Test ID No.:

Admission Procedure – Academic Year 2024/2025

TEST

Master Study Programs
General Medicine and Dentistry

Test contains:

1-25 questions from Biology
26-50 questions from Chemistry
51-60 questions from Physics
61-70 questions from Mathematics

Instructions for test:

1) Mark the correct answer with a cross not exceeding the box.
Put all your answers into the **answer sheet** (answers marked in the test will not be taken as an answer)
Evaluation: only one answer is correct
Point evaluation: correct answer + 1 point
no answer 0 points
incorrect answer 0 points

2) We recommend to mark the correct answer in test and then after a double-check mark the correct answer into the answer sheet.

3) Copying the other student´s work, cheating, using any electronic devices, tables or a dictionary is strictly forbidden, only a simple calculator is allowed. Failing to comply with instructions will result in the termination of the exam.

Biology

1. If we inhibit functions of microfilaments in the given human cell, we could expect the following result.
    1. Suppressed protein synthesis.
    2. Downregulated proteosynthesis.
    3. Improved energy production.
    4. Enhanced endocytosis.
    5. **Suspended cell crawling.**

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2. The liver does not
    1. detoxify blood
    2. make plasma proteins
    3. produce urea
    4. **store bile**
    5. destroy old red blood cells

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3. The diaphragm is a/an
    1. epithelial tissue
    2. bone
    3. gland
    4. **muscle**
    5. organ

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4. The type of signaling where a signal molecule travels to adjacent local cells is called
    1. autocrine
    2. holocrine
    3. **paracrine**
    4. apocrine
    5. endocrine

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5. The region of the brain which contains a number of reflex centers for regulating heartbeat, breathing and blood pressure is
    1. the pons
    2. **the medulla oblongata**
    3. the cerebellum
    4. the reticular formation
    5. the diencephalon

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6. Which of the following structures is not found in the human heart?
    1. Sinoatrial node.
    2. Coronary arteries.
    3. Pericardium.
    4. Bicuspid valve.
    5. **Great saphenous vein.**

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7. What is the corresponding sequence of bases in mRNA, if the original DNA sequence is GAACCTTA?
    1. AATCGGAT
    2. TAGGCTAA
    3. CGAAUCGG
    4. CTCCGATT
    5. **CUUGGAAU**

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8. In males, follicle stimulating hormone
    1. **promotes the production of sperm**
    2. regulates the growth of seminiferous tubules
    3. is not present
    4. suppresses the production of sperm
    5. controls the production of testosterone

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9. Cone cells
    1. show high sensitivity to light
    2. are least packed in fovea centralis
    3. provide us with blurred and indistinct vision
    4. are more numerous than rod cells
    5. **are used for seeing colors**

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10. Simple diffusion across the eukaryotic cell membranes occurs with
    1. **gases**
    2. nucleotides
    3. longer alcohols
    4. proteins
    5. amino acids

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11. In eukaryotic cells, cytochrome c is found in
    1. the cytoplasm
    2. the cell membrane
    3. the nucleus
    4. lysosomes
    5. **mitochondria**

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12. Expiration
    1. leads to alveolar pressure being less than atmospheric pressure
    2. **is passive phase of breathing**
    3. is active phase of breathing
    4. prevents lungs from recoiling
    5. causes diaphragm to contract

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13. A clotting factor released by platelets and damaged tissue is
    1. thrombin
    2. **prothrombin activator**
    3. fibrinogen
    4. streptokinase
    5. fibrin

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14. Eukaryotic DNA contains
    1. adenine, ribose, phosphate
    2. adenine, deoxyribose, uracil
    3. adenine, uracil, phosphate
    4. **adenine, deoxyribose, phosphate**
    5. adenine, deoxyribose, ribose

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15. The sex in human offspring is determined by
    1. **sex chromosome carried by the sperm cell**
    2. sex chromosome carried by the egg cell
    3. the environment of the mother's uterus
    4. autosomes carried by the sperm cell
    5. autosomes carried by the egg cell

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16. Mad cow disease is caused by a
    1. **prion**
    2. hereditary mutation
    3. parasitic protozoan
    4. bacterium
    5. virus

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17. Reverse transcriptase is used by
    1. **HIV**
    2. poliovirus
    3. tobacco mosaic virus
    4. influenza virus
    5. adenovirus

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18. Which of the following is not a feature of life?
    1. Reproduction.
    2. **Indefinite individual existence.**
    3. Evolution.
    4. Responding to stimuli.
    5. Regulation of internal conditions.

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19. Human vertebral column is made of
    1. 34 vertebrae
    2. 32 vertebrae
    3. 35 vertebrae
    4. **33 vertebrae**
    5. 31 vertebrae

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20. A couple has a hemophiliac daughter. The most plausible explanation is
    1. the father has hemophilia only
    2. **both father and mother carry “hemophilia genes”**
    3. the daughter inherited all “hemophilia genes” from the mother
    4. half of the mother's sons would have hemophilia
    5. the mother has hemophilia only

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21. Which of the following pairs is properly matched up?
    1. Kupffer cells - nervous system.
    2. Purkinje cells - excretory system.
    3. Podocytes - respiratory system.
    4. Glial cells - digestive system.
    5. **NK cells - immune system.**

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22. A population in Hardy-Weinberg equilibrium
    1. is subject to bottleneck effect
    2. **does not change**
    3. shows a rapid fluctuation of alleles
    4. never exists
    5. selects for dominant genotypes

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23. The small intestine has 3 regions. The second region is called the
    1. caecum
    2. colon
    3. **jejunum**
    4. ileum
    5. duodenum

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24. Cold loving bacteria are termed as
    1. halophilic
    2. neutrophilic
    3. ethnophilic
    4. **psychrophilic**
    5. thermophilic

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25. In G2 phase, a human somatic cell contains
    1. 128 DNA molecules
    2. 23 DNA molecules
    3. 43 DNA molecules
    4. **92 DNA molecules**
    5. 69 DNA molecules

Chemistry

26. Low solubility in water is typical of
    1. **CCl_4**
    2. urea
    3. sodium acetate
    4. ammonium chloride
    5. methanol

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27. Enzymes
    1. are usually thermostable
    2. affect the value of the equilibrium constant
    3. are usually polynucleotides
    4. **form a complex with the substrate**
    5. are donors of energy

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28. Which of the statements about compound $CH_2 = CH – CONH_2$ is **not** correct:
    1. **it is an example of primary amine**
    2. it is a derivative of propenoic acid
    3. it can be reduced
    4. it is toxic
    5. it can polymerise

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29. In what ratio do you mix a 20% NaCl solution with distilled water to form a 5% NaCl solution?
    1. **1 : 3**
    2. 3 : 1
    3. 1 : 5
    4. 1 : 2
    5. 1 : 4

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30. Five mL of nitric acid (c=0.02 mol/L) were diluted by distilled water up to the final volume of 100 mL. Calculate the pH value of the diluted solution.
    1. 2.7
    2. **3**
    3. 1.7
    4. 2
    5. 4

---

31. Reaction of an acid with an alcohol could result in formation of a/n
    1. ether
    2. ketone
    3. hemiacetal
    4. glycoside
    5. **ester**

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32. Which of the statements about mercury is **not** correct:
    1. it forms toxic compounds
    2. it can exist in oxidation state +1
    3. it is an example of transition element
    4. it could form complex compounds
    5. **its chemical symbol is Me**

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33. Fructose
    1. is an aldohexose
    2. is insoluble in water
    3. **is a component of sucrose**
    4. is a component of starch
    5. forms cis-trans isomers

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34. Diphenylamine is a/n
    1. tertiary amine
    2. **secondary amine**
    3. diamine
    4. amide
    5. primary amine

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35. How many carbon atoms are present in the molecule of oleic acid?
    1. 20
    2. 12
    3. 15
    4. **18**
    5. 16

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36. You need to prepare 50 g of ZnO (M_m = 81.38 g/mol) by the thermal decomposition of $ZnCO_3$ (M_m = 125.38 g/mol). Calculate the amount of zinc carbonate you will need for the reaction assuming the reaction yield of only 88 %.

1. 98
2. 77.0
3. 103.5
4. 67.8
5. **87.5**

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37. Magnesium exists in the oxidation state

1. +1
2. +3
3. **+2**
4. +4
5. -2

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38. The number of carbon atoms in the molecule of propanoic acid is

1. **3**
2. 6
3. 5
4. 8
5. 4

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39. The concentration of $H_3O^+ = 4.5\times10^{-8}$ mol/L was found in the sample. Calculate the OH^- concentration.

1. $5.4x10^{-7}$
2. **$2.2x10^{-7}$**
3. $2.2x10^{-8}$
4. $5.4x10^{-8}$
5. $2.2x10^{-10}$

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40. The concentration of hydrochloric acid (M_m = 36.46 g/mol) was assessed by alkalimetric titration. 7.5 mL of sodium hydroxide (c= 0.050 mol/L) was consumed for the titration of 25 mL of the HCl sample. Calculate the molar concentration of HCl (mol/L).

1. 0.166
2. 0.003
3. $1.5x10^{-4}$
4. **0.015**
5. $1.7x10^{-2}$

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41. Methylacetate is

1. hemiacetal
2. ether
3. glycoside
4. **ester**
5. ketone

---

42. Choose a heterocycle with two nitrogen atoms in its molecule:

1. pyran
2. pyrrole
3. pyridine
4. purine
5. **pyrimidine**

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43. Choose a true statement about the reaction: $FeCl_2 + KMnO_4 + HCl \rightarrow FeCl_3 + MnCl_2 + KCl + H_2O$

1. manganese releases two electrons
2. the reaction cannot proceed in the direction given
3. iron accepts two electrons
4. chloride is oxidised
5. **stoichiometric coefficients are 5, 1, 8 → 5, 1, 1, 4**

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44. Choose a compound with a chiral carbon atom in its molecule:

1. o-dimethyl benzene
2. **2-hydroxypropanoic acid**
3. benzylalcohol
4. vinylchloride
5. 2-chlor-but-1,3-diene

---

45. Ionic bond is typical of
    1. **KBr**
    2. HCl
    3. N_2O_3
    4. H_2O
    5. CH_4

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46. The highest number of oxygen atoms is present in
    1. calcium sulphide
    2. butanoic acid
    3. p-quinone
    4. phenol
    5. **potassium chromate**

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47. The most typical reaction of ethenyl chloride is
    1. electrophilic substitution
    2. **polymerisation**
    3. dehydrogenation
    4. nucleophilic substitution
    5. isomerism

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48. Choose a salt which aqueous solution is the most acidic:
    1. sodium acetate
    2. sodium sulphate
    3. potassium cyanide
    4. barium carbonate
    5. **ammonium chloride**

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49. Choose a reducing agent from those mentioned below:
    1. **CO**
    2. $CaCl_2$
    3. K_2CO_3
    4. $KMnO_4$
    5. $KBrO_3$

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50. Choose an anion that is an example of the strong conjugated base (according to the Brønsted-Lowry concept):

1. Br^-
2. SO_4^{-2}
3. Cl^-
4. NO_3^-
5. **CN^-**

Physics

Use only the values of constants provided in the test. Round the final result, not the partial result in the middle of your calculations. The result should be rounded to three valid digits if not specified otherwise. The results have to be presented in the main (derived SI) physical units if not specified otherwise.

Use these constants:

(pi) = 3.14
$g = 9.81\ m \cdot s^{-2}$
$R = 8.314\ J \cdot K^{-1} \cdot mole^{-1}$
$k = 1.381 \cdot 10^{-23}\ J \cdot K^{-1}$
0 °C = 273.15 K
$e = 1.602 \cdot 10^{-19}\ C$
$h = 6.63 \cdot 10^{-34}\ J \cdot s$
$I_o = 10^{-12}\ W.m^{-2}$
$m_e = 9.11 \cdot 10^{-31}\ kg$
1 year = 365.25 days
relative atomic mass of oxygen = 16
relative atomic mass of aluminium = 27
relative atomic mass of silver = 108
relative atomic mass of nitrogen = 14
Avogadro's number = $6.023 \cdot 10^{23}\ mole^{-1}$
permittivity of vacuum = $8.854 \cdot 10^{-12}\ F \cdot m^{-1}$
specific heat capacity of water = $4180\ J \cdot K^{-1} \cdot kg^{-1}$
latent heat of vaporization of water = $2.257 \cdot 10^{6}\ J \cdot kg^{-1}$
specific melting heat of ice = $334\ 000\ J \cdot kg^{-1}$
density of water = $1000\ kg \cdot m^{-3}$
density of iron = $7860\ kg \cdot m^{-3}$
refractive index of glass = 1.3
refractive index of air = 1.00
speed of light in vacuum = $3 \cdot 10^{8}\ m \cdot s^{-1}$

speed of ultrasound in water = $1500\ m \cdot s^{-1}$
normal atmospheric pressure = 101.3 kPa
half-life of Ra^{226} = 1600 years

Physics

51. A coil of induktance of 5 mH is connected to an alternating current circuit of frequency 50 Hz. What is its inductive reactance?

1. 69.8 Ω
2. 637 Ω
3. 12.7 kΩ
4. **1.57 Ω**
5. 259 Ω

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52. The repulsive force between two electrons in the vacuum is 1 nN. What will be the repulsive force when we replace these electrons by alpha particles?

1. 2 nN
2. 8 nN
3. 1.5 nN
4. 0.5 nN
5. **4 nN**

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53. A 80 kg man runs up a flight of stairs 5 m high in 9,81 s. What average power does he produce to achieve this?

1. 600 W
2. 500 W
3. **400 W**
4. no answer is correct
5. 780 W

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54. Sun shines on a gas tank and the pressure of the gas inside increases by 5 %. What is the result temperature of the gas? The heat has no effect on the volume of the tank and the original temperature of the gas was 27 ^{o}C.

1. **42 ^{o}C**
2. 63 ^{o}C
3. 28 ^{o}C
4. 33 ^{o}C
5. 59 ^{o}C

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55. When the brake pedal of a car moving 72 $km \cdot h^{-1}$ on a straight road is fully pressed, the car can stop in 20 m. How long does it take to stop?

1. **2 s**
2. 3 s
3. 6 s
4. 5 s
5. 4 s

---

56. What is the de Broglie wavelength of an electron moving at speed of 1000 km/s?

1. **0.728 nm**
2. 16.8 μm
3. no answer is correct
4. 35.6 pm
5. 46.5 μm

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57. The intensity level of sound increases by 20 dB. Express how many times increases the intensity of sound.

1. 20 times
2. 10 times
3. 80 times
4. **100 times**
5. 200 times

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58. What is the energy of X-ray of wavelength 1 nm in air? Express in the unit eV.

1. **1.24 keV**
2. no answer is correct
3. 781 eV
4. 3.99 MeV
5. 241 eV

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59. A large artery has a diameter of 10 mm. This artery divides into four identical smaller arteries; the velocity of blood in smaller arteries is the same as the velocity of blood in the larger artery. What is the diameter of the smaller arteries?

1. 3.5 mm
2. 6 mm
3. **5 mm**
4. 2.5 mm
5. 4 mm

60. What is the critical angle for total internal reflection when light of wavelength 550 nm passes from a plastic (refractive index 1.2) to air (refractive index 1.0)?

1. 0.675 rad
2. 0.598 rad
3. no answer is correct
4. 0.895 rad
5. **0.985 rad**

Mathematics

61. Find the acute („sharp“) angle between two tangents to the curves described by functions $y=0.5x^2-3x+6$ and $y=-0.25x^2+1.5x+3$ at points with x coordinate equals 4.

1. 82.6 º
2. 65.6 º
3. **71.6 º**
4. 51.4 º
5. 22.4 º

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62. 25 % of householders have a dog as a pet, 20 % of householders have a cat as a pet, 5 % have both. What is the percentage of householders that breed no pets (cats or dogs)?

1. 45 %
2. no answer is correct
3. **60 %**
4. 40 %
5. 50 %

---

63. Find the slope of the tangent to the curve described by the equation $y = x^2.e^x + x.\ln x$ at the point (1,e).

1. 2
2. **3e+1**
3. e
4. -3
5. 5+e

---

64. Devide complex numbers $(2-2i+i^2)/(2+i)$

1. 3-i
2. 2
3. i
4. **-I**
5. 1

---

65. The family has four children. What is the probability that the family has at least three boys?

1. 0.3
2. 0.2
3. 0.5
4. 0.1
5. **0.4**

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66. Find an area of a triangle in the plane ***xy***, which sides are the parts of lines x = -4, y = -3 and 4y + 3x - 12 = 0

1. **54**
2. 24
3. 12
4. 36
5. 48

---

67. Find the surface of the sphere given by the equation $x^2-2x+y^2-2y+z^2-2z-1=0$ in the (x,y,z) coordinate system.

1. 12π
2. 4π
3. **16π**
4. 8π
5. 8/3π

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68. Find the inverse function to the function $y=10^{-10x}$.

1. y=-10logx
2. $y=10^{10x}$
3. y=10/logx
4. y=1/logx
5. **y=-0.1logx**

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69. Calculate the following expression [(n+2)! /(n+1)!] – [(n+1)! / (n!)].

1. -n
2. n
3. -1
4. **1**
5. n-1

---

70. Find the sum of x and y coordinates of the turning point (vertex) of the parabola given by the equation: $y-x^2+6x-10=0$

1. -2
2. **4**
3. -1
4. 2
5. 3
