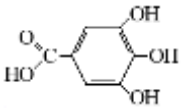
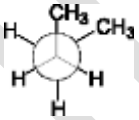
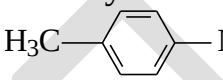
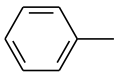
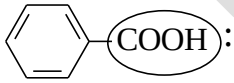
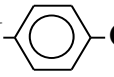
Unit III.
Online test (typical questions)

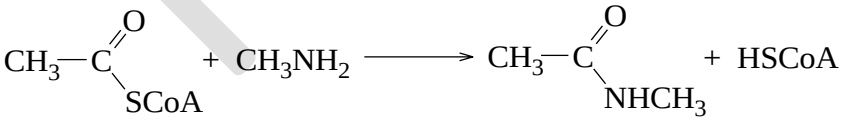
1. Choose the correct name according to the substitutive nomenclature and name all functional groups in the compound 
   a) 3,4,5-trihydroxybenzoic acid b) 1-carboxy-3,4,5-trihydroxyphenol
   c) carboxyl group d) tribasic hydroxy acid
   e) phenolic hydroxyl groups f) 1,2,3-trihydroxy-5-benzoic acid
2. The radicofunctional name of $CH_3CH(OH)CH_3$ is:
   a) propan-2-ol b) propanol c) isopropyl alcohol d) ethyl methyl ether.
3. The substitutive name for $CH_3CH(OH)CH_3$ is:
   a) 1-methylethan-1-ol b) propan-2-ol
   c) isopropyl alcohol d) 2-methylethan-1-ol
4. According to radicofunctional nomenclature, the parent structure for the compound $CH_3CH(NH_2)COOH$ is:
   a) ethylamine b) butyric acid c) propionic acid d) propanoic acid.
5. Choose the compounds which can exist as stereoisomers:
   a) 1,4-dimethylcyclohexane b) aminoacetic acid
   c) 2-butenoic acid d) 1,1-dimethylcyclohexane
6. The following conformation is 
   a) one of ethane conformations b) staggered
   c) gauche conformation d) the most stable conformation
7. Identify the hybridization state(s) of carbon atoms in the molecule  :
   a) sp^3, sp^2 b) sp^3, sp c) only sp^2 d) sp^2, sp
8. Determine the type(s) of conjugation in the molecule  :
   a) no conjugation b) π,π c) π,π and p,π d) p,π
9. Indicating the appropriate substituent effect(s) in the molecule of benzoic acid  :
   a) +I b) –I c) +M d) –M
10. State the type of the following species: $CH_3\cdot$ CH_3NHCH_3 H^+
    a) nucleophile b) free radical c) electrophile
11. Arrange the following compounds in order of increasing acidity:
    a) CH_3CH_2OH b) C_6H_5-SH c) $CH_3CH_2NH_2$ d) CH_3CH_2SH
12. Arrange the following compounds in order of decreasing basicity:

a) $CH_3–NH_2$ b) $CH_3–NH–CH_3$ c) $CH_3–CH_2–NH_2$ d)

8. For aniline, $pK_{BH^+} = 4.60$. The pH of its 0.01 M solution is:
   a) 4.60 b) 7.20 c) 8.30 d) 10.30
9. Match the formulae with the pK_a values:
   1) $Cl_2CHCOOH$ 2) CH_3COOH 3) HCOOH 4) $ClCH_2COOH$
   a) 3.75; b) 2.87; c) 1.26; d) 4.76
10. Are these statements true or false?
    a) electron-donating substituents increase the stability of anions and acidity of conjugate acids;
    b) the stronger the base, the lower is pK_a;
    c) the size of the atom attached directly to hydrogen in an acidic centre does not affect the acidity of the compound;
    d) the electrons of a π-bond are the centre of acidity.
11. Predict the main product of photochemical monobromination of methylbutane:
    a) 2-bromo-2-methylbutane b) 2-bromo_3-methylbutane
    c) 1-bromo-2-methylbutane d) 1-bromo-3-methylbutane
12. The most exact definition for the term *nucleophile* is the following:
    a) a positively charged particle;
    b) a particle with unpaired electron(s);
    c) a particle that has the affinity to a positively charged carbon atom;
    d) a particle that is able to release a proton.
13. The stability of carbocations in the following series:

    a) decreases b) increases c) has no definite pattern d) does not change.
14. The substituent $–NO_2$ in an aromatic ring in S_E reactions:
    a) is an electron-donating substituent b) facilitates S_E reactions;
    c) is a *meta*-directing substituent d) is an *ortho/para*-directing substituent
15. Is the following statement true or false? "The addition of hydrogen halides to $CH_2=CH-CH_3$ obeys Markovnikov's rule."
    a) true b) false
16. Which of the following compounds can react with propene?
    a) KBr b) CH_3NH_2 c) HCl d) NaOH
17. What is the class name for the product of the peroxide oxidation of an alkane?
    a) alcohol b) ether c) hydroperoxide d) epoxide
18. The compound  can participate in the reaction of:
    a) alkylation b) acylation c) elimination d) peroxide oxidation e) hydration

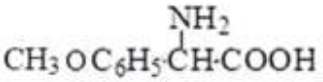
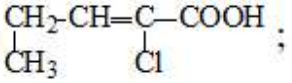
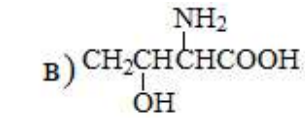
19. Arrange the following species in order of decreasing stability:
    a) $C_6H_5CH_2^{\bullet}$ b) $C_6H_5C^{\bullet}HCH{=}CH_2$ c) $C_6H_5C^{\bullet}HCH_3$
20. Arrange the following compounds in order of increasing nucleophilicity:
    a) CH_3NH_2 b) CH_3SH c) CH_3OH d) CH_3I
21. The reaction of 2-chloropropane with an aqueous solution of an alkali produces:
    a) propan-2-ol b) propene c) 2-methylpropan-1-ol d) propan-1-ol
22. Which of the following reagents can be used for replacing the hydroxyl group in alcohols by a bromine atom?
    a) sodium bromide b) bromine c) hydrogen bromide d) bromoethane
23. The product of the reaction $CH_3CH_2Br + 2\,NH_3 \rightarrow$ is:
    a) 1,2-ethanediamine b) diethyl amine c) ethylammonium bromide d) ethylamine
24. Which species will be the leaving group in the reaction between trimethylsulfonium chloride and trimethylamine?
    a) methyl group b) chlorine anion c) dimethyl sulfide d) dimethylamine
25. The reaction of 2-bromo-2-methylbutane with an alcoholic solution of an alkali produces:
    a) 2-methylbutan-2-ol b) 2-methylbut-2-ene c) methylpropene d) butan-2-ol
26. Acetal is the product of:
    a) oxidation of acetaldehyde
    b) the reaction of an aldehyde with excess alcohol in the presence of an acid
    c) the addition of one alcohol molecule to an aldehyde molecule
    d) the reaction between two molecules of aldehydes
27. Which compound is produced by the reaction of ethanal with ethylamine?
    a) amide b) amino acid c) imine d) amine
28. Aldols are formed in the reaction of:
    a) alcohols with aldehydes b) amines with aldehydes
    c) acids with aldehydes d) aldehydes with ketones
29. The acylating reagent in the following reaction is:



    a) methylamide of acetic acid b) coenzyme A
    c) methylamine d) acetyl coenzyme A
30. *β*-Keto esters are formed in the reaction:
    a) between alcohols and aldehydes b) of ester condensation
    c) of esterification d) of acylation of alcohols

Paper test (typical questions)

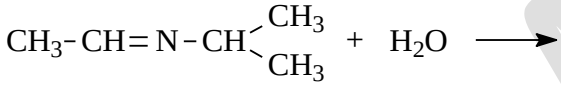
1. For each of the following compounds:

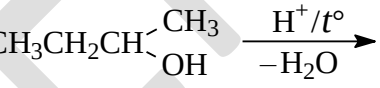
а)  ; б)  ; в) 

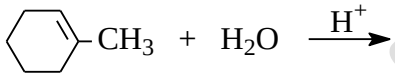
a) Draw two structural formulas of configurational isomers
b) Specify among them enantiomers, σ-diastereomers or π-diastereomers
c) Name the configurations using different stereochemical nomenclature: D,L-; R,S-; Z,E- or cis- trans (wherever it is possible)

2. Draw two structural formulas of phenol and 2,6-dinitrophenol. Compare their relative acidities. Write formulas of the appropriate conjugate bases.
a) Assign the pK_a values (3.7 and 10.0) to the compounds. Draw the formulas for their conjugate bases.
b) Explain your answer by indicating the substituent effects.
c) Calculate pH in 0.1M aqueous solution of 2,6-dinitrophenol.

3. Complete the following reactions:

a) 

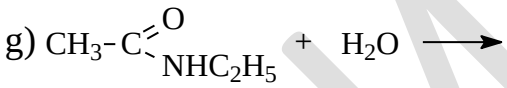
b) 

c) 

d) 

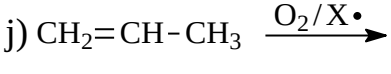
e) $CH_3CH_2Cl + CH_3SNa \longrightarrow$

f) $[(CH_3)_3S^+]Cl^- + (CH_3)_3N \longrightarrow$

g) 

h) 

i) 

j) 

4. For each of the reactions state its type (halogenation, hydrohalogenation, peroxidation, hydration, hydrolysis, deamination, alkylation, acylation, etc.), name the products or give their class names.

5. For the i) from task 3 indicate the reaction type (S_R, A_E, S_E, etc.) substrate, reagent, reaction center in the substrate and its nature (electrophilic, nucleophilic, etc.), type of covalent bond rupture, type of intermediate organic particles formed (carbocation, carboanion, etc.). Write the reaction mechanism. Explain the role of catalyst in the process.