Chemical Calculations, 1st exam **November, 26th ,2012**

name:_____

martriculation number.: _____

duration: **90 min**, max points: 40 points

1 excellent: 40 – 35.5
2 good: 35 – 30.5
3 satisfactory: 30 – 25.5
4 sufficient: 25 – 20
5 insufficient: 19.5 – 0

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1. Fluorine F_2 is reacted with 1.000 g of an uranium oxide U_xO_y. As reaction products oxygen O_2 and 1.255 g uranium hexafluoride UF_6 are formed.
Determine the empirical formula of the uranium oxide!
Write down the reaction equation!

M(F) = 18.9984 g mole^{-1}, M(U) = 238.0289 g mole^{-1}, M(O) = 15.999 g mole^{-1}.

7P

2. A mixture, which contains only NaOH and KOH, weighed 1.0400 g. The mixture was completely dissolved in water and titrated with an aqueous HCl. 23.1 ml of a HCl with c(HCl) = 1 mol l^{-1} were needed to reach the equivalence point.

Calculate the mass fraction of NaOH in the mixture!

Specify your result in % (1 place after the decimal point)!

The corresponding reaction equations are:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

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

M(NaOH) = 39.9971 g $mole^{-1}$, M(KOH) = 56.1053g $mole^{-1}$, M(HCl) = 36.4609 g $mole^{-1}$.

8P

3. The noble gas compound XeF_2 can be safely destroyed by treatment with NaOH:

____ NaOH + ____ XeF_2 → ____ Xe + ____ O_2 + ____ NaF + ____ H_2O

Balance the reaction equation!

Calculate the mass of oxygen in gramms, resulting from the reaction above of 85.0 g XeF_2 with an excess NaOH solution!

M(Xe) = 131.29 g $mole^{-1}$; M(F) = 18.9984 g $mole^{-1}$; M(O) = 15.999 g $mole^{-1}$

4P

4. Propionic acid CH_3CH_2COOH is a weak monovalent acid. 20 ml of an aqueous propionic acid were titrated with a 0.02 M NaOH. To reach the equivalence point 15 ml NaOH were needed.

$K_S(CH_3CH_2COOH) = 1.34 \cdot 10^{-5}$

a) Write down the reaction equation for the titration reaction! **1P**

b) Calculate the concentration of the propionic acid in mole per liter! **2P**

c) Calculate the pH of the propionic acid before the titration! You can use the approximation which is common for weak acids/bases. **2P**

d) Calulate the pH at the equivalence point! You can use the approximation which is common for weak acids/bases. **4.5P**

(Specify the calculated pH-values with two places after the decimal point!)

5. Formic acid HCOOH is a weak acid. 50 ml of an aqueous formic acid with c(HCOOH) = 0.1 mol l^{-1} are mixed with 20 of an aqueous NaOH with c(NaOH) = 0.1 mol l^{-1}. The resulting pH of the mixture is pH = 3.58. Calculate the acid dissociation constant K_S of the formic acid!

Write down the relevant reaction equation!

6.5P

6. A mixture contains as only alkaline compound potassium hydroxide KOH. 2.9980 g of the mixture were completely dissolved in 200 ml of water. The solution was titrated with an aqueous HCl. To reach the equivalence point 48.4 ml of a 1.0 M HCl were needed.

Write down the reaction equation for the titration reaction!

Calculate the mass fraction of KOH in the mixture!

Specify your result in % (1 place after the decimal point)!

$M(KOH) = 56.1053 \text{ g mole}^{-1}$

5P