CHEMISTRY CALCULATIONS WS 3

Moles & Solutions

1 If 10.00 g of NaOH is dissolved in water and the volume is made up to 200.0 cm^3, calculate the concentration in $moldm^{-3}$ and gdm^{-3}.

2 Calculate the number of moles of HCl present in 50.0cm^3 of 2.00 $moldm^{-3}$ hydrochloric acid.

3 Calculate the number of moles of chloride ions present in 50.0cm^3 of a 0.0500 $moldm^{-3}$ solution of iron(III) chloride ($FeCl_3$) and the total concentration of all the ions present.

4 Sulfuric acid is titrated against 25.00cm^3 of 0.2000 $moldm^{-3}$ sodium hydroxide solution; 23.20 cm^3 of sulfuric acid is required for neutralisation. Calculate the concentration of the sulfuric acid.

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

5 For neutralisation, 25.00 cm^3 of phosphoric(V) acid (H_3PO_4) requires 28.70 cm^3 of NaOH of concentration 0.1500mol dm^{-3}.What is the concentration of the phosphoric(V) acid?

$$H_3PO_4(aq) + 3NaOH(aq) \rightarrow Na_3PO_4(aq) + 3H_2O(l)$$

6 Acidified potassium manganate(VII) oxidises hydrogen peroxide to produce oxygen:

$$2KMnO_4(aq) + 3H_2SO_4(aq) + 5H_2O_2(aq) \rightarrow 2MnSO_4(aq) + 8H_2O(l) + K_2SO_4(aq) + 5O_2(g)$$

If 45.00 cm^3 of 0.020 mol dm^{-3} $KMnO_4$ is reacted with excess H_2O_2 and H_2SO_4, calculate the volume of O_2 produced (at RTP).

7 Work out the numbers of moles present in the following solutions:

a. 20.0cm^3 of 0.220 moldm^{-3} NaOH(aq)

b. 27.8 cm^3 of 0.0840 moldm^{-3} HCl(aq)

c. 540 cm^3 of 0.0200 moldm^{-3} $KMnO_4$(aq)

8 If 29.70cm^3 of sulfuric acid of concentration 0.2000 moldm^{-3} is required for neutralisation of 25.00cm^3 of potassium hydroxide solution, calculate the concentration of the potassium hydroxide solution.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

9 Calcium carbonate is reacted with 50.0cm^3 of 0.500 moldm^{-3} hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

a. What mass of calcium carbonate is required for an exact reaction?

b. What volume of CO_2, measured at RTP, will be produced?

10 What volume (in cm^3) of 0.0100 mol dm^{-3} barium chloride must be reacted with excess sodium sulfate to produce 0.100g of barium sulfate?

$$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

11 If 0.100g of magnesium is reacted with 25.00cm^3 of 0.200 mol dm^{-3} hydrochloric acid, calculate the volume of hydrogen gas produced at RTP.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

12 When 2.56 g hydrated magnesium sulfate ($MgSO_4.\boldsymbol{x}H_2O$) is heated, 1.25 g of anhydrous magnesium sulfate ($MgSO_4$) is formed. Determine the value of $\boldsymbol{x}$ in the formula.

a. If 10.00g of hydrated copper sulfate ($CuSO_4.5H_2O$) is dissolved in water and made up to a volume of 250.0 cm^3, what is the concentration of the solution?

b. What mass of anhydrous copper sulfate would be required to make 250.0cm^3 of solution with the same concentration as in **a**?

13 A 3.92 g sample of hydrated sodium carbonate ($Na_2CO_3.\boldsymbol{x}H_2O$) was dissolved in water and made up to a total volume of 250.0 cm^3. Of this solution, 25.00 cm^3 was titrated against 0.100 mol dm^{-3} hydrochloric acid, and 27.40 cm^3 of the acid was required for neutralisation. Calculate the value of ***x*** in $Na_2CO_3.\boldsymbol{x}H_2O$.

14 Limestone is impure calcium carbonate ($CaCO_3$): 2.00 g of limestone is put into a beaker and 60.00 cm^3 of 3.000 moldm^{-3} hydrochloric acid is added.They are left to react and then the impurities are filtered off and the solution is made up to a total volume of 100.0 cm^3. Of this solution, 25.00 cm^3 requires 35.50 cm^3 of 1.000 moldm^{-3} sodium hydroxide for neutralisation. Work out the percentage $CaCO_3$ in the limestone (assume that none of the impurities reacts with hydrochloric acid).

15 A 25.0cm^3 sample of a solution of copper(II) nitrate is added to 10.0cm^3 of 1moldm^{-3} potassium iodide.The iodine produced is titrated against 0.0200 moldm^{-3} sodium thiosulfate solution using starch indicator near the end point. 22.50 cm^3 of the sodium thiosulfate solution was required for the titration. Calculate the concentration of the copper(II) nitrate solution.

$$2Cu(NO_3)_2 + 4KI \longrightarrow 2CuI + I_2 + 4KNO_3$$

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$