Chemistry 11 Acid Base Worksheet Name Key

1. If a 25.00 mL sample of HCl is titrated to a phenolpthalein endpoint with 12.14 mL of .0500 M NaOH what is the concentration of the HCl sample?

$HCl + NaOH \longrightarrow H_2O + NaCl$

mol NaOH = 12.14 mL × 0.0500 M = 0.607 mmol

mol HCl = mol NaOH = 0.607 mmol

$[HCl] = \frac{0.607 \text{ mmol}}{25.00 \text{ mL}} = 0.0243 \text{ M}$

2. If a 2.5 g solid sample of unknown acid HA is titrated to a phenolpthalein endpoint with 25.72 mL of 1.0 M KOH what is the molar mass of the unknown solid acid?

$HA + KOH \longrightarrow H_2O + KA$

mols KOH = 25.72 mL × 1.0 M = 25.72 mmol KOH

mols HA = mols KOH = 25.72 mmol KOH

$FW = \frac{2.5 \text{ g}}{.02572 \text{ mol}} = 97 \text{ g/mol}$

3. Use the following experimental results to find the concentration of the HCl.

25.00 mL of HCl	Trial 1	Trial 2	Trial 3	Trial 4
initial buret reading	0.50 mL	17.35 mL	33.55 mL	2.50 mL
final buret reading	17.35 mL	33.55 mL	49.85 mL	18.70 mL
volume of 0.503 M NaOH	~~16.85~~	16.20	16.30 mL	16.20 mL

$HCl + NaOH \longrightarrow NaCl + H_2O$

Average vol NaOH = (16.20 + 16.30 + 16.20) ÷ 3 = 16.23 mL

mol NaOH = 0.503 M × 16.23 mL = 8.165 mmol

mol HCl = mol NaOH = 8.165 mmol

$[HCl] = \frac{8.165 \text{ mmol}}{25.00 \text{ mL}} = 0.327 \text{ M}$

4. Sulphuric acid H_2SO_4 can be titrated with NaOH. The balanced equation for this reaction is given below:

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2SO_{4(aq)} + 2\,H_2O_{(l)}$$

If a 10.00 mL sample of sulphuric acid is titrated to a phenolpthalein endpoint with 12.75 mL of 0.45 M NaOH what is the concentration of the sulphuric acid in the sample.

mol NaOH = 12.75 mL × 0.45 M = 5.74 mmol NaOH

$\text{mol } H_2SO_4 = 5.74 \text{ mmol NaOH} \left(\frac{1 \text{ mol } H_2SO_4}{2 \text{ mol NaOH}}\right) = 2.87 \text{ mmol } H_2SO_4$

$[H_2SO_4] = \frac{2.87 \text{ mmol}}{10.00 \text{ mL}} = 0.29 \text{ M}$

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1. The addition of 43.2 mL of 0.500 M KOH to 100.00 mL of HCl solution causes phenolphthalein in the resulting solution to turn barely pink. Calculate the concentration of the original HCl solution.

$$HCl + KOH \rightarrow KCl + H_2O$$

$$\text{mol KOH} = 0.500\,M \times 0.0432\,L = 0.0216\ \text{mol KOH}$$

$$0.0216\ \text{mol KOH} \times \frac{1\ \text{mol HCl}}{1\ \text{mol KOH}} = 0.0216\ \text{mol HCl}$$

$$[HCl] = \frac{0.0216\ \text{mol}}{0.10000\ L} = \underline{0.216\ M}$$

Calculate the percentage of HCl in the solution if the solution has a density of 1 g/mL.

FW HCl = 36.5u

$$\text{mass HCl} = 0.0216\ \text{mol} \times 36.5\ \text{g/mol} = 0.788\ \text{g}$$

$$\text{mass of solution} \quad 100.00\ \text{mL} \times 1\ \text{g/mL} = 100\ \text{g}$$

$$\%\ HCl = \frac{0.788\ \text{g}}{100\ \text{g}} \times 100 = \underline{0.788\%} \quad \text{or} \quad 0.8\% \ (1\ \text{sig fig})$$

2. Calculate the concentration of a KOH solution that reaches the equivalence point when 30.0 mL are titrated against 42.7 mL of 0.500 M HNO_3 used as the standardized solution.

$$HNO_3 + KOH \longrightarrow KNO_3 + H_2O$$

$$\text{mol } HNO_3 = 0.500\,M \times 0.0427\,L = 0.0214$$

$$\text{mol KOH} = 0.0214\ \text{mol } HNO_3 \times \frac{1\ \text{mol KOH}}{1\ \text{mol } HNO_3} = 0.0214\ \text{mol KOH}$$

$$[KOH] = \frac{0.0214\ \text{mol}}{0.0300\,L} = \underline{0.712\ M}$$

3. How many millilitres of 0.28 M NaOH would be required to neutralize 28.73 mL of 0.15 M HCl?

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

$$\text{mol HCl} = 0.15\,M \times 0.02873\,L = 4.31 \times 10^{-3}\ \text{mol HCl}$$

$$\text{mol NaOH} = 4.31 \times 10^{-3}\ \text{mol HCl} \times \frac{1\ \text{mol NaOH}}{1\ \text{mol HCl}} = 4.31 \times 10^{-3}\ \text{mol NaOH}$$

$$\text{Vol. NaOH} = \frac{4.31 \times 10^{-3}\ \text{mol}}{0.28\ M} = \underline{0.015\ L \text{ or } 15\ \text{mL}}$$