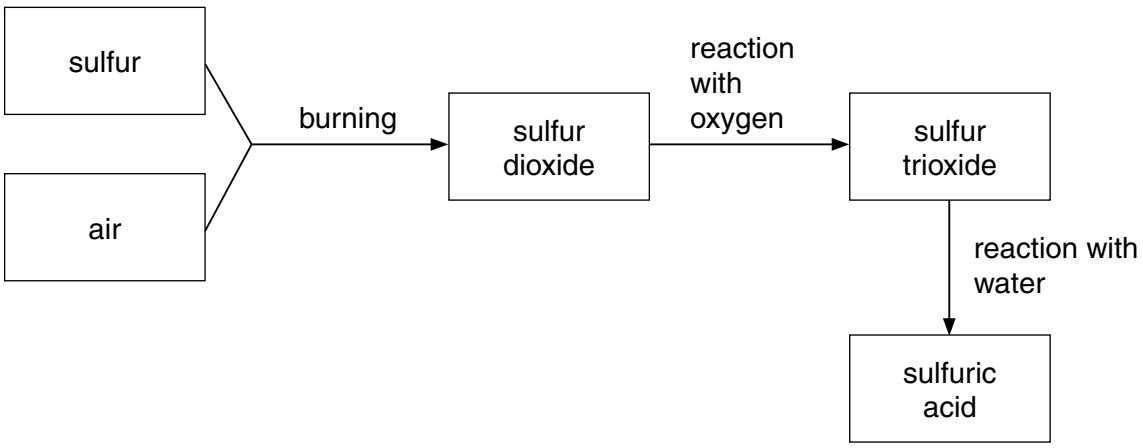
(ii) The molar mass of compound **A** is 62 g/mol.

Suggest the **molecular** formula for compound **A**.

molecular formula ..... **[1]**

8 This question is about the Contact Process used for the manufacture of sulfuric acid.

Look at the flow chart for the Contact Process.



In the Contact Process, sulfur dioxide reacts with oxygen to make sulfur trioxide.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The forward reaction is **exothermic**.

Two of the conditions used in this reaction are

- a temperature of 450 °C
- a catalyst of vanadium(V) oxide, V_2O_5.

(a) Write down **one other** condition used in this reaction.

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

(b) Explain why a temperature of 450 °C rather than 350 °C or 550 °C is used in this reaction.

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

(c) What effect does using a catalyst of vanadium(V) oxide have on

- the rate of the reaction
- percentage yield?

Effect on rate of reaction .....

Effect on percentage yield ..... **[1]**

9 Barium sulfate, $BaSO_4$, is an insoluble salt.

Steve wants to make a pure, dry sample of barium sulfate.

Steve uses solutions of barium chloride and sodium sulfate in a **precipitation** reaction.

Barium chloride solution contains barium ions, Ba^{2+}.

Sodium sulfate contains sulfate ions, SO_4^{2-}.

Describe the stages that Steve can use to prepare a **pure**, **dry** sample of barium sulfate.

Include an **ionic** equation for the reaction.

You may wish to draw a **labelled** diagram.

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

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Section C starts on page 18

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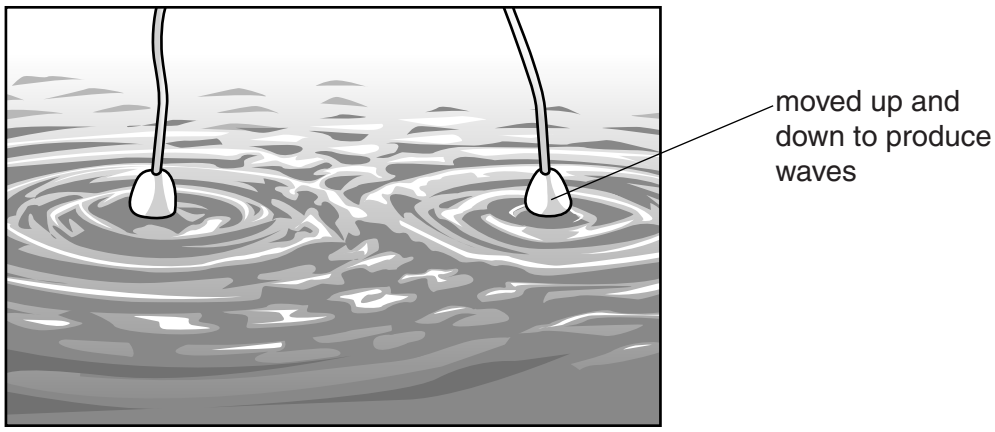
SECTION C – Module P5

10 In his science class Bilhar investigates the behaviour of water waves.

(a) He uses a ripple tank to produce and study the water waves.

Look at the diagram.



The waves cause interference.

This makes a pattern of high waves and calm water.

Explain how the high waves and calm water are produced by interference.

You may draw a diagram to explain your answer.

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

(b) Hundreds of years ago scientists such as Huygens and Newton experimented to find out about the nature of light.

They wanted to know if light was made of waves or particles.

Many scientists at this time shared their results and findings.

Suggest **how** they shared their results and findings.

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Suggest **why** they shared their results and findings.

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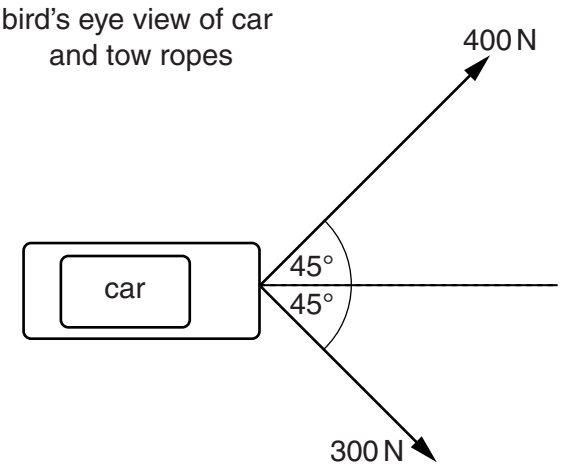
..... **[2]**

11 A car is stuck in the snow.

Two vehicles try to pull the car free using tow ropes.

Look at the diagram showing the forces used by the two vehicles.



The car needs a force of more than 450 N to overcome friction.

(a) Calculate the resultant force to show that the car will move.

You may draw on the diagram to show your answer.

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

(b) Describe how the **velocity** of a car is different from the **speed** of a car.

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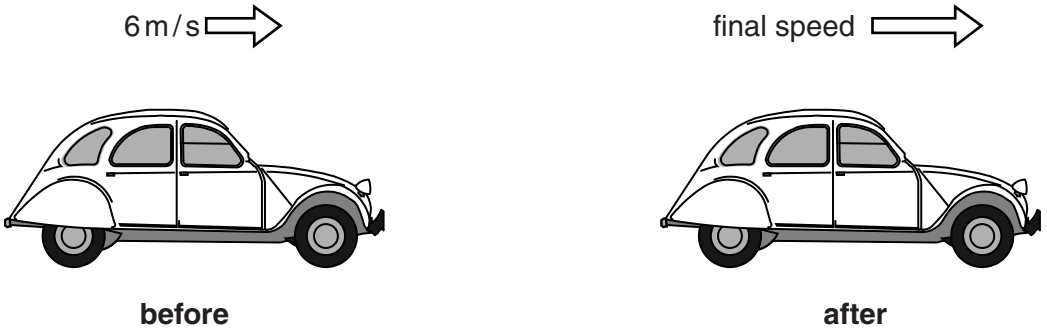
..... **[1]**

(c) Look at the diagram of a car accelerating.



The car accelerates at $0.5\,m/s^2$ for 16 s.

Calculate the final speed of the car.

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

12 Artificial satellites are put into orbit around Earth.

Some satellites are used for weather forecasting.

Look at the information about two types of weather satellite.

Satellite	Average orbital height	Orbital period	Shape of orbit	Uses
Meteosat	38 500 km	24 hours	circular	low definition weather imaging
POES	807 km	101 minutes	elliptical	high definition weather imaging

(a) Meteosat is in orbit above the equator **and** it moves around the Earth once every 24 hours.

POES has a different orbit and it passes over the North and South Poles.

Describe the **advantages** of each orbit for weather forecasting.

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Describe the **disadvantages** of each orbit for weather forecasting.

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

(b) Satellites are kept in orbit by a centripetal force.

What causes this force?

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

(c) The POES satellite is closer to Earth.
It has a lower orbit and travels faster than the Meteosat satellite.

Explain why the POES satellite travels faster.

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

(d) Explain why it is important that the Meteosat satellite has a **circular** orbit rather than an elliptical orbit.

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

(e) TV satellites use microwaves for transmission.

Explain how communications between TV satellites and Earth take place.

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

13 Sam and Jared race their bikes.

Their speeds are measured as they accelerate steadily over a distance of 30 m.

Look at the information about this section of the race.

Sam		**Jared**	
starting speed	finishing speed	starting speed	finishing speed
2 m/s	4 m/s	1 m/s	5 m/s




Jared says, 'my acceleration was four times greater than Sam's'.
Sam says, 'it's not fair; Jared had a longer time to accelerate than I did'.

Use the data and calculations to explain why both Sam and Jared are incorrect.

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

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

END OF QUESTION PAPER

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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.