

1. Booklungs are found in :

- | | |
|--------------|------------------|
| (1) Amoeba | (2) Polystomella |
| (3) Euglypha | (4) Arachnids |

2. Silk is obtained from :

- | | |
|----------------|-----------------------|
| (1) Adult moth | (2) Caterpillar stage |
| (3) Egg | (4) Cocoon |

3. Neurogenic heart is found in :

- | | |
|------------------|-------------------|
| (1) Human beings | (2) Rat |
| (3) Rabbit | (4) Invertebrates |

4. Epiphysis is also known as :

- | | |
|-------------|------------------|
| (1) Pineal | (2) Pituitary |
| (3) Thyroid | (4) Hypothalamus |

5. Simplest and smallest form of amino acid is :

- | | |
|-------------|--------------|
| (1) Glycine | (2) Proline |
| (3) Lysine | (4) Argenine |

6. PCOS is related to :

- | | |
|------------|-------------|
| (1) Ovary | (2) Uterus |
| (3) Testes | (4) Oviduct |

7. Seminogelin is secreted by :

- | | |
|------------------|---------------------|
| (1) Epididymis | (2) Seminal Vesicle |
| (3) Thecal cells | (4) Oviduct |

8. First cleavage in frog is :

- | | |
|----------------|-----------------|
| (1) Horizontal | (2) Meridional |
| (3) Equatorial | (4) Latitudinal |

9. Which of the following is nuclear receptor ?

- | | |
|--------|----------|
| (1) AR | (2) GPCR |
| (3) IR | (4) MT1 |

10. Cryptorchidism is related to :

- | | |
|------------|--------------|
| (1) Testes | (2) Thyroid |
| (3) Ovary | (4) Pancreas |

Multiple choice Questions

11. The peak of Maxwell-Boltzmann distribution for velocity shifts towards a higher value of velocity :
- (1) At higher temperature along with decrease in height.
 - (2) At higher temperature along with increase in height.
 - (3) At lower temperature along with decrease in height.
 - (4) At lower temperature along with increase in height.
12. For a Bose gas, which of the following statements about its chemical potential μ is necessarily correct ?
- (1) $\mu = 0$
 - (2) $\mu \geq 0$
 - (3) No restriction on μ
 - (4) $\mu \leq \epsilon_0$, where ϵ_0 is the minimum energy of the system.
13. Which one of the following functions $y = f(x)$, can not be fitted with experimental data using linear least square fit method ?
- | | |
|-------------------------------|---------------------------------|
| (1) $y = a_0 + a_1x + a_2x^2$ | (2) $y = a_0 + \frac{a_1}{x^2}$ |
| (3) $y = \sin(a_0x)$ | (4) $y = x^{a_1}$ |

Where a_0 , a_1 and a_2 are constants.

14. Photosynthesis involves :

- (1) CO_2 , N_2 and carbohydrates to produce oxygen and energy.
- (2) CO_2 , H_2O and energy to produce carbohydrates and oxygen.
- (3) CO_2 , N_2 and H_2O to produce urea and oxygen.
- (4) CO_2 , Carbohydrates and energy to produce oxygen and H_2O .

15. At the transition temperature of a first order phase transition for a system :

- (1) The specific heat diverges and the entropy remains the same.
- (2) The specific heat diverges and the entropy has finite discontinuity.
- (3) The specific heat remains finite and the entropy has finite discontinuity.
- (4) The specific heat has finite discontinuity and the entropy diverges.

16. The central force Which causes a mass to move in a spiral orbit given by $r = r_0 e^{k\theta}$, k is constant, varies as :

- | | |
|--------------|--------------|
| (1) r^{-3} | (2) r^{-2} |
| (3) r^{-5} | (4) r^{-2} |

17. The vector potential which does not produce a uniform magnetic field,

$2B_0 \hat{x}$ is :

(1) $(0, B_0 Z, -B_0 Y)$

(2) $(0, -B_0 Z, B_0 Y)$

(3) $(0, -2B_0 Z, 0)$

(4) $(0, 0, 2B_0 Y)$

18. The Lagrangian of a system is given by $L(r, \theta, \dot{r}, \dot{\theta}) = \frac{1}{2} m (\dot{r}^2 + r^2 \dot{\theta}^2) + \frac{\alpha}{r}$

Which of the following is not correct ?

(1) $Mr^2 \dot{\theta}$ is constant of motion

(2) θ is cyclic coordinate

(3) Total linear momentum is conserved

(4) Total energy is conserved

19. The ground state wave function for the 1-d system described by the

potential $V(x) = 0$ for $-L \leq x \leq L$

$= \infty$ elsewhere is :

(1) $A \cos \frac{\pi x}{L}$

(2) $A \sin \frac{\pi x}{L}$

(3) $A \sin \frac{\pi x}{2L}$

(4) $A \cos \frac{\pi x}{2L}$

23. Which one of the followings processes is allowed by strong interactions ?

(1) $\pi^+ + p \rightarrow k^+ + p$

(2) $\pi^- + p \rightarrow k^+ + \Sigma^-$

(3) $n + p \rightarrow d + \gamma$

(4) $K^- \rightarrow \pi^- + \pi^0$

24. The diffusion current density in a piece of germanium having electron concentration gradient 1.5×10^{22} electrons/m⁴ and diffusion coefficient of electron as 1.2×10^{-3} m²/sec is :

(1) 1.8×10^{19} A/m²

(2) 2.88 A/m²

(3) 1.92×10^{-22} A/m²

(4) 28.8 A/m²

25. The resulting change in emitter current for a change in the collector current of 2mA with $\alpha = 0.98$ is :

(1) 1.96 mA

(2) 2.04 mA

(3) 2 mA

(4) 0.98 mA

26. Totem pole output in a TTL NAND Gate is used due to :

(1) High impedance

(2) Low output impedance

(3) Zero input impedance

(4) Infinite Output impedance

RET/17/TEST-B

27. The wave vector associated with free electrons at Fermi-Surface has magnitude :

(1) $\left(\frac{2mE_F}{\hbar^2}\right)^{1/2}$

(3) $\left(\frac{2m}{\hbar^2}\right)^{1/2}$

(2) $\frac{2mE_F}{\hbar^2}$

(4) $\left(\frac{2mE_F}{\hbar^2}\right)^{3/2}$

28. If the number density of a free electron gas in three dimensions is increased eight times, its Fermi temperature will :

(1) Decreases by a factor of 4

(2) Increases by a factor of 4

(3) Increases by a factor of 8

(4) Decreases by a factor of 8

29. Atomic packing factor for fcc lattice approximately :

(1) 34%

(2) 52%

(3) 68%

(4) $\frac{4}{6}$

30. For good conductors, the skin depth varies inversely with :

(1) ω

(2)

(3) $\sqrt{\omega}$

(4)

31. A monochromatic electromagnetic wave incident on an ionospheric surface is :

- (1) Mainly transmitted if its frequency is low
- (2) Mainly reflected if its frequency is low
- (3) Completely observed irrespective of its frequency
- (4) Mainly reflected if its frequency is very high

32. Which of the following is not a magneto hydrodynamic (MHD) wave ?

- (1) Sound wave
- (2) Light wave
- (3) Magneto sonic wave
- (4) Alfvén wave

33. For ionospheric plasma critical frequency for propagation is given by :

- (1) $f_c = \frac{9}{\sqrt{N}}$
- (2) $f_c = 100\sqrt{N}$
- (3) $f_c = 9\sqrt{N}$
- (4) $f_c = \frac{100}{\sqrt{N}}$

Where N is plasma

34. The energy density of electromagnetic wave in vacuum is given by :

(1) $\frac{E^2}{2\epsilon_0} + \frac{B^2}{2\mu_0}$

(2) $\frac{1}{2}\epsilon_0 E^2 + \frac{1}{2}\mu_0 B^2$

(3) $\frac{E^2 + B^2}{2}$

(4) $\frac{1}{2}\epsilon_0 E^2 + \frac{B^2}{2\mu_0}$

35. In HCl molecule, the energy gap between the two vibrational level is -0.36 eV. What will be its zero point energy ?

(1) 0

(2) 0.18 eV.

(3) 0.36 eV.

(4) 0.54 eV.

36. The series whose n th term is $\frac{2^n}{n^3}$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) Damped

37. For $0 < \theta < \pi$ the matrix $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$:

(1) Has no real eigen value

(2) Is symmetric

(3) Is skewsymmetric

(4) Is orthogonal

38. The residue of $\cot z$ at $z = 0$ is :

(1) -1

(2) π

(3) 1

(4) $\frac{1}{4} \sin z$

Short Answer Questions

Note: Attempt any **five** questions. Write answer in **150-200** words. Each question carries **16** marks. Answer each question on separate page, after writing Question Number.

01. A particle of mass m is free to slide on a smooth helical wire whose equations in cylindrical coordinates are $\rho = a$, $Z = b\phi$. a , b are constants. The particle is released from rest at $\rho = a, \phi = 0, z = 0$. Discuss the motion of the particle.
02. The partition function of a system is given by $Z = e^{\alpha T^{\gamma}}$,
Where α is a constant. Calculate the internal energy, pressure and entropy of the system.
03. Calculate $\langle \psi_{1s} | \frac{1}{r} | \psi_{1s} \rangle$ for H-atom problem. $\psi_{1s} = \psi_{100}$ represents the ground state of the system.
04. What is parity of a particle? Discuss parity violation in the context of nuclear β -decay.
05. Compute Debye length (λ_D) and number of particles (N_D) in a Debye sphere for Earth's ionosphere with plasma density $n = 10^{12} \text{m}^{-3}$ $kT_e = 0.1 \text{ eV}$.
06. Prove that for electromagnetic wave, the electric field vector \vec{E} , magnetic field vector \vec{B} and propagation vector \vec{R} are perpendicular to each other.

RET/17/TEST-B

07. Describe Nyquist criterion for zero inter symbol interference (ISI). How, ISI is eliminated ?
08. What is Raman effect ? Does the Raman shift depend on the excitation frequency ? Compute the ratio of intensities of stokes and corresponding anti-stokes Raman bands.
09. Write down the expression for effective Mass of electron in solids. With the help of effective mass vs wave vector curve, explain the variation of effective mass. Explain the concept of negative effective mass.
10. Evaluate the following integral using Cauchy integral formula

$$\int_C \frac{4-3z}{z(z-1)(z-2)} dz$$

Where C is the circle $|z|=3/2$