

Variant 1

1. Solution concentration can be calculated using formula $C_x = C_0(d_0/d_x)$, where d_0, d_x layers thickness. 10 measurements give the following results: $d_0 = 1.7$ mm, $s_{d_0} = 0.15$ mm, $d_x = 7.5$ mm, $s_{d_x} = 0.12$ mm. Solution concentration $C_0 = 15\%$. Find absolute and relative solution concentration errors (99 % confidence interval).
2. We can find ethanol viscosity coefficient using formula $\eta = A t / t_0$, where $A = 0.001$ Pa·s, t and t_0 the flowing time of ethanol and reference liquids (water) measured with the same viscometer. 7 measurement gives: $\bar{t} = 8.2$ s; $\bar{t}_0 = 6.1$
3. Find absolute and relative errors for ethanol viscosity coefficient (99 % confidence interval). Standard error of the mean for t and t_0 are respectively 0.01 and 0.02 s.
3. Calculate membrane potential in case of chlorine ion diffusion. $[Cl^-]_i = 114$ mM, $[Cl^-]_e = 592$ mM, $t = 30^\circ\text{C}$, $R = 8.31$ J/mol·deg., $F = 96500$ C/mol.
4. Find rate heartbeats. Speed of paper is 50 mm/s.



5. What is relative refractory period?

1. Find Nernst equation

a) $V_M = \frac{RT}{zF} \cdot \ln \frac{P_K [K^+]_{in} + P_{Na} [Na^+]_{in} + P_{Cl} [Cl^-]_{out}}{P_K [K^+]_{out} + P_{Na} [Na^+]_{out} + P_{Cl} [Cl^-]_{in}}$ b) $\frac{[K^+]_o}{[K^+]_i} = \frac{[Cl^-]_i}{[Cl^-]_o}$

c) $V_M = \frac{RT}{zF} \ln \left(\frac{c_{out}}{c_{in}} \right)$

2. Fat-soluble drugs penetrate to cells better than water-soluble ones because

- a) Hydrophobic substances have a low permeability through bilayer membranes
- b) Hydrophilic substances have a high permeability through bilayer membranes
- c) Hydrophobic substances have a high permeability through bilayer membranes
- d) Hydrophobic substances have a medium permeability through bilayer membranes

3. Find Van't Hoff formula

a) $D = \frac{kT}{6\pi\eta r}$ b) $D = \mu kT / q$ c) $\Pi = kT c$ d) $P \equiv \frac{DK}{l}$

4. People are considered to have normal hearing

- a) with thresholds of 120 dB
- b) with thresholds of 20 dB or above
- c) with thresholds of 0 dB
- d) with thresholds of 20 dB or below

5. Make up the expression for volume of fluid which flow through cross-section the tube during time t:

$V = \left| \begin{array}{l} a. P_1 - P_2 \\ b. \eta \\ c. R^4 \end{array} \right| \text{ divide } \left| \begin{array}{l} d. R^2 \\ e. 8\eta l \\ f. \eta \end{array} \right| \text{ times } \left| \begin{array}{l} g. \eta \\ j. \pi R^2 \\ h. \pi R^4 t \end{array} \right|$

η – viscosity coefficient, $P_1 - P_2$ – difference of pressure, R – radius of tube (vessel), l – length of tube (vessel), t – time, $\pi = 3,14$.

6. Basic characteristics of ultrasound:

- a) frequency, loudness, phase, tone, propagation velocity, absorption coefficient
- b) intensity, frequency, propagation velocity, absorption coefficient
- c) frequency, attenuation coefficient, phase, timbre, density, propagation velocity
- d) frequency, attenuation coefficient, tone, refractive index, permittivity

7. Rayl is a unit of

- a) Attenuation
- b) Viscosity coefficient
- c) Surface tension coefficient
- d) Sound volume
- e) Acoustic impedance

8. Normal urine has a surface tension of about

- a) 33 dynes/cm
- b) 66 dynes/cm
- c) 72 dynes/cm
- d) 10 dynes/cm

9. Relationship $Z = \left(\sqrt{\frac{1}{R^2} + \left(\frac{1}{X_C} - \frac{1}{X_L} \right)^2} \right)^{-1}$ **describes**

- a) Resistance
- b) in
- c) d) parallel circuit

- b) Impedance e) series circuit
c) Reactance

10. For speech understanding is very important region of frequencies

- a) 100-1000 Hz b) 1 kHz c) 200-500 Hz d) 2-5 kHz e) 20-20000Hz f) 125-8000 Hz

11. Sound volume is determined by

- a) Harmonic spectrum b) frequency c) sound pressure d) ear sensitivity e) health of the ear

12. The method of recording of shift in the center of gravity of the body as result of heart activity is

13. QRS Complex

- a) Indicates atrial depolarization b) Represents ventricular depolarization
c) Represents ventricular repolarization d) Indicates ventricular depolarization

14. Attenuation coefficient of US depends on

- a) frequency of US waves b) tissues compositions c) applied gel
d) transducers form e) no correct answers

15. Reynolds number depend on

- a) liquid density, average speed of the fluid along the direction of flow, diameter of the tube, time
b) average speed of the fluid along the direction of flow, form of the tube, viscosity of the fluid
c) liquid density, average speed of the fluid along the direction of flow, diameter of the tube, viscosity of the fluid
d) all are correct

16. Find Goldman equation

- a) $V_M = \frac{RT}{zF} \ln \frac{c_{out}}{c_{in}}$ b) $V_M = \frac{RT}{zF} \cdot \ln \frac{P_K [K^+]_{in} + P_{Na} [Na^+]_{in} + P_{Cl} [Cl^-]_{out}}{P_K [K^+]_{out} + P_{Na} [Na^+]_{out} + P_{Cl} [Cl^-]_{in}}$
c) $\frac{[K^+]_o}{[K^+]_i} = \frac{[Cl^-]_i}{[Cl^-]_o}$ d) $[K^+]_o \times [Cl^-]_o = [K^+]_i \times [Cl^-]_i$

17. The method of recording the magnitude and direction of the electrical forces that are generated by the heart is

- a) Dynamocardiography b) Electrocardiography c) Balistocardiography d) Vectorcardiography

18. Absolute refractory period is time during witch

- a) one cardiac cycle is complete
b) cell posed resting potential
c) another action potential is possible
d) another action potential is impossible

19. Minimum amplitude required to depolarize nerves fiber at infinitely long phase duration is

- a) strength duration curve b) chronaxie c) rheobase d) RMS of sinusoidal wave

20. Lead I is composed of the

- a) left abdomen positive, right arm negative and left arm ground
b) left arm positive, right arm negative and right leg ground
c) left abdomen positive, left arm negative and right arm ground
d) no correct answer

21 Find Fik's law for membrane

- a) $D = \mu kT/q$ b) $J_x = -\frac{DK}{l} (n_{o2} - n_{o1})$ c) $D = \frac{kT}{6\pi\eta r}$ d) $J_{total} = -\frac{uRT}{F} \frac{\partial c}{\partial x} - u c z \frac{\partial \phi}{\partial x}$

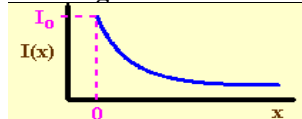
22. Value of Seebeck coefficient σ does not depend on

- a) a given material c) the length of the conductor wire,
b) any geometrical feature of the conductor wire d) diameter of the conductor wire,

23. Cardiac diastole involves

- a) Atria contraction b) Ventricular contraction c) Relaxation of atria and ventricles
d) Relaxation of atria only e) Relaxation of ventricles only

24. In figure attenuation of US is given in



- a) log-log scale b) lin-log scale c) lin-lin scale

25. Cells whose voltage is more negative than typical are said to be

- a) depolarized b) hyperpolarized c) repolarized d) resting