2 Basic laboratory procedures I

1. What is dissolution?
2. How do you dilute concentrated acids with water? Give the reason.
3. What is filtration for? How do you filtrate? Write in two sentences.
4. What is decantation?
5. Write up the reaction between silver nitrate and sodium chloride.
6. If you started 10.51 g of mixture and after dissolving sodium chloride you had 6.53 g of remained solid, what was the mass percentage of calcium carbonate in the original mixture?
7. If you started 10.51 g of mixture and after dissolving sodium chloride you had 6.53 g of remained solid, what was the mass percentage of sodium chloride in the original mixture?
8. Write up the formula of the following compounds: ammonium oxalate, silver nitrate, and barium chloride
9. Name the following compounds: CaC_2O_4, AgCl, $BaSO_4$
10. Complete the following equations:
$CaCl_2 + (NH_4)_2(COO)_2 = NH_4Cl + Ca(COO)_2$
$Ca^{2+} + (COO)_2^{2-} = Ca(COO)_2$

3 Basic laboratory procedures II

1. What is a mixture in chemistry? What could be their state of matter?
2. What is sublimation?
3. How to light up a Bunsen burner?
4. If you started 0.91 g of mixture and after sublimation of phthalic anhydride the residual was 0.63 g, what was the mass percentage of phthalic anhydride in the original mixture?
5. If you started 0.91 g of mixture and after sublimation of phthalic anhydride the residual was 0.63 g, what was the mass percentage of sodium chloride in the original mixture?
6. If you started 0.91 g of mixture and after sublimation the mass of collected phthalic anhydride was 0.14 g, what was the mass percentage of phthalic anhydride in the original mixture?
7. If you started 0.91 g of mixture and after sublimation the mass of collected phthalic anhydride was 0.14 g, what was the mass percentage of sodium chloride in the original mixture?
8. What is undercooling (or supercooling or overcooling)?
9. How could you cease the undercooled state?
10. Write up the formula of the following compounds: sodium chloride, sodium thiosulphate pentahydrate, dihydrogen monoxide

4 Solutions

1. Define what a solution is.
2. How do you dilute concentrated acids with water? Give the reason.
3. The mass of a clean, dry, empty volumetric flask was 50.15 g. Its mass when it was filled with water was 101.05 g. The density of water was 0.99730 g/cm^3. What is the volume of the flask?
4. The density of water is 0.99821 g/cm^3 at 20 °C, and 0.99679 g/cm^3 at 26 °C. What is the density at 24 °C?
5. What mass of NaCl should be dissolved in water to give 100.15 cm^3 solution of 0.1 mol/dm^3 concentration? M_r(NaCl)=58.44
6. What mass of NaCl should be dissolved in 135 g water to get a solution of 10 m/m% NaCl?
7. What mass of water should be used to dissolve 15 g NaCl to get a solution of 10 m/m% NaCl?
8. Write up the formula of ethanol, carbon tetrachloride, iodine.
9. Write up the formula of potassium nitrate, calcium acetate, sodium chloride.
10. Name the following compounds: $NaCH_3COO$, $Na_2S_2O_3$, $BaCl_2$

5 Preparative practices

1. What is filtration for? How do you filtrate? Write in two sentences.
2. What is decantation?
3. What is solubility?
4. What is the formula of alum, copper sulphate and potassium permanganate?
5. 5.15 g of the mixture of alum, sand and copper sulphate contained 2.12 g of sand and copper sulphate. 1.51 g of pure alum could be collected. What was the yield of purifying alum? Yield means the ratio of theoretical amount and the actual (yielded) amount.
6. Complete the following equation:
$KMnO_4 = K_2MnO_4 + MnO_2 + O_2$
7. The vapor pressure of water is 17.5 Torr at 20 °C, and 25.2 Torr at 26 °C. What is the vapor pressure at 24 °C?
8. The mass of oxygen gas evolved by heating potassium permanganate was 0.26 g. Its volume was 166 cm^3 at a given pressure and temperature. What is the molar volume of oxygen at this condition? $M_r(O_2)=32.00$
9. What would be the molar volume of oxygen at 298 K temperature and 100 kPa pressure if it were an ideal gas? The gas constant is,
R = 8.314 J/(mol K)
10. What is pascal (Pa), atmosphere (atm), torr (Torr) expressed in SI base units?

6 Stoichiometrical practices I

1. Name the following substances:
Na_2SiO_3, SiO_2, HCl
2. Give the formula of the following substances: sodium carbonate, hydrochloric acid, carbonic acid, carbon dioxide
3. Name the following substances:
Na_2SO_3, H_2SO_3, SO_2
4. Give the formula of the following substances: copper(II) sulphate, sodium hydroxide, copper(II) hydroxide
5. Name the following substances: NH_4Cl, CaO, NH_3
6. Give the formula of the following substances: barium chloride, sulphuric acid, barium hydroxide
7. Complete the equation:
$NH_4Cl + CaO = NH_3 + CaCl_2 + H_2O$
8. Complete the equation:
$NaOH + CuSO_4 = Na_2SO_4 + Cu(OH)_2$
9. What is the amount of substance of $CuSO_4 \cdot 5H_2O$ in 5.05 g sample? How much mass of K_2SO_4 is the same amount of substance? $M_r(CuSO_4)= 159.61$, $M_r(K_2SO_4) = 174.26$, $M_r(H_2O)= 18.02$
10. If 5 g of $CuSO_4 \cdot 5H_2O$ and 3.49 g K_2SO_4 was dissolved together, what mass of $K_2Cu(SO_4)_2 \cdot 6H_2O$ double salt could be expected? What is the theoretical yield? $M_r(CuSO_4)= 159.61$, $M_r(K_2SO_4) = 174.26$, $M_r(H_2O)= 18.02$

7 Stoichiometrical practices II

1. Name the following substances:
KIO_3, H_2SO_4, KI
2. Give the formula of the following substances: potassium permanganate, hydrogen peroxide, sodium sulphite
3. Name the following substances:
CCl_4, $FeCl_3$, $FeSO_4$
4. Give the formula of the following substances: iron(II) hydroxide, iron(III) hydroxide, potassium hydroxide
5. Name the following substances:
$MnSO_4$, MnO_2, K_2MnO_4
6. What is the oxidation number of sulphur in the following substances: S_8, K_2SO_3, K_2SO_4
7. What is the oxidation number of oxygen in the following substances:
$KMnO_4$, H_2O_2, Na_2SO_3
8. Complete the equations:
$FeCl_3 + KI = FeCl_2 + I_2$;
$Fe(OH)_2 + H_2O_2 = Fe(OH)_3$
9. What is melting point and what is freezing point? What is the difference between them?
10. Does the melting point change with pressure, and if it so, how?

8 Thermochemistry

1. What is heat?
2. What is heat capacity, specific heat capacity, and molar heat capacity?
3. Give the formula of the following substances: sodium sulphate decahydrate, sodium sulphate, lead, aluminum
4. Transferring certain amount of heat, the temperature of 200 g water increased by 2.5 °C. The specific heat capacity of water is 4.184 J/(g K). How much heat was added?
5. Transferring certain amount of heat, the temperature of 1 mol lead increased by 2.5 °C. The molar heat capacity of lead is 26 J/(mol K). How much heat was added?
6. Transferring 60 J heat, the temperature of 200 g lead increased by 2.5 °C. The molar heat capacity of lead is 26 J/(mol K). Estimate the relative atomic mass of lead.
7. Placing 100 g lead of 22.5 °C temperature into 200 g water of 295.65 K temperature, what will be the common temperature? The specific heat capacity of water is 4.184 J/(g K), the specific heat capacity of lead is 0.1256 J/(g K).
8. Mixing 100 g water of 20 °C temperature with 200 g water of 30 °C temperature, what will be the common temperature? The specific heat capacity of water is 4.184 J/(g K).
9. What is boiling point?
10. What is overheating? Why it could happen?

9 Chemical equilibria

1. Name the following substances:
$FeCl_3$, KSCN, $Fe(SCN)_3$
2. Name the following substances:
$HgCl_2$, NaF, $Hg(SCN)_2$
3. Complete the equation:
$FeCl_3 + KSCN \rightleftharpoons Fe(SCN)_3 + KCl$
and write it as an ionic equation, too.
4. Write up the equilibrium constants for the formation of iron(III) thiocyanate (considering only the ions taking part in the reaction).
5. How the equilibrium of an $A + B \rightleftharpoons C$ reaction is shifted if you add A to the system? What would be the result if C is added? What would be the result if A and B is removed?
6. What is hydrolysis?
7. Give the formula of the following substances: aluminum sulphate, disodium hydrogen phosphate, trisodium phosphate
8. What are buffers?
9. What are buffers used for?
10. In an acetic acid solution the pH=3. What is the concentration of acetate and hydrogen ions?

10 Volumetric analysis

1. What is titration?
2. What are indicators in acid base titration?
3. What mass of oxalic acid should be measured to prepare 250 cm^3, 0.05 M oxalic acid solution? $M_r(H_2C_2O_4)=90.04$
4. What mass of oxalic acid dihydrate should be measured to prepare 250 cm^3, 0.05 M oxalic acid solution? $M_r(H_2C_2O_4 \cdot 2H_2O)=126.08$
5. If 10 cm^3 of 1 M NaOH was diluted to 100 cm^3, and 10 cm^3 of the diluted solution was taken as a sample for titration, how much was the amount of substance of NaOH in the sample?
6. If 10 cm^3 of a 0.1 M NaOH reacted completely with 12.5 cm^3 oxalic acid, what was the concentration of oxalic acid?
7. If 20.3 cm^3 of a 0.05 M oxalic acid reacted completely with 20 cm^3 NaOH solution, what was the concentration of NaOH solution?
8. An unknown volume of 1 M NaOH was diluted to 100 cm^3. 10 cm^3 of this sample was titrated by 0.05 M oxalic acid. The equivalence point was reached adding 12.3 cm^3 of oxalic acid. What was the concentration of the diluted NaOH solution?
9. An unknown volume of 1 M NaOH was diluted to 100 cm^3. 10 cm^3 of this sample was titrated by 0.05 M oxalic acid. The equivalence point was reached adding 12.3 cm^3 of oxalic acid. What was the volume of the 1 M NaOH solution?
10. 10 cm^3 of 1 M NaOH was diluted to 100 cm^3. 10 cm^3 of this sample was titrated by oxalic acid. The equivalence point was reached adding 10.5 cm^3 of oxalic acid. An unknown volume of 1 M NaOH was diluted to 100 cm^3. 10 cm^3 of this sample was titrated by the same oxalic acid solution. The equivalence point was reached adding 13.5 cm^3 of oxalic acid. What was the unknown volume?

11 Electrochemical practices

1. Name the following substances:
Cu, Fe, Zn, Mg, Sn
2. Give the formula of the following substances: potassium hexacyano ferrate(III), carbon tetrachloride, mercury(I) nitrate, potassium iodide
3. Complete the following equations:
$Mg + HCl =$; $Zn + H_2SO_4 =$
4. What are half cells? What is a voltaic cell and what is an electrolysis cell?
5. Write the half cell reactions and the cell reaction of a Daniell-cell. Which could be the cathode and the anode?
6. What is the Nernst equation for a metal electrode?
7. What is electromotive force, and how can it be calculated from the electrode potential of the cathode and anode?
8. Calculate the electromotive force for the following Daniell-cell, if $E^0_{Zn} = -0.76\,V$ and $E^0_{Cu} = 0.34\,V$.
$Zn|ZnSO_4(0.1\,M) \vdots CuSO_4(0.1\,M)|Cu$
9. Complete the following equation:
$Zn + [Fe(CN)_6]^{3-} + H^+ = H_2 + Zn_3[Fe(CN)_6]_2$
10. Write up the half cell reactions for the electrolysis of water.

12 Chemical kinetics

1. Name the following substances:
$Na_2S_2O_3$, H_2SO_4, Na_2SO_4, SO_2, S
2. Give the formula of the following substances: Sulphurous acid, iodic acid, iodine, potassium iodate, potassium iodide
3. Complete the equations.
$H_2O_2 = H + O_2$; $Fe^{3+} + H = Fe^{2+} + H^+$; $H_2O_2 = H_2O + O$; $Fe^{2+} + O + H^+ = Fe^{3+} + H_2O$
4. How the reaction rate in a homogeneous reaction is defined?
5. How does the reaction rate depend on the concentrations? What is reaction order and the overall order? What is the rate constant (coefficient)?
6. Write up the Arrhenius equation for the temperature dependency of the rate constant.
7. If at $x_1 = 1.23$, $y_1 = 2.11$, and at $x_2 = 3.25$, $y_2 = 4.33$, what is the slope of the straight line?
8. If the slope of the straight line of the natural logarithm of the rate constant versus the reciprocal of the temperature is -6150 K, what is the activation energy of the reaction?
R=8.314 (J/(mol K).
9. If the rate constant is $1.2 \cdot 10^{-4}$ 1/s at 300 K temperature, and the activation energy is 50 kJ/mol, what is the preexponential factor in the Arrhenius equation?
10. What are catalysts, what is catalysis?