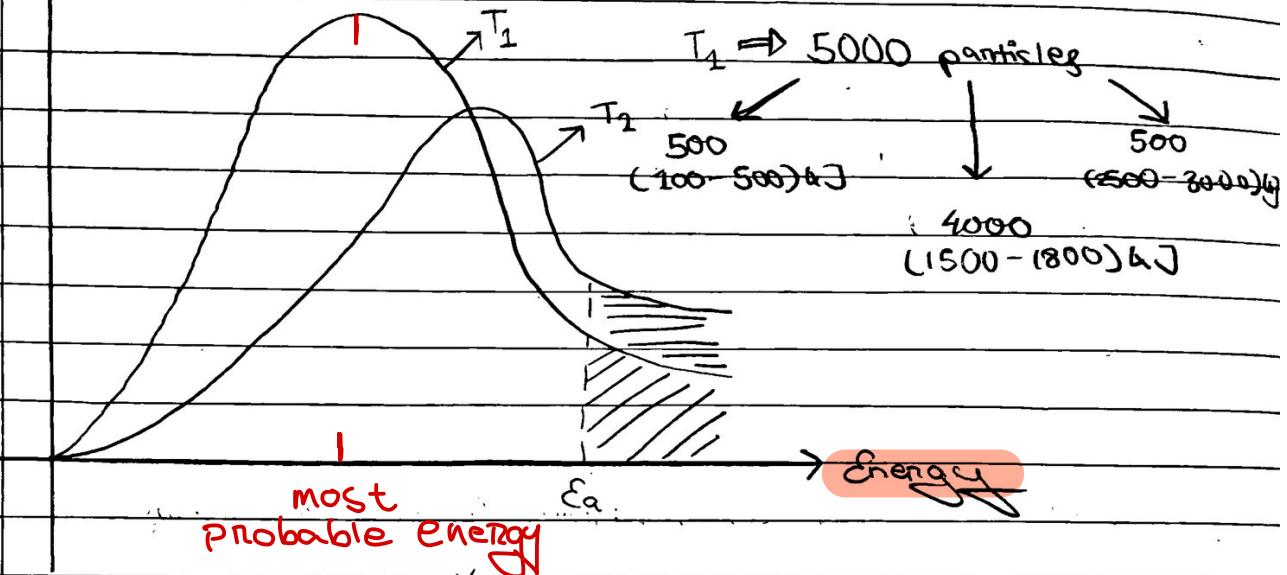


- Assumptions  
(need confirmation)
- Raj bhaiya imp notes
- Stuff I added  
(confirmed)

no. of particles

## Boltzmann Distribution



#  $E_a$  is set by the reaction NOT the reactants.

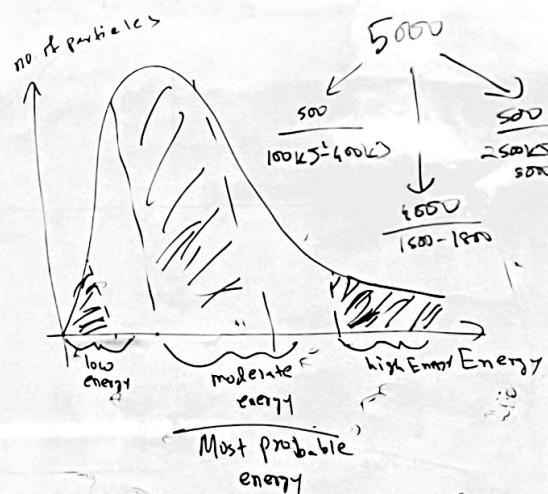
# the peak will also shift to the right.

# Area = number of particles  $\rightarrow$  they both curves have the same area.

# rate of react: Change in the amount of reactant or product per unit time

2, 3, 5, 7, 13, 14, 15, 16, 17, 18, 19, 32, 33 Reaction Kinetics  
Maxwell Boltzmann Distribution Curve

- \* At a fixed temperature, all the particles in an object do not possess same amount of energy. There are few particles with small amount of energy, few particles with large amount of energy and most of the particles have energy in between this large & small values. The graphical representation of this distribution of energy is called Boltzmann distribution curve.



No. of reactant particles



Temperature

$E_a$   $E_a$  (uncatalysed)  
(catalysed)

Energy

What is meant by the terms:  
heterogeneous: different states  
homogeneous: same state

## Type of Catalyst

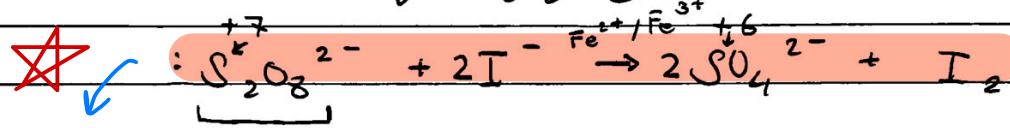
↳ There are 2 types of catalysts

↳ homogenous catalyst: The reactant and the catalyst are in the same state or phase

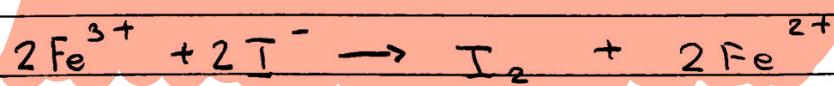
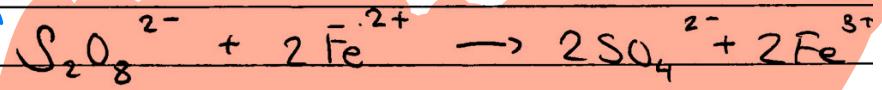
↳ heterogeneous catalyst: The reactant and the catalyst are in different state or phase

## Catalysis

↳ Homogeneous Catalysis: A homogeneous catalyst always catalyzes a reaction by changing its oxidation state.



half of this  
should be  $\text{2SO}_4^{2-}$   
but each  $\text{SO}_4^{2-}$   
going an  $e^-$  from  
 $2\text{Fe}^{2+}$  ion



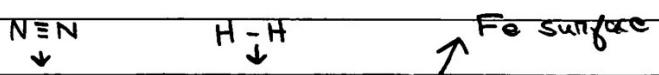
# You must Always use the above example.

# The overall reac<sup>n</sup> must be the same of the base reaction

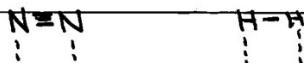
→ Heterogeneous Catalysis: Catalysis occurs over the surface of the catalyst.

→ Haber Process Heterogeneous Catalyst: Steps:

1) Diffusion to the Surface

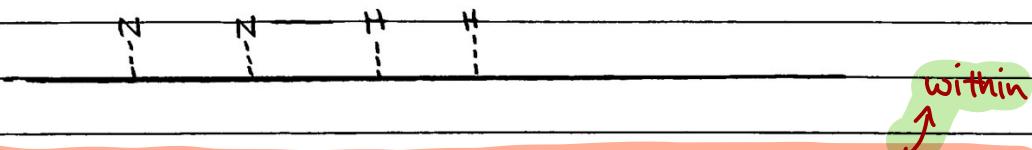


2) Adsorption



The reactant forming bond with the surface of the catalyst  
During formation of this bond, energy is released.

3) Reaction



The energy released is used to break the bond between the separate reactant molecules. Thus the reactant are able to form new bond with each other.

4) Desorption

The energy released during formation of bonds in product molecules is used to break the bond of the product with the surface of the catalyst. Thus, the product can escape the surface and new reactant molecules can diffuse the surface.



# Misc Notes

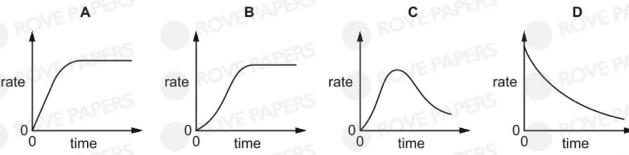
# Most probable energy is the energy value of the peak

## Reaction Kinetics

28

An autocatalytic reaction is a reaction in which one of the products catalyses the reaction.

Which curve would be obtained if the rate of an autocatalytic reaction is plotted against time?



Paper 1 Variant 3 Winter 2016 | Q11

Answer:

C

[Hide Answer](#)

## Redox

18

Sulfur dioxide can be catalytically oxidised by an oxide of nitrogen in the atmosphere.

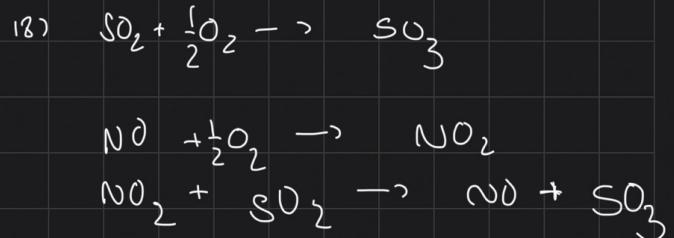
Which reaction shows the regeneration of the catalyst?

- A  $\text{N}_2 + 2\text{O}_2 \rightleftharpoons 2\text{NO}_2$
- B  $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$
- C  $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$
- D  $\text{NO} + \frac{1}{2}\text{O}_2 \rightarrow \text{NO}_2$

Paper 1 Variant 2 Summer 2018 | Q19

Answer:

D

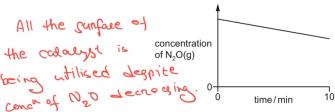


↳ Example of homogenous catalysis (Cannot use this in P2. Must only use  $\text{S}_2\text{O}_8^{2-}$  react)

15 A large amount of  $\text{N}_2\text{O}(g)$  decomposes into nitrogen gas and oxygen gas in the presence of a tiny amount of a gold foil catalyst.

The gold foil provides a solid surface on which the catalysed reaction takes place.

The graph shows the concentration of  $\text{N}_2\text{O}(g)$  against time as it decomposes. The graph is a straight line.



Which row describes:

- the change in rate of reaction as  $\text{N}_2\text{O}(g)$  decomposes from 0 to 10 minutes
- the effect of adding more gold foil catalyst on the rate of decomposition of the same amount and concentration of  $\text{N}_2\text{O}(g)$ ?

There is excess  $\text{N}_2\text{O}$  in excess.

Now we get the ideal result.

	change in rate of reaction as $\text{N}_2\text{O}(g)$ decomposes	effect of adding more gold foil on the rate of decomposition
A	none	increases
B	none	none
C	decreases	increases
D	decreases	none

Rate is directly proportional to  $[\text{N}_2\text{O}]^n$ . This is 0 order reactant.

We will encounter zero, first and second order reactants.

Rate is dependent on the catalyst.

16 The Haber process for the manufacture of ammonia is represented by the equation shown.

23 Primary halogenoalkanes undergo hydrolysis reactions.

Which reaction would occur most rapidly if they are all warmed to the same temperature?

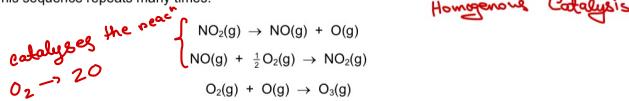
- A  $\text{C}_2\text{H}_5\text{Br}$  with  $\text{H}_2\text{O}$
- B  $\text{C}_2\text{H}_5\text{Br}$  with  $\text{NaOH(aq)}$
- C  $\text{C}_2\text{H}_5\text{Cl}$  with  $\text{H}_2\text{O}$
- D  $\text{C}_2\text{H}_5\text{Cl}$  with  $\text{NaOH(aq)}$

# Br lower than Cl in Group -7, longer atomic radius - bond length = ↓ bond energy

\* 11 NO and NO<sub>2</sub> are both present in the lower atmosphere as pollutants.

The reaction sequence shows the production of ozone from oxygen in the lower atmosphere.

This sequence repeats many times.



Which statement about this reaction sequence is correct?

- A NO is acting as a catalyst, but NO<sub>2</sub> is not acting as a catalyst. ✓
- B NO<sub>2</sub> is acting as a catalyst, but NO is not acting as a catalyst.
- C Neither NO nor NO<sub>2</sub> are acting as catalysts.
- D Both NO and NO<sub>2</sub> are acting as catalysts.

\* 36 Nitrogen dioxide gas is produced when petrol is burned in car engines.

Which acids are made in the atmosphere as a result of this release of nitrogen dioxide into the air?

- 1 H<sub>2</sub>SO<sub>3</sub> ✗
- 2 H<sub>2</sub>SO<sub>4</sub> ✓
- 3 HNO<sub>3</sub> ✓

Because NO<sub>x</sub> catalyzes the oxidation of SO<sub>2</sub> into SO<sub>3</sub> which in turn forms H<sub>2</sub>SO<sub>4</sub>. Since SO<sub>2</sub> directly forms H<sub>2</sub>SO<sub>3</sub>, NO<sub>x</sub> plays no role in its formation

# Impurities damage the surface area of a catalyst (poison the catalyst). Thus catalyst will not catalyse the reaction efficiently

# Define homogeneous catalyst.

↓      ↓  
1 mark    2 marks  
in the same state / phase as the reactants



Increases Rate AND  
lowering E<sub>a</sub> AND  
Without being chemically altered / } at the  
are regenerated      end of  
the reaction