Year 9 Term 1 Science

Home Learning

Name	
Teacher	
Class	

Year 9 Home Learning Booklet – Term 1

Instructions:

- Complete 1 section per week
- Bring this booklet to the lesson specified by your teacher for them to check
- Your work will either be self-assessed or marked by your teacher

Home Learning Number	Day & Date to Hand In	Week		Period	Checked by Teacher
1		A	B		
2		A	B		
3		A	B		
4		A	B		
5		A	B		
6		A	B		

Periodic Table and GCSE Physics Equations are on pages 2 and 3

The 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 **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	[285] **Cn** copernicium 112	[286] **Uut** ununtrium 113	[289] **Fl** flerovium 114	[289] **Uup** ununpentium 115	[293] **Lv** livermorium 116	[294] **Uus** ununseptium 117	[294] **Uuo** ununoctium 118

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.

GCSE Physics Equations 1

HT = Higher Tier only equations

kinetic energy = 0.5 × mass × (speed)^2	$E_k = \frac{1}{2}\, m\, v^2$
elastic potential energy = 0.5 × spring constant × (extension)^2	$E_e = \frac{1}{2}\, k\, e^2$
gravitational potential energy = mass × gravitational field strength × height	$E_p = m\, g\, h$
change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m\, c\, \Delta\theta$
power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
charge flow = current × time	$Q = I\, t$
potential difference = current × resistance	$V = I\, R$
power = potential difference × current	$P = V\, I$
power = (current)^2 × resistance	$P = I^2\, R$
energy transferred = power × time	$E = P\, t$

GCSE Physics Equations 2

	energy transferred = charge flow × potential difference	$E = Q\,V$
HT	**potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil**	$\boldsymbol{V_p\,I_p = V_s\,I_s}$
	density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
	thermal energy for a change of state = mass × specific latent heat	$E = m\,L$
	weight = mass × gravitational field strength	$W = m\,g$
	work done = force × distance (along the line of action of the force)	$W = F\,s$
	force = spring constant × extension	$F = k\,e$
	distance travelled = speed × time	$s = v\,t$
	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
	(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2\,a\,s$
	resultant force = mass × acceleration	$F = m\,a$
HT	**momentum = mass × velocity**	$\boldsymbol{p = m\,v}$
	period = $\frac{1}{\text{frequency}}$	$T = \frac{1}{f}$
	wave speed = frequency × wavelength	$v = f\,\lambda$
HT	**force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length**	$\boldsymbol{F = B\,I\,l}$

Week 1 – Scientific Skills

1. Jason recorded the effect of temperature on the rate of his reaction. He repeated the same reaction three times at each temperature.

   a) Circle the anomaly in the table:

Temperature (°C)	Rate of Reaction (g/min)			Mean Rate of Reaction (g/min)
	Repeat 1	Repeat 2	Repeat 3	
10	3.9	4.9	6.2	(3.9+4.9+6.2)÷3 = **5.0**
15	8.0	8.0	6.5	(8.0+8.0+6.5)÷3 =_______
20	11.5	10.0	10.0	
25	11.5	3.0	13.5	
30	14.9	15.2	14.9	

   b) Why do we do repeats when performing experiments?

   ____

2. Complete the table by calculating the mean for each row. The first one has been done for you. Remember, we don't include the anomaly in these calculations.

3. What is the...

   a) Independent variable: ______________________________

   b) Dependent variable: ______________________________

4. Which sort of graph should you draw with the data in the table?

- ❑ Bar Chart
- ❑ Line Graph

5. Label the graph using the headings in the table.

6. Number the axis using a sensible scale.

Light Intensity (AU)	Oxygen Produced by Photosynthesis (cm^3)
2	11
4	22
6	30
8	34
10	35
12	35

Week 2 – Exothermic and Endothermic Reaction

Chemical reactions that transfer energy to the surroundings are called **exothermic reactions**. Usually this energy transfer is by heating and so there will be a rise in temperature.

The most obvious example of an exothermic reaction is that of **combustion**. Burning of a fuel like petrol is one example of combustion. This will increase the temperature of the surroundings. The general word equation for combustion is:

fuel + oxygen → carbon dioxide + water

Hi-Res Images of Chemical Elements, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons

Other examples of exothermic reactions are **neutralisation** and many **oxidation** reactions. Again, the temperature of the surroundings will increase.

We've seen before that the general word equations for neutralisation are:

acid + metal oxide → salt + water

acid + metal hydroxide → salt + water

acid + metal carbonate → salt + carbon dioxide + water

We've also seen that the general chemical equation for a metal undergoing oxidation is:

metal + oxygen → metal oxide

While exothermic reactions transfer energy to the surroundings, **endothermic reactions** take in energy from the surroundings. This results in a fall in temperature.

One example of an endothermic reaction is **thermal decomposition**. Thermal decomposition is when a compound is heated and breaks down into smaller and simpler products.

Both exothermic and endothermic reactions have everyday applications. Exothermic reactions are used in hand warmers and self-heating cans of hot drinks.

Endothermic reactions are used in "instant cold" packs used to treat sports injuries. These packs usually consist of two bags (with one inside the other). One contains water and one contains a different compound. When the inner bag is squeezed and bursts, water combines with this compound and an endothermic reaction occurs. The "instant cold" pack then decreases in temperature.

Q1. Describe what is meant by an exothermic reaction.

....

....

Q2. State two examples of exothermic reactions.

....

Q3. Describe what is meant by an endothermic reaction.

....

....

Q4. State an example of an endothermic reaction.

....

Q5. The following statements are either true or false. State which are true and which are false.

a) Oxidation is an example of an endothermic reaction.

....

b) Thermal decomposition is an example of an endothermic reaction.

....

c) Neutralisation is an example of an exothermic reaction.

....

Q6. Complete the general word equation for the reaction between an acid and a metal hydroxide.

acid + metal hydroxide → .... + ...

Q7. State whether the reaction in question 6 is exothermic or endothermic.

....

Q8. Copper carbonate undergoes thermal decomposition to form copper oxide and carbon dioxide.

a) State the reactant in this reaction.

....

b) State the products of this reaction.

....

c) Complete the chemical equation.

$CuCO_3 \rightarrow CuO +$ ....

d) State whether this reaction is exothermic or endothermic.

....

Week 3 – Rate of Reaction

The phrase “rate of reaction” means how quickly a chemical reaction takes place. The rate of reaction depends on the frequency of **successful collisions** between reacting particles.

The rate of reaction depends on:

- **The temperature of the reactants**. Higher temperatures cause particles to move more quickly. This increases the frequency of collisions and the energy of those collisions, thus increasing the rate of reaction.
- **The concentration or pressure of reactants.** In a more concentrated solution, there are more particles within the same volume. Similarly, a gas at higher pressure has more particles in the same volume. In both cases, more particles lead to a higher rate of collisions, increasing the rate of reaction.
- **The surface area.** For solid reactants, breaking them into smaller pieces increases their surface area to volume ratio. This allows more collisions to occur on the surface of the solid, increasing the rate of reaction.
- **The use of a catalyst.** A catalyst is a substance that increases the rate of reaction without being used up in the process. It works by providing an alternative pathway with a lower activation energy for the reaction, therefore increasing the rate at which collisions result in a reaction.

The rate of reaction can be measured with a few different methods. These include:

- **Measuring the change in mass**. For reactions that produce a gas, the rate can be measured by the loss of mass. One example of this is the reaction between magnesium and hydrochloric acid to form magnesium chloride and hydrogen gas. The hydrogen gas would escape and so the mass measured on the balance would decrease.
- **Measuring the volume of gas produced**. If a reaction produces a gas, the rate can also be measured by capturing the gas in a gas syringe and measuring the volume of gas produced over time.
- **Observing precipitation**. Precipitation is the formation of a solid in a solution during a chemical reaction. The rate of reaction can be measured by observing the time it takes for the precipitate to form. This can be done visually or using a light sensor to detect when a certain level of cloudiness is reached in the solution. One example of this is the reaction between sodium thiosulfate and hydrochloric acid. This reaction forms a yellow sulfur precipitate. The reaction can take place in a conical flask placed above a piece of paper with a black cross drawn on it. The time can then be measured for the black cross to no longer be visible.
- **Monitoring colour change**. Some reactions involve a change in colour. The rate of reaction can be measured by timing how long it takes for the colour change to occur.

Q1. The following statements are either true or false. State which are true and which are false.

a) Particles at a higher temperature move more quickly.

....

b) A catalyst is used up during a chemical reaction.

....

c) The rate of reaction depends on the frequency of successful collisions.

....

d) Breaking a solid up into smaller pieces decreases the surface area to volume ratio.

....

e) A gas at a higher pressure has more particles in the same volume.

....

Q2. Explain why increasing the temperature of reactants increases the rate of reaction.

....

....

Q3. Sodium thiosulfate is reacting with hydrochloric acid. A yellow sulfur precipitate is formed.

a) State what effect increasing the concentration of hydrochloric acid would have on the reaction. Explain the reasons why.

....

....

b) Describe an experiment that could investigate how the rate of reaction depends on the temperature of hydrochloric acid.

....

....

....

....

Q4. Magnesium is added to hydrochloric acid.

a) State whether magnesium powder or large pieces of magnesium would have a higher rate of reaction Explain the reasons why.

....

....

b) Describe how we could experimentally verify which of magnesium powder or large pieces of magnesium would have a higher rate of reaction.

....

Week 4 – Balancing Equations

When we write a chemical equation for the oxidation of copper, we can do so in words as in the equation below:

copper + oxygen → copper oxide

We can also represent this reaction using chemical symbols and formulae. The chemical symbol for copper is "Cu" and for oxygen is "O". However, oxygen exists as a diatomic molecule meaning that we write it as "O_2" (instead of just "O" by itself). The symbol for copper oxide is "CuO" meaning that each copper oxide particle has one copper atom and one oxygen atom. If we just used these symbols instead of words, then we'd end up with:

	$Cu + O_2$	**→ CuO**
Number of Cu atoms	1	→ 1
Number of O atoms	2	→ 1

As we can see, there are two oxygen atoms on the left side of the equation but only one oxygen atom is on the right side of the equation. This is not correct – there must be the same number of each of the atoms on each side of the chemical equation. We must **balance** the chemical equation to fix this.

The first step in balancing this equation will be to look at increasing the number of oxygen atoms on the right hand side of the equation. The only way that we can do this is to increase the number of "CuO" particles. We could change this to "2CuO" – this means that we have two lots of copper oxide particles. Changing the number in front of a compound is the only way that we can try to balance the equation. We cannot, for example, change "CuO" to "CuO_2" as that is changing what compound we have.

However, we now would have two copper atoms on the right side of the equation. We can fix this by changing the number of copper atoms on the left side of the equation to two. We now have:

	$2Cu + O_2$	**→ 2CuO**
Number of Cu atoms	2	→ 2
Number of O atoms	2	→ 2

The number of copper and oxygen atoms on each side of the equation is now the same. We have balanced the equation.

Note that if, for example, we have two lots of water particles (written as "$2H_2O$") then we will have a total of four hydrogen atoms and two oxygen atoms. Changing the number in front of a compound multiplies the number of all the atoms by that amount.

Q1. Hydrogen has the chemical symbol "H". State how many hydrogen atoms there are in each of the below:

a) H_2O ....

b) $2H_2O$ ....

c) $10H_2O$ ....

d) CH_4 ....

e) C_2H_4 ....

f) $4C_2H_4$ ....

g) $2C_7H_{16}$ ....

Q2. a) Write a word equation for the oxidation of zinc.

....

b) Balance the chemical equation for the oxidation of zinc by filling in the gaps

.... $Zn + O_2 \rightarrow 2ZnO$

Q3. Balance the chemical equations below by filling in the gaps:

a) Oxidation of magnesium.

$2Mg + O_2 \rightarrow$ .... MgO

b) Complete combustion of methane.

$CH_4 +$ .... $O_2 \rightarrow CO_2 + 2H_2O$

c) Incomplete combustion of ethene.

$C_2H_4 + 2O_2 \rightarrow$ .... $CO + 2H_2O$

d) Oxidation of silver.

.... $Ag + O_2 \rightarrow 2Ag_2O$

e) Photosynthesis

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 +$ .... O_2

f) Reaction of sodium and chlorine.

.... $Na +$ .... $Cl_2 \rightarrow$ .... $NaCl$

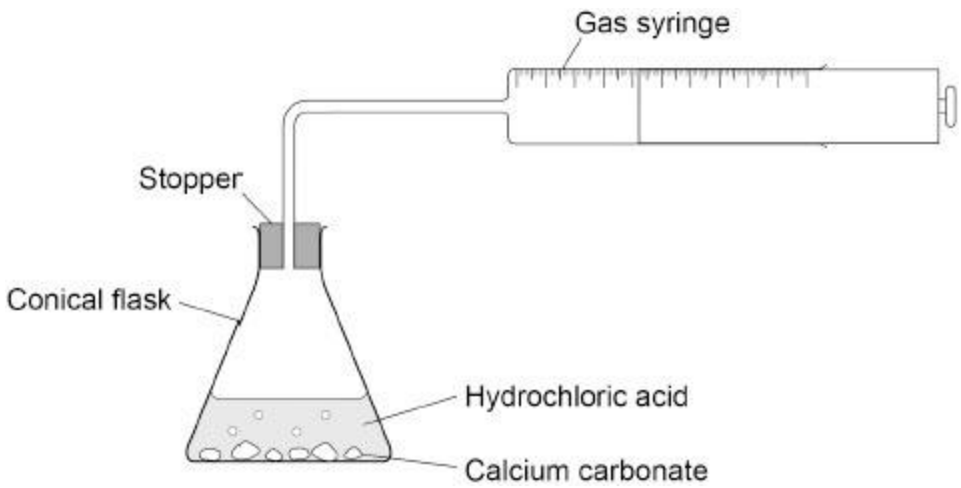
Week 5 – GCSE Style Questions

Q1.

A student investigated the reaction of calcium carbonate with hydrochloric acid.

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Measure 50 cm^3 of hydrochloric acid into a conical flask.
2. Add 4.0 g of calcium carbonate to the conical flask.
3. Insert the stopper into the conical flask as quickly as possible.
4. Start a timer.
5. Measure the volume of gas collected every 30 seconds for 3 minutes.
6. Repeat steps 1 to 5 using different concentrations of hydrochloric acid.

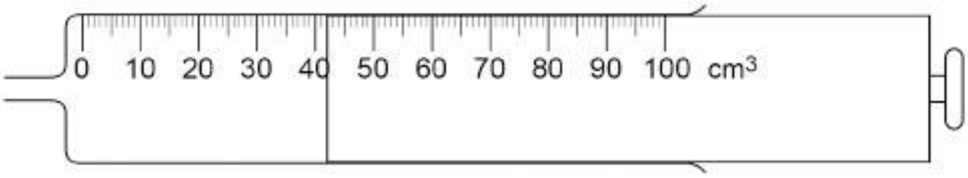
(a) Name a suitable piece of equipment to measure 4.0 g of calcium carbonate.

____

(1)

(b) **Figure 2** shows the gas syringe during the investigation.

Figure 2



What is the reading on the gas syringe?

____________ cm^3

(1)

(c) What is the independent variable in the investigation?

Tick (✓) **one** box.

Concentration of hydrochloric acid ☐

Mass of calcium carbonate ☐

Temperature of the room ☐

(1)

(d) Why did the student insert the stopper into the conical flask as quickly as possible in step 3?

____

____

(1)

(e) The gas produced during the investigation is carbon dioxide.

The test for carbon dioxide uses limewater.

What is the chemical name for limewater?

Tick (✓) **one** box.

Calcium hydroxide solution ☐

Potassium carbonate solution ☐

Sodium chloride solution ☐

(f) The student measured the volume of gas collected every 30 seconds for 3 minutes.

The volume of gas was zero at the start.

For one concentration of hydrochloric acid, the volumes of gas collected were:

43 cm^3 66 cm^3 78 cm^3 83 cm^3 84 cm^3 85 cm^3

Complete the table below.

You should:

- add headings to each column
- add units
- add all of the results to the table.

0	0

(4)

(g) The student used a different concentration of hydrochloric acid.

18 cm^3 of gas was collected in the first 30 seconds.

Calculate the mean rate of reaction for the first 30 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas collected in cm}^3}{\text{time taken in seconds}}$$

Choose the unit from the box.

cm^3	**cm^3/s**	**s**	**s/cm^3**

____

____

____

Mean rate of reaction = ____________________ Unit _______________

(3)

(h) Increasing the concentration of hydrochloric acid increases the rate of the reaction.

What are **two** reasons why?

Tick (✓) **two** boxes.

The particles are closer together.	☐
The particles collide more frequently.	☐
The particles have a lower surface area.	☐
The particles have less energy.	☐
The particles move faster.	☐

(2)
(Total 14 marks)

Week 6 – GCSE Style Questions

Q1.

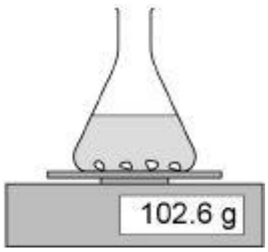
A student investigated the effect of the size of marble chips on the rate of the reaction between marble chips and hydrochloric acid.

This is the method used.

1. Add 10.0 g of marble chips into the flask.
2. Add 50 cm^3 of hydrochloric acid and start a timer.
3. Record the mass lost from the flask every 10 seconds.
4. Repeat steps 1 to 3 with different sizes of marble chips.

Figure 1 shows the apparatus.

Figure 1



(a) Draw **one** line from each type of variable to the correct example of the variable.

Type of variable	Example of variable
	Mass lost from flask
Independent	Size of flask
	Size of marble chips
Control	Time taken
	Volume of acid

(2)

(b) The equation for the reaction is:

$$CaCO_3(s) + 2HCl(aq)\ CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Name the **three** products.

1. ________________________________

2. ________________________________

3. ________________________________

(2)

(c) Another student suggests putting some cotton wool in the top of the flask.

Suggest why this improves the investigation.

____

____

(1)

(d) The reaction produces 1.6 g of gas in 30 seconds.

Calculate the mean rate of the reaction in the first 30 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{mass of product produced in grams}}{\text{time in seconds}}$$

____

____

Mean rate of reaction = __________________________

(1)

(e) What is the unit for the mean rate of reaction calculated in part **(d)**?

Tick **one** box.

g ☐ g/s ☐ s ☐ s/g ☐

(1)

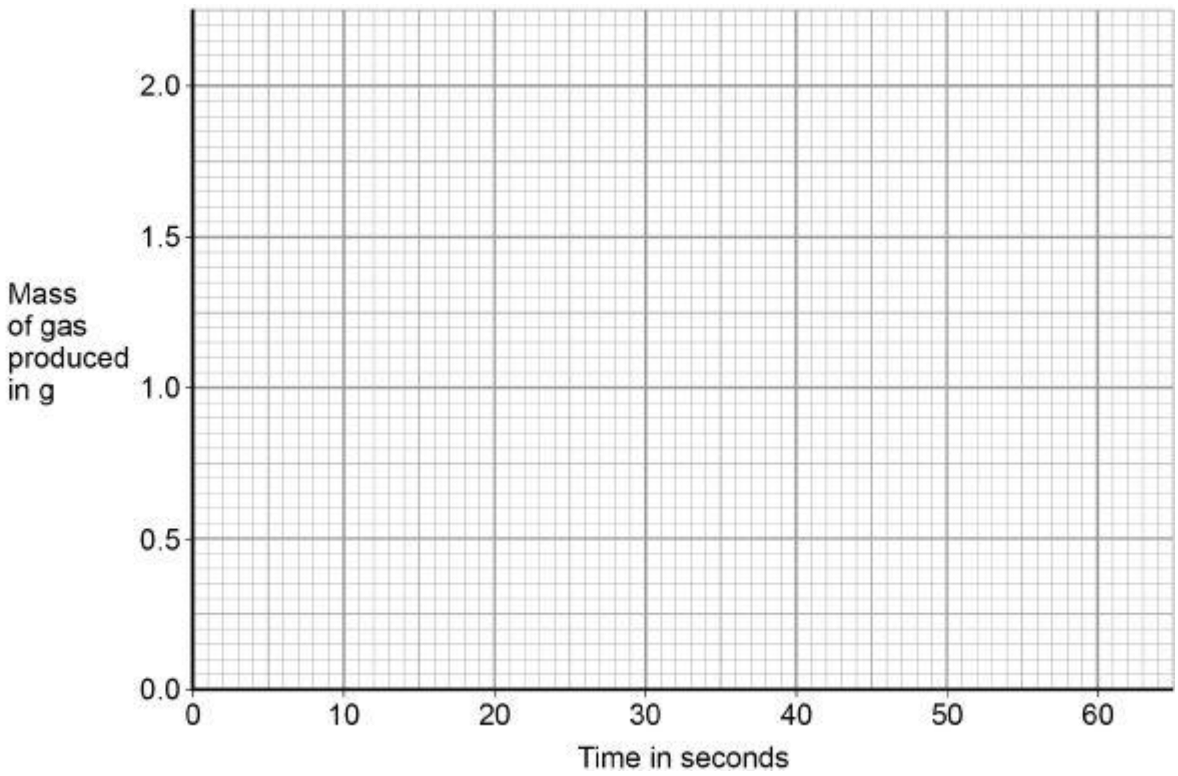
(f) The table below shows the student's results.

Time in seconds	**Mass of gas produced in g**
0	0.0
10	0.8
20	0.6
30	1.6
40	1.8
50	2.0
60	2.0

Plot the data from the table above on **Figure 2**

Draw a line of best fit.

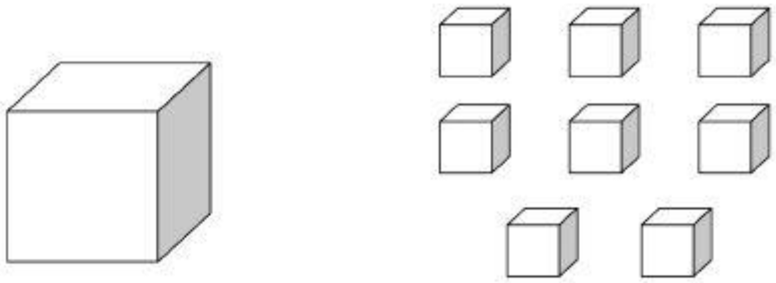
Figure 2



(3)

(g) **Figure 3** shows a large marble chip and eight small marble chips.

Figure 3



Large marble chip   Eight small marble chips

The large marble chip has the same total volume as the eight small marble chips, but a different surface area.

Why do the eight small marble chips react faster than the large marble chip?

Tick **one** box.

The eight small marble chips have a larger surface area, so less frequent collisions.	☐
The eight small marble chips have a larger surface area, so more frequent collisions.	☐
The eight small marble chips have a smaller surface area, so less frequent collisions.	☐
The eight small marble chips have a smaller surface area, so more frequent collisions.	☐

(1)
(Total 11 marks)