Topic:- PHY PHD S2

1) A small mass m with a charge q is attached to a spring of spring- constant k and allowed to oscillate with amplitude A. Assuming that the amplitude of the oscillations and the speed of the mass is small, the time averaged power radiated by the system in Gaussian units is

[Question ID = 1426]

1. $\frac{q^2k^2A^2}{3c^3m^2}$

   [Option ID = 5698]
2. $\frac{q^2k^2A^2}{3c^4m^2}$

   [Option ID = 5699]
3. $\frac{2q^2k^2A^2}{3c^3m^2}$

   [Option ID = 5700]
4. None of these

   [Option ID = 5701]

Correct Answer :-

- $\frac{q^2k^2A^2}{3c^3m^2}$

  [Option ID = 5698]

2) **A sphere of radius a made of a material of dielectric constant $\epsilon_r = \frac{\epsilon}{\epsilon_0}$ has a uniform charge density (ρ). Assuming V(∞) = 0, the potential V(0) at the center of the sphere is**

[Question ID = 1427]

1. $V(0) = \frac{\rho a^2}{6\epsilon_0\epsilon_r}(2\epsilon_r + 1)$

   [Option ID = 5702]
2. $V(0) = 0$

   [Option ID = 5703]
3. $V(0) = \frac{\rho a^2}{4\pi\epsilon_0}(2\epsilon_r + 1)$

   [Option ID = 5704]
4. $V(0) = \frac{4\pi a^2\rho}{3\epsilon_0\epsilon_r}$

   [Option ID = 5705]

Correct Answer :-

- $V(0) = \frac{\rho a^2}{6\epsilon_0\epsilon_r}(2\epsilon_r + 1)$

  [Option ID = 5702]

3) In the planetary model of the hydrogen atom, the time taken for the electron of charge e and mass m in the first Bohr orbit ($a_o = \frac{\hbar^2}{me^2}$) to spiral into the nucleus is given by

[Question ID = 1428]

1. $\frac{m^2c^3a_0^3}{4e^4}$

[Option ID = 5706]

2. $\frac{c^3 a_0^3}{2e^4}$

[Option ID = 5707]

3. $\frac{m^2 c^3 a_0^3}{2\hbar e^4}$

[Option ID = 5708]

4. None of these

[Option ID = 5709]

Correct Answer :-

- $\frac{m^2 c^3 a_0^3}{4e^4}$

[Option ID = 5706]

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4) A particle of mass *m* and charge *q* is accelerated from rest in a uniform electric field E = $E\,\hat{x}$ for a time t. Assuming relativistic motion, the speed of the particle at time t is given by

[Question ID = 1429]

1. $\frac{qEct}{\sqrt{(qEt)^2 + (mc)^2}}$

[Option ID = 5710]

2. $(\frac{qE}{m})t$

[Option ID = 5711]

3. $\frac{qEct}{2\sqrt{(qEt)^2 + (mc)^2}}$

[Option ID = 5712]

4. $\frac{qEct^2}{\sqrt{(qEt)^2 + (mc)^2}}$

[Option ID = 5713]

Correct Answer :-

- $\frac{qEct}{\sqrt{(qEt)^2 + (mc)^2}}$

[Option ID = 5710]

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5) A circular air filled parallel plate capacitor of radius R and separation d has an electric field $E(t)$ which varies as $\frac{\partial E}{\partial t}$. Ignoring edge effects, the magnitude of the magnetic field is given by

[Question ID = 1430]

1. $B = \frac{R}{2c}\frac{\partial E}{\partial t}$

[Option ID = 5714]

2. $B = \frac{R^2}{2cd}\frac{\partial E}{\partial t}$

[Option ID = 5715]

3. $B = \frac{d^2}{Rc}\frac{\partial E}{\partial t}$

[Option ID = 5716]

4. $B = \frac{R^2}{2d}\frac{\partial E}{\partial t}$

[Option ID = 5717]

Correct Answer :-

- $B = \frac{R}{2c}\frac{\partial E}{\partial t}$

[Option ID = 5714]

...e first-order correction to the ground state energy of an isotropic 3-dimensional harmonic oscillator with the ...bation $V = \lambda xyz^2$ is

[Question ID = 1431]

1. 0

   [Option ID = 5718]
2. $\lambda^2 \left(\frac{\hbar}{2m\omega}\right)$

   [Option ID = 5719]
3. ∞

   [Option ID = 5720]
4. $\left(\frac{\hbar}{2m\omega}\right)^2 \lambda^2$

   [Option ID = 5721]

Correct Answer :-

- 0

  [Option ID = 5718]

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7) Consider a particle of mass *m* constrained in the segment -*a* ≤ *x* ≤ *a* and subject to the repulsive potential $V(x) = \lambda\delta(x), \lambda > 0$. Consider *V (x)* as a perturbation and calculate the 1st order correction $\Delta E_0^{(1)}$ and $\Delta E_1^{(1)}$ to the energies of the ground and first excited states

[Question ID = 1432]

1. $\Delta E_0^{(1)} = \frac{\lambda}{a}$ and $\Delta E_1^{(1)} = 0$

   [Option ID = 5722]
2. $\Delta E_0^{(1)} = 0$ and $\Delta E_1^{(1)} = \frac{\hbar^2\pi^2}{8ma^2}$

   [Option ID = 5723]
3. $\Delta E_0^{(1)} = \frac{\lambda}{a}$ and $\Delta E_1^{(1)} = \frac{\lambda}{a}$

   [Option ID = 5724]
4. $\Delta E_0^{(1)} = \frac{\hbar^2\pi^2}{8ma^2}$ and $\Delta E_1^{(1)} = \frac{\lambda}{a}$

   [Option ID = 5725]

Correct Answer :-

- $\Delta E_0^{(1)} = \frac{\lambda}{a}$ and $\Delta E_1^{(1)} = 0$

  [Option ID = 5722]

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8) If the scattering amplitude $f(\theta) = 4\sin(\theta) + i5\cos(\theta)$, the total cross-section σ_T is

[Question ID = 1433]

1. $\frac{20\pi}{k}$

   [Option ID = 5726]
2. $\frac{5}{k^2}$

   [Option ID = 5727]
3. $\frac{4}{k^2}$

   [Option ID = 5728]
4. 0

   [Option ID = 5729]

Correct Answer :-

- $\frac{20\pi}{k}$

[Option ID = 5726]

...d the first order probability of transition of a harmonic oscillator to go from its ground state |0 > to the first exited state |1 > for a time-dependent perturbation $H(t) = xe^{\frac{-t}{\tau}}$, $t \geq 0, \tau > 0$, for $t \to \infty$ (late time), and $\tau \to 0$. $P_{0\to1}$ is therefore equal to

[Question ID = 1434]

1. 0

   [Option ID = 5730]
2. $\dfrac{1}{2m\hbar\omega^3}$

   [Option ID = 5731]
3. 1

   [Option ID = 5732]
4. ∞

   [Option ID = 5733]

Correct Answer :-

- 0

  [Option ID = 5730]

10) The angle between two *(hkl)* planes corresponding to (100) and (110) is

[Question ID = 1435]

1. 45°

   [Option ID = 5734]
2. 60°

   [Option ID = 5735]
3. 30°

   [Option ID = 5736]
4. 15°

   [Option ID = 5737]

Correct Answer :-

- 45°

  [Option ID = 5734]

11) The Madelung constant of a one dimensional crystal consisting of alternate positive and negative ions with interatomic distance R is given by the expression α = 2 ln2. The Madelung constant for a divalent ion can be expressed as:

[Question ID = 1436]

1. α = 8 ln2 [Option ID = 5738]
2. α = 4 ln2 [Option ID = 5739]
3. α = ln2 [Option ID = 5740]
4. 0 [Option ID = 5741]

Correct Answer :-

- α = 8 ln2 [Option ID = 5738]

12) The total scattering amplitude of reflection from (h,k,l) plane is given by the expression

$F(h,k,l) = \sum_j e^{2\pi i(u_j h + v_j k + w_j l)}$. Where (u_j, v_j, w_j) represent the coordinates of the jth atom. The allowed reflections for (h,k,l) values for a FCC structure are

[Question ID = 1437]

1. all odd or all even

   [Option ID = 5742]
2. all odd

   [Option ID = 5743]
3. all even

   [Option ID = 5744]
4. zero

   [Option ID = 5745]

Correct Answer :-

- all odd or all even

  [Option ID = 5742]

one dimensional lattice chain consists of periodic arrangement of atoms with lattice spacing 'a'. Each atom is represented by the potential $V(x) = aV_0\delta(x)$. the energy gaps between the bands in the nearly free electron approximation is

[Question ID = 1438]

1. $2V_0$

   [Option ID = 5746]
2. V_0

   [Option ID = 5747]
3. $V_0/2$

   [Option ID = 5748]
4. $\sqrt{V_0}$

   [Option ID = 5749]

Correct Answer :-

- $2V_0$

  [Option ID = 5746]

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14) If an AC current of frequency 1 GHz is observed through a Josephson junction, then the applied dc voltage is, (Given h = 6.625 x 10 $^{-34}$)

[Question ID = 1439]

1. 2.07 μV [Option ID = 5750]
2. 3.8 μV [Option ID = 5751]
3. 1 μV [Option ID = 5752]
4. 5.48 μV [Option ID = 5753]

Correct Answer :-

- 2.07 μV [Option ID = 5750]

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15) Suppose that Newton's theory of gravitation is modified for short range. In this modified theory the potential energy between two masses m_1 and m_2 are given by,

$$V(r) = -\frac{Gm_1m_2}{r}(1 - ae^{-r/\lambda})$$

Where a is a constant and other symbols have their usual physical significance. For short distances $r \ll \lambda$ calculate the force between m_1 and m_2 .

[Question ID = 1440]

1. $F = -Gm_1m_2\,(1-a)/r^2$

   [Option ID = 5754]
2. $F = -Gm_1m_2\,a/\lambda r$

   [Option ID = 5755]
3. $F = -Gm_1m_2\,(1+a)/r^2$

   [Option ID = 5756]
4. $F = -Gm_1m_2\,a/r^2$

   [Option ID = 5757]

Correct Answer :-

- $F = -Gm_1m_2\,(1-a)/r^2$

  [Option ID = 5754]

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16) A statistical system is composed of two ultra-relativistic particles moving in a segment of length L. The Hamiltonian of the system is given by,

$$H(p_1, p_2) = c(|p_1| + |p_2|)$$

Where, p_1 and p_2 are the momenta of the particles and c is the speed of light in vacuum. The volume of phase space enclosed by the surface of constant energy E is given by,

[Question ID = 1441]

1. $\Sigma(E, L) = \frac{2E^2L^2}{c^2}$

   [Option ID = 5758]

2. $L) = \frac{E^2L^2}{c}$

[Option ID = 5759]

3. $\Sigma(E, L) = \frac{2EL^2}{c^2}$

[Option ID = 5760]

4. $\Sigma(E, L) = 2E^2L^2$

[Option ID = 5761]

Correct Answer :-

- $\Sigma(E, L) = \frac{2E^2L^2}{c^2}$

[Option ID = 5758]

17) Consider an ensemble of *N* distinguishable particles distributed in two energy levels ε and -ε, with number of particles in them *N+* and *N-* , respectively in equilibrium. The ensemble is isolated and has a fixed energy *E* at temperature *T* given by, $E = -N\varepsilon\tanh(\frac{\varepsilon}{k_BT})$, where *kB* is the Boltzmann Constant.

If $\varepsilon = k_B \ln 2$, find out the temperature at which $N_+/N_- = 1/2$.

[Given, $\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$]

[Question ID = 1442]

1. +2K

   [Option ID = 5762]
2. -2K

   [Option ID = 5763]
3. +1K

   [Option ID = 5764]
4. -4K

   [Option ID = 5765]

Correct Answer :-

- +2K

  [Option ID = 5762]

18) Primary advantage of a crystal oscillator is that

[Question ID = 1443]

1. it can oscillate at any frequency [Option ID = 5766]
2. it gives a high output voltage [Option ID = 5767]
3. its frequency of oscillation remains almost constant [Option ID = 5768]
4. it gives a constant a d.c. output voltage [Option ID = 5769]

Correct Answer :-

- its frequency of oscillation remains almost constant [Option ID = 5768]

19) In the spectrum of a frequency-modulated wave -

[Question ID = 1444]

1. the carrier frequency disappears when the modulation-index is large [Option ID = 5770]
2. the amplitude of any sideband depends on the modulation-index [Option ID = 5771]
3. the total number of sidebands depends on the modulation-index [Option ID = 5772]
4. the carrier frequency cannot disappear [Option ID = 5773]

Correct Answer :-

- the amplitude of any sideband depends on the modulation-index [Option ID = 5771]

20) The largest value of output voltage from an 8-bit digital-to-analog converter that produces 1.0 V for a digital input of 00110010 is

[Question ID = 1445]

1. 5.1 V [Option ID = 5774]
2. 10.2 V [Option ID = 5775]
3. 20.4 V [Option ID = 5776]
4. 2.5 V [Option ID = 5777]

Correct Answer :-

- 5.1 V [Option ID = 5774]

21) Which of the following statement is NOT correct for a Depletion type n-channel MOSFET
[Question ID = 1446]
1. Channel width can be increased [Option ID = 5778]
2. Channel width can be decreased [Option ID = 5779]
3. Can work with both positive and negative gate bias [Option ID = 5780]
4. Initially the channel between drain and source is completely blocked by a p-region [Option ID = 5781]

Correct Answer :-
- Initially the channel between drain and source is completely blocked by a p-region [Option ID = 5781]

22) If an inverter is placed between the inputs of an S-R Flip-Flop, the resulting Flip-Flop is a
[Question ID = 1447]
1. D-Flip Flop [Option ID = 5782]
2. J-K Flip Flop [Option ID = 5783]
3. Master Slave Flip Flop [Option ID = 5784]
4. Remains a S-R Flip-Flop [Option ID = 5785]

Correct Answer :-
- D-Flip Flop [Option ID = 5782]

23) The Carnot engines X and Y are operating in series. The first engine X receives heat at 1200 K and rejects to a reservoir at temperature T. The second engine Y receives the heat rejected by X, and thereafter re-ejects to a heat reservoir at 300 K. Calculate the temperature (in Kelvin) for the situation, when the work output of the two engines is equal.
[Question ID = 1448]
1. 750 K [Option ID = 5786]
2. 600 K [Option ID = 5787]
3. 0 K [Option ID = 5788]
4. 450 K [Option ID = 5789]

Correct Answer :-
- 750 K [Option ID = 5786]

24) The quantum mechanical energy states of an atom are described by the energy states such as 0 and ϵ at the thermal equilibrium temperature T. Now the system has partition function Q such that its total internal energy will be:

[Question ID = 1449]
1. $U = \frac{\epsilon}{e^{\frac{\epsilon}{kT}}+1}$

   [Option ID = 5790]
2. $U = \frac{2\epsilon}{e^{\frac{2\epsilon}{kT}}+1}$

   [Option ID = 5791]
3. $U = \frac{kT}{e^{\frac{\epsilon}{kT}}+1}$

   [Option ID = 5792]
4. $U = \frac{\epsilon kT}{e^{\frac{2\epsilon}{kT}}+1}$

   [Option ID = 5793]

Correct Answer :-
- $U = \frac{\epsilon}{e^{\frac{\epsilon}{kT}}+1}$

  [Option ID = 5790]

25) 1 Kg of water at 273 K is brought in contact with a heat reservoir at 373 K. Now after the transfer of heat to the heat reservoir, there is a change of entropy in the system when the water reaches 373 K. What is the change in entropy.

[Given specific heat $s = 10^3$ cal/Kg-K]

[Question ID = 1450]
1. $2.303 \log_{10}(\frac{373}{273})\, cal/K$

[Option ID = 5794]

2. $10^3 \times 2.303 \log_{10}(\frac{373}{273})\ cal/K$

   [Option ID = 5795]

3. $10^3 \times \log_{10}(\frac{373}{273})\ cal/K$

   [Option ID = 5796]

4. None of these

   [Option ID = 5797]

Correct Answer :-

- $10^3 \times 2.303 \log_{10}(\frac{373}{273})\ cal/K$

  [Option ID = 5795]

26) Roughing vacuum range is

[Question ID = 1451]

1. $10^{-7} - 10^{-5}$ mbar

   [Option ID = 5798]

2. $10^{-11} - 10^{-9}$ mbar

   [Option ID = 5799]

3. $10^{-3} - 10^{-1}$ mbar

   [Option ID = 5800]

4. $10^{3} - 10^{1}$ mbar

   [Option ID = 5801]

Correct Answer :-

- $10^{-3} - 10^{-1}$ mbar

  [Option ID = 5800]

27) Pirani gauge works in pressure range of

[Question ID = 1452]

1. $10^{5} - 10^{1}$ Torr

   [Option ID = 5802]

2. $10^{-4} - 10^{-1}$ Torr

   [Option ID = 5803]

3. $10^{-8} - 10^{-4}$ Torr

   [Option ID = 5804]

4. $10^{-12} - 10^{-3}$ Torr

   [Option ID = 5805]

Correct Answer :-

- $10^{-4} - 10^{-1}$ Torr

  [Option ID = 5803]

28) 3 Isospin (I) of elementary particle Ω^- is

[Question ID = 1453]

1. $\frac{1}{2}$

   [Option ID = 5806]

2. $\frac{3}{2}$

   [Option ID = 5807]

3. 1

   [Option ID = 5808]

4. 0

   [Option ID = 5809]

29) Which one of the following particle has a strangeness quantum number 1 ?
[Question ID = 1454]
1. π^+ [Option ID = 5810]
2. Λ^0 [Option ID = 5811]
3. K^+ [Option ID = 5812]
4. Ω^- [Option ID = 5813]

Correct Answer :-
- K^+ [Option ID = 5812]

30) Hypercharge (Y) of elementary particle K^+ is

[Question ID = 1455]
1. 0

   [Option ID = 5814]
2. +1

   [Option ID = 5815]
3. -1

   [Option ID = 5816]
4. -2

   [Option ID = 5817]

Correct Answer :-
- +1

  [Option ID = 5815]

31) Quark structure of elementary particle Σ^+ is

[Question ID = 1456]
1. uus

   [Option ID = 5818]
2. uds

   [Option ID = 5819]
3. sds

   [Option ID = 5820]
4. sus

   [Option ID = 5821]

Correct Answer :-
- uus

  [Option ID = 5818]

32) Total number of down quarks in ^7_3Li are

[Question ID = 1457]
1. 9

   [Option ID = 5822]
2. 10

   [Option ID = 5823]
3. 11

   [Option ID = 5824]
4. 12

   [Option ID = 5825]

Correct Answer :-
- 11

  [Option ID = 5824]

33) If the probability that a problem will be solved by three students is 1/2, 1/3 and 1/6, then what is the probability that the problem will be solved?

[Question ID = 1458]
1. 13/18,

   [Option ID = 5826]
2. 1/36

   [Option ID = 5827]
3. 1/18

   [Option ID = 5828]
4. none of these

   [Option ID = 5829]

Correct Answer :-
- 13/18,

  [Option ID = 5826]

34) Find the eigenvalues of $4A^{-1}+3A+2I$, where I is the identity matrix and $A = \begin{pmatrix} 1 & 0 \\ 2 & 4 \end{pmatrix}$

[Question ID = 1459]
1. 9,15

   [Option ID = 5830]
2. 9,36

   [Option ID = 5831]
3. 7,28

   [Option ID = 5832]
4. None of these

   [Option ID = 5833]

Correct Answer :-
- 9,15

  [Option ID = 5830]

35) If $u = x^2 + y^2 + z^2$ and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ then $div(u\,\vec{r})$ is

[Question ID = 1460]
1. u

   [Option ID = 5834]
2. 2u

   [Option ID = 5835]
3. 4u

   [Option ID = 5836]
4. 5u

   [Option ID = 5837]

Correct Answer :-
- 5u

  [Option ID = 5837]

36) The value of complex integral $\oint \frac{z}{z^2+9}\,dz$ with the closed contour $|z-2i| = 4$ is

[Question ID = 1461]
1. πi

   [Option ID = 5838]
2. $2\pi i$

   [Option ID = 5839]
3. $3\pi i$

   [Option ID = 5840]
4. $4\pi i$

   [Option ID = 5841]

[Option ID = 5838]

37) The Fourier transform of $f(x) = \begin{cases} 0, & x \le 0 \\ e^{-ax}, & x > 0 \end{cases}$ is

[Question ID = 1462]

1. $\frac{1}{2\pi is+a}$

   [Option ID = 5842]
2. $\frac{1}{2\pi is+2a}$

   [Option ID = 5843]
3. $\frac{1}{2\pi is-a}$

   [Option ID = 5844]
4. None of these

   [Option ID = 5845]

Correct Answer :-

- $\frac{1}{2\pi is+a}$

  [Option ID = 5842]

38) Given the operator $\hat{\vec{J}} = \hat{J}_x\hat{\imath} + \hat{J}_y\hat{\jmath} + \hat{J}_z\hat{k}$, where the commutator $[\hat{J}_j, \hat{J}_k] = i\sum_{l=1}^{3}\epsilon_{jkl}\hat{J}_l$, as well as two constant vector $\vec{u}$ and $\vec{v}$, then the commutator $[\vec{u}.\hat{\vec{J}}, \vec{v}.\hat{\vec{J}}]$ is equal to,

[Question ID = 1463]

1. $i(\vec{u} \times \vec{v}).\ \hat{\vec{J}}$

   [Option ID = 5846]
2. $i\left(\sum_{k=1}^{3} u_k v_k \hat{J}_k\right)^2$

   [Option ID = 5847]
3. $i\sum_{k=1}^{3} u_k v_k \hat{J}_k$

   [Option ID = 5848]
4. $i\sum_{k=1}^{3} u_k v_k\ \hat{\vec{J}}.\hat{\vec{J}}$

   [Option ID = 5849]

Correct Answer :-

- $i(\vec{u} \times \vec{v}).\ \hat{\vec{J}}$

  [Option ID = 5846]

39) For $-1 \le x \le +1$, the series $\sum_{n=0}^{\infty}(-1)^n\frac{x^{2n+1}}{2n+1}$ is equal to:

[Question ID = 1464]

1. $\tan^{-1}x$

   [Option ID = 5850]
2. $\frac{xexpx}{\pi}$

   [Option ID = 5851]
3. $\sin^2 x$

[Option ID = 5852]

4. 2

[Option ID = 5853]

Correct Answer :-

- $\tan^{-1} x$

  [Option ID = 5850]

40) The integral, $\int_{-\infty}^{+\infty} \frac{d(\delta(y))}{dy} \sin y \; dy$ is equal to,

[Question ID = 1465]

1. -1

   [Option ID = 5854]
2. $\cos y$

   [Option ID = 5855]
3. +1

   [Option ID = 5856]
4. π

   [Option ID = 5857]

Correct Answer :-

- -1

  [Option ID = 5854]

41) The solution of the differential equation, $(1+x^2)\frac{df}{dx} + xf(x) = 0$ is given by, A being an arbitrary constant,

[Question ID = 1466]

1. $A(x^2+1)^{-1/2}$

   [Option ID = 5858]
2. $\ln\left(A(x^2+1)\right)$

   [Option ID = 5859]
3. $\ln\left(A(x^2+1)^{-1/2}\right)$

   [Option ID = 5860]
4. $\cos\left(A(x^2+1)\right)$

   [Option ID = 5861]

Correct Answer :-

- $A(x^2+1)^{-1/2}$

  [Option ID = 5858]

42) If $\nabla \times \vec{F}(\vec{r}) \neq 0$ but $\nabla \times \left(g(\vec{r})\vec{F}(\vec{r})\right) = 0$ then,

[Question ID = 1467]

1. $\vec{F}(\vec{r}).\left(\nabla \times \vec{F}(\vec{r})\right) = 0$

   [Option ID = 5862]
2. $\nabla \times \left(\nabla \times \vec{F}(\vec{r})\right) = 0$

   [Option ID = 5863]
3. $\nabla.\vec{F}(\vec{r}) = 0$

   [Option ID = 5864]
4. $\nabla g(\vec{r}).\left(\nabla \times \vec{F}(\vec{r})\right) = 0$

   [Option ID = 5865]

Correct Answer :-

- $\vec{F}(\vec{r}).\left(\nabla \times \vec{F}(\vec{r})\right) = 0$

  [Option ID = 5862]

43) $\frac{d(\delta(y))}{dy}$ equals to:

ion ID = 1468]

1. $\frac{i}{2\pi}\int_{-\infty}^{+\infty} xe^{ixy}dx$

[Option ID = 5866]

2. $\int_{-\infty}^{+\infty} \frac{e^{ixy}}{x}dx$

[Option ID = 5867]

3. $\frac{1}{\pi}\int_{-\infty}^{+\infty} xe^{ixy}dx$

[Option ID = 5868]

4. $\frac{i}{2\pi}\int_{-\infty}^{+\infty} x^2e^{ixy}dx$

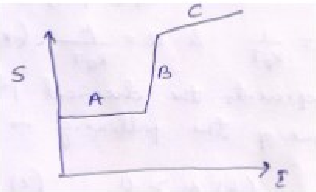
[Option ID = 5869]

Correct Answer :-

- $\frac{i}{2\pi}\int_{-\infty}^{+\infty} xe^{ixy}dx$

[Option ID = 5866]

44) The entropy S of a thermodynamic system as a function of energy E is given by the following graph



If T_A, T_B and T_C are the temperatures for the phases A, B, and C respectively, then
[Question ID = 1469]

1. $T_B > T_C > T_A$

[Option ID = 5870]

2. $T_A > T_B > T_C$

[Option ID = 5871]

3. $T_C > T_A > T_B$

[Option ID = 5872]

4. $T_C > T_B > T_A$

[Option ID = 5873]

Correct Answer :-

- $T_B > T_C > T_A$

[Option ID = 5870]

45) If the half-life of radium is about 1600 years, then for a given ball of pure radium weighing 4 gm now, what would be the amount of time required to have only 0.125 gm of radium to be left,
[Question ID = 1470]

1. 9600 yrs [Option ID = 5874]
2. 4800 yrs [Option ID = 5875]
3. 7200 yrs [Option ID = 5876]
4. 8000 yrs [Option ID = 5877]

Correct Answer :-

- 8000 yrs [Option ID = 5877]

46) The Hamiltonian for a 1-dimensional system is given to be $H(x,p) = \alpha p + \beta x$, where α and β are positive real numbers, respectively. The phase space trajectory in the position -momentum $(x-p)$ plane is given by,

[Question ID = 1471]

1. An ellipse

[Option ID = 5878]

2. A straight line with a positive slope

[Option ID = 5879]

3. A parabola

[Option ID = 5880]

4. A straight line with a negative slope

[Option ID = 5881]

Correct Answer :-

- A straight line with a negative slope

  [Option ID = 5881]

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47) The Lagrangian for a system is given by $L = \alpha e^{-bt}\dot{x}^2 - e^{-bt}\beta x$, where α and β are positive real numbers. The constant *b* is also a positive real number. The equation of motion that follows from this Lagrangian is

[Question ID = 1472]

1. $2\alpha\ddot{x} - b\dot{x} + \beta e^{-bt} = 0$

   [Option ID = 5882]
2. $e^{-bt}(\alpha\ddot{x} - 2b\dot{x}) + \beta = 0$

   [Option ID = 5883]
3. $\alpha(\ddot{x} + b\dot{x}) + \beta = 0$

   [Option ID = 5884]
4. $2\alpha(\ddot{x} - b\dot{x}) + \beta = 0$

   [Option ID = 5885]

Correct Answer :-

- $2\alpha(\ddot{x} - b\dot{x}) + \beta = 0$

  [Option ID = 5885]

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48) The Hamiltonian of a system is given by,

$H = ap^3 + bp + x^2$

where a and b are positive constants. The corresponding Lagrangian is

[Question ID = 1473]

1. $\pm\frac{2}{\sqrt{3a}}(\dot{x} - b)^2 - x^2$

   [Option ID = 5886]
2. $\frac{2}{3\sqrt{3a}}(\dot{x} - bx)^{3/2} - x^2$

   [Option ID = 5887]
3. $\pm(\dot{x} - b)^{3/2} + x^2$

   [Option ID = 5888]
4. $\pm\frac{2}{3\sqrt{3a}}(\dot{x} - b)^{3/2} - x^2$

   [Option ID = 5889]

Correct Answer :-

- $\pm\frac{2}{3\sqrt{3a}}(\dot{x} - b)^{3/2} - x^2$

  [Option ID = 5889]

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49) **Consider the transformation,**

$q \to Q = \alpha_1 q + \beta_1 p$

$p \to P = \alpha_2 q + \beta_2 p$,

where, α_1 , α_2 , β_1 , and β_2 are real constants. This transformation is:

[Question ID = 1474]

1. Always canonical as it is a linear transformation.

   [Option ID = 5890]
2. Never a canonical transformation since it is linear.

   [Option ID = 5891]
3. A canonical transformation if $\beta_1 = 1$ and , $\alpha_2 = 1$ while $\alpha_1 = 0$ and $\beta_2 = 0$.

   [Option ID = 5892]
4. A canonical transformation if $\alpha_1\beta_2 - \beta_1\alpha_2 = 1$

   [Option ID = 5893]

Correct Answer :-

canonical transformation if $\alpha_1\beta_2 - \beta_1\alpha_2 = 1$

[Option ID = 5893]

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50) A free-particle moving in 1-dimension is described by the wavefunction,

$$\psi(x,t)\left[Ae^{\frac{ipx}{\hbar}} + Be^{\frac{-ipx}{\hbar}}\right]e^{\frac{-ip^2t}{2m\hbar}},$$

which of the following options is correct?

[Question ID = 1475]

1. $\psi(x,t)$ is an eigenstate of the momentum operator

   [Option ID = 5894]
2. $\psi(x,t)$ is not a solution of the Schrodinger equation, but is an eigenstate of the Hamiltonian.

   [Option ID = 5895]
3. $\psi(x,t)$ is an eigenstate of the momentum operator as well as an eigenstate of the Hamiltonian.

   [Option ID = 5896]
4. $\psi(x,t)$ is a solution of the Schlrodinger equation and is an eigenstate of the Hamiltonian.

   [Option ID = 5897]

Correct Answer :-

- $\psi(x,t)$ is a solution of the Schlrodinger equation and is an eigenstate of the Hamiltonian.

  [Option ID = 5897]