FORM 12

1. (8 points) On the right, there is a list of statements that describe properties or reactions of organic compounds. Assign them correctly to structures shown on the left. Descriptions may be used more than once, and there are 1-3 descriptions for each compound. **Every incorrect assignation cancels out a correct one.**

a. ___

b. ___

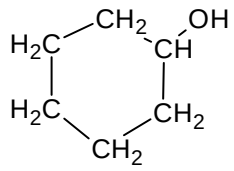
c. ___

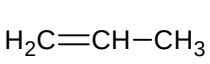
d. ___

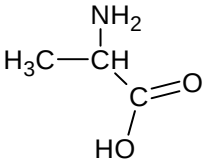
e. ___

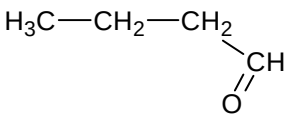
f. ___

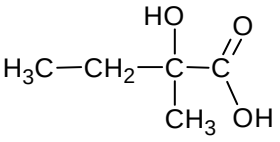
g. ___

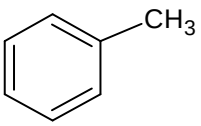


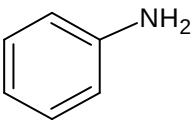












1. An aromatic compound
2. A gas at room temperature and normal pressure
3. Reacts with bromine to yield bromotoluene
4. Oxidation gives a ketone
5. Contains two carbon-carbon sigma bonds and one carbon-carbon pi bond
6. In an aqueous solution exists as a zwitterion
7. Oxidation gives a carboxylic acid
8. A constituent of proteins
9. May exist in a chair conformation
10. The reaction with NaOH gives a sodium salt
11. Aqueous solution is acidic
12. May react in a an acidic solution with water producing an alcohol
13. An optically active alcohol
14. A secondary alcohol

2. (9 points) You are studying the following seven metals:

aluminum, zinc, silver, calcium, potassium, copper and iron.

a) Which of these metals will “dissolve” in water?

b) Which of the remaining “dissolve” in hydrochloric acid?

c) Which of those left over from a) evolve hydrogen with a solution of sodium hydroxide?

d) How can you dissolve the metals that have proved to be unreactive previously?

Answer in reaction equations.

3. (9 points) Ammonium nitrate when heated decomposes to dinitrogen oxide and water.

a) Write the reaction equation for the process

b) How do the oxidation states change in the reaction?

c) Dinitrogen oxide is a linear polar molecule. Is the arrangements of atoms in the molecule NNO or NON. Give reasoning for your choice.

d) What is the hybridization of the central atom in the dinitrogenoxide molecule?

e) Gaseous dinitrogen oxide formed in the reaction is gathered into an evacuated vessel with a volume of 1.00 L at 25^{o}C. When pressure in the vessel is 101 kPa, how many grams of ammonium nitrate has decomposed?

4. (9 points) The waste-water was treated biologically in a purification plant. 45 % of carbohydrates $(CH_2O)_n$ contained in the waste-water were oxidized completely and 10 % of then decomposed anaerobically in a fermentation reaction to two gaseous compounds. The rest stayed unchangeable in the waste-water. In the process altogether 16 m^3 of gases were formed during one day (25 ^{o}C, 101 kPa).

a) How much (kg/day) of the carbohydrates were left (stayed) in the waste-water?

b) How much heat (kJ/day) can be produced in the plant by burning the methane formed during the process? The combustion enthalpy of methane is 882 kJ/mol?

c) How large amount of waste-water was treated in the purification plant in one day (m^3 water/day)? The content of carbohydrates in the waste-water was 250 mg/dm^3

5. (10 points) Element **M** is one of the metals that is used when metal alloy called Duralumin is produced. Unlike many other metals **M** reacts very violently with gases **X**, **Y** and **Z** in certain circumstances. When M reacts with **X** a solid mixture of two substances **A** and **B** is obtained. The aqueous solution of **A** is alkaline**.** **B** is insoluble in any known solvent. When **M** and **Y** react with each other only a compound **A** is formed. When **M** and **Z** react with each other only a compound **C** is formed. When **C** reacts with water a slightly soluble compound **D** and very strongly smelling gas **E** are formed. **E** is very soluble in water and its aqueous solution is basic. When **D** is heated water and compound **A** are formed. When compound **F** is heated **A** and gas **X** are formed.

a) Identify **M, X, Y, Z, A, B, C, D, E** and **F** by giving their formulas and names.

b) Write chemical equations for the following processes: i) **M** + **X**, ii) **M** + **Z**, iii) **C** + H_2O