Basic Calculations

Question Paper

Level	Pre U
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Basic Calculations-Physical Chemistry
Booklet	Question Paper

Time Allowed: **18 minutes**

Score: **/15**

Percentage: **/100**

Grade Boundaries:

1. (a) When aqueous barium chloride is added to a solution containing sulfate ions a white precipitate of barium sulfate is formed. This white precipitate is very sparingly soluble in water.

(i) Write the **ionic** equation, including state symbols, for the formation of the white precipitate.

..... [1]

(ii) Write the expression for the solubility product, K_{sp}, of barium sulfate.

[1]

(iii) Given that the value of K_{sp} for barium sulfate is 1.08×10^{-10} at 298 K, calculate the concentration of sulfate ions in a saturated solution of barium sulfate. Give your answer to **three** significant figures.

..... $mol\,dm^{-3}$ [2]

(iv) Regulations state that the maximum permitted level of sulfate ions in drinking water is $250\,mg\,dm^{-3}$ ($1\,mg = 1 \times 10^{-3}\,g$).

$200\,cm^3$ of aqueous barium chloride solution was added to $300\,cm^3$ of drinking water and a white precipitate formed. Assume that the sample of water contained the maximum permitted level of sulfate ions. Calculate the minimum concentration, in $mol\,dm^{-3}$, of barium chloride in the solution that was added to the sample of drinking water.

..... $mol\,dm^{-3}$ [3]

(b) The electrode potential of silver in contact with a solution of silver ions, $Ag^+(aq)$, is impossible to measure directly but can be measured using a standard hydrogen electrode.

Using this method, the standard electrode potential of silver, $E^{\ominus}$, is found to be +0.80 V.

(i) Complete the cell diagram for the cell used to measure the standard electrode potential of silver. State the concentration of $H^+(aq)$ used.

..... | H_2 (g) | $2H^+(aq)$ || .....

concentration of $H^+(aq)$ = ... mol dm^{-3} [3]

(ii) When an excess of sodium chloride solution is added to the right-hand half-cell the silver ions will be precipitated as solid silver chloride, AgCl. Use Le Chatelier's principle to explain qualitatively how the cell emf will change as a result.

.....

.....

.....

..... [2]

(iii) At 298 K, the expression below can be used to calculate the concentration of silver ions in solution under non-standard conditions, from a measurement of the electrode potential.

$$E = E^{\ominus} - 0.030 \log \frac{1}{[Ag^+(aq)]^2}$$

E = electrode potential of silver under non-standard conditions
$E^{\ominus}$ = standard electrode potential of silver = +0.80 V

The addition of excess aqueous sodium chloride, NaCl(aq), to the right-hand half-cell results in a chloride ion concentration of 2.1 mol dm^{-3}.

Given that K_{sp} for silver chloride, AgCl, is 1.8×10^{-10} at 298 K, calculate the value of E, in the cell shown in **(b)(i)**, after the addition of the excess aqueous sodium chloride to the right-hand half-cell.

E = ...V [3]

[Total: 15]