

name: _____

matriculation 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

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!

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

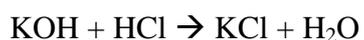
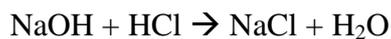
7P

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 $c(\text{HCl}) = 1 \text{ mol l}^{-1}$ 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:



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

8P

3. The noble gas compound XeF₂ can be safely destroyed by treatment with NaOH:



Balance the reaction equation!

Calculate the mass of oxygen in grams, resulting from the reaction above of 85.0 g XeF₂ with an excess NaOH solution!

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

4P

4. Propionic acid $\text{CH}_3\text{CH}_2\text{COOH}$ 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.

$$K_s(\text{CH}_3\text{CH}_2\text{COOH}) = 1.34 \cdot 10^{-5}$$

- 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) Calculate 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 $c(\text{HCOOH}) = 0.1 \text{ mol l}^{-1}$ are mixed with 20 ml of an aqueous NaOH with $c(\text{NaOH}) = 0.1 \text{ mol l}^{-1}$. The resulting pH of the mixture is $\text{pH} = 3.58$. 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)!

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

5P