KATHMANDU UNIVERSITY
End Semester Examination [C]
January 2025

Marks Scored:

Level : B.Sc./B.Tech.
Year : I

12 JAN 2025

Course : PHYS 105
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"
[20Q. × 1 = 20 marks]

Choose and encircle the most appropriate answer.

1. Which of the following is the difference between active and passive transport?
   a. Active transport need energy, and passive does not need energy.
   b. Active transport does not need energy, and passive need energy.
   c. Active and passive transport both need energy.
   d. Active and passive transport both do not need energy.

2. According to Fick's Law of Diffusion, if the concentration gradient was increased by a factor of 2 and the membrane permeability doubled, by what factor will the flux change?
   a. Flux increases by a factor of 4
   b. Flux increases by a factor of 8
   c. Flux decreases by a factor of 4
   d. Flux decreases by a factor of 8

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

4. Which of the following structure at a synapse has the neurotransmitter?
   a. Schwan cell
   b. Syanptic cell
   c. Synaptic knobs
   d. Synaptic vesicles

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

6. What is the role of the Schrodinger equation in quantum mechanics?
   a. It calculates the exact positions of particles at any given time.
   b. It predicts the momentum of particles in closed systems.
   c. It describes the probability distribution of particles' states over time.
   d. It measures the total energy of particles and their interactions.

7. What does the gyromagnetic ratio represent?
   a. The rate of precession of a spinning object.
   b. The ratio of the magnetic moment to angular momentum.
   c. The strength of the external magnetic field.
   d. The orientation of electron orbits in space.

8. In NMR spectroscopy, which atomic nuclei are commonly used for analysis?
   a. Oxygen (O)
   b. Hydrogen (H)
   c. Carbon (C)
   d. Sodium (Na)

9. In molecular spectroscopy, what is the selection rule for vibrational-rotational transitions?
   a. $\Delta n = 1$ and $\Delta j = \pm 1$
   b. $\Delta n = \pm 1$ and $\Delta j = 0$
   c. $\Delta n = 0$ and $\Delta j = \pm 1$
   d. $\Delta n = 1$ and $\Delta j = 0$

10. What does Hund's rule state?
    a. Electrons fill lower energy orbitals first
    b. Electrons occupy each orbital singly before pairing up
    c. An electron can revolve around the nucleus only in specific orbits
    d. Electrons jump from an outer orbit to an inner orbit by emitting radiation

Fill in the blanks with appropriate answer.

11. The difference in concentration of a substance from one location to another is called _____.

12. The action potential while the propagation of a nerve impulse is due to the movement of _____ ions from intercellular to extracellular fluid.

13. For the outstanding achievement of voltage clamp technique in Neuro Biophysics, the 1963 Nobel prize in physiology and medicine was awarded to _____.

14. _____ receptors which is responsible for the sensation of the body such as touch, pressure, pain, temperature etc. spread through a body.

15. Neurotransmitter molecules are released from the synaptic vesicles when an action potential arrives at the _____.

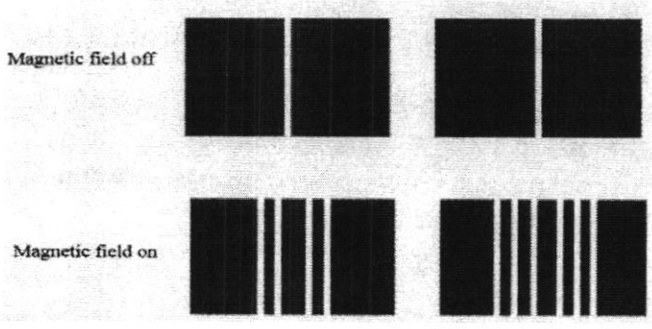
16. The type of interaction involves the electrostatic attraction or repulsion between ions is called _____.

17. The quantum number specifies the shape of an orbital is called _____.

18. The phenomenon where molecules absorb radiation in the UV or visible range and re-emit it at a longer wavelength is _____.

19. The principle of quantum mechanics allows electrons to tunnel through barriers in the STM is _____.

20. _____effect is shown below.



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SECTION "B"
[5Q × 4 = 20 marks]

Attempt ALL questions.

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

OR

An average cell is about 20μm across while the axon of a neuron extending from the spinal cord to the toes is about 1m long. A glucose molecule has a radius of 0.5nm, and the medium size protein has a radius of about 5nm. How long would it take a glucose molecule to diffuse 20μm? How long would it take for protein?

2. What is called sensory receptors? Discuss any three sensory receptors.

3. What is the electromagnetic spectrum? Differentiate between continuous and line spectra.

OR

Write the properties of wave functions.

4. Differentiate between bonding and antibonding molecular orbitals.

5. Differentiate between AFM and STM in five points.

OR

Differentiate between Fluorescence and Phosphorescence

SECTION "C"
[5Q × 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.

OR

What do you mean by active transport? Discuss resting membrane potential of cells and hence derive Goldmann-Hodgkin-Katz equation.

P.T.O.

7. Write in detail about the nervous system with neat diagram of neuron. Also give in detail the theory of synapse (transformation of information in the nervous system).

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

OR

Discuss the voltage clamp technique and hence obtain an expression for externally applied current I_{ext} ?

9. Explain the Zeeman effect and anomalous Zeeman effect. Differentiate between them.

10. Explain any five main points of MOT using example of your choice and find the bond order and magnetic nature of H_2 molecule.

OR

Explain the working of NMR spectroscopy with schematics and charts.