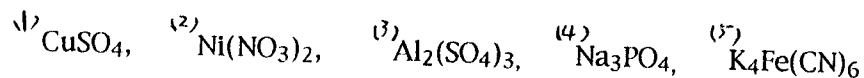
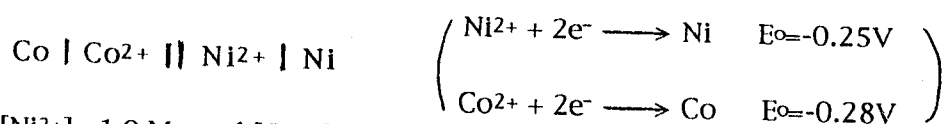


1. (10%) What concentrations of the following have the same ionic strength as 0.1 M NaCl?



2. (10%) Calculate the emf of the cell.



(a) [Ni<sup>2+</sup>] = 1.0 M, and [Co<sup>2+</sup>] = 0.1 M

(b) [Ni<sup>2+</sup>] = 0.01M, and [Co<sup>2+</sup>] = 1.0 M

3. (10%) Describe some of the most important characteristic of a chemisorbed layer. In what ways does a physisorbed layer differ?

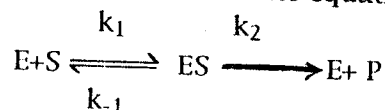
4. (10%) A second-order reaction in solution has a rate constant (*k*) of 5.7 × 10<sup>-5</sup> dm<sup>3</sup> mol<sup>-1</sup> s<sup>-1</sup> at 25°C and of 16.4 × 10<sup>-5</sup> dm<sup>3</sup> mol<sup>-1</sup> s<sup>-1</sup> at 40°C. Calculate the activation energy (*E*) and the preexponential factor (*A*), assuming the Arrhenius law ( $k = Ae^{-E/RT}$ ; *R* is the gas constant, equal to 8.314 J K<sup>-1</sup> mol<sup>-1</sup>) to apply.

(Note: log 16.4 × 10<sup>-5</sup> = -3.785, log 5.7 × 10<sup>-5</sup> = -4.244)

5. (20%)  $\Delta G = \Delta H - T\Delta S$  is a equation of the second thermodynamics. Please (i) define the meaning of *G*, *H*, *S*, respectively.

(ii) describe the relationship between this equation and chemical reaction.

6. (20%) Obtain the rate equation corresponding to the mechanism



Here *E* and *S* are the enzyme and substrate, *P* is the product. Usually the substrate concentration is much higher than that of the enzyme concentration. Under these conditions the concentration of the enzyme-substrate complex *ES* must be very much less than that of the substrate. Express the catalytic constant *k*<sub>cat</sub> and the Michaelis constant *K*<sub>m</sub> in terms of *k*<sub>1</sub>, *k*<sub>-1</sub>, and *k*<sub>2</sub>.

7. (20%)

(i) Derive the integrated rate equation for a reversible reaction of stoichiometry  $A \xrightleftharpoons[k_{-1}]{k_1} Y + Z$

Take the initial concentration of *A* as *a*<sub>0</sub> and the concentration at time *t* as *a*<sub>0</sub> - *x*.

(ii) Obtain the integrated equation in terms of *k*<sub>1</sub> and the equilibrium constant *K* = *k*<sub>1</sub>/*k*<sub>-1</sub>