Rate of Reaction – Revision Pack (C3)

Rate of Reaction: Concentration:

- Rate of reaction can be increase by increasing the concentration
- As the concentration increases the particles become more crowded. This will increase the number of successful collisions between the reacting particles per second
- More collision per second means more successful collisions
- This will result in an increased rate of reaction

Rate of Reaction: Temperature:

- As the temperature increases the particles gain KINETIC ENERGY (move more) and move around more quickly
- Therefore particles will collide more frequently with more energy resulting in more collisions per second and therefore more successful collisions resulting in increased rate of reaction

Rate of Reaction: Surface Area:

- As the surface area increases, the particles are more exposed, as such, more collisions are possible
- This increases the rate of reaction because more particles are available to react → increased availability = quicker rate of reaction

Rates of Reaction: GAS:

- You can only increase the pressure if the reactants are gases
- The reacting particles are squished together. This increases collisions frequency per second which means increased number of successful collisions and therefore increased rate of reaction

To Calculate Rate of Reaction: calculate the gradient of a select part of a graph → **y** divided by **x**

A **limiting reactant** is the reactant not is excess; it is the first reactant be used up and limits the continuation of the chemical reaction.

Rate of Reaction – Revision Pack (C3)

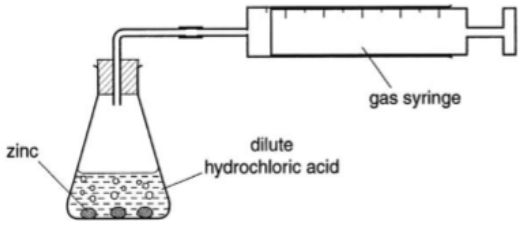
Past Paper Questions:

PPQ(1)

7 Colin and Ann investigate the reaction between zinc lumps and hydrochloric acid.

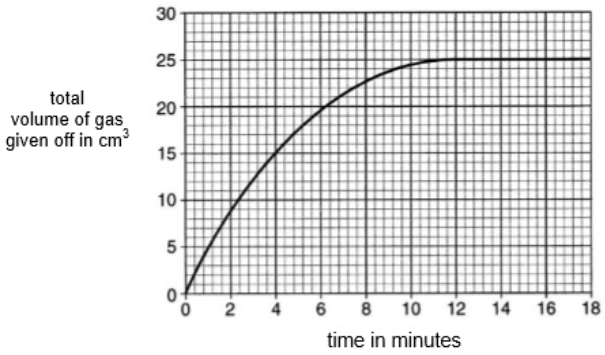
Hydrogen and a solution of zinc chloride are made.

The diagram shows the apparatus they use.



Look at the graph.

It shows their results when 1 g of zinc lumps reacts with 20 cm^3 of dilute hydrochloric acid.



(a) How long does it take for the reaction to stop?

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

(b) **(i)** Calculate the average rate of reaction during the first 4 minutes.

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

.....

answer.....unit ..... **[2]**

(ii) How does the average rate of reaction for the first 4 minutes compare to the average rate between 4 and 8 minutes?

Show how you calculated your answer.

.....

.....

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

13

(c) Colin and Ann want the reaction to go faster.

They do not want to change the volume of acid or mass of zinc.

They say that they could:

- increase the temperature of the hydrochloric acid
- increase the concentration of the hydrochloric acid
- use powdered zinc instead of lumps of zinc.

Explain, using the reacting particle model, why **two** of these methods increase the rate of this reaction.

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

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

[Total: 10]

2011 Specimen Paper – B3 C3 P3

PPQ(2)

6 Christina investigates the reaction between magnesium and hydrochloric acid.

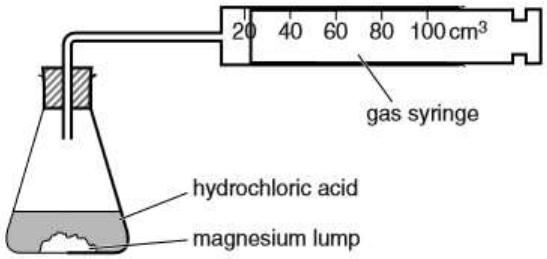
Magnesium chloride and hydrogen are made.

(a) Write down the **balanced symbol** equation for this reaction.

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

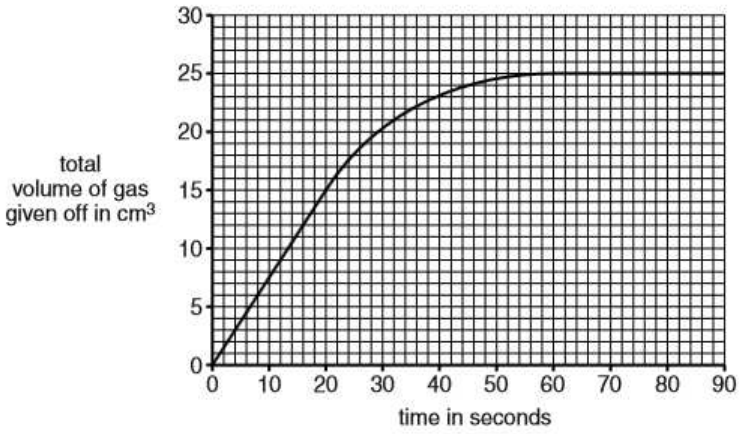
(b) Look at the diagram.

It shows the apparatus Christina uses.



She measures the volume of gas in the syringe every 10 seconds.

Look at the graph. It shows her results.



(i) At what time did the reaction finish?

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

(ii) Calculate the **rate of reaction** for this reaction during the time interval **0 – 20 seconds**.

.....

.....

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

(c) Christina repeats the experiment.

This time she uses **powdered** magnesium.

The reaction is much faster.

Use ideas about the collision theory model to explain why.

.....

.....

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

[Total: 6]

May 2012 OCR Gateway Paper – B3 C3 P3

PPQ(3)

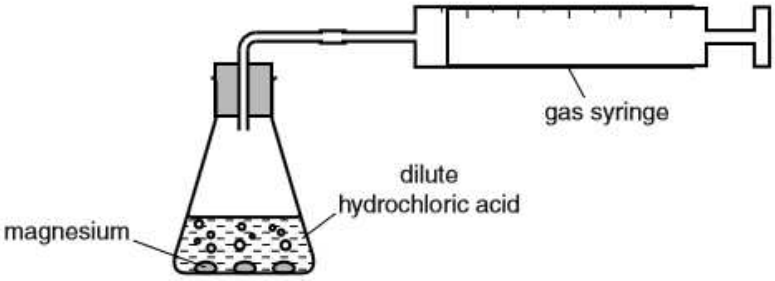
8 Jan and Mike investigate the reaction between magnesium lumps and hydrochloric acid, HCl.

Magnesium chloride solution, $MgCl_2$, and hydrogen gas, H_2, are made.

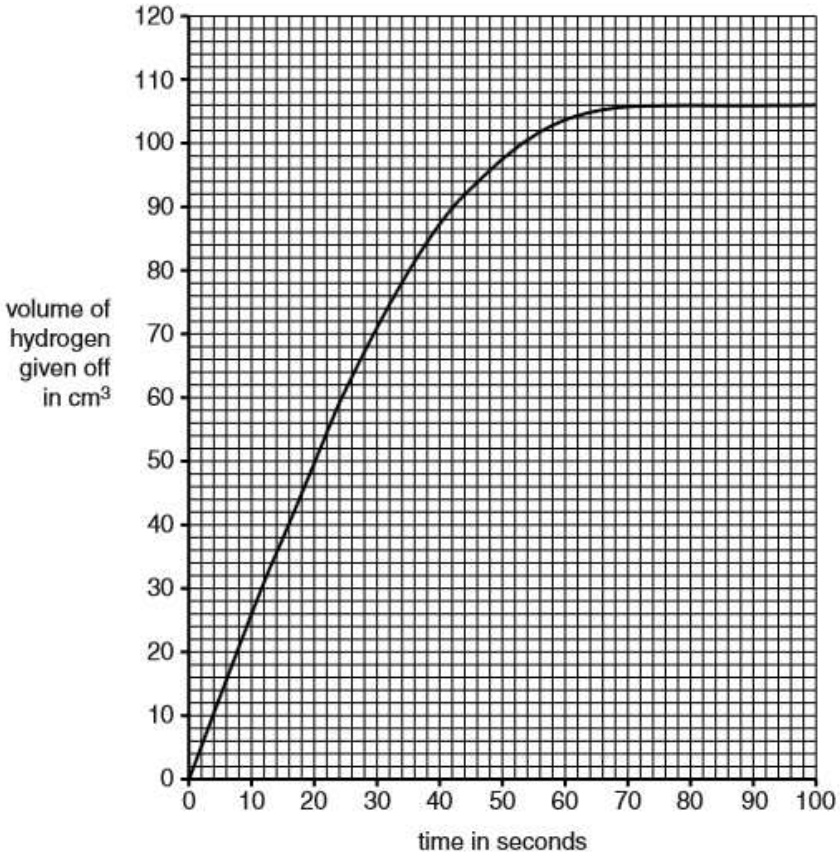
(a) Write a **balanced symbol** equation for this reaction.

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

(b) Look at the diagram. It shows the apparatus they use.



Look at the graph of their results



(i) What volume of gas is made when the reaction has finished?

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

(ii) Calculate the rate of reaction during the first 20 seconds.

.....

.....

.....

rate of reaction = ... **[2]**

(c) Increasing the temperature of the hydrochloric acid increases the rate of the reaction.

Use the reacting particle model to explain why.

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

(d) Breaking the lumps of magnesium into a **powder** increases the rate of the reaction.

Use the reacting particle model to explain why.

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

[Total: 10]

January 2013 OCR Gateway Paper – B3 C3 P3

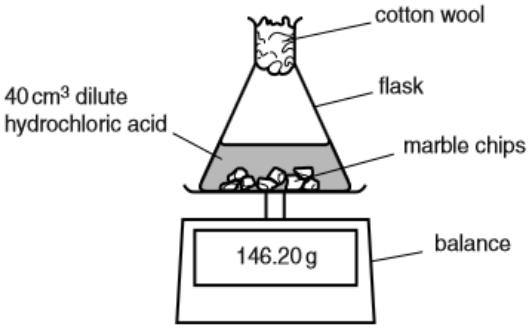
5 This question is about rates of reaction.

Julie and Trevor investigate the reaction between marble chips (calcium carbonate) and dilute hydrochloric acid.

They use 20.0 g of marble chips and 40 cm^3 of dilute hydrochloric acid.

The temperature of the acid is 25 °C.

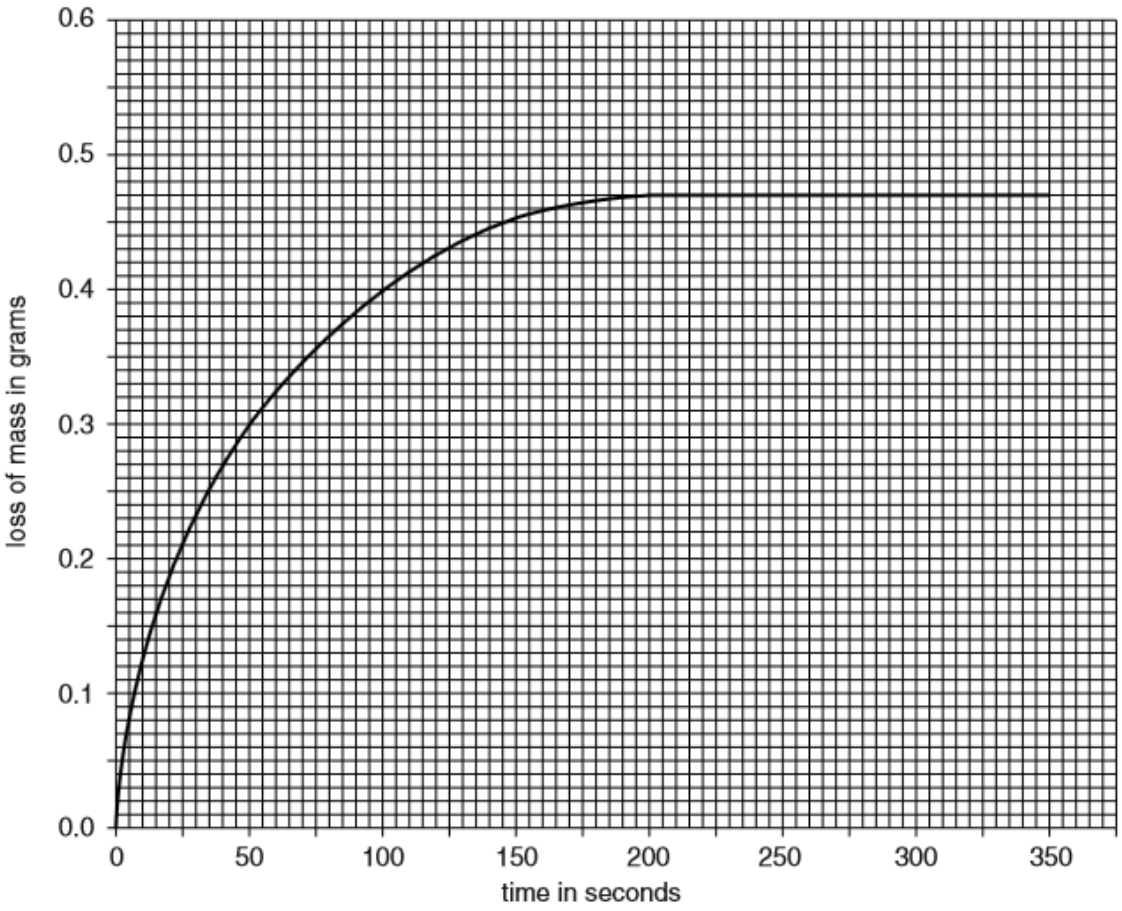
Look at the diagram. It shows the apparatus they use.



They measure the mass every 50 seconds until the reaction stops.

They calculate the loss in mass.

Look at the graph on the next page.



(a) How long does it take for the reaction to stop?

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

(b) Some marble chips are still left at the end of the experiment.

The hydrochloric acid is the **limiting reactant**.

What is meant by the limiting reactant?

.....

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

(c) Julie and Trevor repeat the experiment using 20.0 g of **larger** marble chips.

They use the same volume of hydrochloric acid at the same temperature.

On the grid sketch the curve they would get using the larger marble chips. **[2]**

(d) Julie and Trevor can increase the rate of reaction between marble chips and hydrochloric acid by:

- increasing the concentration of the hydrochloric acid
- increasing the temperature of the hydrochloric acid.

Explain, in terms of the reacting particle model, why both these methods increase the rate of this reaction.

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

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

[Total: 10]

June 2013 OCR Gateway Paper – B3 C3 P3

Rate of Reaction – Revision Pack (C3)

Mark Schemes:

PPQ(1):

No mark scheme available

PPQ(2):

Question			Answer	Marks	Guidance
6	(a)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ formulae correct (1) balancing (1)	2	balancing mark is conditional on correct formulae **allow** = instead of → **allow** multiples **allow** one mark for correct balanced equation with minor errors e.g. Mg + 2HCl → MgCl2 + H2
	(b)	(i)	54-58(s) (1)	1	
		(ii)	0.75 (cm^3/s) (1)	1	
	(c)		powered magnesium has a greater (surface) area (1) therefore greater frequency of collisions (between magnesium and hydrochloric acid particles) (1)	2	**allow** greater frequency / chance of collisions / more collisions per second / rate of collisions faster / collisions more likely (1) **ignore** just more collisions / more successful collisions **ignore** references to energy of reaction
			Total	**6**	

PPQ(3):

Question			Answer	Marks	Guidance
8	**(a)**		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **but** **allow** one mark for balanced equation with minor errors of subscripts, superscripts, etc eg MG + 2HCl → MgCl2 + H^2 **not** and or & for + **allow** = instead of → **allow** correct multiples eg $2Mg + 4HCl \rightarrow 2MgCl_2 + 2H_2$
	(b)	**(i)**	106 (cm^3)	1	
		(ii)	2.5 cm^3 / s scores (2) but if answer incorrect then 50 scores (1) 20	2	allow answers in range 2.45 – 2.55 2.5 with no units or incorrect units scores 1 **allow** 150cm^3 / min (2) 49 to 51 (1) 20 20
	(c)		idea that (acid) particles move faster or have more energy (1) idea that there are more (frequent) collisions (between acid and magnesium particles) (1) **but** idea that there are more successful / energetic / effective / harder collisions (between acid and magnesium particles) (2)	3	**ignore** vibrate more **allow** more chance of a collision **ignore** faster collisions all marking points are comparative
	(d)		more surface area (on magnesium) (1) more (frequent) collisions (between acid and magnesium particles) (1)	2	**allow** reverse argument for lumps / more particles exposed (on the surface) **allow** collisions are more likely **allow** reverse argument for lumps all marking points are comparative
			Total	**10**	

PPQ(4):

Question			Answer	Marks	Guidance
5	(a)		200 (seconds) (1)	1	**allow** any answer in range 190–200 seconds (1) **ignore** units
	(b)		reactant not in excess/reactant that is all used up (at the end of the reaction)/reactant that is used up first (1)	1	**ignore** only lasts a limited time
	(c)		gradient of new curve less steep than original curve, but still passes through origin (1) levels out at 0.47g (1)	2	 the line **must not** go above 0.47g

Question			Answer	Marks	Guidance
	(d)		**[Level 3]** **Applies knowledge and understanding of reacting particle model to explain <u>both</u> factors in detail although the reference to more collisions may only be made for one of the factors.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **Applies knowledge and understanding of reacting particle model to explain one of the factors in detail <u>or</u> partially explain both factors** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** **Appreciation that the rate of any reaction depends on the number of collisions in whatever context it is used** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to C** At all levels **ignore** reference to faster collisions and to more particles and **ignore** particles vibrate more **allow** answers that give ora but it must be very clear that this is what candidate has done **Indicative scientific points at levels 2 and 3 may include:** <u>rate increases with **temperature** because</u> • acid particles move faster/acid particles have more energy • more collisions between particles of acid and marble – this does not have to be qualified eg more (successful) collisions or more collisions (per second) **allow** – higher level answers for temperature that refer to more acid particles having sufficient energy to react or more acid particles having energy above that of the activation energy **concentration of hydrochloric acid:** • idea of more crowded acid particles/more acid particles in same volume • more collisions between particles of acid and marble – this does not have to be qualified eg more (successful) collisions or more collisions (per second) **ignore** references to 'more particles' **Indicative scientific points at level 1 may include:** • more collisions gives a faster reaction even if referring to particle size or pressure • link between number of collisions and rate of reaction **Use L1, L2, L3 annotations in scoris; do not use ticks.**
			Total	**10**	