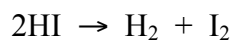


Marks
4

- At a certain temperature the following data were collected for the decomposition of HI.



Experiment	Initial [HI] (mol L ⁻¹)	Initial rate of reaction (mol L ⁻¹ s ⁻¹)
1	1.0×10^{-2}	4.0×10^{-6}
2	2.0×10^{-2}	1.6×10^{-5}
3	3.0×10^{-2}	3.6×10^{-5}

Determine the rate law for the reaction.

What is the value of the rate constant for the decomposition of HI?

Answer:

- Four experiments were conducted to discover how the initial rate of consumption of BrO_3^- ions in the reaction below varied as the concentrations of the reactants were changed.



Experiment	Initial concentration (mol L^{-1})			Initial rate ($\text{mol L}^{-1} \text{s}^{-1}$)
	BrO_3^-	Br^-	H^+	
1	0.10	0.10	0.10	1.2×10^{-3}
2	0.20	0.10	0.10	2.4×10^{-3}
3	0.10	0.30	0.10	3.5×10^{-3}
4	0.20	0.10	0.15	5.4×10^{-3}

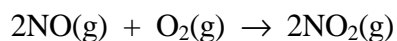
Use the experimental data in the table above to determine the order of the reaction with respect to *each* reactant.

What is the rate of formation of Br_2 when $[\text{BrO}_3^-] = [\text{Br}^-] = [\text{H}^+] = 0.10 \text{ M}$?

Write the rate law for the reaction and determine the value of the rate constant, k .

Marks
7

- Nitrogen monoxide, a noxious pollutant, reacts with oxygen to produce nitrogen dioxide, another toxic gas:



The following rate data were collected at 225 °C.

Experiment	[NO] ₀ (M)	[O ₂] ₀ (M)	Initial rate, $-\text{d}[\text{O}_2]/\text{dt}$, (M s ⁻¹)
1	1.3×10^{-2}	1.1×10^{-2}	1.6×10^{-3}
2	1.3×10^{-2}	2.2×10^{-2}	3.2×10^{-3}
3	2.6×10^{-2}	1.1×10^{-2}	6.4×10^{-3}

Determine the rate law for the reaction.

Calculate the value of the rate constant at 225 °C.

Answer:

Calculate the rate of appearance of NO₂ when [NO] = [O₂] = 6.5×10^{-3} M.

Answer:

Suggest a possible mechanism for the reaction based on the form of the rate law.
Explain your answer.

Marks
5

- 2-Bromo-2-methylpropane reacts with hydroxide ions to give 2-methyl-2-propanol.



The following rate data were collected at 55 °C.

Experiment	$[(\text{CH}_3)_3\text{CBr}]_0$ (M)	$[\text{OH}^-]_0$ (M)	Initial rate ($d[(\text{CH}_3)_3\text{COH}]/dt$, M s^{-1})
1	0.050	0.10	5.0×10^{-4}
2	0.20	0.10	2.0×10^{-3}
3	0.20	0.30	2.0×10^{-3}

Determine the rate law for the reaction.

Calculate the value of the rate constant at 55 °C.

Answer:

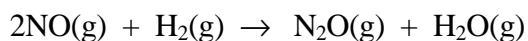
Suggest a possible mechanism for the reaction based on the form of the rate law.
Explain your answer.

The reaction is exothermic. Draw the potential energy *vs* reaction coordinate diagram for this mechanism, labelling all species that can be isolated.

Marks
2

Marks
5

- Nitric oxide, a noxious pollutant, and hydrogen react to give nitrous oxide and water according to the following equation.



The following rate data were collected at 225 °C.

Experiment	[NO] ₀ (M)	[H ₂] ₀ (M)	Initial rate (d[NO]/dt, M s ⁻¹)
1	6.4×10^{-3}	2.2×10^{-3}	2.6×10^{-5}
2	1.3×10^{-2}	2.2×10^{-3}	1.0×10^{-4}
3	6.4×10^{-3}	4.4×10^{-3}	5.1×10^{-5}

Determine the rate law for the reaction.

Calculate the value of the rate constant at 225 °C.

Answer:

Calculate the rate of appearance of N₂O when [NO] = [H₂] = 6.6×10^{-3} M.

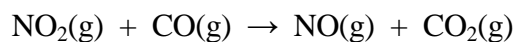
Answer:

Suggest a possible mechanism for the reaction based on the form of the rate law.
Explain your answer.

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Marks
7

- The major pollutants NO(g), CO(g), NO₂(g) and CO₂(g) are emitted by cars and can react according to the following equation.



The following rate data were collected at 225 °C.

Experiment	[NO ₂] ₀ (M)	[CO] ₀ (M)	Initial rate (d[NO ₂]/dt, M s ⁻¹)
1	0.263	0.826	1.44×10^{-5}
2	0.263	0.413	1.44×10^{-5}
3	0.526	0.413	5.76×10^{-5}

Determine the rate law for the reaction.

Calculate the value of the rate constant at 225 °C.

Answer:

Calculate the rate of appearance of CO₂ when [NO₂] = [CO] = 0.500 M.

Answer:

Suggest a possible mechanism for the reaction based on the form of the rate law.
Explain your answer.

Marks
4

- 2-Propanol can be oxidised to acetone using $\text{Cr}_2\text{O}_7^{2-}$ in acidic solution as indicated in the reaction below. The rate of decrease of the $\text{Cr}_2\text{O}_7^{2-}$ ion under a certain set of conditions is $3.0 \text{ mol L}^{-1} \text{ s}^{-1}$.



What is the rate of increase in the concentration of Cr^{3+} ?

What is the rate of decrease in the concentration of 2-propanol?

The rate law for this reaction is: $\text{Rate} = k [\text{Cr}_2\text{O}_7^{2-}][\text{CH}_3\text{CH}(\text{OH})\text{CH}_3][\text{H}^+]^2$

Complete the following table by writing *increase*, *decrease* or *no change* in the box to indicate how the rate of the reaction is affected by each of the following changes.

Increase in $[\text{CH}_3\text{CH}(\text{OH})\text{CH}_3]$

Increase in $[\text{CH}_3\text{COCH}_3]$

Increase in pH

Increase in temperature

4

- Complete the following table.

Formula	Systematic name	Oxidation state of transition metal	Number of <i>d</i> -electrons
$\text{K}_2[\text{Pt}(\text{CN})_4]$			
$[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$			

Marks
2

- Explain in terms of their electronic configurations and ionisation energies why the alkali metals (Group 1) are powerful *reducing* agents.

3

- The half-life for the first order decomposition of $\text{N}_2\text{O}_5(\text{g})$ is $6.00 \times 10^4 \text{ s}$ at 20°C . Calculate the rate constant, k , at this temperature.

 $k =$

What percentage of the N_2O_5 molecules will have reacted after one hour?

ANSWER: