



Answer by encircling the letter in front of one of the offered answers. Each correct answer is worth 2 points. A wrong answer is penalized by  $-0.25$  points. Unanswered questions do not alter the score. Using a pencil, encircling of two or more answers or drawing over the answer is penalized by  $-0.25$  points. Each problem is worth a total of 5 points.

JURY ONLY

Total points: \_\_\_\_\_

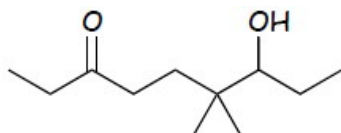
Checked by: \_\_\_\_\_

I. MULTIPLE CHOICE TEST WITH A SINGLE CORRECT ANSWER  
(Encircle **only one** of the answers A, B, C, D or E)

1. What is the type of hybridization of the carbon atom bonded to the  $-OH$  group in saturated alcohols and what is the hybridization type in phenols?

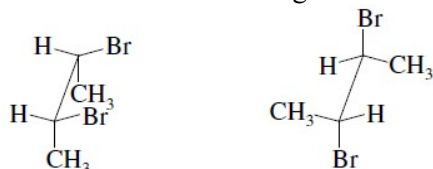
- A.  $sp^3$ -hybridization in both cases.
- B.  $sp^3$ -hybridization in alcohols and  $sp^2$ -hybridization in phenols.
- C.  $sp^2$ -hybridization in both cases.
- D.  $sp^2$ -hybridization in alcohols and  $sp^3$ -hybridization in phenols.
- E.  $sp^3$ -hybridization in alcohols and  $sp$ -hybridization in phenols.

2. What is the name of this compound?



- A. 7-oxo-4,4-dimethylnonan-3-ol.
- B. 5,5-dimethyl-6-hydroxyheptan-2-one.
- C. 4,4-dimethyl-5-hydroxypentanal.
- D. 6,6-dimethyl-7-hydroxynonan-3-one.
- E. 6-isopropyl-7-hydroxynonan-3-one.

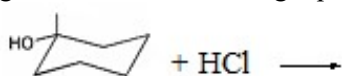
3. Which of the following statement/s is/are true for the molecules with the given structures?



- I. Both molecules contain chiral C-atoms.
- II. They are geometrical isomers.
- III. They are conformational stereoisomers.

- A. Only II.
- B. All.
- C. II and III.
- D. I and III.
- E. None.

4. Which compound is the product of the reaction given with the following equation?



- A. 2-chlorocyclohexanol.
- B. 1-chlorocyclohexanol.
- C. 1-chloro-1-chlorocyclohexane.
- D. Cyclohexene.
- E. 1-methylcyclohexene.

5. Which of the following statements is true?

- A. Alcohols in water solutions behave as acids.
- B. Alcohols in water solutions behave as bases.
- C. Alcohols have higher boiling temperatures than aldehydes with the same number of C-atoms.
- D. Aromatic alcohols do not take part in electrophilic aromatic substitution reactions.
- E. Alcohols with 20-25 C-atoms are soluble in water.

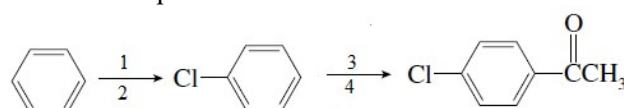
6. Which is/are the expected product/s of the reaction of buta-1,3-diene with HBr, when reacting in a mole ratio 1:1?

- A. Only 1-bromobut-2-ene.
- B. Only 2-bromobut-3-ene.
- C. Only 3-bromobut-1-ene.
- D. 1-bromobut-2-ene and 3-bromobut-3-ene.
- E. 3-bromobut-1-ene and 1-bromobut-2-ene.

7. Which organic compound is obtained by hydrolysis of sodium ethoxide?

- A. Ethane.
- B. Ethine.
- C. Ethene.
- D. Ethanal.
- E. Ethanol.

8. Which formulas (for reactants 1 and 3, and for catalysts 2 and 4) are missing in the equations of the reactions presented below?



- A. 1. HCl 2. HNO<sub>3</sub> 3. CH<sub>3</sub>OH 4. AlCl<sub>3</sub>.
- B. 1. Cl<sub>2</sub> 2. H<sub>2</sub>SO<sub>4</sub> 3. CH<sub>3</sub>CHO 4. Zn.
- C. 1. Cl<sub>2</sub> 2. FeCl<sub>3</sub> 3. CH<sub>3</sub>(CO)Cl 4. AlCl<sub>3</sub>.
- D. 1. Cl<sub>2</sub> 2. Fe 3. CH<sub>3</sub>(CO)Cl 4. Pt.
- E. 1. HCl 2. Zn 3. CH<sub>3</sub>OH 4. H<sub>2</sub>SO<sub>4</sub>.

9. Which of the following compounds can give a positive iodoform reaction?

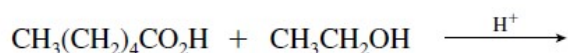
- A. Acetophenone
- B. Methanal
- C. Pentan-3-one
- D. Benzoic acid
- E. Benzyl alcohol

10. What type of compound will be the product of the reaction given with the following equation?



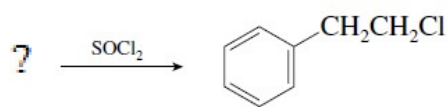
- A. Carboxylic acid.
- B. Hemiacetal.
- C. Dihydroxy alcohol.
- D. Hydroxy ketone.
- E. Acetal.

11. Which compound is a product of the reaction given with the equation:



- A. Octane.
- B. Octyl alcohol.
- C. Pentyl acetate.
- D. Ethyl hexanoate.
- E. Hexane dicarboxylic acid.

12. What is the reactant in the reaction given by the following equation?

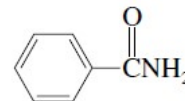


- A. 3-phenylpropane.
- B. 2-phenylethanol / фенилетанол.
- C. Vinyl benzene.
- D. Benzaldehyde.
- E. Benzyl alcohol.

13. Mark the solution with the lowest pH value.

- A. Pentanoic acid.
- B. Methyl alcohol.
- C. 3-aminopropanoic acid.
- D. 2-chloropropanoic acid.
- E. Benzamide.

14. Which are the products of hydrolysis of this compound?



- A. Benzene and ammonium hydroxide.
- B. Benzoic acid and ammonia.
- C. Benzyl alcohol and ammonia.
- D. Benzaldehyde and ammonium hydroxide.
- E. Benzene, carbon dioxide and ammonia.

15. Which of the following compounds is a secondary ammine?

- A. *N*-methylaniline.
- B. 2-phenylethylamine.
- C. *sec*-butylamine.
- D. 2,2-dimethylpropylamine.
- E. Aniline.

Write the procedure and the result in the rectangle under each problem and only the written in the rectangles will be checked. You may freely use the other side of the paper, but that will not be checked nor will points be assigned, unless written as advised.

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## II. PROBLEMS

1. How can you obtain *m*-nitrotoluene, and how can you obtain 2,4-dinitrotoluene, starting from benzene in both cases? Write the equations of these reactions with all reactants and catalysts and give an explanation for your ideas.

Solution:

2. The mass fractions of carbon and hydrogen in one aliphatic hydrocarbon (**A**) are as follows:  $w(\text{C}) = 85,7\%$ ;  $w(\text{H}) = 14,3\%$ . When this hydrocarbon reacts with hydrogen, in mole ratio 1:1, a saturated hydrocarbon (**B**) is obtained. One gram of the hydrocarbon A completely reacts with 38,05 g bromine solution with mass fraction of bromine  $w(\text{Br}_2; \text{solution}) = 5\%$  (to complete decoloration).

A) Write at least three possible formulas and the corresponding names of unbranched isomers of the compound A.

B) Select one of the possible compounds A and write the equation of the reaction with bromine and the name of the product.

Solution:

3. A) Write the equation of the reaction of complete neutralization of ethanedioic acid with sodium hydroxide.

B) Calculate the mass of the salt that is obtained if solution with volume of 500 mL of ethanedioic acid with concentration of the acid 0,01 mol/L reacts with excess of sodium hydroxide!

C) Write the equation of the reaction of ethanedioic acid with ethane-1,2-diol and write down what type of reaction is it.

Solution:

4. In the molecule of the compound (A) there is one quaternary and one secondary C-atom. One hydroxyl group is bonded to the secondary C-atom.

A) Write the condensed formula of this compound.

B) Write the name of the compound.

C) Write the equation of the oxidation of compound A and name the product.

D) Write the equation of the dehydration of compound A and name the product.

Solution:

$$A_r(\text{C}) = 12,00; \quad A_r(\text{H}) = 1,00; \quad A_r(\text{O}) = 16,00; \quad A_r(\text{Na}) = 23,00;$$

