KATHMANDU UNIVERSITY
End Semester Examination
August/September 2017

Mark Scored :

AUG 31 2017

Level : B. Tech.
Year : II

Course : BIOT 209
Semester : II

Exam. Roll No. :

Time: 30 mins.

F.M. : 20

Registration No.:

Date :

SECTION "A"
[10 Q. × 1 = 10 marks]

Choose and tick the most appropriate answer.

1. If a small spherical particle of radius 'a' is moving in a fluid of viscosity η at temperature T, then the coefficient of diffusion or diffusivity D is given by

[a] $\frac{K_B T}{3\pi a\eta}$ [b] $\frac{K_B T}{6\pi a\eta}$ [c] $\frac{2K_B T}{3\pi a\eta}$ [d] $\frac{3K_B T}{2\pi a\eta}$

2. If P is the hydrostatic pressure and π is the osmotic pressure, then we get a water flux out of the capillary and into the cells around it if

[a] $(\pi_{blood} + \pi_{cell}) > (P_{blood} + P_{cell})$
[b] $(P_{blood} + P_{cell}) > (\pi_{blood} + \pi_{cell})$
[c] $(\pi_{blood} - \pi_{cell}) > (P_{blood} - P_{cell})$
[d] $(P_{blood} - P_{cell}) > (\pi_{blood} - \pi_{cell})$

3. Active transport is
[a] the movement of a particle along its concentration gradient, usually concerned with accumulating high concentrations of molecules, and it uses energy
[b] the movement of a particle against its concentration gradient, usually concerned with accumulating high concentrations of molecules, and it uses energy
[c] the movement of a particle along its concentration gradient, usually concerned with accumulating high concentrations of molecules, and it does not use any energy
[d] the movement of a particle against its concentration gradient, usually concerned with accumulating high concentrations of molecules, and it does not use any energy

4. In voltage clamp technique, when the membrane potential is clamped at a voltage exceeding the threshold value for initiating the action potential,
[a] a transient current flows outward for a few milliseconds which is a K^+ current and then the current reverses and flows inward which is a Na^+ current
[b] a transient current flows inward for a few milliseconds which is a Na^+ current and then the current reverses and flows outward which is a K^+ current
[c] a transient current flows inward for a few milliseconds which is a K^+ current and then the current reverses and flows outward which is a Na^+ current
[d] a transient current flows outward for a few milliseconds which is a Na^+ current and then the current reverses and flows inward which is a K^+ current

5. Olfaction and taste both respond to chemical stimulation but they are quite different because
[a] olfaction requires that the chemical be volatile, and taste requires that the chemical be soluble both in water and mucous secretions
[b] olfaction requires that the chemical be soluble both in water and mucous secretions, and taste requires that the chemical be volatile
[c] olfaction requires that the chemical be volatile and soluble in mucous secretions, and taste requires that the chemical be soluble in water
[d] olfaction requires that the chemical be soluble in water, and taste requires that the chemical be volatile and soluble in mucous secretions

6. The energy of the ground state of a hydrogen atom is –13.6 eV without considering the mass of nucleus. If m and M are the mass of electron and nucleus, then energy of the ground state is

[a] $-\frac{m}{m+M}\times 13.6$ eV [b] $-\frac{M}{m+M}\times 13.6$ eV

[c] $-\frac{M}{M-m}\times 13.6$ eV [d] $-\frac{m}{M-m}\times 13.6$ eV

7. A spinning electron has a magnetic dipole moment of

[a] one Bohr magnetron. [b] one-half the Bohr magnetron.

[c] 1.5 times the Bohr magnetron. [d] two times the Bohr magnetron.

8. In ion-dipole interaction, the potential energy is inversely proportional to the

[a] separation distance between the ion and dipole.

[b] square of the separation distance between the ion and dipole.

[c] fourth power of the separation distance between the ion and dipole.

[d] sixth power of the separation distance between the ion and dipole.

9. The operator $-\frac{\hbar^2}{2m}\nabla^2 + V(\vec{r})$ is called

[a] energy operator [b] Hamiltonian operator

[c] momentum operator [d] angular momentum operator.

10. The shifting of the position of the resonance peak in the spectrum due to the moving electron in a molecule is called

[a] relaxation shift. [b] NMR shift

[c] NMR line broadening [d] chemical shift.

SECTION "B"

[10 Q. × 1 = 10 marks]

Fill in the blanks.

11. Methylene chloride is a common ingredient of paint removers. When using this, protective gloves should be worn. If protective gloves of butyl rubber of thickness 0.04 cm are used, the diffusive flux of methylene chloride through the glove is _____ gm/cm^2.s assuming that the diffusion coefficient in butyl rubber is 110×10^{-8} cm^2/s and the surface concentrations are 0.44 gm/cm^3 and 0.02 gm/cm^3.

12. The particle flux ϕ is related with the mobility u, concentration c and chemical potential μ as _____

13. Diffusion potential develops in ionic solutions when the positive and negative ions have different mobilities; and if the negative ions have zero mobility, the diffusion potential reduces to _____

14. A perception of one's body from an outside position, also known as body separation or out of body experience, is one of the different stages of _____

15. Sensations of hunger and thirst seems to be provided by _____ receptors.

16. The spectral notation for sodium D_1 line is _____

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17. The energy of anti-bonding orbital is increased by an amount Δ, known as _____

18. The ground state vibrational energy of a diatomic molecule in terms of its reduced mass μ and force constant k is _____

19. In STM, the scanning resolution is about _____ in xy-direction and _____ in z-direction.

20. The hologram does not contain a distinct image of the object but carries a record of both _____ of the light at each point.

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F.M. : 55

SECTION "C"
[5 Q. × 4 = 20 marks]

Attempt *ALL* questions.

1. Define the term chemical potential. Derive an expression for the particle flux J relating it with the membrane permeability P considering a practical situation of diffusion process.

OR

Derive an expression for Nernst equation.

2. Discuss the classification of sensory systems (detectors).

3. Show that magnetic dipole moment due to the orbital motion of electron is quantized.

OR

What is hybridization? Explain sp^3 -hybridization with diagram and wave functions.

4. For what value of potential energy function $V(x)$, the wave function $\psi(x,t) = A\exp\left[-a\left(\frac{mx^2}{\hbar} + it\right)\right]$ satisfies the time dependent Schrodinger's equation.

5. What is the basic difference between ionic and Van der Waals interactions? Explain the induced dipole-induced dipole interaction.

OR

Explain the working principle of AFM with schematic diagram.

SECTION "D"
[5 Q. × 7 = 35 marks]

Attempt *ALL* questions.

6. What do you understand by diffusion? Discuss Langevin's theory (analysis) of random movements and obtain a result analogy with Einstein's result. Comparing the two results, determine the expression for coefficient of diffusion or diffusivity.

7. Show that the particle flux $\phi = -$ u.c.grad(μ) and use it to show that the water flux $\phi_w = -u_w$ grad($P-\pi$).

OR

What do you mean by active transport? Explain it, in brief, with an example. Discuss resting membrane potential of cells and hence derive Goldman–Hodgkin–Katz equation.

8. Discuss neuronal cable theory and show that the voltage signal falls away exponentially.

OR

Define the term action potential. Write down the properties of action potential. Discuss the action potential with Na^+ and K^+ permeabilities.

9. What are the chemical shift and relaxation parameters in NMR technique? Explain in detail.

10. What is Zeeman Effect? Explain the experimental setup to observe the Zeeman Effect with schematic diagram. Also give the theory of normal Zeeman Effect.

OR

Explain the theory of origin of pure rotational spectra of a molecule. How can this theory be applicable to find the inter-nuclei distance of a diatomic molecule?