66. Weak nuclear forces act on :

(A) Both hadrons and leptons

(B) Hadrons only

(C) All the charged particles

(D) None of these

67. Which of the following elementary particle is a lepton :

(A) Photon

(B) μ-meson

(C) Neutron

(D) proton

68. Biot-Savarts law in magnetic field is analogous to law in electric field :

(A) Gauss law

(B) Faraday law

(C) Coulombs law

(D) Ampere law

69. The Ampere law is based on

(A) Stoke's theorem

(B) Green's theorem

(C) Gauss divergence theorem

(D) Maxwell theorem

70. The magnetic flux density of a finite length conductor of radius 12 cm and current 3 A in air is :

(A) 5×10^{-6}

(B) 4×10^{-6}

(C) 6×10^{-6}

(D) 7×10^{-6}

12. In Young's double slit experiment, the separation of the slits is 1.9 mm and the fringe spacing is 0.31mm at a distance of 1 metre from the slits. The wavelength of the slit is :

(A) 4890 Å

(B) 5890 Å

(C) 6890 Å

(D) 7890 Å

13. f(t) is a periodic function with period T. The average value is :

(A) $\int_0^T f(t)dt$

(B) $\frac{1}{T}\int_0^T f(t)dt$

(C) $\frac{2}{T}\int_0^T f(t)dt$

(D) $\frac{1}{2T}\int_0^T f(t)dt$

14. If $\int_{-1}^{+1} P_n(x)dx = 2$: then n is,

(A) 0

(B) 1

(C) −1

(D) None of these

15. If $\Gamma n = \frac{\Gamma(n+1)}{n}$, then $\Gamma(-n)$ is :

(A) 0

(B) 1

(C) ∞

(D) None of these

16. The efficiency of Carnot's engine working between the steam point and the ice point is :

(A) 24.31 %

(B) 25.21 %

(C) 23.52 %

(D) 26.80 %

17. Two ends of the rod are kept at 127°C and 227°C. When 2000 Cal of heat flows in this rod, then the change in entropy is :

(A) 1 Cal/K

(B) 20 Cal/K

(C) 6.9 Cal/K

(D) 0.7 Cal/K

18. In a gas, the relative magnitude of the most probable speed (V_p), the average speed $\bar{V}$ and root mean square speed (V_{rms}) of the molecule are :

(A) $V_{rms} > \bar{V} > V_p$

(B) $\bar{V} > V_{rms} > V_p$

(C) $V_p > \bar{V} > V_{rms}$

(D) $V_p > V_{rms} > \bar{V}$

19. The residue of $\frac{z}{(z-a)(z-b)}$ at infinity is :

(A) 1

(B) -1

(C) 0

(D) ∞

20. The Fourier transform of the function f(x) is $F(k) = \int e^{ikx} f(x)dx$. The Fourier transform of $\frac{df(x)}{dx}$ is :

(A) $\frac{dF(k)}{dk}$

(B) $\int F(k)dk$

(C) $-ik\,F(k)$

(D) $ikF(k)$

21. If $f(s) = \int_0^\infty e^{-st}F(t)dt$ is the Laplace transform of a function F(t), the Laplace transform of kt is :

(A) $\frac{1}{s^2}$

(B) $\frac{k}{s^2}$

(C) $\frac{k}{s}$

(D) $\frac{s^2}{k}$

22. When an electron jump from the fourth orbit to the second orbit, one can get :

(A) First line of Pfund series

(B) Second line of Lyman series

(C) Second line of Paschen series

(D) Second line of Balmer series

23. Davisson and Germer experiments relates to :

(A) Interference

(B) Polarization

(C) Electron diffraction

(D) Phosphorescence

37. For good conductors, skin depth (δ) varies with frequency (ω) as :

(A) $\frac{1}{\omega}$

(B) $\frac{1}{\sqrt{\omega}}$

(C) ω

(D) $\sqrt{\omega}$

38. The thickness of half wave plate of quartz for a wavelength of 5000 Å (given refractive index $\mu_{Extraordinary} = 1.553$ and refractive index $\mu_{ordinary} = 1.544$) is :

(A) 2.78×10^{-3} cm

(B) 2.78×10^{-5} cm

(C) 2.78×10^{-7} cm

(D) 3.78×10^{-5} cm

39. In a micro-canonical ensemble, a system A of fixed volume is in contact with a large reservoir B. Then :

(A) A can exchange only energy with B

(B) A can exchange only particles with B

(C) A can exchange neither energy nor particles with B

(D) A can exchange both energy and particles with B

40. The Fermi-Dirac distribution function is given as $f_{F\text{-}D}(\varepsilon_F) = \frac{1}{\exp\left(\frac{\varepsilon - \varepsilon_F}{kT}\right) + 1}$ where

ε_F is the Fermi energy. The value of $f_{F\text{-}D}(\varepsilon_F)$ at the absolute zero temperature is :

(A) 0

(B) 1

(C) $\frac{1}{2}$

(D) Infinity

41. Two bodies have their moments of inertia I and 2I respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio of :

(A) 1 : 2

(B) 2 : 1

(C) $1 : \sqrt{2}$

(D) $\sqrt{2} : 1$

24. Which is incorrect according to the shell model of the nucleus ?

(A) Magic number exist

(B) Nucleons interact with their nearest neighbours only

(C) Nucleons in a nucleus interact with a general force field

(D) Large electronic quadrupole moment exists for certain nuclei

25. Which of the following is not used as a moderator in a nuclear reactor ?

(A) H_2O

(B) D_2O

(C) C

(D) Al

26. Which of the following is used in VLSI technology to form integrated circuit ?

(A) Transistors

(B) Switches

(C) Diodes

(D) Buffers

27. The Boolean expression for the output of the logic circuit shown in the Figure is

(A) $Y = AB + A\bar{B} + C$

(B) $Y = \bar{A}\bar{B} + A\bar{B} + \bar{C}$

(C) $Y = A\bar{B} + \bar{A}B + C$

(D) $Y = AB + \bar{A}B + C$

28. Digital circuit can be made by repetitive use of :

(A) NOT gates

(B) OR gates

(C) NAND gates

(D) AND gates

29. Asynchronous counter are known as :

(A) Ripple counters

(B) Modulus counters

(C) Decade counters

(D) Multiple check counters

30. According to Schrödinger, a particle is equivalent to a :

(A) Single wave
(B) Sound wave
(C) Light wave
(D) Wave packet

31. Position and momentum operators satisfy $[\hat{x},\hat{p}]=i\hbar$, the value of $[\hat{p},[\hat{x},\hat{p}]]$ is :

(A) 1
(B) 0
(C) $\hbar$
(D) $i\hbar$

32. The normal Zeeman effect is :

(A) Observed only in atoms with an even number of electrons
(B) Observed only in atoms with an odd number of electrons
(C) Confirmation of space quantization
(D) Not a confirmation of space quantization

33. For Bragg's reflection by a crystal to occur, the X-ray wavelength λ and interatomic distance d must be :

(A) $\lambda > 2d$
(B) $\lambda = 2d$
(C) $\lambda \leq 2d$
(D) $\lambda < 2d$

34. According to the band theory of solids, the potential energy of two types of standing waves inside the crystal differ by an amount of :

(A) Energy gap
(B) 6 eV
(C) 2 eV
(D) None of these

35. The magnetic lines of force cannot penetrate the body of a superconductor. This phenomenon is known as :

(A) Isotopic effect
(B) BCS theory
(C) Meissner effect
(D) London theory

36. The Poynting vector S of an electromagnetic wave is :

(A) $\vec{S} = \vec{E} \times \vec{H}$
(B) $\vec{S} = \vec{E} \times \vec{B}$
(C) $\vec{S} = \frac{\vec{E}}{\vec{B}}$
(D) $\vec{S} = \frac{\vec{E}}{\vec{H}}$

42. A particle executing simple harmonic motion of amplitude 5 cm has a maximum speed of 31.4 cm/s. The frequency of its oscillation is :

(A) 4 Hz
(B) 3 Hz
(C) 2 Hz
(D) 1 Hz

43. In a reversible cycle, the value of the integral $\oint \frac{dQ}{T}$ is :

(A) $\oint \frac{dQ}{T} > 0$
(B) $\oint \frac{dQ}{T} < 0$
(C) $\oint \frac{dQ}{T} = 0$
(D) $\oint \frac{dQ}{T}$ = constant

44. What is the correct expression for the phase angle in an RLC series circuit ?

(A) $\varphi = \tan^{-1}(X_L - X_C)/R$
(B) $\varphi = \tan^{-1}(X_L + X_C)/R$
(C) $\varphi = \tan(X_L - X_C)/R$
(D) $\varphi = \tan^{-1}(X_L - X_C)$

45. The time constant of an R-C circuit is :

(A) RC
(B) R/C
(C) R
(D) C

46. The value of the time constant in the R-L circuit is :

(A) L/R
(B) R/L
(C) R
(D) L

47. In Newton's rings experiment, the diameter of the 15th ring was found to be 0.590 cm and that of the 5th ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, the wavelength of light used :

(A) 4880 Å
(B) 5880 Å
(C) 6680 Å
(D) 7680 Å

48. If a charged particle of mass m is accelerated through a potential difference V volts, the de-Broglie wavelength is proportional to

(A) V
(B) $V^{-1/2}$
(C) V^2
(D) $V^{1/2}$

49. The lowest energy possible for a particle in a potential box is 2 eV. The next highest energy of the particle is :

(A) 4 eV
(B) 16 eV
(C) 32 eV
(D) 8 eV

50. A rod has length of 1 metre. If the rod is placed inside a satellite moving with a velocity of 0.8 c relative to the laboratory, the length of the rod by the observer in the laboratory is :

(A) 0.5 metre
(B) 0.6 metre
(C) 0.7 metre
(D) 0.8 metre

51. As an object approaches the speed of light, it's mass becomes :

(A) Zero
(B) Double
(C) Remains Same
(D) Infinite

52. Nuclear forces are :

(A) Gravitational attractive
(B) Electrostatic repulsive
(C) Long range and strong attractive
(D) Short range and strong attractive

53. The binding energy per nucleon is maximum for the nucleus :

(A) ^{56}Fe
(B) ^{4}He
(C) ^{208}Pb
(D) ^{101}Mp

54. The mean life time of one of the atoms of a radioactive sample with disintegration constant λ is :

(A) $1/\lambda$
(B) $\ln 2/\lambda$
(C) $\lambda \ln 2$
(D) $\ln \lambda/2$

55. If a generalized coordinate has the dimensions of momentum, the generalized velocity will have the dimension of :

(A) Velocity
(B) Acceleration
(C) Force
(D) Torque

56. Hamilton's canonical equations of motion are :

(A) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = \frac{\partial H}{\partial q_i}$
(B) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = -\frac{\partial H}{\partial q_i}$
(C) $\dot{q}_i = \frac{\partial H}{\partial \dot{p}_i}$ and $\dot{p}_i = \frac{\partial H}{\partial \dot{q}_i}$
(D) $\dot{q}_i = \frac{\partial H}{\partial \dot{p}_i}$ and $\dot{p}_i = -\frac{\partial H}{\partial \dot{q}_i}$

57. The generalized velocity co-ordinate q_k of a classical system with Lagrangian 'L' is said to be cyclic if :

(A) $\frac{\partial L}{\partial_{qk}} = \dot{q}_k$
(B) $\frac{\partial L}{\partial_{qk}} = 0$
(C) $\frac{\partial L}{\partial_{qk}} = 0$
(D) None of these

58. A particle moves in a circular orbit about the origin under the action of a central force $\vec{F} = -\frac{k\hat{r}}{r^3}$. If the potential energy is zero at infinity, the total energy of the particle is :

(A) $-\frac{k}{r^2}$
(B) $-\frac{k}{2r^2}$
(C) 0
(D) $\frac{k}{r^2}$

59. The law at given temperature, the ratio of spectral emissive and absorptive powers of a body is called :

(A) Wien's law
(B) Kirchoff's law
(C) Stefan's law
(D) Displacement law

6. At what speed will the mass of a body be 1.25 times its rest mass ?

(A) 0.1c (B) 0.3c

(C) 0.4c (D) 0.6c

7. The electric filed intensity $\vec{E}$ due to an infinite uniformly charged plane sheet at a point of distant r from the sheet is related as

(A) $\vec{E} \propto r$ (B) $\vec{E} \propto r^{-1}$

(C) $\vec{E} \propto r^2$ (D) $\vec{E}$ is independent of r

8. The magnetic field due to a long straight current carrying conductor of radius R, when r > R (r is the distance between the point and the axis of wire) proportional to

(A) r (B) r^{-1}

(C) r^2 (D) r^{-2}

9. The self-inductance of a coil with turns 50, flux 3 units and a current of 0.5A is :

(A) 75 (B) 150

(C) 300 (D) 450

10. The dielectric constant for a material with electric susceptibility of 5 is :

(A) 6 (B) 4

(C) 3 (D) 0

11. Two thin convex lenses having focal lengths 5cm and 2 cm are coaxial and separated by a distance of 3 cm. The equivalent focal length is :

(A) 0.5 cm

(B) 2.5 cm

(C) 1.5 cm

(D) 3.5 cm

1. The directional derivative of the scalar function $\varphi = x^2yz + 4xz^2$ at the point $(1, -2, -1)$ in the direction $2\hat{i} - \hat{j} - 2\hat{k}$.

(A) $\frac{3}{27}$

(B) $\frac{27}{3}$

(C) 35

(D) 20

2. The value of div $\left(\frac{\vec{r}}{r^3}\right)$:

(A) 0

(B) 1

(C) 3

(D) ∞

3. The value of $\int_{-}^{-} f(x)\delta(x-2)dx$ is :

(A) f(0)

(B) f(1)

(C) f(2)

(D) $f(\infty)$

4. Moment of inertia of a sphere of mass M and radius R about one of its diameter is :

(A) $2/5\ MR^2$

(B) $2/3\ MR^2$

(C) $1/2\ MR^2$

(D) MR^2

5. Which of the following is true for the relation between modulus of rigidity (η), Young's modulus (Y) and Poisson's ratio (σ) ?

(A) $\eta = \frac{Y}{2(1+\sigma)}$

(B) $\eta = \frac{Y}{3(1+\sigma)}$

(C) $\eta = \frac{Y}{2(1-\sigma)}$

(D) $\eta = \frac{Y}{3(1-\sigma)}$

60. A permanent memory, which helps to start-up the computer and does not erase data after power off :

(A) Network interface card
(B) CPU
(C) RAM
(D) ROM

61. Which of the following is non-volatile storage?

(A) Backup
(B) Secondary
(C) Primary
(D) Cache

62. A half adder is a logic circuit with :

(A) Two inputs and two outputs
(B) Three inputs and one output
(C) Three inputs and two outputs
(D) Two inputs and one output

63. An oscillator differs from an amplifier because :

(A) It has more gain
(B) It has less gain
(C) It requires no input signals
(D) It requires no dc supply

64. In a ferromagnetic material, as the applied filed is gradually reduced to zero, the polarization still left is known as :

(A) Coercive polarization
(B) Spontaneous polarization
(C) Space charge polarization
(D) Remanent polarization

65. The splitting of spectral line in the presence of an electric field is called as :

(A) Stark effect
(B) Zeeman effect
(C) Paschen-Back effect
(D) Raman effect

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