

TASKS OF ENTRANCE EXAMINATION ON CHEMISTRY IN NSU

1. Draw the Lewis structures of the following compounds
 - a. Silicon dioxide
 - b. Methane
 - c. NaOH
 - d. NH_4Cl
 - e. PCl_3
 - f. $\text{CH}_3\text{N}^+\text{H}_3$
2. Determine the oxidation state of phosphorus:
 - a. H_3PO_4
 - b. PH_3
 - c. Na_2HPO_4
3. What is the oxidation state of the central metal atom in the following complexes?
 - a. $\text{K}[\text{Al}(\text{OH})_4]$
 - b. $[\text{Au}(\text{CN})_4]^-$
 - c. $\text{Na}_2[\text{Zn}(\text{OH})_4]$
 - d. $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
4. Write the electronic configuration for the following elements or ions:
 - a. Cl
 - b. Ca
 - c. Ti^{4+}
 - d. Fe^{2+}
 - e. Ru^{2+}
5. Balance the following equations by electronic balance:
 - a. $\text{Ca}_3\text{P}_2 + \text{KMnO}_4 + \text{H}_2\text{SO}_4 = \text{Ca}_3(\text{PO}_4)_2 + \text{MnSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$
 - b. $\text{As}_2\text{S}_3 + \text{HNO}_3 + \text{H}_2\text{O} = \text{NO} + \text{H}_3\text{AsO}_4 + \text{H}_2\text{SO}_4$
6. Complete and balance by electronic balance the following reaction:
 - a. $\text{Zn} + \text{H}_3\text{PO}_4$ (diluted acid) = ...
 - b. $\text{K}_2\text{Cr}_2\text{O}_7 + \text{KI} + \text{H}_2\text{SO}_4 = \dots$
7. Milk of magnesia is typically an 8.7 % w/v (8.7 grams in 100 ml of water) aqueous suspension of magnesium hydroxide.
 - a. What are the chemical formula and the molecular weight of magnesium hydroxide?
 - b. How many moles of such magnesium compound are present in a 100 ml suspension?
 - c. How many milliliters of HCl solution ($C = 0.10 \text{ M}$) are required for complete neutralization of a 100 ml such suspension?
8. Draw the condensed structure of a compound that contains only carbon and hydrogen atoms and that has:

- three sp^3 carbons.
- one sp^3 carbon and two sp^2 carbons.
- two sp^3 carbons and two sp carbons.

9. Write a structural formula for each of the following compounds:

- 1,1,2,2-Tetrabromoethane
- Oct-1-ene
- Methylcyclohexane
- 1,2-Dichloropropane
- 1-Heptene
- Hexachloroethane
- 1-Heptyne
- 1,7-Octadiyne
- isoheptyl alcohol
- 4-*tert*-butylheptane
- 1,1-dimethylcyclohexane
- 4,5-diisopropylnonane
- triethylamine

10. Draw all isomers that have the molecular formula $C_5H_{11}Br$.

- Give the systematic name for each of the isomers.
- How many of the isomers are primary alkyl halides?
- How many of the isomers are secondary alkyl halides?
- How many of the isomers are tertiary alkyl halides?

11. Write the major product for each of the following reactions:

