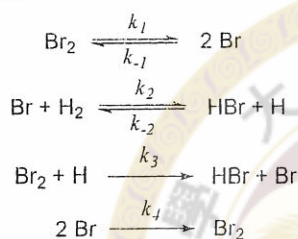


- When 2.00 mol of $\text{SO}_2(\text{g})$ reacts completely with 1.00 mol of $\text{O}_2(\text{g})$ to form 2.00 mol of $\text{SO}_3(\text{g})$ at 25°C and a constant pressure of 1.00 atm, 198.00 kJ of energy is released as heat. a) Write a balanced equation. b) Calculate ΔH (enthalpy), w (work) and ΔE (energy) for this process. 5%
- The reaction of nitrogen gas and hydrogen gas yields ammonia. A closed vessel at 200°C is filled with nitrogen gas with partial pressure of 1.40 atm and hydrogen gas with partial pressure of 2.60 atm. When the system is brought to equilibrium the total pressure become 2.40 atm. What is the partial pressure of hydrogen at equilibrium. 5%
- The formula Fe_3O_4 is commonly used to consider a equal mixture of Fe_2O_3 and FeO . If the formula of a sample is determined to be $\text{Fe}_{0.91}\text{O}_{1.00}$. What is the ratio of $\text{Fe}^{3+}/\text{Fe}^{2+}$ in this sample? 5%
- The gas phase reaction between Br_2 and H_2 to form HBr is assumed to proceed by the following mechanism:



- Under what conditions does the rate law have the form: $\text{Rate} = k'[\text{Br}_2]$?
 - Under what conditions does the rate law have the form: $\text{Rate} = k''[\text{H}_2][\text{Br}_2]^{1/2}$?
 - Give expressions for k' and k'' in terms of the rate constants used to define the mechanism. 5%
- Draw energy level diagram and all corresponding bonding and antibonding molecular orbitals from 2s and 2p atomic orbitals for the diatomic molecule B_2 . 10%
 - Knowing that the atomic weight and density of copper are 63.546 g and 8.95 g/cm^3 , respectively, and copper crystallizes as a face centered cubic lattice, calculate the radius of the copper atom. 10%
 - Use the Clausius Claypeyron Equation to calculate the boiling point of water at the pressure of 24 mm Hg. Heat of vaporization of water ΔH_{vap} is 40.7 kJ/mol. 10%
 - Write the Lewis structure for a) Cl_2O ; b) H_2O_2 ; c) PCl_5 ; d) XeO_3 ; e) ICl_4^- . 10%
 - An organic compound containing only carbon and hydrogen is 85.63% C by mass. The molar mass of the hydrocarbon is between 50 and 60 g/mol. a) Give the formula of the compound. b) Draw all possible structures of the compound. Reaction of this compound with H_2O produces a tertiary alcohol as the major product and a primary alcohol as the minor product. c) Identify the correct structure. 10%
 - Consider the voltaic cell at 298 K. $\text{Zn}_{(\text{s})} + \text{Cd}^{2+}_{(\text{aq})} \rightarrow \text{Cd}_{(\text{s})} + \text{Zn}^{2+}_{(\text{aq})}$; ($E^\circ = 0.763 \text{ V}$ for $\text{Zn}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Zn}_{(\text{s})}$; $E^\circ = -0.400 \text{ V}$ for $\text{Cd}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Cd}_{(\text{s})}$)
 - What is the E°_{cell} for this cell?
 - If $E_{\text{cell}} = 0.390 \text{ V}$ and $[\text{Cd}^{2+}] = 2.00 \text{ M}$ what is $[\text{Zn}^{2+}]$?
 - $E^\circ = 0.771 \text{ V}$ for $\text{Fe}^{3+}_{(\text{aq})} + \text{e}^- \rightarrow \text{Fe}^{2+}_{(\text{aq})}$ and $E^\circ = -0.440 \text{ V}$ for $\text{Fe}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Fe}_{(\text{s})}$; What is the E° for $\text{Fe}^{3+}_{(\text{aq})} + 3\text{e}^- \rightarrow \text{Fe}_{(\text{s})}$? 10%
 - $\text{Co}(\text{NH}_3)_4\text{Br}_2\text{Cl}$ is an octahedral complex. a) give the charge and electron configuration of the metal b) Draw all possible structures. 10%
 - The weight percent of Mg in a mixture of MgCl_2 and $\text{Mg}(\text{NO}_3)_2$ is 21.25%. What is the weight percent of MgCl_2 in this mixture? 10%

Useful data: Atomic weight: H:1.008; C: 12.01; N: 14.01; O: 16.00; Mg: 24.31; Cl: 35.45; Fe: 55.85.

$R = 8.3145 \text{ J}/(\text{K mol})$;

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