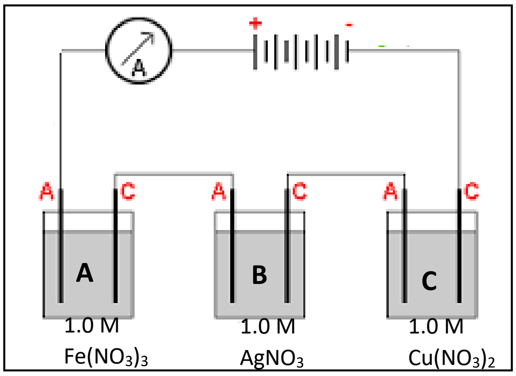
Revision – Electrolysis, rates and equilibrium.



1. An electric charge of 1.30×10^5 Coulomb was passed through three electrolytic cells connected in series as shown in diagram 1. The solutions are 1.0 $Fe(NO_3)_3$, 1.0 M $Cu(NO_3)_2$ and 1.0 M $AgNO_3$.

a. On which electrodes is solid metal deposited? Explain.

b. What mass of metal forms in each cell

c. What current, in amps, is passed through each cell if it operates for 12.50 hours?

2. Consider the reaction below at equilibrium.

$$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92.4 \text{ kJ/mol}$$

a. For the chemical system described above, which statements is/are true? Explain

i. The reaction below represents the reverse reaction to the Haber process.
$NH_3(g) \rightarrow 1\frac{1}{2} H_2(g) + \frac{1}{2} N_2(g)$ $\Delta H = +92.4$ kJ/mol

ii. If the activation energy for the reverse reaction is 126kJ/mol then the activation energy for the forward reaction, **at equilibrium**, is also 126kJ/mol

iii. The rate of the forward reaction is greater than the rate of the reverse reaction as the system approaches equilibrium.

b. Exothermic reactions proceed quickly at higher temperatures but are plagued, by uneconomical low yields. Using an energy profile for the above reaction and the Maxwell-Boltzmann energy distribution curves explain why, at high temperatures, the rate of reaction is high but the equilibrium yield is low.

c. The rate of the reaction above is given by the expression ($\Delta[NH_3]/\Delta t$), where t is time in seconds. Which one of the expressions below is a valid expression for the rate of formation of NH_3? Explain

i. $\frac{1}{2} \Delta[H_2]/\Delta t = \Delta[NH_3]/\Delta t$
ii. $3 \times \Delta[H_2]/\Delta t = \Delta[NH_3]/\Delta t$
iii. $-\Delta[N_2]/\Delta t = \Delta[NH_3]/\Delta t$
iv. $-2\Delta[N_2]/\Delta t = \Delta[NH_3]/\Delta t$
v. $-3\Delta[H_2]/2\Delta t = \Delta[NH_3]/\Delta t$