KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.Tech.
Year : I

Course : PHYS 105
Semester: II

Exam. Roll No. :
Registration No.:

Time: 30 mins.

F.M. : 20
Date : May-26, 022

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SECTION "A"
[21Q × 1 = 20 marks]

Choose and tick the most appropriate answer.

1. In case of diffusion process between two compartments with concentrations C_1 and C_2 ($C_1 > C_2$), separated by a membrane with permeability P that allows diffusion, the particle flux J is equal to
[a] $P(C_1+C_2)$ [b] $P(C_1-C_2)$ [c] $P(C_2-C_1)$ [d] $-P(C_1+C_2)$

2. In ..... the solute tends to move, in ..... the solution tends to move.
[a] passive transport, active transport [b] osmosis, diffusion
[c] diffusion, osmosis [d] active transport, passive transport

3. The particle flux ϕ is related with the mobility u, concentration c and chemical potential μ as
[a] $u.c.grad(\mu)$ [b] $\mu.c.grad(u)$ [c] $-\mu.c.grad(u)$ [d] $-u.c.grad(\mu)$

4. You smell something delicious baking. Which sensory receptors receive that information?
[a] Telereceptors [b] Olfactory receptors
[c] Somatic receptors [d] Visceral receptors

5. The voltage clamp method controls the ..... at any desired level.
[a] membrane potential [b] frequency of action potential
[c] amplitude of the action potential. [d] K^+ current

6. Infrared emission is due to the transition of electron from higher energy levels to
[a] third energy level of an atom [b] first energy level of an atom
[c] second energy level of an atom [d] fourth energy level of an atom

7. Which one of the following operators in quantum mechanics corresponds to the linear momentum?
[a] $i\hbar\frac{\partial}{\partial t}$ [b] $i\hbar\nabla$ [c] $-i\hbar\nabla$ [d] $-i\hbar(\vec{r}\times\nabla)$

8. Which one of the following interactions has the temperature dependent potential energy?
[a] Ion-dipole interaction [b] Dipole-dipole interaction
[c] Ion-induced dipole interaction [d] Induced dipole-induced dipole interaction

9. If E_2 is the energy of 2nd state of rotational energy levels, then the energy of the 3rd state is
[a] $3E_2$ [b] $2E_2$ [c] $4E_2$ [d] $6E_2$

10. The movement of tip or substrate in STM or AFM is carried out by the help of special type of material called

[a] dielectric material
[b] ferroelectric material
[c] paramagnetic material
[d] piezoelectric material

Fill in the blanks with appropriate answer.

11. An average cell is about $25\mu m$. A glucose molecule has a radius $0.7nm$. Given that coefficient of viscosity inside body is $0.00178NS/m^2$ and temperature of the body is $310K$ and Boltzmann constant $k_B = 1.38\times10^{-23}J/K$. The time to diffuse $25\mu m$ for glucose molecule is .....

12. Active transport is the movement of the particles against ..... gradient. It requires external energy sources and mechanisms.

13. The formation of action potential upon stimulation a rapid transition increase the permeability of Na^+ occurs as a result Na^+ will flow inside the cell such a polarization is called .....

14. For the outstanding achievement of voltage clamp technique in neuro biophysics, the 1963 Nobel prize in physiology and medicine was awarded to .....

15. When an axon potential arrives at the terminal of presynaptic fiber, it triggers the release of chemical substance, called .....

16. The effect of a magnetic field on an electron moving in an orbit is to acquire a precession motion of the entire orbit about the direction of magnetic field. This effect is called .....

17. A quantum particle has the wave function Ψ. The probability density of finding the particle in space is .....

18. The energy of bonding molecular orbital is lower than that of anti-bonding molecular orbital by an amount 2Δ. The quantity Δ is called .....

19. The phenomenon of absorption of radiation in near ultra-violet and visible range and its re-emission in longer wavelength is called .....

20. In X-ray diffraction spectrometer, the .....acts as the telescope in ordinary spectrometer.

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F. M. : 55

SECTION "B"
[5 Q. × 4 = 20 marks]

1. By the concept of water flux, explain about water transport outside the capillary.

OR

Oxygen gas is flowing through a 10m long circular pipe with a radius 16cm. The concentrations of oxygen at the ends of the pipe are $30kg/m^3$ and $10kg/m^3$. The diffusion constant for O_2 at 20^0C is $1.8\times10^{-5}\ m^2/s$.

(a) Calculate the diffusion flow rate.

(b) How long will take 100kg of oxygen to travel through this pipe?

2. Discuss the visual, chemical, somatic and visceral receptors.

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

OR

What are the nature of molecular bonding and rules for linear combination of atomic orbital?

4. For what value of potential energy function, $V(x)$, the wave function

$$\Psi(x) = A\exp\left(-a\left[\frac{mx^2}{\hbar} + it\right]\right)$$

satisfies the time-dependent Schrodinger's equation.

5. What is the difference between fluorescence and phosphorescence? Explain phosphorescence with energy level diagram.

OR

Explain the working principle of AFM with schematic diagram.

SECTION "C"
[5 Q. × 7 = 35 marks]

6. What do you mean by diffusion? Discuss Langevin's theory of random movements and obtain a result analogy with Einstein's result. Compare the two results; determine the expression for coefficient of diffusion or diffusivity.

7. Write in detail about diffusion potential. At what condition diffusion potential becomes Nernst potential.

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

OR

Define the terms action potential and synapse. Write down the properties of action potential. Discuss the transport of information in the nervous system.

9. Explain the theory of origin of pure vibrational spectra of a molecule. The force constant of the bond in CO molecule is 187 Nm^{-1}. Calculate the spacing between the vibrational energy levels in eV. Given reduced mass 1.14×10^{-26} kg.

10. What is Zeeman Effect? Explain the experimental setup to observe the Zeeman Effect with schematic diagram. What are the nature of lines in different views?

OR

Explain the chemical shift and relaxation parameters involved in the NMR technique.