JEST-2011 Questions , Series- Q

1.A 3-D harmonic oscillator having energy eigen values $\hbar\omega\left(n+\frac{3}{2}\right)$ where n=0,1,2,3.. The degree of degeneracy of the quantum state n is

a. n+1   b. $\frac{n^2+5n+2}{2}$ c. . $\frac{n^2+3n+2}{2}$ d. n^2+n+1

2.For what real values of 'p' the series $\sum_{n=1}^{\infty}\left[\frac{1}{n}-\sin\frac{1}{n}\right]^p$ converges

a. p>1   b. p>3   c.P>0   d.P >1/2

3. Consider a heat reservoir kept at temperature 20^0C. The latent heat of melting of ice is 80cal/gram. The minimum energy required to freeze one liter of water originally at T = 0^0C will be

a. 10^4J   b.2 X10^4J   c. 3X10^5J   d. 10^5J

4.An electromagnetic wave has propagation vector $k=\frac{\omega}{\sqrt{2}\,c}(\bar{x}+\bar{y})$ and the electric field has the direction $E=\frac{1}{\sqrt{2}}(\bar{y}-\bar{x})$ where E_0 is the amplitude $\bar{y},\bar{x},\bar{z}$ are the unit vectors. Then the magnetic field is given by

a. $\frac{1\,E_0}{c}\bar{z}Sin\left(wt-\frac{\omega}{\sqrt{2}\,c}(\bar{x}+\bar{y})\right)$ b. $\frac{1\,E_0}{c}\bar{z}Sin\left(wt+\frac{\omega}{\sqrt{2}\,c}(\bar{x}-\bar{y})\right)$

c. $\frac{1\,E_0}{c}\bar{x}Sin\left(wt-\frac{\omega}{\sqrt{2}\,c}(\bar{x}+\bar{y})\right)$ d. $\frac{1\,E_0}{c}\bar{z}Sin\left(wt-\frac{\omega}{\sqrt{2}\,c}(\bar{x}-\bar{y})\right)$

5.Unpolarized light of intensity I_0 is incident on a series of 3 polarizing filters. The axis of second is at 45^0 to that of the first, while the axis of the third filter is 90^0 to that of first filter. What is the intensity of the light transmitted through the third filter.

a. 0   b. $\frac{I_0}{8}$ c. $\frac{I_0}{4}$ $\frac{I_0}{2\sqrt{2}}$

6.The Hamiltonian H = f(t)p^2 +V(x). f(t) is some function of time and V(x) is the potential then find the true statement.

a. Total energy and canonical momentum is conserved.   b. Total energy &canonical momentum not conserved

c. Total energy conserved but canonical momentum not. d. Momentum only conserved but total energy not .

7.A rubber bell loses half of its kinetic energy in each time it bounces at a surface. Assume that it is dropped from rest such that it takes T to hit the surface for the first time. The additional time it will take before it comes to rest is

a. ∞   b. $\frac{2T}{2^{\frac{1}{2}}-1}$ c. 2T   d. $\frac{2^{\frac{3}{2}}T}{2^{\frac{1}{2}}-1}$

8. In a pin hole camera the distance of pinhole form the photographic plate is 10cm. One would like to take a picture of sun in visible range (5000A^0). Then the diameter of the pinhole should be used in order to obtain from sharpest resolution is

a.0.002mm   b.0.02mm   c. 2mm   d.0.2mm

9.In the process $e^+ + e^- \rightarrow 2e^+ + 2e^-$, the minimum value of liner momentum of each initial electrons in the centre of mass system is

a.0   b. M_eC c. $\sqrt{2}M_eC$ d. $\sqrt{3}M_eC$

10.Let f_1 and f_2 be the two linearly independent solutions of the differential equation $\frac{d^2f}{dx^2}+\sin f=0$. Then $w(x)=f_1\frac{df_2}{dx}-f_2\frac{df_1}{dx}$ is

a.0   b. Independent of x   c. a solution of the given differential equation.   d.None.

11. A series of batteries with one volt potential are arranged on a circle as shown in figure. The resultant voltage is

a. 0   b. V   c. (n-1)V   d. v-1.

12.The potential energy of a system is given by $V(x)=\frac{1}{4}x^4$ with energy E_0. As E_0 changes with time then T=

a. Independent of E_0 b. proportional to E_0 c. proportional to $E_0^{\frac{1}{2}}$ d. c. proportional to $E_0^{\frac{1}{4}}$

13. A neutron π^0(135 MeV/C^2)decays into two photons while moving at relativistic speeds. The energy of each photon in the laboratory system is measured to be 100MeV. What is the speed of the π^0

a. 0.90c   b. 0.74c   c. 0.68c   d. 0.45c

14. A particle in a one dimensional potential have wave function $\psi(x)=Ae^{-\lambda|x|}$. Then $\langle x^2\rangle - \langle x\rangle^2$

15.N particles are distributed among three energy states E=0, k_BT, $2k_BT$ The equilibrium energy is $1000k_BT$ .Then Total number of molecules in the system is a. 1400 b.2400 c.3400 d.4400

16.How long it will take for sound to travel the distance l between two points A and B between the time periods T_1 and T_2 .Assume that the velocity proportional to $\alpha\sqrt{T}$

a. $\frac{l}{\alpha(\sqrt{T_1}+\sqrt{T_2})}$ b. $\frac{2l}{\alpha(\sqrt{T_1}+\sqrt{T_2})}$ c. $\frac{l}{\alpha(T_1+T_2)}$ d. $\frac{l}{\alpha\sqrt{T_1+T_2}}$

17. The wave function of a particle in a one dimensional potential well $\psi(x,t) = A\left[1+\frac{x}{L}\right]$; $-L \leq x < 0$

$A\left[1-\frac{x}{L}\right]$; $0 \leq x < L$

0; $x > L$

Then a. Probability of finding the particle is ½ $0 \leq x < L$ b. <x> =0 c. A=$\frac{3}{2L}$ d. It is a stationary state.

18.Two spherical conductors A_1, A_2 with radius r_1,r_2 where $r_1 < r_2$. The outer conductor is earthed and lower conductor has given a voltage then the capacitance of the system is..

a. $4\pi\varepsilon_0(r_1+r_2)$ b. $4\pi\varepsilon_0\frac{r_1r_2}{r_2-r_1}$ c. $4\pi\varepsilon_0(r_2r_1)$ d. $4\pi\varepsilon_0(r_1-r_2)$

19.f= x^2-y^2+2ixy, g= f= x^2+y^2-2ixy then

a. f,g are analytic in z b. f,g are not analytic in z c. f analytic ,g not analytic d. g analytic g not analytic

20.Two identical point charges are separated by a string and the tension between them is T. When an another identical charge is places half way between the two point charges then the tension is..

a. T b.2T c.4T d.5T

21. A force F = 2x+y-3z is applied to a particle having with a velocity v=3x-y if we have F= F parallel + F perpendicular as a sum of a vector F parallel to v and vector F perpendicular to V then F perpendicular is given by..

a. ½ x +3/2 y -2z b. x+3y-6z c. 3/2 x-3/2 y d. 8x+4y –z

22.A particle m is confined to move in a range 0<x< : the potential v(x) = ½ mw^2x^2.The partition function for the temperature T=$\frac{1}{k_B\beta}$

a. $\frac{e^{\frac{\beta\hbar\omega}{2}}}{e^{\beta\hbar\omega}-1}$ b. $\frac{1}{1-e^{-\beta\hbar\omega}}$ c. $\frac{e^{\frac{-\beta\hbar\omega}{2}}}{e^{-\frac{\beta\hbar\omega}{2}}-1}$ d. $\frac{e^{\frac{\beta\hbar\omega}{2}}}{e^{\beta\hbar\omega}-1}$ (options c,d might not correct)

23.$F = k\rho^{\alpha}R^{\beta}V^{\gamma}\eta^{\delta}$ using dimensional analysis identify the relation between LHS and RHS.

k a constant, density , R length, v velocity then eta coefficient of viscousity.

As I don’t remember options I am not providing here..

24.V(x)= $V_0(\frac{x}{L}+\frac{L}{x}+2V_0)$ then the ground state energy is

a. V_0 b. $\frac{2\hbar}{L}\sqrt{\frac{V_0}{m}}$ c. $\frac{\hbar}{L}\sqrt{\frac{V_0}{m}}$ d. $\frac{\hbar}{L}\sqrt{\frac{V_0}{2m}}$

25. The potential V= ½ kx^2 for a particle of mass m $\psi(x,t+\tau) = \psi(x,t)$ then the minimum time is

a. $\sqrt{\frac{m}{k}}$ b. $2\pi\sqrt{\frac{m}{k}}$ c. $\pi\sqrt{\frac{m}{k}}$ d. $4\pi\sqrt{\frac{m}{k}}$

26. A mass of m_1 is hanged from string and a mass of m_2 is attached with the mass m_1 with a string. The degrees of freedom of the system is..

a. 6 b.5 c.4 d.3

27. Eigen values of skew- hermitian(Anti Hermitian) matrix are..

a. Real b.Purely imaginary or zero c. Exaxtly zero d.None.

28. A collection of N two level system is at the bath temperature T. The number of exciting systems are..

a. 0 b.N/2 c. 3N/4 d.N

29. Consider the ESR spectrum of Cu^{+2} and Cu^{+} find the correct statement ..

a. Cu^{+2} shows ESR spectrum and Cu^{+} does not show ESR spectrum

b. Cu^{+2} does not shows ESR spectrum and Cu^{+} show ESR spectrum

c. Cu^{+2} and Cu^{+} does not show ESR spectrum

d. None

30. A container volume is divided into 3:1 by using a partition. The number of Ne molecules are 1000 in the larger volume and the number of He molecules are 100 in smaller volume. To get equilibrium the partition is removed then the ratio Ne to He molecules in the larger volume is..

a. 10:1 b.1:10 c.3:1 d.1:3

31. The gas which has maximum average speed is..

a. O_2 b. N_2 c. NO_2 d. CO_2

32. A state of a particle is given by $(x) = \sqrt{\frac{1}{7}}a_1 + \sqrt{\frac{4}{7}}a_2 + \sqrt{\frac{2}{7}}a_3$. Then the probability of finding the particle in a_2 state is

a. $\frac{4}{7}$ b. $\sqrt{\frac{4}{7}}$ c. $\sqrt{\frac{2}{7}}$ d. $\frac{1}{7}$

33. C-14 is used to determine the ages of fossils. In a certain fossil it is found that the radio activity is $\frac{1}{8}$ of the fossil now. If the half life of the c-14 is 5600 years then the age of the fossil is ..

a. 25000years b. 50000 Years c. 16800 d. 5600 years

34.Two ends A and B of wire of length 'l' is converted into a circle of radius R. If the ρ is the resistance per unit length of the wire. Another wire joining the A and B passing through the centre. That wire also having ρ as the resistance per unit length. Then find the resistance between the points A and B.

a. 0.5 ρR b 0.6 ρR c. 0.8 ρR d.0.9 ρR

35…

36….

37.At z=0 f(z)= $\sqrt{\frac{z}{\sin z}}$ having

a. one pole and …….point b. Both pole and A.P c. only A.P d.none

38. {x,p} =1 then the Possion braket $\{x^2+2px+p^2\}$ = …

a. 0 b. p^2 c. 2x+p d.1.

39. The colour which has maximum angle of diffraction at the straight edge is…

a. Blue b.Green c. Yellow d.Red.

40. The operator $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} - x\right)$=

a. $\left(\frac{d}{dx} - x\right)^2$ b. $\left(\frac{d^2}{dx^2} - 2x\frac{d}{dx} - x^2\right)$ c. $\left(\frac{d^2}{dx^2} - x\frac{d}{dx} - x^2\right)$ d. None

41. Consider a parallel plate capacitor separated by a distance. Now one plate of the parallel plate capacitor is tilted so that the capacitance of the capacitor becomes..

a. Increases b. Decreases c. Remains same. d.zero,

42.If the displacement current term is absent in the maxwell's equations then..

a. Magnetic monopoles will exist b. Electric dipoles will not exist.

c. Charge continuity is violated. d. Lenz law has not meaning

43. A liner harmonic oscillator having frequency ω. A force of F(t)Sin(Ωt) is applied then ω (This question is difficult to remember to me)

44.In order to find the interatomic distance between two molecules of a compound we require..

X ray diffractormeter, Screen, ..

45…..

46.The electric filed vector is given by… $E = E_0\cos(kz - wt) - E_0\sin(kz - wt)$ then the type of the polarization of the wave..

a. Circularly polarized. B.Linearly polarized c. Elliptically polarized d.Plane polarized.

47.In a quantum mechanical system $H|1> = |2> = 2|1>$ Then eigen values of the operator H are....

a. 1,2 b. ±1 c.±2 d.$\pm\sqrt{2}$

48.Identify in which parity is conserved…

a. $\frac{1}{2}(p_1^2+p_2^2+p_3^2) + (x+2)^2 + 2y^2 + z^2$ b. . $\frac{1}{2}(p_1^2+p_2^2+p_3^2) + y^2 + x^2 + (z-1)^2$

b. . $\frac{1}{2}(p_1^2+p_2^2+p_3^2)+\ (x)^2+2y^2+2z$ d. . $\frac{1}{2}(p_1^2+p_2^2+p_3^2)+\ (x)^2+2(y-1)^2+z^2$

49. There are five particles in a quantum mechanical system. The spin of particle is -1/2. The energy of each particle is 1eV, Then the total energy of the system is..

a. 5eV b. 9eV c. 13eV d. 12eV

50. In a thermodynamic system $S = A(VE)^{\frac{1}{3}}$ where A is a constant S is entropy V is volume, E is energy. Then the temperature of the system is..if A=1, V=1 and E=1

Answers.. a .0 b. 1 c. log 3 d. infinite.