

**Part I**

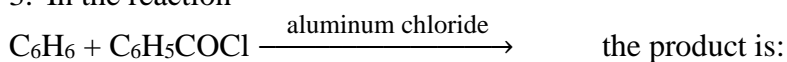
1. What is the number of possible structural isomers of the hydrocarbons containing five carbon atoms in the molecule, without unsaturated bonds and with one ring in the structure?

- A. 3.                      B. 4.                      **C. 5.**                      D. 6.

2. Which of the following compounds is an isomer of acetaldehyde?

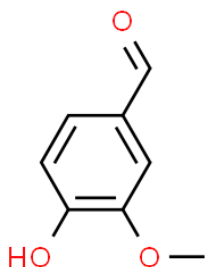
- A. Allyl alcohol.                      B. Dimethyl ketone.  
**C. Vinyl alcohol.**                      D. Propenal.

3. In the reaction



- A. benzaldehyde.      B. acetophenone.      **C. benzophenone.**      D. anhydride of benzoic acid.

4. The formula of vanillin is given. What is true for vanillin?



- A. There are eight hydrogen atoms in the molecule of vanillin.**  
B. All carbon atoms in the molecule of vanillin are  $\text{sp}^2$  hybridized.  
C. This compound is a ketone.  
D. The functional group with highest priority in vanillin is the hydroxyl group.

5. One of the products in the reaction of oxidation of 1-phenylpropan-2-one in alkaline solution of iodine is:

- A. benzoic acid.                      B. salicylic acid.  
C. phenylpropanoic acid.                      **D. phenylethanoic acid.**

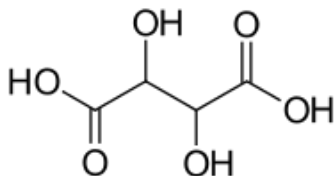
6. Which of the given compounds has a chiral carbon atom in the molecule?

- A. 2-phenylpropanal.**                      B. Ethyl phenyl ketone.  
C. Benzyl methyl ketone.                      D. 3-phenylpropanoic acid.

7. Which compound is obtained in the reaction of benzaldehyde with  $\text{LiAlH}_4$ ?

- A.  $\text{C}_6\text{H}_5\text{OH}$ .      B.  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ .      C.  $\text{C}_6\text{H}_5\text{COCH}_3$ .      D.  $\text{C}_6\text{H}_5\text{COOH}$ .

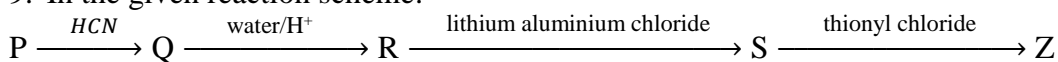
8. The salts of the acid that has the given formula



are called:

- A. citrates.      B. lactates.      C. succinates.      D. tartarates.

9. In the given reaction scheme:

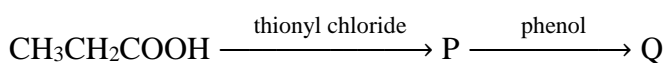


P is a carbonyl compound with a molecular formula  $\text{C}_4\text{H}_8\text{O}$  that does not react with an ammoniacal solution of silver nitrate. Which of the following statements for the compounds marked with P to Z in the reaction scheme are correct?

- I. The name of the compound P is butanal.  
 II. Upon addition of HCN to the carbonyl compound, the product is a compound with the rational structural formula  $\text{CH}_3\text{CH}_2\text{C}(\text{OH})(\text{CN})\text{CH}_3$ .  
 III. The compound marked with R in the reaction scheme is reduced to the compound S, whose name is 2-methylbutane-1,2-diol.  
 IV. The rational structural formula of the compound marked with Z is  $\text{CH}_3\text{CH}_2\text{CCl}_2\text{CH}_3$ .

- A. Only I and II.      B. Only I, II and III.      C. Only II and III.      D. Only II, III and IV.

10. What is the rational structural formula of the product Q obtained in the reactions that are given with the following reaction scheme:



- A.  $\text{CH}_3\text{CH}_2\text{COOC}_6\text{H}_5$ .      B.  $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}_3$ .  
 C.  $\text{CH}_3\text{CH}_2\text{COC}_6\text{H}_5$ .      D.  $\text{CH}_3\text{CH}_2\text{COOCOC}_6\text{H}_5$ .

11. Which of the given compounds can form hydrogen bonds with water molecules?

- A.  $\text{N}_2$ .      B.  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3$ .      C.  $\text{CH}\equiv\text{CH}$ .      D.  $\text{CH}_3\text{CH}_2\text{CONH}_2$ .

12. What is obtained upon addition of acetaldehyde to acetone?

- A.  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CHO}$ .      B.  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CHO}$ .  
 C.  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{COCH}_3$ .      D.  $\text{CH}_3\text{COCH}_2\text{CHO}$ .



13. What is true for butan-1-ol?

A. In reaction with pentanoic acid the product is  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}(\text{CH}_2)_4\text{CH}_3$ .

**B. It reacts with potassium and a gas is liberated in this reaction.**

C. It is oxidized by  $\text{K}_2\text{Cr}_2\text{O}_7$  in the presence of sulfuric acid and valerianic (valeric) acid is obtained.

D. It is obtained in a reaction of hydration of but-1-ene.

14. Which of the following alcohols is easily oxidized to a ketone?

A. 1-ethylcyclopentanol.

B. 3-ethylpentan-3-ol.

**C. 3-methylbutan-2-ol.**

D. isobutyl alcohol.

15. In the molecule of the compound named 4-ethenylcyclopent-1-ene the number of the  $\text{sp}^3$  hybridized carbon atoms is:

A. 2.

**B. 3.**

C. 4.

D. 5.

### Part II

16. Citric acid is a weak organic acid. Its systematic name is 2-hydroxypropane-1,2,3-tricarboxylic acid.

A. Write down the rational structural formula of citric acid.

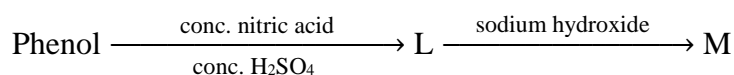
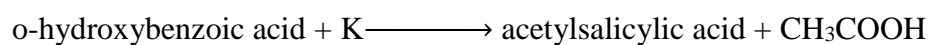
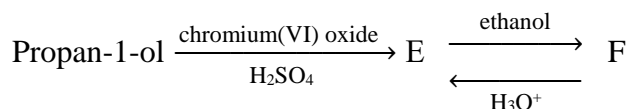
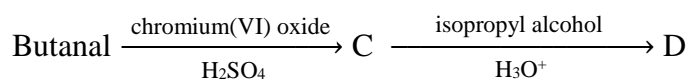
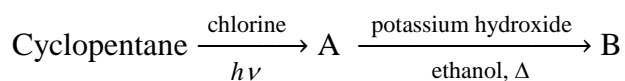
B. Citric acid forms salts called citrates. Write down the formula of the salt sodium citrate.

B. Calculate the volume of the solution of sodium hydroxide that has to be pipetted in order to obtain 1,29 g of sodium citrate if a solution of sodium hydroxide is available with a weight percent of 15% and a density of  $1,135 \text{ g/cm}^3$ .

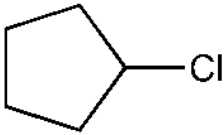
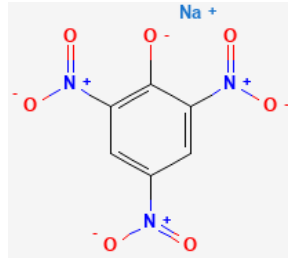
8 points

**See the Macedonian version for the correct answers.**

17. In the table below draw the structural formula of the compounds marked with the letters A, C, E, F, L and M, and the names of the compounds marked with the letters B, D, G, H, I, J and K in the following reactions:



12 points

	A	B	C
D	E	I	J
Isopropyl butanoate/butyrate	CH <sub>3</sub> CH <sub>2</sub> COOH	<i>p</i> -nitro- <i>tert</i> -butylbenzene	1,2-dibromo-1-phenylethane
G	L	M	
<i>tert</i> -butylbenzene	<i>o</i> -nitro- <i>tert</i> -butylbenzene		
K	Anhydride of acetic acid		