KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

Marks Scored:

Level: B.Tech.
Year : I

Course : PHYS 105
Semester : II

Exam. Roll No.:

Time: 30 mins.

F.M. : 20

Registration No.:

Date :

SECTION "A"
[20Q. × 1 = 20 marks]

Encircle the most appropriate option.

1. Which of the phenomenon does require energy?
[a] Gravity
[b] Osmosis
[c] Active transport
[d] Passive transport

2. Which of the following is an example of primary active transport?
[a] $Na^+ - Ca^{2+}$ exchange
[b] Na^+K^+ ATPase
[c] $Na^+ - Ca^{2+}$ ATPase
[d] $Na^+ - H^+$ exchange

3. 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 is given by
[a] $\frac{K_B T}{3\pi\eta a}$
[b] $\frac{K_B T}{6\pi\eta a}$
[c] $\frac{3K_B T}{\pi\eta a}$
[d] $\frac{6K_B T}{\pi\eta a}$

4. Flux of water ϕ_w is related to the hydrostatic pressure P and osmotic pressure π as
[a] $-u_w\, grad\,(p-\pi)$
[b] $u_w\, grad\,(p-\pi)$
[c] $-u_w c_w\, grad\,(p-\pi)$
[d] $u_w c_w\, grad\,(p-\pi)$

5. Which is not a common feature of the near death experience (NDE)?
[a] Going through a tunnel
[b] A panoramic review of one's life
[c] Hovering over the physical body
[d] Judgment by a divine panel

6. The radius of second orbit of hydrogen atom is 0.212 nm. The radius of third orbit is
[a] 0. 477 nm
[b] 0.318 nm
[c] 0.636 nm
[d] 0.159 nm

7. In which one of the following interactions, the interaction energy is inversely proportional to the fourth power of the separation distance two atoms?
[a] Ion-Ion interaction
[b] Ion-Dipole interaction
[c] Dipole-Dipole interaction
[d] Ion-Induced dipole interaction.

8. The frequency difference between two successive lines in pure rotational spectrum of a diatomic molecule of moment of inertia I is
[a] $\frac{h}{4\pi I}$
[b] $\frac{h}{4\pi^2 I}$
[c] $\frac{\hbar}{4\pi^2 I}$
[d] $\frac{h}{2\pi I}$

9. For a wave function $\Psi(x,t)$, the quantity $\int_{-\infty}^{+\infty} \Psi^* \left(i\hbar \frac{\partial}{\partial t} \right) \Psi dx$ gives

[a] probability of finding the particle in whole space.
[b] expectation value of energy.
[c] expectation value of momentum.
[d] probability of finding a particle in a unit volume.

10. The physical technique for structure determination in which the variation of quantum mechanical tunneling current plays the role as a major physical quantity is
[a] STM [b] AFM [c] holography [d] NMR

Fill in the blanks with correct answers.

11. If two solution of different concentration are separated by a semi permeable membrane, then the solvent will tend to move across the membrane from less concentrated solution to more concentrated solution. The process is known as .....

12. The third parameter that the particle flux ϕ increases with the increase of the mobility u, concentration c and .....

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

14. A stimulus (disturbance) upsets the resting membrane potential and causes a transient change in the membrane potential, called .....

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

16. The ratio of magnetic dipole moment and angular momentum is called .....
.....

17. The energy difference between bonding molecular orbital and atomic orbital is called ..... energy

18. The quantum mechanical operator $-\frac{\hbar^2}{2m}\nabla^2 + V$ is called ..... operator.

19. The selection rule for pure vibrational spectra with quantum number n is .....

20. When a hologram is cut off into the small pieces then each piece can be used to reconstruct the image. But the image becomes .....intense than the original image.

KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

Level: B.Tech.
Year: I
Time: 2 hrs. 30 mins.

Course : PHYS 105
Semester : II
F.M. : 55

SECTION "B"
[5Q. × 4 = 20 marks]

1. Write short note about near death experience (NDE).

OR

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

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

3. Explain the effect of nuclear motion on atomic spectra.

OR

What are the natures of molecular bonding? Write three rules for linear combination of atomic orbitals.

4. Calculate the average energy and de Broglie's wavelength of thermal neutron at $T = 300$ K and compare with that of electron. Given $k_B = 1.38\times10^{-23}$ J/K, $h = 6.62\times10^{-34}$ Js, mass of neutron $= 1.67\times10^{-27}$ kg and mass of electron $= 9.1\times10^{-31}$

5. Explain the recording of hologram with schematic diagram.

OR

What is phosphorescence? Explain it with appropriate energy diagram.

SECTION "C"
[5Q. × 7 = 35 marks]

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.

OR

Oxygen gas is flowing through a 10m long circular pipe with a radius 16cm. The concentrations of oxygen at the ends of pipe are 30kg/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 many kg of oxygen will flow through this pipe in 15 minutes?
c. Calculate the concentration gradient?

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

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

OR

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

9. Explain the Zeeman effect with appropriate experimental set up. Also give the theory of normal Zeeman effect.

10. Explain the theory of pure vibrational spectra of a diatomic molecule.

OR

Explain the NMR technique with schematic diagram. Also obtain the NMR equation.