DU MSc Physics

Topic:- DU_J19_MSC_PHY

1) In 2's complement representation, the number 10110101 represents the decimal number

[Question ID = 12977]

1. -53 [Option ID = 21907]
2. 75 [Option ID = 21905]
3. 93 [Option ID = 21906]
4. -75 [Option ID = 21908]

Correct Answer :-

- 75 [Option ID = 21905]

2) Water has a constant heat capacity of 4.2 J/K/kg over the temperature range 0–100 C. A kilogram of water, initially at 0 C is brought in contact with a heat reservoir at 100 C. When the water comes to equilibrium, what is the total change in entropy of the universe?

[Question ID = 12978]

1. 2437.8 J/K [Option ID = 21909]
2. 1310.8 J/K [Option ID = 21911]
3. 184.8 J/K [Option ID = 21912]
4. 369.2 J/K [Option ID = 21910]

Correct Answer :-

- 2437.8 J/K [Option ID = 21909]

3) The Sun is approximately 25,000 light years away from the centre of the Milky Way and moves around it, in an approximately circular path, in roughly 170 million years. Given that sunlight takes approximately 8 min to reach the Earth, what is the ratio of the masses of the galaxy and the Sun? [Question ID = 12944]

1. 1.5×10^{12} [Option ID = 21775]
2. 1.5×10^{11} [Option ID = 21773]
3. 5×10^{11} [Option ID = 21774]
4. 5×10^{10} [Option ID = 21776]

Correct Answer :-

- 1.5×10^{11} [Option ID = 21773]

4) An AND gate has two inputs A and B and one inhibit input S. The output is 1 if

[Question ID = 12980]

1. A = 1, B = 1, S = 1 [Option ID = 21918]
2. A = 1, B = 1, S = 0 [Option ID = 21920]
3. A = 1, B = 0, S = 0 [Option ID = 21917]
4. A = 1, B = 0, S = 1 [Option ID = 21919]

Correct Answer :-

- A = 1, B = 0, S = 0 [Option ID = 21917]

5) A wire carrying a current 2A is bent into the shape of a two semi circles, one with a radius 1m and the other with radius 2m . The two semi circles are connected at their ends that is along the two radii. The magnetic field at the center of the semi-circles is

[Question ID = 12957]

1. $\pi\times10^{-7}$ T [Option ID = 21827]
2. cannot be determined from the information provided above. [Option ID = 21828]
3. 16×10^{-7} T [Option ID = 21825]

4. 2×10^{-7} T [Option ID = 21826]

Correct Answer :-

- 16×10^{-7} T [Option ID = 21825]

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6) Under ideal conditions, the electric and magnetic fields inside a superconductor are zero. Which of the following must be true just outside the surface of the superconductor?

[Question ID = 12974]

1. B =0 [Option ID = 21893]
2. B is perpendicular to the surface [Option ID = 21895]
3. B is tangential to the surface [Option ID = 21894]
4. The magnetic flux is quantized. [Option ID = 21896]

Correct Answer :-

- B =0 [Option ID = 21893]

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7) Under certain conditions, a beam of electrons impinging on a crystal surface will diffract and a scattering pattern of the beam can be obtained. What is the approximate kinetic energy of the electrons needed in order to see the pattern? (Assume the lattice spacing of the crystal tobe 0.4 nm.)

[Question ID = 12973]

1. 100 eV [Option ID = 21892]
2. 1 eV [Option ID = 21890]
3. 0.1 eV [Option ID = 21889]
4. 10 eV [Option ID = 21891]

Correct Answer :-

- 0.1 eV [Option ID = 21889]

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8) Fermat's principle of ray optics states, "A ray oflight follows the path between two points which requires the least time." This principle can beused to derive which of the following?
I. Snell's law of refraction
II. The law of reflection
III. Rayleigh's criterion for resolution

[Question ID = 12972]

1. I and II [Option ID = 21885]
2. I only [Option ID = 21886]
3. I, II and III [Option ID = 21888]
4. II only [Option ID = 21887]

Correct Answer :-

- I and II [Option ID = 21885]

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9) For a mole of ideal gas at T=35 C , what is the work done for an isothermal expansion from a volume V_0 to 10 V_0 ?
[Question ID = 12947]

1. 10^4 J [Option ID = 21785]
2. 10^3 J [Option ID = 21788]
3. 3×10^3 J [Option ID = 21787]
4. 6×10^3 J [Option ID = 21786]

Correct Answer :-

- 10^4 J [Option ID = 21785]

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10) A single photon of energy 100 MeV decays into an electron and a positron. Which of the following statements is true?

[Question ID = 12970]

1. It does not violate any of the above conservation laws. [Option ID = 21879]
2. This process violates energy momentum conservation. [Option ID = 21880]
3. This process violates angular momentum conservation. [Option ID = 21878]
4. This process violates lepton number conservation. [Option ID = 21877]

Correct Answer :-

- This process violates lepton number conservation. [Option ID = 21877]

11) An electric field E can pull an electron out of a Helium atom in the same time that the electron takes to go around the nucleus once. Then E is [Question ID = 12965]

1. 2×10^{12} V/m [Option ID = 21860]
2. 5×10^{11} V/m [Option ID = 21858]
3. 10^{12} V/m [Option ID = 21859]
4. 10^{13} V/m [Option ID = 21857]

Correct Answer :-

- 10^{13} V/m [Option ID = 21857]

12) A material has a heat capacity at constant volume C that is unchanging over a wide temperature range. Two identical bodies made of this material, at initial temperatures T and $9T$, respectively, are used to drive a heat engine. The maximum amount of work that can be obtained from this engine is

[Question ID = 12979]

1. 9 C T [Option ID = 21915]
2. 4 C T [Option ID = 21914]
3. 8 C T [Option ID = 21913]
4. 3 C T [Option ID = 21916]

Correct Answer :-

- 8 C T [Option ID = 21913]

13) An electrical device operates on 9 V and has a resistance of 21Ω. It is connected to a power supply of 120 V output through a transformer. The current in the primary of the transformer is [Question ID = 12971]

1. 0.032 A [Option ID = 21882]
2. Cannot be determined from the information supplied. [Option ID = 21884]
3. 0.23 A [Option ID = 21883]
4. 2.32 A [Option ID = 21881]

Correct Answer :-

- 2.32 A [Option ID = 21881]

14) The frequency of oscillation of an LC circuit is ω . The plates of the parallel plate capacitor are pulled apart to twice the original distance and a dielectric with dielectric constant k is inserted. The frequency of oscillation for the new configuration is [Question ID = 12961]

1. $\omega\sqrt{2/k}$ [Option ID = 21841]
2. $k\omega/2$ [Option ID = 21844]
3. $2\omega/k$ [Option ID = 21842]
4. $\omega\sqrt{k/2}$ [Option ID = 21843]

Correct Answer :-

- $\omega\sqrt{2/k}$ [Option ID = 21841]

15) One mole of a monoatomic perfect gas is initially at a constant temperature T_0 . It expands from a volume V_0 to $2V_0$ under constant pressure. The heat absorbed by the gas is [Question ID = 12946]

1. $\frac{3}{2}RT_0$ [Option ID = 21781]
2. $\frac{5}{2}RT_0$ [Option ID = 21783]
3. $2RT_0$ [Option ID = 21784]
4. RT_0 [Option ID = 21782]

Correct Answer :-

- $\frac{3}{2}RT_0$ [Option ID = 21781]

16) A scalar meson decays into three pseudoscalar mesons. The decay happens through [Question ID = 12968]

1. strong interaction [Option ID = 21870]
2. weak interaction [Option ID = 21869]
3. gravitational interaction [Option ID = 21872]
4. electromagnetic interaction [Option ID = 21871]

Correct Answer :-

- weak interaction [Option ID = 21869]

17) An ideal monoatomic gas, initially at T=20 C , expands adiabatically from a volume V_0 to 5 V_0 . What is the final temperature [Question ID = 12948]

1. -33 C [Option ID = 21792]
2. -113 C [Option ID = 21791]
3. -20 C [Option ID = 21789]
4. -173 C [Option ID = 21790]

Correct Answer :-

- -20 C [Option ID = 21789]

18) Consider three identical, ideal capacitors. The first capacitoris charged to a voltage V and then disconnected from the battery.The other two capacitors, initially uncharged and connected in series, are then connected across the first. What is the final voltage across the first capacitor?

[Question ID = 12975]

1. V / 3 [Option ID = 21899]
2. V [Option ID = 21898]
3. 2 V / 5 [Option ID = 21897]
4. 2 V / 3 [Option ID = 21900]

Correct Answer :-

- 2 V / 5 [Option ID = 21897]

19)

Two rockets approach a planet from opposite directions with speeds $\pm\frac{c}{2}$ with respect to the planet. The proper length of each rocket is L. How long does each rocket appear to the other rocket?

[Question ID = 12981]

1. $\frac{\sqrt{3}}{5}$ [Option ID = 21924]
2. $\frac{3}{5}$ [Option ID = 21922]
3. $\frac{\sqrt{3}}{2}$ [Option ID = 21923]
4. $\frac{1}{3}$ [Option ID = 21921]

Correct Answer :-

- $\frac{1}{3}$ [Option ID = 21921]

20)

Consider the (2π)–periodic function $f(x)$ defined by

$$f(x) = \begin{cases} x(\pi - x), & x \in [0, \pi] \\ x(x - \pi), & x \in [-\pi, 0] \end{cases}$$

Which of the following is true?

[Question ID = 12935]

1. $f(x) = \frac{4}{\pi}\sum_{k=0}^{\infty} \frac{\sin([2k+1]x)}{(2k+1)^2} + \frac{4}{\pi}\sum_{k=0}^{\infty} \frac{\cos([2k+1]x)}{k^2}$ [Option ID = 21740]
2. $f(x) = \frac{8}{\pi}\sum_{k=0}^{\infty} \frac{\sin(kx)}{k^3}$ [Option ID = 21738]
3. $f(x) = \frac{8}{\pi}\sum_{k=0}^{\infty} \frac{\sin[(2k+1)x]}{(2k+1)^3}$ [Option ID = 21737]
4. $f(x) = \frac{4}{\pi}\sum_{k=0}^{\infty} \frac{\sin(kx)}{k^2} + \frac{4}{\pi}\sum_{k=0}^{\infty} \frac{\cos(kx)}{k^2}$ [Option ID = 21739]

Correct Answer :-

- $f(x) = \frac{8}{\pi}\sum_{k=0}^{\infty} \frac{\sin[(2k+1)x]}{(2k+1)^3}$ [Option ID = 21737]

21)
Consider a rotating spherical planet such that the effective gravitational attraction at the equator is only 75% of that at the pole. If the linear velocity of a point on the equator is v_0, what is the escape velocity for a polar particle?

[Question ID = 12941]

1. $v_0\sqrt{2}$ [Option ID = 21762]
2. $2v_0$ [Option ID = 21761]
3. $v_0\sqrt{8}$ [Option ID = 21763]
4. $4v_0$ [Option ID = 21764]

Correct Answer :-

- $2v_0$ [Option ID = 21761]

22)
If the Fourier transform of $e^{-\alpha x^2}$ is $e^{-k^2/4a}/\sqrt{a}$, then the Fourier transform of $f(x) = x^2 e^{-\alpha x^2}$ is

[Question ID = 12934]

1. $F(k) = \frac{k^2 - 2a}{4a^{5/2}} e^{-k^2/4a}$ [Option ID = 21736]
2. $F(k) = \frac{-k^2 + 2a}{4a^{5/2}} e^{-k^2/4a}$ [Option ID = 21733]
3. $F(k) = \frac{k^2 + 2a}{4a^{3/2}} e^{-k^2/4a}$ [Option ID = 21735]
4. $F(k) = \frac{k^2 + 2a}{4a^{3/2}} e^{-k^2/4a}$ [Option ID = 21734]

Correct Answer :-

- $F(k) = \dfrac{-k^2 + 2a}{4a^{5/2}} e^{-k^2/4a}$ [Option ID = 21733]

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23) Let C be the unit circle, travelled counterclockwise. Evaluate

$$\oint_C [(e^{-x^2} - y^3)dx + x^3 dy]$$

[Question ID = 12937]

1. 2π [Option ID = 21747]
2. $\dfrac{3\pi}{2}$ [Option ID = 21745]
3. $\dfrac{\sqrt{\pi}}{2} + 2$ [Option ID = 21746]
4. $\dfrac{\sqrt{\pi}}{2} - 2$ [Option ID = 21748]

Correct Answer :-

- $\dfrac{3\pi}{2}$ [Option ID = 21745]

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24)
A body of mass m moving with a speed v collides with an identical body at rest and sticks with it. The mass M and momentum P of the final clump of matter is $\left(\gamma = \frac{1}{\sqrt{1-v^2/c^2}}\right)$

[Question ID = 12982]

1. $\mathrm{M = 2m,\ P = 2\gamma\, m\, v}$ [Option ID = 21926]
2. $\mathrm{M = m\gamma,\ P = \gamma\, m\, v}$ [Option ID = 21928]
3. $\mathrm{M = m\sqrt{\gamma},\ P = m\, v/2}$ [Option ID = 21927]
4. $\mathrm{M = m\sqrt{(2(1+\gamma))},\ P = \gamma\, m\, v}$ [Option ID = 21925]

Correct Answer :-

- $\mathrm{M = m\sqrt{(2(1+\gamma))},\ P = \gamma\, m\, v}$ [Option ID = 21925]

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25) Using Boolean algebra, simplifying the expression

$$\overline{\overline{(a \cdot b \cdot \bar{c})} + \overline{(\bar{c} \cdot d)}}$$

Yields

[Question ID = 12959]

1. $a \cdot b + \bar{c} \cdot d$ [Option ID = 21834]
2. $a \cdot b \cdot d$ [Option ID = 21833]
3. $a \cdot b + d$ [Option ID = 21835]
4. $a \cdot b \cdot \bar{c} \cdot d$ [Option ID = 21836]

Correct Answer :-

- $a \cdot b \cdot d$ [Option ID = 21833]

26)
A large and spherical soap film of thickness d has a refractive index $4/3$. A narrow beam of yellow light ($\lambda \approx 6400$ Å) is incident on the film at an angle of 30^o. What is the value of d for which a constructive second order interference would occur for the reflected wave?

[Question ID = 12952]

1. 4800 Å [Option ID = 21806]
2. 5500 Å [Option ID = 21808]
3. 5200 Å [Option ID = 21805]
4. 3900 Å [Option ID = 21807]

Correct Answer :-

- 5200 Å [Option ID = 21805]

27) The integral

$$\oint_{-\infty}^{\infty} \frac{d\delta(y)}{dy} \sin y dy$$

is ,

[Question ID = 12940]

1. π [Option ID = 21759]
2. 0 [Option ID = 21757]
3. +1 [Option ID = 21758]
4. -1 [Option ID = 21760]

Correct Answer :-

- 0 [Option ID = 21757]

28)
A cylinder of length L is made up of an inner core of steel of radius r and an outer sheath of copper of thickness r . The resistivities of steel and copper are ρ_1 and ρ_2 respectively. The total resistance of the cylinder is

[Question ID = 12963]

1. $\frac{(3\rho_1+\rho_2)L}{\pi r^2}$ [Option ID = 21849]
2. $\frac{\rho_1\rho_2 L}{\pi r^2(\rho_1+\rho_2)}$ [Option ID = 21851]
3. $\frac{(2\rho_1+\rho_2)L}{\pi r^2}$ [Option ID = 21850]
4. $\frac{\rho_1\rho_2 L}{\pi r^2(3\rho_1+\rho_2)}$ [Option ID = 21852]

Correct Answer :-

- $\frac{(3\rho_1+\rho_2)L}{\pi r^2}$ [Option ID = 21849]

29)
A particle confined to move in $0 \le x \le \infty$ is described by the wave function $\psi(x)=e^{-x/2}$. Calculate the probability of finding the particle between x=0 and x=ln(2).

[Question ID = 12943]

1. 2 [Option ID = 21770]
2. 1/2 [Option ID = 21769]
3. 1 [Option ID = 21772]
4. 3/2 [Option ID = 21771]

Correct Answer :-
- 1/2 [Option ID = 21769]

30)
Let V be the region in R^3 determined by the inequalities $x^2+y^2 \le 1$ and $0 \le z \le 4-x^2-y^2$. Determine

$$\iiint_V (x^2+y^2)d^3r$$

[Question ID = 12936]

1. $\frac{5\pi}{3}$ [Option ID = 21742]
2. $\frac{3\pi}{4}$ [Option ID = 21743]
3. $\frac{2\pi}{3}$ [Option ID = 21741]
4. $\frac{5\pi}{4}$ [Option ID = 21744]

Correct Answer :-
- $\frac{2\pi}{3}$ [Option ID = 21741]

31)
Let $\psi_0(x)$ and $\psi_1(x)$ be the wave functions corresponding to the ground and the first excited states of a one dimensional harmonic oscillator respectively. Consider the normalized state $\phi(x)=\alpha\psi_0(x)+\beta\psi_1(x)$ where α and β are real numbers. The values of α and β for which $\langle x\rangle$, the average value of the position is a minimum are

[Question ID = 12955]

1. $\alpha=-\beta=1/\sqrt{2}$ [Option ID = 21820]
2. $\alpha=\beta=1/\sqrt{2}$ [Option ID = 21817]
3. $\alpha=1/\sqrt{3}$ and $\beta=-\sqrt{2/3}$ [Option ID = 21819]
4. $\alpha=1/\sqrt{3}$ and $\beta=\sqrt{2/3}$ [Option ID = 21818]

Correct Answer :-

- $\alpha = \beta = 1/\sqrt{2}$ [Option ID = 21817]

32)
A particle confined in one dimension, due a potential $V(x)$, has the following wave function

$$\psi(x) = \left(\frac{x}{a}\right)^n \exp(-x/a)$$

where a is a constant. If $V(x) \to 0$ as $x \to \infty$, then $V(x)$ is given by

[Question ID = 12954]

1. $\frac{\hbar^2}{2m}\left[\frac{n(n+1)}{x^2} - \frac{n}{ax}\right]$ [Option ID = 21814]
2. $\frac{\hbar^2}{2m}\left[\frac{n(n-1)}{x^2} + \frac{n+1}{ax}\right]$ [Option ID = 21815]
3. $\frac{\hbar^2}{2m}\left[\frac{n(n+1)}{x^2} + \frac{n-1}{ax}\right]$ [Option ID = 21816]
4. $\frac{\hbar^2}{2m}\left[\frac{n(n-1)}{x^2} - \frac{2n}{ax}\right]$ [Option ID = 21813]

Correct Answer :-

- $\frac{\hbar^2}{2m}\left[\frac{n(n-1)}{x^2} - \frac{2n}{ax}\right]$ [Option ID = 21813]

33) Let S be the surface defined by the parametric equations

$$x = 4\alpha^2 + \beta, y = \sin\beta, z = \cos\alpha$$

The equation for the plane tangent to S at the point $(\pi^2, 0, 0)$ is given by

[Question ID = 12938]

1. $x + y - 2\pi z = \pi^2$ [Option ID = 21751]
2. $4x + y - z = 4\pi^2$ [Option ID = 21750]
3. $4x - y + z = 4\pi^2$ [Option ID = 21749]
4. $x - y + 4\pi z = \pi^2$ [Option ID = 21752]

Correct Answer :-

- $4x - y + z = 4\pi^2$ [Option ID = 21749]

34)
For waves in a certain medium, the group velocity is v_g while the phase velocity is v_p . Which of the following is necessarily true? (c is the velocity of light.)

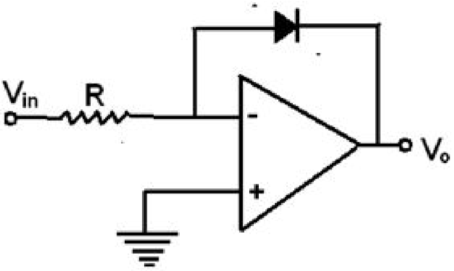
[Question ID = 12962]

1. $v_p < c$ and v_g can be anything [Option ID = 21846]

2. $v_g < c$ and v_p can be anything [Option ID = 21846]
3. $v_p < v_g < c$ [Option ID = 21847]
4. $v_g < c$ and $v_g v_p < c^2$ [Option ID = 21848]

Correct Answer :-
- $v_g < c$ and v_p can be anything [Option ID = 21845]

35)
The circuit of following figure uses an ideal OP-Amp for small positive values of V_{in}. The circuit works as:



[Question ID = 12983]

1. an exponential amplifier [Option ID = 21929]
2. a half wave rectifier [Option ID = 21930]
3. a logarithmic amplifier [Option ID = 21932]
4. a differentiator [Option ID = 21931]

Correct Answer :-
- an exponential amplifier [Option ID = 21929]

36) For $-1 \le x \le +1$, the sum

$$\sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{2n+1}$$

equals

[Question ID = 12939]

1. $\sin^2 x$ [Option ID = 21755]
2. $\frac{x \exp x}{\pi}$ [Option ID = 21753]
3. $\cos^2 x$ [Option ID = 21756]
4. $\tan^{-1} x$ [Option ID = 21754]

Correct Answer :-
- $\frac{x \exp x}{\pi}$ [Option ID = 21753]

37)
A narrow light beam of wavelength λ is travelling along the x - axis, when it is faced by a barrier with narrow slits at $y = 0, \pm d$ (and all at $x = 0$). There is a vertical screen at $x = D \gg d$. What is the angle θ that the central bright spot and the next-nearest dark spot subtend at the central slit $[(x, y) = (0,0)]$

[Question ID = 12951]

1. $\theta = \sin^{-1}\dfrac{\lambda}{2d}$ [Option ID = 21802]
2. $\theta = \sin^{-1}\dfrac{2\lambda}{d}$ [Option ID = 21801]
3. $\theta = \sin^{-1}\dfrac{3\lambda}{d}$ [Option ID = 21803]
4. $\theta = \sin^{-1}\dfrac{\lambda}{d}$ [Option ID = 21804]

Correct Answer :-

- $\theta = \sin^{-1}\dfrac{2\lambda}{d}$ [Option ID = 21801]

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38)
A stream of water flowing with a constant speed v manages to move some pebbles. If the density of water is ρ and the acceleration due to gravity is g, then the mass of the heaviest pebble that it can move is (here, A is a constant)

[Question ID = 12960]

1. $A\rho v^5 / g^2$ [Option ID = 21837]
2. $A\rho v^6 / g^3$ [Option ID = 21840]
3. $A\rho^2 v^3 / g^4$ [Option ID = 21838]
4. $A\rho^2 v^8 / g^4$ [Option ID = 21839]

Correct Answer :-

- $A\rho v^5 / g^2$ [Option ID = 21837]

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39) The expectation value of momentum of a particle whose wave function is:
$\Psi(x) = A \exp\left(-\dfrac{x^2}{2\alpha^2} + ikx\right)$ is given as:

[Question ID = 12949]

1. $\dfrac{i\hbar}{a^2}$ [Option ID = 21796]
2. $\hbar k$ [Option ID = 21795]
3. 0 [Option ID = 21794]
4. $\dfrac{\hbar k}{a}$ [Option ID = 21793]

Correct Answer :-

- $\dfrac{\hbar k}{a}$ [Option ID = 21793]

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40)
Two particles of mass m each are connected by a massless spring of length ℓ and spring constant k. The system is lying (in the relaxed state) on a frictionless horizontal table. A very short impulse P is applied to the first mass (along the axis of the system) at $t = 0$. When would the *second* mass first come to rest?

[Question ID = 12945]

1. $t = \pi \dfrac{\sqrt{m}}{2k}$ [Option ID = 21778]
2. $t = 2\pi \dfrac{\sqrt{2m}}{k}$ [Option ID = 21777]
3. $t = \pi \dfrac{\sqrt{m}}{k}$ [Option ID = 21779]
4. $t = \pi \dfrac{\sqrt{2m}}{k}$ [Option ID = 21780]

Correct Answer :-

- $t = 2\pi \dfrac{\sqrt{2m}}{k}$ [Option ID = 21777]

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41) Consider a particle whose normalized wave function is:

$$\Psi(x) = 2\,\alpha\sqrt{\alpha}\;x\;e^{-\alpha x} \qquad x>0$$
$$= 0 \qquad x<0.$$

For what value of x does $P(x) = |\psi(x)|^2$ peak?

[Question ID = 12956]

1. x = 0 [Option ID = 21823]
2. None of these [Option ID = 21824]
3. x = 1/α [Option ID = 21821]
4. x = 1 [Option ID = 21822]

Correct Answer :-

- x = 1/α [Option ID = 21821]

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42) A self-contained machine has, as its input, two equal steady stream of a fluid at temperatures T_1 and $4T_1$ respectively. The only output is a single high-speed jet of the same fluid at temperature T. The heat capacity per unit mass of the fluid is c (and is independent of the temperature). What is the maximum possible speed of the jet? [Question ID = 12950]

1. $\sqrt{CT_1}$ [Option ID = 21798]
2. $\sqrt{CT_1/4}$ [Option ID = 21799]
3. $\sqrt{2CT_1}$ [Option ID = 21800]
4. $\sqrt{4CT_1}$ [Option ID = 21797]

Correct Answer :-

- $\sqrt{4CT_1}$ [Option ID = 21797]

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43) A particle of mass M decays at rest into two particles. One particle has mass m and the other particle is massless. The momentum of the massless particle is [Question ID = 12958]

1. $\dfrac{M^2 - 2m^2}{4M}c$ [Option ID = 21830]
2. $\dfrac{M^2 - m^2}{2M}c$ [Option ID = 21831]
3. $\dfrac{M^2 + m^2}{2M}c$ [Option ID = 21832]

4. $\frac{M^2 - m^2}{4M}c$ [Option ID = 21829]

Correct Answer :-

- $\frac{M^2 - m^2}{4M}c$ [Option ID = 21829]

44) The distribution of weights of 100 students in a class follows normal distribution with a mean of 58 kg and a standard deviation of 25 kg. How many students have weights in the range 53 – 63 kg ? [Question ID = 12967]

1. 32 [Option ID = 21866]
2. 68 [Option ID = 21867]
3. 99 [Option ID = 21868]
4. 88 [Option ID = 21865]

Correct Answer :-

- 88 [Option ID = 21865]

45) A gas cell with an optical path length of 10 cm is placed in one arm of a Michelson interferometer. If the light source for the interferometer is a laser with a wavelength of 632.2 nm, then 100 fringes are counted as the gas cell is evacuated. What isthe index of refraction of the original gas?

[Question ID = 12976]

1. 0.99968 [Option ID = 21904]
2. 1.00063 [Option ID = 21902]
3. 1.00032 [Option ID = 21903]
4. 1.00016 [Option ID = 21901]

Correct Answer :-

- 1.00016 [Option ID = 21901]

46) A child of mass 3m sits on a swing, the base of which has mass m, while the rope (of length l) has a negligible mass. An older child pulls back the swing (with the child) until the rope makes an angle of half-a-radian with the vertical, and, then, pushes with a force mg along the arc of a circle until the rope is exactly vertical, and releases it. If the rope was always taut, for how long did the child push?

[Question ID = 12942]

1. $\pi\frac{\sqrt{2\ell}}{3g}$ [Option ID = 21767]
2. $\frac{\sqrt{2\ell}}{3g}$ [Option ID = 21768]
3. $\frac{\pi}{3}\frac{\sqrt{\ell}}{g}$ [Option ID = 21766]
4. $\frac{\sqrt{\ell}}{g}$ [Option ID = 21765]

Correct Answer :-

- $\frac{\sqrt{\ell}}{g}$ [Option ID = 21765]

47) X-rays undergo Bragg reflection from a simple cubic crystal, with a density known with an accuracy of one percent. If the angle of the reflected X-ray with the crystal plane is 6° and is measured with an accuracy of 3 minutes of arc, what is the relative error in the measurement of wavelength? [Question ID = 12964]

1. 5.6×10^{-3} [Option ID = 21853]
2. 1.1×10^{-2} [Option ID = 21855]

3. 3.3×10^{-3} [Option ID = 21854]
4. 6.5×10^{-3} [Option ID = 21856]

Correct Answer :-

- 5.6×10^{-3} [Option ID = 21853]

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48) An uncharged spin-half particle of mass m is confined to move on a circular wire of radius a . The particle has magnetic moment μ . A magnetic field B is applied perpendicular to the plane of the wire. Then the energy eigenvalues of the particle are (here n is an integer) [Question ID = 12953]

1. $\frac{\hbar^2 n^2}{4ma^2} \pm 2\mu B$ [Option ID = 21809]
2. $\frac{\hbar^2 n^2}{4ma^2} \pm \mu B$ [Option ID = 21812]
3. $\frac{\hbar^2 n^2}{2ma^2} \pm 2\mu B$ [Option ID = 21811]
4. $\frac{\hbar^2 n^2}{2ma^2} \pm \mu B$ [Option ID = 21810]

Correct Answer :-

- $\frac{\hbar^2 n^2}{4ma^2} \pm 2\mu B$ [Option ID = 21809]

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49) A photon of initial wavelength 0.4 Å suffers two successive collision with two electrons. The deflection in the first collision is 90° and in the second collision is 60°. The final wavelength of the photon is: [Question ID = 12966]

1. 0.024 Å [Option ID = 21861]
2. 0.436 Å [Option ID = 21862]
3. 0.4 Å [Option ID = 21864]
4. 0.012 Å [Option ID = 21863]

Correct Answer :-

- 0.024 Å [Option ID = 21861]

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50) A sample of a certain element is placed in a 0.300-T magnetic field. How far apart are the Zeeman components of the 450-nm spectral line of this element? [Question ID = 12969]

1. 0.000283 nm [Option ID = 21875]
2. 2.83 nm [Option ID = 21876]
3. 0.00283 nm [Option ID = 21874]
4. 0.23 nm [Option ID = 21873]

Correct Answer :-

- 0.23 nm [Option ID = 21873]
