

**Paper 2 Chapter 6 — Rate and Extent of Chemical Change**

**Reversible Reactions**



Add a symbol to show the above reaction is reversible.

What is a reversible reaction?

The direction of a reversible reaction can be changed by changing the r \_\_\_\_\_ c \_\_\_\_\_.



If heat favours the forward reaction what conditions must favour the backward reaction?

**Rate of Reaction**

Give 2 equations that can be used to find the mean rate of reaction.

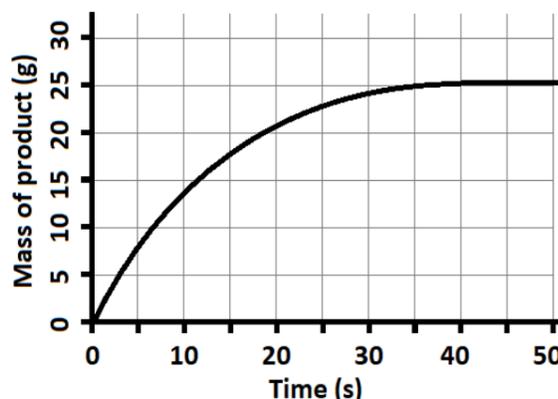
- mean rate of reaction =
- mean rate of reaction =

The amount of a substance could be recorded as either \_\_\_\_ in grams, \_\_\_\_ in cm<sup>3</sup> (or moles HT Only).

The units for rate of reaction could therefore be either \_\_\_\_ or \_\_\_\_ (or \_\_\_\_ HT Only).

Using the graph

- What is the total mass of product is produced in the reaction?
- At what time does the reaction end?
- What is the mean rate of reaction over the first 40s?
- Draw a tangent on the graph to show the rate at 10s.
- (HT Only) calculate the gradient of the tangent to find the rate of reaction at 10s.



**Collision Theory**

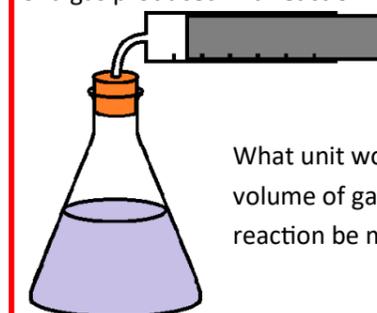
According to Collision Theory, chemical reactions can occur only when particles \_\_\_\_\_ with each other and have enough \_\_\_\_\_ to react. The minimum energy that particles must have to react is called the \_\_\_\_\_.

Give 5 ways to increase the rate of reaction and use collision theory explain each rate increase.

Method	Explanation
Use a catalyst	Reduces activation energy so more successful collisions
Increase _____ of gases	
Increase _____ of solutions	
In solids increase the _____	
_____ the temperature	Reason 1 - Reason 2 -

**Measuring Rate of Reaction**

Label equipment used to measure the volume of a gas produced in a reaction.

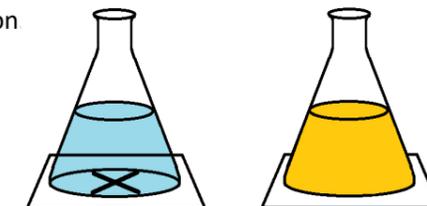


What unit would the volume of gas and rate of reaction be measured in?

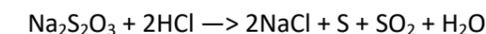
How would the equipment be changed to measure the mass of gas produced?

**Measuring Rate of Reaction**

Equipment to measure change in turbidity in a reaction



What is turbidity?



Why does the solution go turbid?

How can you improve the accuracy of results?

**(HT) Changing Equilibrium**

“If a change is made to the conditions of a system at equilibrium, the system will respond to counteract the change.” L\_ C \_\_\_\_\_’s Principle

Which of the following are possible at equilibrium

- Mostly reactants few products
- Mostly products few reactants
- Equal amounts of reactants and products

Give 3 reaction conditions that effect the equilibrium position.

- 
- 
- 

What effect do catalysts have on the equilibrium position?

**(HT) Temperature and Equilibrium**

In system at equilibrium, increasing the temperature will increase the amount of product for the endothermic reaction and \_\_\_\_\_ the amount of product for the exothermic reaction. Decreasing the temperature will \_\_\_\_\_ the amount of product in the endothermic reaction and \_\_\_\_\_ the amount of product for the \_\_\_\_\_ reaction.

**(HT) Pressure and Equilibrium**

For reactions involving \_\_\_\_\_ the equilibrium position can be shifted by changing the pressure. Increasing the pressure shifts the equilibrium position to the side with the \_\_\_\_\_ number of molecules, decreasing the pressure shifts the equilibrium position to the side with the \_\_\_\_\_ number of molecules.



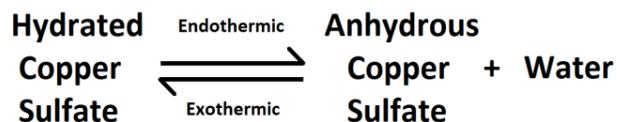
Increasing the pressure would increase the proportion of \_\_\_\_ .  
Decreasing the pressure would increase the proportion of \_\_\_\_ and \_\_\_\_ .

**(HT) Concentration and Equilibrium**

If the concentration of one substance in a reaction a equilibrium is changed the reaction is no longer at \_\_\_\_\_. The concentration of the other substances will than change until equilibrium is reached again. To increase the amount of product in a reaction you could increase the concentration of the \_\_\_\_\_ or decrease the concentration of the \_\_\_\_\_.

**Energy and Reversible Reactions**

If a reversible reaction is exothermic in one direction it must be \_\_\_\_\_ in the other direction. The energy released in the exothermic direction must be (higher than/equal to/lower than) the energy absorbed in the endothermic direction.



Which is correct? Equilibrium is reached when the ...

- ... mass of the products equals the mass of the reactants.
- ...forward reaction is at the same rate as the backwards reaction.

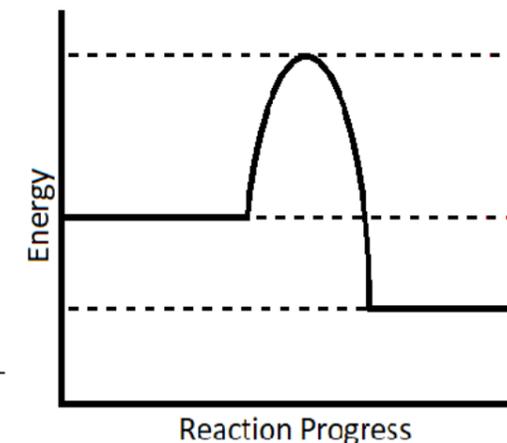
**Catalysts**

- Different reactions need (stronger/more concentrated/the same/different) catalysts.
- Catalysts (increase/reduce) the rate of chemical reactions.
- They (are/are not) used up in the reaction
- They (are/are not) included in the equation for the reaction.
- A Biological Catalyst is called an \_\_\_\_\_.

The reaction shown has no catalyst

Add a line to show the reaction with a catalyst

Label the activation energy with and without a catalyst



## Paper 2 Chapter 6 — Rate and Extent of Chemical Change

### Reversible Reactions



Add a symbol to show the above reaction is reversible.

What is a reversible reaction?

When the products can react to produce the original reactants.

The direction of a reversible reaction can be changed by changing the reaction conditions.



If heat favours the forward reaction what conditions must favour the backward reaction?

Cool conditions

### Rate of Reaction

Give 2 equations that can be used to find the mean rate of reaction.

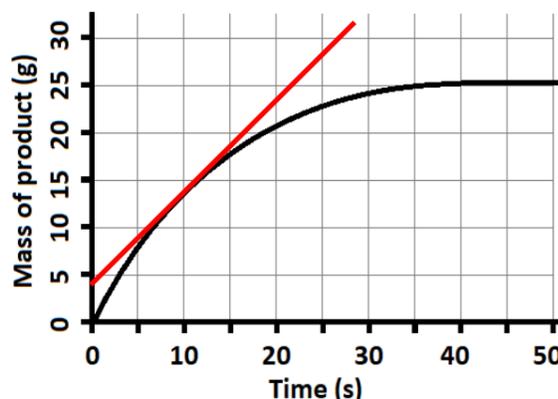
- mean rate of reaction =  $\frac{\text{quantity of reactant used}}{\text{time taken}}$
- mean rate of reaction =  $\frac{\text{quantity of product formed}}{\text{time taken}}$

The amount of a substance could be recorded as either mass in grams, volume in  $\text{cm}^3$  (or moles HT Only).

The units for rate of reaction could therefore be either  $\text{g/s}$  or  $\text{cm}^3/\text{s}$  (or  $\text{mol/s}$  HT Only).

Using the graph

- What is the total mass of product is produced in the reaction? **25g**
- At what time does the reaction end? **40s**
- What is the mean rate of reaction over the first 40s?  $25/40 = 0.63\text{g/s}$
- Draw a tangent on the graph to show the rate at 10s. **On graph**
- (HT Only) calculate the gradient of the tangent to find the rate of reaction at 10s. **0.90-1.00g/s**



### Collision Theory

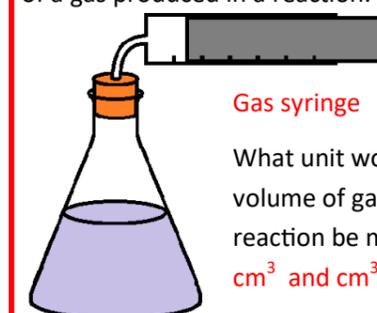
According to Collision Theory, chemical reactions can occur only when particles collide with each other and have enough energy to react. The minimum energy that particles must have to react is called the activation energy.

Give 5 ways to increase the rate of reaction and use collision theory explain each rate increase.

Method	Explanation
Use a catalyst	Reduces activation energy so more successful collisions
Increase pressure of gases	More particles in same area so more collisions
Increase concentration of solutions	More particles in same area so more collisions
In solids increase the surface area	More particles exposed to possible collisions
Increase the temperature	Reason 1 - Particles move faster so more collisions
	Reason 2 - Collisions have more energy

### Measuring Rate of Reaction

Label equipment used to measure the volume of a gas produced in a reaction.



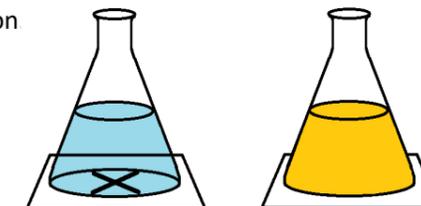
Gas syringe

What unit would the volume of gas and rate of reaction be measured in?  
 $\text{cm}^3$  and  $\text{cm}^3/\text{s}$

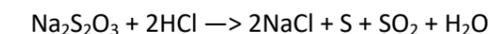
How would the equipment be changed to measure the mass of gas produced? Complete reaction on a balance, record change in mass = mass of gas produced.

### Measuring Rate of Reaction

Equipment to measure change in turbidity in a reaction



What is turbidity? Cloudiness



Why does the solution go turbid? Produces Sulfur which is a solid

How can you improve the accuracy of results? Use the same person to judge when the cross disappears or use a light meter.

### (HT) Changing Equilibrium

"If a change is made to the conditions of a system at equilibrium, the system will respond to counteract the change." Le Chatelier's Principle

Which of the following are possible at equilibrium

- Mostly reactants few products
- Mostly products few reactants
- Equal amounts of reactants and products **All 3**

Give 3 reaction conditions that effect the equilibrium position.

- Temperature
- Pressure
- Concentration

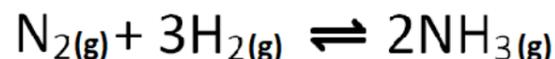
What effect do catalysts have on the equilibrium position? No effect

### (HT) Temperature and Equilibrium

In system at equilibrium, increasing the temperature will increase the amount of product for the endothermic reaction and decrease the amount of product for the exothermic reaction. Decreasing the temperature will decrease the amount of product in the endothermic reaction and increase the amount of product for the exothermic reaction.

### (HT) Pressure and Equilibrium

For reactions involving gases the equilibrium position can be shifted by changing the pressure. Increasing the pressure shifts the equilibrium position to the side with the smaller number of molecules, decreasing the pressure shifts the equilibrium position to the side with the larger number of molecules.



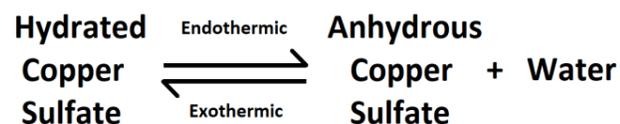
Increasing the pressure would increase the proportion of  $\text{NH}_3$ .  
Decreasing the pressure would increase the proportion of  $\text{N}_2$  and  $\text{H}_2$ .

### (HT) Concentration and Equilibrium

If the concentration of one substance in a reaction a equilibrium is changed the reaction is no longer at equilibrium. The concentration of the other substances will than change until equilibrium is reached again. To increase the amount of product in a reaction you could increase the concentration of the reactants or decrease the concentration of the products.

### Energy and Reversible Reactions

If a reversible reaction is exothermic in one direction it must be endothermic in the other direction. The energy released in the exothermic direction must be (higher than/equal to/lower than) the energy absorbed in the endothermic direction.



Which is correct? Equilibrium is reached when the ...

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### Catalysts

- Different reactions need (stronger/more concentrated/the same/different) catalysts.
- Catalysts (increase/reduce) the rate of chemical reactions.
- They (are/are not) used up in the reaction
- They (are/are not) included in the equation for the reaction.
- A Biological Catalyst is called an enzyme.

The reaction shown has no catalyst

Add a line to show the reaction with a catalyst

Label the activation energy with and without a catalyst

