19. Examinations:

1) Organic sample weighed 0.185 g was ignited in an excess of oxygen, then all carbon dioxide were collected in barium hydroxide solution. Calculate the percentage of carbon in the sample, if you know that the precipitate formed (barium carbonate) weighed 0.526 gm. What the name of this type of gravimetric analysis?

Typical Answer for 1):

Volatilization Method

$Ba(OH)_2 + CO_2 \rightarrow BaCO_3 + H_2O$

Wt. of C = Wt. of $BaCO_3$ x (At.Wt. C/M.Wt. $BaCO_3$)

Wt. of C = 0.526 x (12/197) =0.0320 gm

C% = (Wt. of C/Wt. of Sample) x 100 = (0.0320/0.185) x 100 = 17.29%

2) Calculate the weight of carbon dioxide liberated from 1.5 g sample include 34% magnesium carbonate?

Typical Answer for 2):

$MgCO_3$ % = (Wt. $MgCO_3$/Sample weight) x 100

34 % = (Wt. $MgCO_3$/1.5) x 100

Wt. $MgCO_3$ = 0.51 gm

Wt. of CO_2 = Wt. of $MgCO_3$ x (Mt.Wt. CO_2/M.Wt. $MgCO_3$)

Wt. of CO_2 = 0.51 x (44/84)

Wt. of CO_2 = 0.267 gm

3) Calculate the barium sulphate solubility in 0.1 M HCl, if you know that solubility product constant for the precipitate is equal to 1.08×10^{10} and the second dissociation constant for sulphuric acid equal to 1.2×10^{-2}

Typical Answer for 3):

$BaSO_4 + H^+ \rightarrow Ba^{2+} + HSO_4^-$

$HSO_4^- \rightarrow H^+ + SO_4^{2-}$ K2

$K2=[H^+][SO_4^{2+}]/[HSO_4^-]= 1.2x10^{-2}$.....1

$Ksp=[Ba^{2+}][SO_4^{2-}]= 1.08 \times 10^{-10}$.....2

$[Ba^{2+}]= [HSO_4^-]+[SO_4^{2-}]$.....3

$1.2 \times 10^{-2} = [0.1][SO_4^{2+}]/[HSO_4^-]$

$[HSO_4^-]= 8.3\ [SO_4^{2+}]$

$[Ba^{2+}]= 8.3\ [SO_4^{2+}]+[SO_4^{2-}]$

$[Ba^{2+}]= 9.3\ [SO_4^{2+}]$

$[SO_4^{2+}]=[Ba^{2+}]/9.3$

$Ksp=[Ba^{2+}][Ba^{2+}]/9.3= 1.08 \times 10^{-10}$

$[Ba^{2+}]^2 = 9.3 x10^{-10}$

$[Ba^{2+}] = 3 \times 10^{-5}$ mol/l

4) Calculate the barium fluoride solubility in 0.1 M HCl, if you know that solubility product constant for the barium fluoride is equal to 1.7 x 10^{-6} and the dissociation constant for fluoric acid equal to 7.4 x 10^{-4}.

Typical Answer for 4):

$BaF_2 + 2H^+ \rightarrow Ba^{2+} + 2HF$

$HF \rightarrow H^+ + F^-$

$Ka= [H^+][F^-]/[HF]= 7.4 x10^{-4}$

Square the both side

$Ka^2 = [H^+]^2[F^-]^2/[HF]^2= (7.4 x10^{-4})^2$

$Ksp=[Ba^{2+}][F^-]^2 = 1.7 \times 10^{-6}$

Dividing eq 2 on eq 1

$Ksp/Ka = (1.7 \times 10^{-6})/(7.4 \times 10^{-4}) = [Ba^{2+}][F^-]^2[HF]^2/[H^+]^2[F^-]^2$

Assume $[Ba^{2+}] = X$

[HF]=2X

Subsitiuted in eq 3

$(1.7 \times 10^{-6}) \times 0.01/(7.4 \times 10^{-4})^2 = [x][2x]^2$

$0.031=4X^3$

X= 0.197 mole/l

5) Why solubility of calcium oxalate precipitate was increased when adding hydrochloric acid?

Typical Answer for 5):

Because the negative ion which produced from salt dissociation combined with the positive ion and produced a weak acid unstable, then the defect could be happed in the equilibrium state…

According to Lee- Shatelia principle the reaction orientation depart from the left to the right…..

6) Calculate the ionic strength for 0.05 M KNO3 and 0.1 M Na2SO4 solution?

Typical Answer for 6):

$$\underset{0.1M}{Na_2SO_4} \rightarrow \underset{0.2M}{2Na^+} + \underset{0.1M}{SO_4^{2-}} \qquad \underset{0.05M}{KNO_3} \rightarrow \underset{0.05M}{K^+} + \underset{0.05M}{NO_3^-}$$

$$I = \frac{1}{2}\sum_{i=1}^{n} c_i z_i^2$$

$$I = \left[\frac{[0.05x(1)^2]+[0.05x(1)^2][0.2x(1)^2]+[0.1x(2)^2]}{2}\right] = 0.35$$

7) Calculate the solubility of Ba(IO3)2 in 0.02 M of KIO3 , solubility product of Ba(IO3)2 equal to 1.57 x10-9

Typical Answer for 7):

$$Ba(IO_3)_2 \rightarrow Ba^{2+} + 2IO_3^-$$

$$Ksp = \left[Ba^{2+}\right]\left[IO_3^-\right]^2$$

$$1.57x10^{-9} = [X][2X + 0.02]^2$$

$$1.57x10^{-9} = 4x10^{-4}X$$

$$X = 3.9x10^{-6}M$$

8) What are the main differences between specific and selective reagents?

Typical Answer for 8):

Specific reagents, which are rare, react only with a single chemical species.

Selective reagents, which are more common, react with only a limited number of species.

9) Show the properties of colloidal and crystalline suspensions?

Typical Answer for 9):

(1) Colloidal suspensions (10-7 to 10-4 cm in diameter)

show no tendency to settle from solution and are not easily filtered

(2) Crystalline suspension

Tend to settle spontaneously and are easily filtered.