

**Home learning activities**

Subject
Science
Year Group
Year 8
Unit of work / Knowledge organiser
Rates of Reaction
Activities
<ul style="list-style-type: none"><li>• Complete the 'Knowledge Check' by clicking on the link below (Mr Tobin has also emailed this link out to you): <a href="https://forms.office.com/Pages/ResponsePage.aspx?id=tWqUKrjGMEuM3bZvypd0-1JR5WsjulFPvbjl4VXu0Y1UNzZXWVBLU0Y4SDAyOTAxNFg4NzBRR0VXMy4u">https://forms.office.com/Pages/ResponsePage.aspx?id=tWqUKrjGMEuM3bZvypd0-1JR5WsjulFPvbjl4VXu0Y1UNzZXWVBLU0Y4SDAyOTAxNFg4NzBRR0VXMy4u</a></li><li>• Read through the Sections of the 'Knowledge Organiser' on 'Rates of Reaction'.</li><li>• Make careful and detailed notes on the Sections of the 'Knowledge Organiser' on 'Rates of Reaction', including writing out the details from the Sections on 'Collision Theory'.</li><li>• Describe, in your own words, why 'temperature' affects the rate of a reaction, without looking at your earlier notes from the 'Factors affecting rate' Section.</li><li>• Complete 'Rates of Reaction – Activity 1' by filling in the missing words; the answers are provided at the end, but do not look at these until you have tried to complete the work yourself (<b>be strict with yourself here</b>).</li><li>• Complete the 'Rates of Reaction – Activity 2' questions. Use the mark scheme (<b>once you have tried the questions</b>) to mark your answers carefully.</li></ul>
Where do you complete the work?
In Study Books.
What to do if you finish the work? (Extension activity)
<ul style="list-style-type: none"><li>• Complete the exam question on 'Rates of Reaction' using the 'Knowledge Organiser' to help you. Use the mark scheme (<b>once you have tried the question</b>) to mark your answers carefully.</li></ul>

These websites might help:

- BBC Bitesize -> Secondary -> KS3 -> Science -> Chemistry -> Chemical Reactions and Tests -> Types of Reaction

If you are struggling with your work or if you have finished.

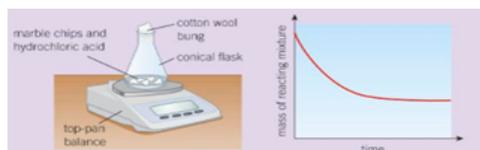
**Please email your classroom teacher directly using the email list found in the Home Learning section of the website.**

# Measuring Rate

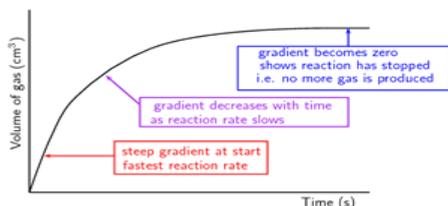
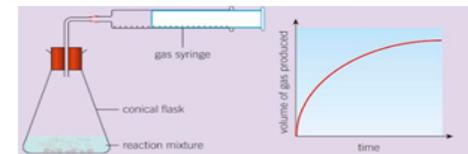
To measure the rate of a reaction you can:

- **Measure how fast the reactants are used up**
- **Measure how fast the products are made**

e.g. Measure mass lost due to gas formed



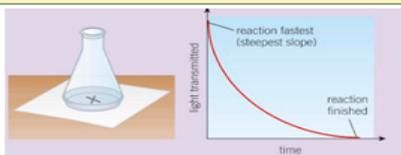
e.g. Measure volume of gas made



Rate = volume of gas ÷ time

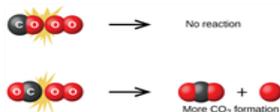
$\text{cm}^3/\text{s}$

e.g. Measure time for insoluble product to form



# Collision theory

For a reaction to happen reactants must: **collide with enough energy (activation energy)**



A successful collision is one that leads to a reaction

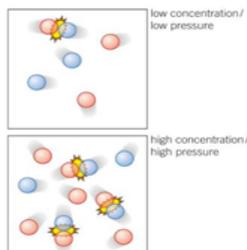
So to increase the rate of a reaction you must either

- **Increase the frequency of collisions**
- **Increase the energy of the collisions**
- **Decrease the energy needed for a collision to be successful**

# Factors affecting rate

## Concentration and Pressure

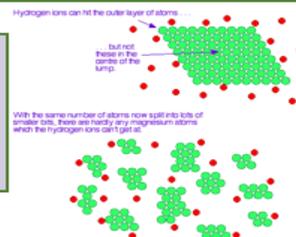
**More particles in the same space. More frequent collisions**



# YR8 Rates of reaction

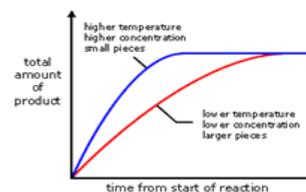
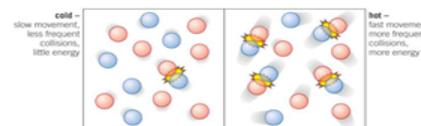
## Surface area

**More particles available to react. More frequent collisions**



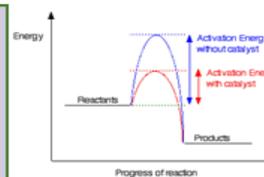
## Temperature

Particles **move faster**. So they **collide more frequently**. Particles collide **with more energy**. So more of the collisions are **successful**.

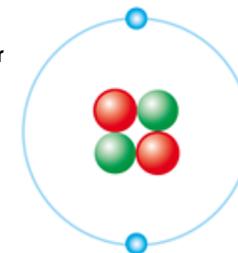


## Catalysts

**Lower the energy needed for successful collisions. (Activation energy) Not used up. Biological catalysts are called enzymes**



**4. Atomic (proton) number** is the number of protons in an atom.



**Mass number** is the number of

	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Carbon	6	12	6	6	6
Fluorine	9	19	9	9	10
Sodium	11	23	11	11	12

**Isotopes** of an atom have the same number of protons and electrons, but a different number of neutrons. **The relative atomic mass ( $A_r$ )** is the mass of the different isotopes of an element.

$$A_r = (\text{Mass } \% \text{ of isotope 1}) + (\text{Mass } \% \text{ of isotope 2})$$

100

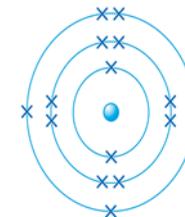
**Electrons occupy shells:**

1st shell = 2 electrons

2nd shell = 8 electrons

3rd shell = 8 electrons

The electron structure can be numbered. Eg.



If an atom loses an electron it becomes charged. The charged par-

## The structure of the atom

	Relative charge	Relative Mass
Electron	-1	0.0005
Proton	+1	1
Neutron	0	1

## Rates of Reaction – Activity 1

- 1 There are four main factors that affect the rate of reaction. These are:
- a) C..... . This is a measure of how crowded the particles are in a solution and the frequencies of c..... .
  - b) S..... a..... . This is a measure of how much solid is exposed to reaction and therefore how many c..... take place.
  - c) T..... . This affects the energy of the particles and how quickly they c..... . It also affects the f..... with which the particles collide. The energy required for any reaction to take place is called the a..... energy for that reaction.
  - d) The presence of a c..... . These speed up a chemical reaction but is u..... chemically. They work by lowering the activation e..... for the reaction.

## Rates of Reaction – Activity 1 – Answers

- 1 There are four main factors that affect the rate of reaction. These are:
- e) **concentration** . This is a measure of how crowded the particles are in a solution and the frequencies of **collisions**
  - f) **Surface area** . This is a measure of how much solid is exposed to reaction and therefore how many **collisions** take place.
  - g) **Temperature**. This affects the energy of the particles and how quickly they **collide**. It also affects the **frequency** with which the particles collide. The energy required for any reaction to take place is called the **activation** energy for that reaction.
  - h) The presence of a catalyst . These speed up a chemical reaction but is **unused** chemically. They work by lowering the **activation energy** for the reaction.

## Rates of Reaction – Activity 2

1. Using data from the table, when did the reaction stop? (Chose an answer from below)

Time / s	Volume of gas / cm <sup>3</sup>
0	0
20	20
40	34
60	38
80	40
100	40

60 s   80 s   100 s

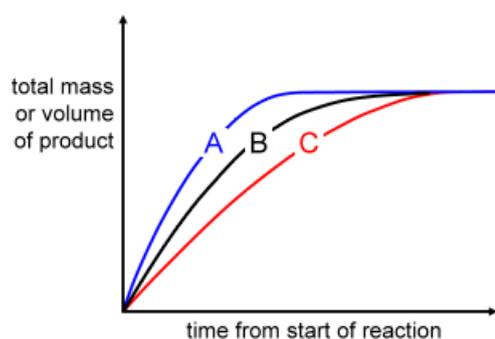
2. Using data from the table, what was the mean rate of reaction? (Chose an answer from below)

2 cm<sup>3</sup>/s   0.4 cm<sup>3</sup>/s   0.5 cm<sup>3</sup>/s

3. Why does reaction rate increase as the temperature increases? (Chose an answer from below)

- Particles begin to collide at higher temperatures
- At higher temperatures particles move faster and collide more often
- There are more particles at higher temperatures, so they collide more

4. Which line represents the fastest reaction? (A, B or C)



5. Why does reaction rate increase as the concentration increases? (Chose an answer from below)

- The particles have more energy so there are more collisions
- There are more particles so there are more collisions
- The surface area is increased so there are more collisions

6. Which of the following statements about collisions is correct? (Chose an answer from below)

- All colliding particles have the same amount of energy
- Only fast-moving particles collide with each other
- Reactions can happen if the colliding particles have enough energy

7. A successful collision is one in which: (Chose an answer from below)

- The particles hit each other
- Enough energy is transferred for particles to react
- Enough energy is transferred for particles to bounce off each other

## Rates of Reaction – Activity 2 – Answers

1. Using data from the table, when did the reaction stop? (Chose an answer from below)

Time / s	Volume of gas / cm <sup>3</sup>
0	0
20	20
40	34
60	38
80	40
100	40

80 s

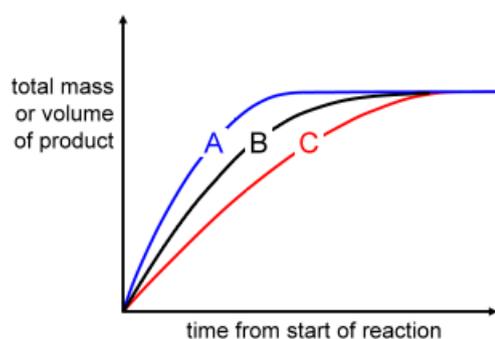
2. Using data from the table, what was the mean rate of reaction? (Chose an answer from below)

$$40\text{cm}^3 / 80\text{s} = 0.5 \text{ cm}^3/\text{s}$$

3. Why does reaction rate increase as the temperature increases? (Chose an answer from below)

- 
- At higher temperatures particles move faster and collide more often
- 

4. Which line represents the fastest reaction? (A, B or C)



A

5. Why does reaction rate increase as the concentration increases? (Chose an answer from below)

- 
- There are more particles so there are more collisions
- 

6. Which of the following statements about collisions is correct? (Chose an answer from below)

- Reactions can happen if the colliding particles have enough energy

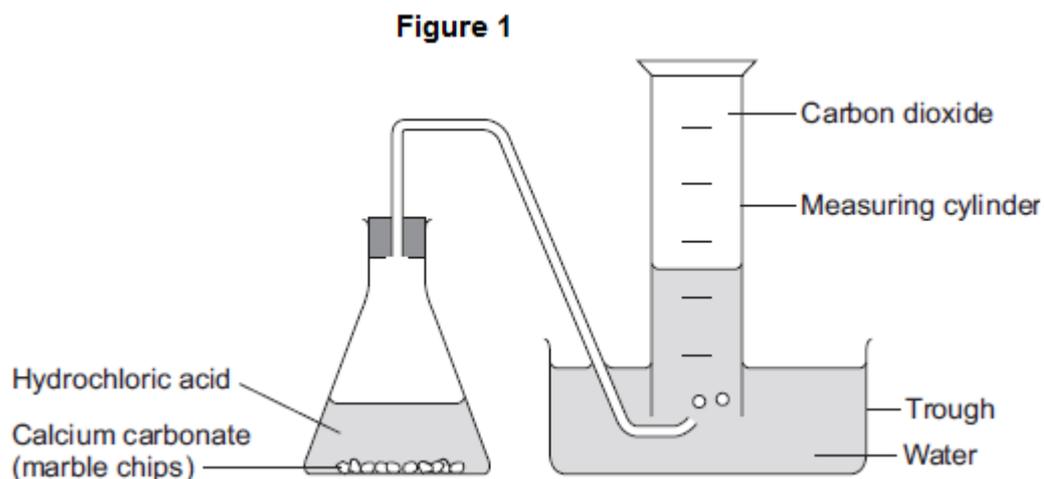
7. A successful collision is one in which: (Chose an answer from below)

- 
- Enough energy is transferred for particles to react
-

## Rates of Reaction – Exam-Style Question

**Q1.** A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student used the apparatus shown in **Figure 1**.



The student:

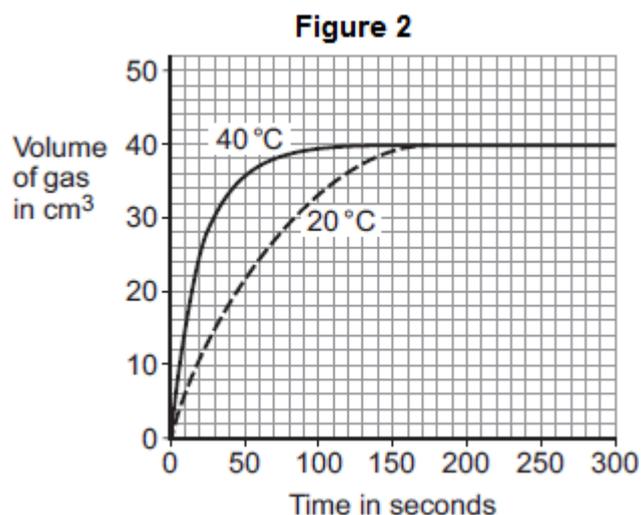
- recorded the volume of gas collected every 5 seconds
- repeated the experiment using hydrochloric acid at different temperatures.

The equation for the reaction is:



(a) The student plotted results for the hydrochloric acid at 20 °C and 40 °C on a graph.

**Figure 2** shows the student's graph.



Use information from **Figure 2** to answer these questions.

- (i) State **one** conclusion the student could make about the effect of temperature on the rate of the reaction.

.....  
 .....

(1)

- (ii) Give **one** reason why the student could make this conclusion.

.....  
 .....

(1)

- (iii) For the hydrochloric acid at 60 °C the student had collected 30 cm<sup>3</sup> after 15 seconds.

Calculate the average rate of reaction from 0 to 15 seconds.

.....  
 .....

Rate of reaction = ..... cm<sup>3</sup> per second

(1)

- (b) The student then investigated how the surface area of marble chips affected the rate of reaction.

- (i) Which **two** variables should the student keep constant?

Tick (✓) **two** boxes.

Amount of water in the trough

Concentration of acid

Mass of marble chips

Size of marble chips

Volume of measuring cylinder

(2)

- (ii) Explain, in terms of particles and collisions, the effect that increasing the surface area of the marble chips has on the rate of reaction.

.....  
.....  
.....  
.....

**(2)**

- (c) Calcium carbonate is a catalyst for the industrial production of biodiesel.

Give **one** reason why using a catalyst reduces costs.

.....  
.....

**(1)**

**(Total 8 marks)**

## Rates of Reaction – Exam-Style Question – Answers

- M1.**
- (a) (i) the higher the temperature, the greater the rate  
**or**  
 at 40 °C rate is faster than at 20 °C  
*accept the higher the temperature, the faster the reaction* 1
- (ii) 40 °C curve is steeper  
*accept the 40 °C line becomes horizontal sooner*  
*accept at higher temperatures the reaction finishes sooner*  
*accept reaction finishes sooner at 40 °C*  
*accept at higher temperatures the gas is produced faster*  
**or**  
 correct comparison of data from the graph 1
- (iii) 2 1
- (b) (i) Concentration of acid  
 Mass of marble chips 2
- (ii) increases rate  
*incorrect reference to energy = max 1* 1
- (because of) more frequent collisions (between particles)  
*accept particles are more likely to collide*  
*ignore more collisions*  
*ignore more successful collisions* 1
- (c) any **one** from:  
 • increases rate of reaction  
 • reduces energy required  
 • lower temperature can be used  
 • catalyst is not used up. 1

[8]