



**JESSENIUS FACULTY
OF MEDICINE IN MARTIN**
Comenius University
Bratislava

JFMED admission exam

Chemistry

Preparing for the JFMED admission exam

JFMED admission exam is held [online](#) and in two subjects; chemistry and biology. During the exam, you will be presented with 40 multiple-choice questions in each subject with only one correct answer. For each correct answer you receive one point. Points are not deducted for incorrect answers. The exam lasts two hours.

The admission exam is structured around the content and scope of the learning covered at the secondary (high school) school in Slovakia. This document offers a range of chemistry topics that the exam is likely to be structured around as well as some mock questions selected from the previous entry exams.

Chemistry

General and inorganic chemistry

Classification and properties of matter. Physical versus chemical change. Elements, compounds, and mixtures. Unit conversion. Density. Temperature. Units of energy. Molecular weight. Relative weights. How many particles is in a mole? Moles of compounds. Gram-moleparticle conversions Atomic theory. Atomic number. Charged atoms - ions. Isotopes. Mass number. Relative atomic mass. Average atomic weight. Electronic versus nuclear changes. Radioactivity. Properties of radiation. Ionizing radiation. **Electron structure of atoms and bonds.** Electron configuration notation. Periodic table. Metals and nonmetals. Oxidation – reduction. Formulas for ionic compounds. Nomenclature. The nature of the ionic bond. Diatomic molecules. The nature of the covalent bond. Coordinate covalent bonds. Electronegativity and polarity. Recognizing ionic versus molecular compounds. Molecular shape. Molecular polarity. **Chemical reactions and equations.** Balancing equations. Types of reactions. Oxidationreduction reactions. Molar interpretation of the balanced equation. The mole ratio. Mole-mole, mole-gram, gram-gram conversions. Heat and chemical reactions. **Gases, liquids, solids.** Characteristics of gases. Intermolecular forces. Physical properties of liquids. Classes of crystalline solids. Properties of solids. Solution terminology. Factors influencing solubility. Electrolytes. Particles in solution. Concentration expressions. Colligative properties of solutions. Osmotic pressure of solutions. Colloids and suspensions. Active transport. Osmotic pressure and fluid transport. **Thermodynamics and equilibrium.** Principles of thermodynamics. The origin of heats of reaction (H). Entropy. Gibbs free energy. **Rate of reactions.** Activation energy. Factors influencing reaction rate. Reversible reactions. Equilibrium constant. **Acids and bases.** The Arrhenius definition. Brønsted-Lowry definition. Acid and base strength. Ionization of water, measurement of pH. Reactions of acids and bases. Acid-base indicators.

Organic chemistry and biochemistry

General properties of organic compounds. Bonding in carbon compounds. Structural formulas for organic molecules. Condensed structural formulas. Functional-group concept. Homologous series. The R-group concept. Isomerism. Geometry around carbon atoms. Rotation about single bonds.

Nomenclature. Common nomenclature. Writing structures from names. Nomenclature and isomerism.

Hydrocarbons. Physical properties of hydrocarbons. Chemical properties of alkanes. Alkenes. Nomenclature of alkenes. Geometric isomerism. Bonding in alkenes - The double bond. Alkene reactions. Polymerization. Alkynes. Cyclic hydrocarbons. Aromatic hydrocarbons. Biologically significant hydrocarbons. Properties of the halogenated hydrocarbons.

Alcohols. The alcohol functional group. Hydrogen bonding in alcohols. Nomenclature of alcohols. Dehydration of alcohols. Oxidation of alcohols.

Ethers, aldehydes and ketones. The carbonyl group. Aldehyde and ketone nomenclature. Physical properties of aldehydes and ketones. Oxidation and reduction of aldehydes and ketones. Alcohol addition to aldehydes and ketones. Aldol addition of aldehydes and ketones. Reactions of aldehydes and ketones with nitrogen compounds. Phenols. Thiols.

Saccharides. Stereoisomerism. Stereoisomerism and glucose. Fischer projections. Multiple chiral centers. Classification: D-family versus L-family. Intramolecular hemiacetals and hemiketals.

Haworth projections. Mutarotation. Formation of di- and polysaccharides. Monosaccharides. Classification: Reducing and nonreducing sugars. Disaccharides. Polysaccharides.

Amines. Classification of amines. Nomenclature Physical properties of amines. Amine basicity.

Carboxylic acids. Nomenclature of carboxylic acids. Physical properties of carboxylic acids. Acidity and salt formation. Fatty acid salts as soap. Esterification. Esters from phosphoric acids. Thioesters. Hydrolysis of esters. Anhydrides of carboxylic acids. Amides. Amide formation.

Lipids - waxes, fats and oils. Hydrogenation of oils. Hydrolysis of simple lipids and digestion. Complex lipids. Phospholipids. The lipid bilayer of cell membranes. Steroids.

Amino acids and proteins. Structure of amino acids. Classification of amino acids. Stereoisomerism in amino acids. The peptide bond. Polypeptides. Primary structure of proteins. Secondary structure of proteins. Tertiary structure of proteins. Quaternary structure of proteins. Classification of proteins. Denaturation. Hydrolysis of proteins.

Nucleic acids. Chemical composition of DNA. The primary structure of DNA. The secondary structure of DNA. Ribonucleic acids. The genetic code. Protein biosynthesis I: Transcription. Protein biosynthesis II: Translation.

Enzymes. Enzyme composition, classification and nomenclature. Mechanism of enzyme activity. Substrate specificity and the enzyme-substrate complex. Factors affecting enzyme catalysis. Enzyme inhibition. Coenzymes and vitamins classification, relationship. The role of ATP.

Hormones - classification, target effects

Mock questions. The correct answers are located at the end of this document.

1. What of the following cannot be determined if only the atomic number is known?
 - a. charge of the nucleus
 - b. number of electrons in atom
 - c. mass number
 - d. number of protons
 - e. all of them can be determined
 - f. none of them can be determined
2. Which of electron orbitals does not exist?
 - a. 6 s
 - b. 5 d
 - c. 2 p
 - d. 3 d
 - e. 4 d
 - f. all of them exist
3. Choose the correct statement about 1 mol of N_2 ($A_r=14$).
 - a. it contains 6.022×10^{20} molecules of N_2
 - b. its weight is 14 g
 - c. it contains 6.022×10^{23} molecules of N_2
 - d. its weight is 28 g
 - e. true is a. and b.
 - f. true is c. and d.
4. Choose the correct pair of formula – name of compound:
 - a. $BaSO_4$ – barium sulfide
 - b. H_2SO_4 –sulfurous acid
 - c. Mg_2CO_3 – magnesium carbonate
 - d. $AlCl_2$ – aluminum chloride
 - e. NH_4OH – ammonium hydroxide
 - f. all pairs are correct
5. The number of electrons exchanged between reactants in oxidation-reduction reaction:
 - a. oxidizing agent loses less electrons than reducing agent gains
 - b. is equal
 - c. depends on reactants
 - d. depends on oxidation state of reactants
 - e. oxidizing agent loses more electrons as reducing agent gains
 - f. answers b. and e. are correct
6. Oxidation is:
 - a. loss of electrons
 - b. gaining of protons
 - c. gaining of electrons
 - d. loss of protons

- e. gaining of neutrons
f. none of the previous answers is correct
7. Choose the correct statement about effect of catalyst on chemical reaction:
a. catalyst increases the equilibrium constant
b. catalyst decreases amount of released energy
c. catalyst decreases the equilibrium constant
d. catalyst increases amount of released energy
e. answers a. and b. are correct
f. none of the previous answers is correct
8. What amount of NaOH ($M_r=40$) is required to prepare 1 dm^3 of 0.5 mol.dm^{-3} solution?
a. 500 mmol
b. 20 g
c. 1000 mmol
d. 40 g
e. answers a. and b. are correct
f. answers c. and d. are correct
9. 1 mol of Ba(OH)_2 can neutralize:
a. 1 mol of H_2SO_4
b. 2 mol of HNO_3
c. 2 mol of H_2SO_4
d. 1 mol of CH_3COOH
e. 1 mol of H_3PO_4
f. answers a. and b. are correct
10. Solution of HCl has concentration 0.1 mol.dm^{-3} . What is the pH of solution if it was 100-times diluted?
a. 2
b. 3
c. 4
d. 5
e. 6
f. pH is not changed
11. Which of the following acids are weakly dissociated?
a. hydrochloric acid
b. sulfuric acid
c. carbonic acid
d. nitric acid
e. all of them are weakly dissociated
f. all of them dissociate completely
12. Choose the correct statement about bases:
a. bases react with acids to form water and salts

- b. ammonium hydroxide is weaker base than sodium hydroxide
 - c. they solutions have concentration of OH^- ions greater than 10^{-7}
 - d. strength of base is determined by its dissociation constant
 - e. all previous answers are correct
 - f. none of the previous answers is correct
13. Reaction of H_2 with O_2 to form water is:
- a. is oxidation-reduction reaction
 - b. precipitation reaction
 - c. is acid-base reaction
 - d. neutralization reaction
 - e. correct answers are a. and d.
 - f. none of the previous answers is correct
14. Choose the correct statement about nitrogen:
- a. it belongs among biogenic macroelements
 - b. its highest oxidizing state is V
 - c. in nature exists as diatomic molecule N_2
 - d. the bond in N_2 is nonpolar covalent
 - e. all of the previous answers are correct
 - f. none of the previous answers is correct
15. Which of the following compounds is well soluble?
- a. LiCl
 - b. Na_2S
 - c. NaCl
 - d. K_2S
 - e. all are well soluble
 - f. all are insoluble
16. Which of the following is not a biogenic element?
- a. iron
 - b. mercury
 - c. calcium
 - d. magnesium
 - e. copper
 - f. none of them is biogenic elements
17. Chiral carbon atom is:
- a. bound to four different groups of atoms
 - b. carbon that determines optical activity
 - c. bound to four identical groups of atoms
 - d. carbon that determines solubility
 - e. correct answers are a. and b.
 - f. none of the previous answers is correct

18. Addition of water on pent-1-ene gives:
- pentan-2-one
 - pentanal
 - ethyl methyl ether
 - pentan-2-ol
 - pentanoic acid
 - none of them
19. Reaction which results in formation of single bond from double bond is:
- addition
 - elimination
 - isomerization
 - substitution
 - molecular rearrangement
 - none of the previous answers is correct
20. Which of the following compounds does not have double bond?
- cyclopentene
 - butenoic acid
 - ethene
 - propene
 - diethyl ether
 - all of them have double bond
21. Which of the following compounds cannot form hydrogen bonds?
- benzene
 - ammonia
 - ethanol
 - water
 - all of them can form
 - none of them can form
22. Choose the secondary alcohol:
- butan-1-ol
 - ethanol
 - butan-2-ol
 - ethane-1,2-diol
 - all of them are secondary alcohols
 - none of them is secondary alcohol
23. Which of the following is not a dicarboxylic acid?
- maleinic acid
 - succinic acid
 - propanoic acid
 - fumaric acid
 - malonic acid

f. oxalic acid

24. Which of the following is an esterification reaction:
- reaction of carboxylic acid with aldehyde
 - reaction of alcohol with aldehyde
 - reaction of carboxylic acid with alcohol
 - reaction of 2 molecules of alcohol
 - reaction of 2 molecules of carboxylic acid
 - none of the previous answers is correct
25. Choose the correct statement about purine:
- it is a component of proteins
 - it is a component of starch
 - it is a component of ATP
 - it is a component of saccharides
 - it is a component of lipids
 - none of the previous answers is correct
26. Which of the following is not an aromatic compound?
- pyrrole
 - furan
 - tiophene
 - benzene
 - all of them are aromatic
 - none of them is aromatic
27. Choose the correct statement about triacylglycerols:
- they are insoluble in water
 - they a main components of membranes
 - they are richer source of energy than glucose
 - they are components of nucleic acids
 - true is a., b. and c.
 - true is a. and c.
28. Which of the following compounds is not essential for humans?
- ascorbic acid
 - linoleic acid
 - palmitic acid
 - folic acid
 - linolenic acid
 - none of them is essential
29. Which of the following does not contain nitrogen?
- glucose
 - amino acid
 - uric acid
 - urea

- e. pyrrole
- f. all of them contain nitrogen

30. Choose the correct statement about starch:

- a. it is a polypeptide of plant origin
- b. it is a polysaccharide of plant origin
- c. it is a polypeptide of animal origin
- d. it is a polysaccharide of animal origin
- e. it is a polynucleotide of plant origin
- f. it is a polynucleotide of animal origin

31. Which of the following amino acids contains heterocycle?

- a. glycine
- b. threonine
- c. alanine
- d. serine
- e. all of them
- f. none of them

32. Essential amino acids can be produced in the body:

- a. by dehydration reaction of oxoacids
- b. by dehydration reaction of hydroxyacids
- c. by transamination reaction of oxoacids
- d. by transamination reaction of hydroxyacids
- e. by all previous reactions
- f. they are not synthesized in the body and must be supplied in the diet

33. Choose the correct statement about amino acids:

- a. they are building blocks of polysaccharides
- b. they are building blocks of triacylglycerols
- c. all of them are essential and must be supplied in the diet
- d. they are building blocks of nucleic acids
- e. all of them can be synthesized in the human body
- f. none of previous answers is correct

34. Anticodon is a sequence of three nucleotides in:
- t-RNA
 - m-RNA
 - DNA
 - r-RNA
 - all of them
 - none of them
35. Transfer RNA and messenger RNA differ in:
- pyrimidine components
 - purine components
 - saccharide component
 - their cellular function
 - all previous answers are correct
 - none of the previous answers is correct
36. Connection in pair of nucleotides with bases cytosine and guanine is stabilized by:
- 1 hydrogen bond
 - 2 hydrogen bonds
 - 3 hydrogen bonds
 - 4 hydrogen bonds
 - 5 hydrogen bonds
 - they are not bound by hydrogen bonds
37. Physiologic solution has concentration 0.15 mol.dm^{-3} NaCl. What happens to mitochondria in solution of 0.05 mol.dm^{-3} NaCl?
- their volume increases
 - their volume decreases
 - their volume is unchanged
 - they absorb water
 - correct answers are a. and d.
 - correct answers are b. and d.
38. If transport of Ca^{2+} ions across membrane requires ATP it is:
- active transport
 - transport into a site of lower concentration of Ca^{2+} ions
 - simple diffusion
 - facilitated diffusion
 - exergonic process
 - none of the previous answers is correct

39. Which of the following is not a digestive enzyme?
- a. hemoglobin
 - b. trypsin
 - c. lipase
 - d. amylase
 - e. lactase
 - f. pepsin
40. Which of the following increases blood glucose level?
- a. trypsin
 - b. adrenalin
 - c. insulin
 - d. pepsin
 - e. none of them
 - f. all of them

Correct answers:

- | | |
|-------|-------|
| 1. c | 21. a |
| 2. f | 22. c |
| 3. f | 23. c |
| 4. e | 24. c |
| 5. b | 25. c |
| 6. a | 26. e |
| 7. f | 27. f |
| 8. e | 28. c |
| 9. f | 29. a |
| 10. b | 30. b |
| 11. c | 31. f |
| 12. e | 32. f |
| 13. a | 33. f |
| 14. e | 34. a |
| 15. e | 35. d |
| 16. b | 36. c |
| 17. e | 37. e |
| 18. d | 38. a |
| 19. a | 39. a |
| 20. e | 40. b |

