Control Questions

#2 and #3 Separation from a ternary mixture by dissolution and filtration

1. Give the chemical formula of the following substances: sand, salt and limestone.
2. How to separate limestone and sand from salt in the practice?
3. How to separate limestone from sand and salt in the practice?
4. Sketch a filtration equipment.
5. Define decantation.
6. Define dissolution. What kind of dissolution is used in the practice?
7. Why do we use hot water to dissolve the salt from the ternary mixture?
8. How can you check that the filtrate is chloride ion free? Write the balanced equation for the reaction.
9. Calculate the mass percentage of sand in the ternary mixture if the mass of the filter paper with the solid left after the HCl dissolution of the sample originally weighing 2.0105 g is 0.3473 g. The mass of the dry filter paper is 0.1023 g.
10. Calculate the mass percentage of salt in the ternary mixture if the mass of the filter paper with the solid left after the hot water dissolution of the sample originally weighing 2.0105 g is 0.9809 g. The mass of the dry filter paper is 0.1023 g.

#4 and #5 Solution preparation, density measurements

1. Define solution.
2. Define molar concentration (molarity) and molality.
3. Define density and mass concentration.
4. How to determine the volume of the volumetric flask during the practice?
5. How to prepare a solution from a solid?
6. How to prepare a solution from a more concentrated (stock) solution?
7. What do H and P sentences stand for on the labels of the chemicals?
8. What is a safety data sheet?
9. How do you dilute concentrated acids with water? Give reasoning.
10. What should you do if you splash concentrated acid or base on your skin?

 # 6 Titration

1. Define molarity.
2. Define titration.
3. What is a pipette. What are the different types of pipettes?
4. Give the balanced equation of the reaction used in the practice.
5. Why do you need to warm up the solution after the addition of the first few drops of titrant during the titration in the practice?
6. Define the equivalence (or end) point of a titration.
7. What indicates the endpoint in the practice?
8. Determine the oxidation number of Mn in the following compounds: $KMnO_4$, K_2MnO_4, MnO_2 and $MnSO_4$?
9. Calculate the molarity of $KMnO_4$ solution, when 10.00 cm^3 of 0.0502 mol/dm^3 $(COOH)_2$ solution is titrated with $KMnO_4$ solution. It takes 9.87 cm^3 of $KMnO_4$ solution to complete the reaction.
10. Calculate the molarity of $(COOH)_2$ solution when 10.00 cm^3 of $(COOH)_2$ solution is titrated with 0.0202 mol/dm^3 $KMnO_4$ solution. It takes 10.13 cm^3 $KMnO_4$ solution to complete the reaction.

#7 Reaction kinetics

1. Define reaction rate.
2. Define the order of reaction and the order of the overall reaction and rate coefficient.
3. Give the rate law and the integrated rate law of a first-order reaction.
4. What is the Arrhenius equation?
5. Write down the linearized form of the Arrhenius equation.
6. Write down the balanced equation of the reaction between KI and $K_2S_2O_8$.
7. Describe how to determine the reaction rate experimentally in the iodine clock reaction.
8. Calculate the reaction rate if the time needed to the blue discoloration is 3 min 15 s, and $[S_2O_3^{2-}]_0 = 0.0156$ M?
9. Write the balanced equation for the decomposition of thiosulfuric acid.
10. Explain how to monitor the decomposition of thiosulfuric acid experimentally.

Solution composition exercises (one test question for Practice #4 and #5)

1. Calculate the mass of NaCl necessary to prepare 250 cm^3 NaCl solution with 0.25 mol/dm^3 molarity. $M_r(NaCl)$ = 58.5.
2. Calculate the mass of Mohr salt ($Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$) necessary to prepare 500 cm^3 solution containing Fe^{2+} with 0.125 mol/dm^3 molarity. $M_r[Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O]$ = 392.18.
3. Calculate the mass of $BaCl_2 \cdot 2H_2O$ necessary to prepare 350 kg barium chloride solution of 15 w%. $M_r(BaCl_2 \cdot 2H_2O)$ = 244.27 and $M_r(H_2O)$ =18.02.
4. Calculate the volume of the HCl stock solution of 36 w% and density of 1.180 g/cm^3 necessary to dilute with water to prepare 500 cm^3 HCl solution with 1.25 mol/dm^3 molarity. $M_r(HCl) = 36.46$.
5. Calculate the volume of the sulfuric acid stock solution (60.65 w% and density of 1.51 g/cm^3) required to prepare 2 litre sulfuric acid solution with 2.50 mol/dm^3 molarity. $M_r(H_2SO_4)$ = 98.08.
6. Calculate the molarity of acetic acid in a vinegar with 20 w% if the density of the vinegar is 1.0261 g/cm^3. $M_r(CH_3COOH)$ = 60.05.
7. What is the molality of ethanol of a solution containing 45 g ethanol dissolved in 250 g water? What is the mole fraction of ethanol in this solution? $M_r(C_2H_5OH)$ = 46.07 and $M_r(H_2O)$ = 18.02.
8. The level of blood sugar of diabetics is $\sim$ 0.140 g glucose in 100 ml blood. Calculate the molarity of glucose in the blood. $M_r(C_6H_{12}O_6) = 180.16$
9. What is the mass of ethanol in 1 litre gin of 78 degrees. The density of ethanol is 0.80 g/cm^3 and the degree stands for twice of the volume fraction of ethanol.
10. We have a stock solution of alanine with mass concentration of 0.0203 mg/l. How would you prepare a 10 cm^3 solution of alanine with 1.5 $\mu g/l$ mass concentration?

Stochiometric exercises (one test question for Practice #6 and #7)

1. Calculate the concentration of the solution containing Fe^{2+}, when 20.0 cm^3 of it reacts with 19.2 cm^3 $K_2Cr_2O_7$solution of 0.104 mol/dm^3 molarity according to the following balanced equation:

$$Cr_2O_7^{2-} + 6\,Fe^{2+} + 14\,H^+ \longrightarrow 2\,Cr^{3+} + 6\,Fe^{3+} + 7\,H_2O$$

2. The concentration of iodine can be determined by titration with arseneous acid. Calculate the concentration of the I_2 solution if 0.360 g H_3AsO_3 reacts with 27.7 cm^3 I_2 solution according to the following balanced equation and $M_r(H_3AsO_3)$=125.9:

$$I_2 + H_3AsO_3 + H_2O \longrightarrow 2\,I^- + H_3AsO_4 + 2\,H^+$$

3. The concentration of $K_2Cr_2O_7$ can be determined by titrating it with KI. Calculate the concentration of $K_2Cr_2O_7$ in the solution if 50.5 cm^3 of it reacts with 28.3 cm^3 KI solution of 0.102 mol/dm^3 molarity according to the following balanced equation:

$$Cr_2O_7^{2-} + 6\,I^- + 14\,H^+ \longrightarrow 2\,Cr^{3+} + 3\,I_2 + 7\,H_2O$$

4. Calculate the volume in dm^3 of N_2 gas evolved at 60048 Pa pressure and 299 K temperature upon the dissolution of 42 g cobalt in concentrated nitric acid according to the following balanced equation with A_r(Co)=58.93 and R=8.314 J/(mol K)

$$5\,Co + 12\,HNO_3 \longrightarrow 5\,Co(NO_3)_2 + N_2 + 6\,H_2O$$

5. Calculate the volume in dm^3 of NO gas evolved at 10^5 Pa pressure and 290 K temperature upon the dissolution of 53 g vanadium in concentrated nitric acid according to the following balanced equation with A_r(V)=50.94 and R=8.314 J/(mol K)

$$6\,V + 10\,HNO_3 \longrightarrow 3\,V_2O_5 + 10\,NO + 5\,H_2O$$

6. Calculate the concentration of Ag^+ in the $AgNO_3$ solution if 20.0 cm^3 of it reacts with 3.45 cm^3 Na_3PO_4 solution of 0.102 mol/dm^3 molarity according to the following balanced equation: $3\,Ag^+ + PO_4^{3-} \longrightarrow \underline{Ag_3PO_4}$
7. Calculate the concentration of $(COOH)_2$ in a solution if 10.12 cm^3 of it reacts with 13.02 cm^3 $KMnO_4$ solution of 0.0199 mol/dm^3 molarity according to the following balanced equation:

$$2\,KMnO_4 + 5\,(COOH)_2 + 3H_2SO_4 \longrightarrow 2\,MnSO_4 + K_2SO_4 + 10\,CO_2 + 8\,H_2O$$