

APEX CARE**INSTITUTE FOR PG - TRB, SLET AND NET IN PHYSICS**

1. The average kinetic energy of a CO₂ molecule at room temperature will be approximately:
A) 1 eV B) 0.1 eV C) 0.37 eV D) 0.037 eV

2. Let H(S,P) represent the enthalpy of a system expressed as a function of entropy and pressure. Which pair of equations are true for its partial derivatives?
A) $(\partial H/\partial S)_P = T$ and $(\partial H/\partial P)_S = V$
B) $(\partial H/\partial S)_P = P$ and $(\partial H/\partial P)_S = S$
C) $(\partial H/\partial S)_P = V$ and $(\partial H/\partial P)_S = T$
D) $(\partial H/\partial S)_P = S$ and $(\partial H/\partial P)_S = P$

3. A gas with $\gamma = 1.5$ is adiabatically compressed to 1/9th of its volume. What will be the ratio of the initial and final temperatures?
A) 1:1 B) 1:3 C) 3:1 D) 1:9

4. The thermodynamical relation $(\partial T/\partial P)_H = (1/C_p)[T(\partial V/\partial T)p - V]$ refers to one of the following effects. Which one is it?
A) Joule heating B) Joule-Thomson effect
C) Peltier effect D) Seebeck effect

5. In the demonstration of uncertainty principle using gamma-ray microscope thought experiment, if X-rays are used instead of gamma rays, the uncertainty in the measurement of position of the electron
A) Increases
B) Decreases
C) Independent of the wavelength of the radiation
D) May increase or decrease

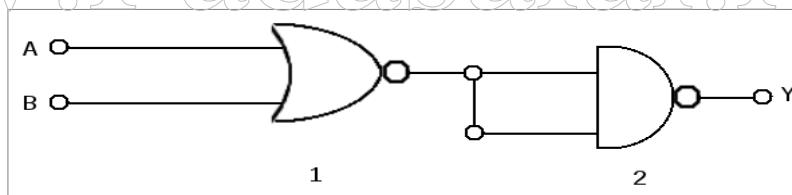
5. Which special functions are part of the radial component of the hydrogenic wave function?
A) Associated Legendre functions
B) Associated Laguerre functions
C) Hermite polynomials
D) Spherical Bessel functions

6. A particle of mass m moving in a cubical box of side a has energy equal to $14h^2/8ma^2$. What is the degeneracy of this energy level (h = Planck's constant)?
A) 1 B) 2 C) 3 D) 4

7. An electron is in an infinite square well of width a. What will be the expectation value of the dipole moment of the electron?
A) 0 B) ea C) 2ea D) ea/2

8. The normalized ground state wave function of the hydrogen atom is given by $\psi(r) = Ae^{-r/a_0}$ where a_0 is the Bohr radius. The electron will be spending major part of the time at which distance from the nucleus?
- A) 0 B) $a_0/2$ C) $a_0/\sqrt{2}$ D) a_0
9. Which of the following quantities is proportional to the electron density at a point?
- A) The wave function
 B) The absolute square of the wave function
 C) The de Broglie wavelength
 D) The reciprocal of the de Broglie wavelength
10. A quantum state is specified by its wave function $\sin x x_1 + e^{i\phi} \cos x x_2$. Here x_1 and x_2 are the spin wave functions for spin up and down cases respectively. Which of the following states will be orthogonal to this state?
- A) $\sin x x_1 + e^{-i\phi} \cos x x_2$
 B) $\cos x x_1 + e^{-i\phi} \sin x x_2$
 C) $\sin x x_1 - e^{-i\phi} \cos x x_2$
 D) $\cos x x_1 - e^{i\phi} \sin x x_2$
11. A muon can be considered to be a heavy electron with a mass $m = 207m_e$. Imagine replacing the electron in a hydrogen atom with a muon. What are the energy levels E_n for this new form of hydrogen in terms of the binding energy of ordinary hydrogen E_0 , the mass of the proton m_p , and the principal quantum number n ?
- A) $E_n = -(E_0/n^2)(m_e/m)$
 B) $E_n = -(E_0/n^2)(m/m_e)$
 C) $E_n = -(E_0/n^2)[(m_e/m_e)(m_p+m_e)/(m_p+m)]$
 D) $E_n = -(E_0/n^2)[(m_p+m_e)/(m_p+m)]$
12. In the simple variational method one takes a parametrized trial wave function and finds the parameters that make the expectation value of the Hamiltonian
- A) Maximum B) Minimum C) Positive D) Negative
13. Which one of the following has the longest wavelength?
- A) A 1 MeV gamma ray B) A red light photon
 C) A 1 eV electron D) A cricket ball moving at 100 m/s
14. The uncertainty relation is **not** applicable to one of the following pairs of variables. Which one is it?
- A) Energy and time
 B) Position and corresponding momentum
 C) Energy and position
 D) Angular position and angular momentum
15. Which relation is satisfied by the angular momentum operators?
- A) $L \times L = 0$
 B) $L \times L = i\hbar L$
 C) $L \cdot L = i\hbar L_z$
 D) $[L^2, L_z] = i\hbar L_z$

16. Consider a single electron atom with orbital angular momentum $L = \sqrt{2}\hbar$. Which of the following gives the possible values of a measurement of L_z , the z-component of L?
- A) 0 B) $0, \hbar$ C) $0, \hbar, 2\hbar$ D) $-\hbar, 0, +\hbar$
17. Considering the Pauli spin matrices σ_x , σ_y , σ_z and the identity matrix I, which of the following is the value of the commutator $[\sigma_x, \sigma_y]$?
- A) I B) $2i \sigma_x$ C) $2i \sigma_y$ D) $2i \sigma_z$
18. The decay constant for an atom making a transition from the first excited state to the ground state is 10^{-10} s^{-1} . If the matrix element connecting the two states is increased by a factor of two, what will be the new decay constant?
- A) $4 \times 10^{-10} \text{ s}^{-1}$ B) $1.414 \times 10^{-10} \text{ s}^{-1}$
 C) $2 \times 10^{-10} \text{ s}^{-1}$ D) $0.5 \times 10^{-10} \text{ s}^{-1}$
19. Which of the following best describes a n-type semiconductor?
- A) A material with electrons in donor levels which may be thermally promoted to the conduction band.
 B) A material with no band gap which conducts with little resistance.
 C) A material with a sizeable band gap.
 D) A material with empty acceptor levels to which electrons from the valence band may be thermally promoted.
20. The following diagram represents a gate formed by a suitable combination of two other gates. What are the names of the individual gates 1 and 2 and the combination gate?



- A) NOR, NAND, OR B) NAND, NOR, OR
 C) NOR, NAND, AND D) NOR, NAND, XOR
21. The resistivity of pure silicon is $2300 \Omega \text{ m}^{-1}$. The mobilities of electrons and holes in it are $0.135 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$ respectively for electrons and holes. The electron and hole concentrations are respectively
- A) $2.01 \times 10^{16} \text{ m}^{-3}$ and $5.66 \times 10^{16} \text{ m}^{-3}$
 B) $1.49 \times 10^{16} \text{ m}^{-3}$ and $1.49 \times 10^{16} \text{ m}^{-3}$
 C) $1.49 \times 10^{16} \text{ m}^{-3}$ and zero
 D) Zero and $1.49 \times 10^{16} \text{ m}^{-3}$

22. The mid frequency gain of amplifier is 200 without feedback and the band width is 50 kHz. On applying feedback the gain is reduced to 150. Choose from the following the correct combination of the type of feedback, the feedback factor and the new band width :
- A) Positive, 1/200, 37.5 kHz B) Positive, 1/600, 66.7 kHz
 C) Negative, 1/600, 66.7 kHz D) Negative, 1/200, 37.5 kHz
23. A silicon pn junction diode has a built-in potential barrier of 0.65 Volts. If the acceptor impurity concentration is doubled, the new barrier potential will be (Take $kT/e = 0.025$ eV)
- A) Remains the same 0.65 V B) Reduced to about 0.63 V
 C) Increased to about 0.67 V D) Increases by a factor of 2.
24. In the experimental determination of the ratio e/k (e being the electronic charge and k the Boltzmann constant) using a transistor, the current I is measured as a function of temperature. Then
- A) A plot of $\log I$ vs T is made to get a straight line, the slope of which gives the required ratio
 B) A plot of $\log I$ vs $1/T$ is made to get a straight line, the slope of which gives the required ratio
 C) A plot of $\log I$ vs $1/T$ is made to get a straight line, the y intercept of which gives the required ratio
 D) A plot of $\log I$ vs T is made to get a straight line, the y intercept of which gives the required ratio
25. A mod 10 counter requires a minimum of how many flip-flops?
- A) 10 B) 5 C) 4 D) 2
26. A source follower is
- A) A common source amplifier with very high gain
 B) A common source amplifier with very low input impedance
 C) A common drain amplifier with unity gain
 D) A common source amplifier with unity gain
27. Determine the output frequency for a frequency division circuit that contains 12 flip-flops with an input clock frequency of 20.48 MHz.
- A) 20 kHz B) 10 kHz C) 1.706 MHz D) 5 kHz
28. A 12 bit ADC is used to digitize analog signals of amplitudes lying in the range from 0 V to +10 V. What digital output will an analog input of 3.004 V correspond to?
- A) 100011001111 B) 010011001111
 C) 010011001110 D) 010111001110
29. A Zener diode is usually used
- A) To obtain a stable reference voltage
 B) As a variable voltage source
 C) In an oscillator circuit
 D) To reduce the ripple in a voltage regulator

30. One of the following types of filters has a bandwidth equal to its cut off frequency.
one input resistor divided by the number of inputs, the output will be equal to
 A) Sum of the inputs B) Average of the inputs
 C) Inverted sum of the inputs D) Inverted average of the inputs
31. An amplitude modulated waveform has at its maximum 100 V p-p and at the minimum 40 V p-p. What is the modulation percentage?
 A) 250% B) 43% C) 25% D) 37.5%
32. Which one of the following optoelectronic devices works under reverse bias conditions?
 A) LED B) Photo diode
 C) Solar cell D) Diode laser
33. Which of the following statements is **NOT TRUE** of an OPAMP integrator?
 A) Its gain increases with increasing frequency of the input
 B) It uses capacitive feedback
 C) Usually the circuit works well at high frequencies
 D) It converts a dc input into a ramp voltage
34. Which one of the following devices has the highest input impedance?
 A) BJT B) FET C) MOSFET D) Diode
35. When a positron comes close enough to an electron, a bound system called positronium can be formed. Given that the K-shell energy in hydrogen atom is 13.6 eV, what will be the corresponding energy in a positronium atom?
 A) 6.8 eV B) 3.4 eV C) 1.36 eV D) 13.6 eV
36. Which one of the following sets of quantum numbers (n, l, m_l, m_s) is valid for an electron in an atom?
 A) 2 3 -3 +1/2 B) 4 3 4 -1/2
 C) 3 1 0 +1/2 D) 1 -1 1 +1/2
37. An air filled rectangular waveguide has internal dimensions of a cm x b cm. Given that $a = 2b$ and the cut off frequency of TE_{02} mode is 6 GHz, what will be the cut off frequency of the dominant mode?
 A) 6 GHz B) 4 GHz
 C) 3 GHz D) 1.5 GHz
38. The experimental spectrum of a fireball closely resembles that of a black body whose peak emission occurs at 29 Å. What will be its approximate temperature?
 A) 1000 K B) 10000 K C) 100000 Å D) 1 million K

Highlights

- * Class are handled by TRB / NET / SLET qualified faculties
- * PG -TRB 2015 – 16 , District I st Place and 18 students qualified
- * PG - TRB 2016 – 17 , District I st Place and 23 students qualified
- * 2017 – 18 : SLET Interaction class is going on /
Admission Free - (Selection based on Entrance)

PG - TRB Admission going on.....

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