Volumetric Analysis

1. The following steps were followed in a method during an experiment to produce a standard solution of potassium chromate:
   i. *4.22g of solid potassium chromate (K2CrO4) was dissolved in a small amount of water and then transferred to a 500mL volumetric flask and made up to the mark with distilled water.*
   ii. *100 mL of this solution was transferred to another 500 mL volumetric flask.*
   iii. *The 500 mL volumetric flask was made up to the mark with distilled water.*
   a. Calculate the amount, in mol, of potassium chromate used in step i.
   b. Calculate the concentration, in mol L-1, of potassium chromate solution formed in step i.
   c. Calculate the concentration, in g L-1, of potassium chromate solution formed in step i.
   d. State the concentration of potassium chromate solution, in mol L-1, in the 100 mL solution in step ii.
   e. Calculate the amount, in mol, in the 100 mL of potassium chromate used in step ii.
   f. Calculate the concentration, in mol L-1, of potassium chromate solution formed in step iii when the solution is diluted to the 500 mL mark on the volumetric flask.
   g. State the amount, in mol, of potassium chromate in the 500 mL volumetric flask after step iii is completed.

2. A simple titration is taking place between sodium hydroxide and hydrochloric acid solutions. A pipette contains 20.00 mL of 0.4447 M sodium hydroxide. This requires 17.63 mL of hydrochloric acid to react with it. What is the concentration of the acid?

3. In the titration of a strong acid against a strong base, which of the following statements *best* describes the equivalence point?
   i. the point at which the rate of the forward reaction equals the rate of the reverse reaction
   ii. the point at which the same number of moles of acid and base have been put into the flask
   iii. the point at which the first sign of colour change is seen
   iv. the point at which equal numbers of moles of H^+(aq) and OH^-(aq) have been put into the flask

4. The end point in an acid–base titration is the point when:
   i. the solution is neutral
   ii. the indicator changes colour
   iii. equal volumes of reactants have been mixed
   iv. reactants have been mixed in the appropriate stoichiometric ratio.

5. Lactic acid, $HC_3H_5O_3$, is a weak monoprotic acid that accumulates as a waste product in muscle tissue during exertion, leading to pain and a feeling of fatigue. What must be the concentration of a sample of lactic acid if 20.00 mL of sodium hydroxide of concentration 0.1426 mol/L requires 24.58 mL of the acid for a complete reaction? The full equation for the reaction is:
$HC_3H_5O_3(aq) + NaOH(aq) \rightarrow NaC_3H_5O_3(aq) + H_2O(l)$

6. a Write the balanced full equation for the neutralisation of potassium hydroxide solution by nitric acid.
b What volume of nitric acid of concentration 0.145 mol/L would be required to react completely with 20.00 mL of potassium hydroxide solution of concentration 0.099 mol/L?

7. a Write the balanced full equation for the neutralisation of sodium hydroxide solution by sulfuric acid.
b What volume of sulfuric acid of concentration 0.162 mol/L is needed to exactly neutralise 20.00 mL of sodium hydroxide of concentration 0.250 mol/L?

1. a. 2.17×10^{-2} mol

   b. 4.34×10^{-2} M

   c. 2.11 gL^{-1}

   d. 4.34×10^{-2} M

   e. 4.34×10^{-3} mol

   f. 8.69×10^{-3} M

   g. 4.34×10^{-3} mol

2. 0.5045 M

3. d

4. b

5. 0.116 M

6. a. $KOH(aq) + HNO_3(aq) \rightarrow KNO_3(aq) + H_2O(l)$

   b. 0.0137 L

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

   b. 0.0154 L