PHYSICS

BOOKS - NTA MOCK TESTS

NTA JEE MOCK TEST 52

Physics

1. A hydrogen atom and a Li^{2+} ion are both in the second excited state. If l_H and l_{Li} are their

respective electronic angular momenta, and E_H and E_{Li} their respective energies, then

A. $l_H > l_{Li}$ and $|E_H| > |E_{Li}|$

B. $l_H = l_{Li}$ and $|E_H| < |E_{Li}|$

C. $l_H < l_{Li}$ and $|E_H| > |E_{Li}|$

D. $l_H > l_{Li}$ and $|E_H| > > |E_{Li}|$

Answer: B

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2. A box is put on a scale which is adjusted to read zero, when the box is empty. A stream of pebbles is then poured into the base from a height h above its bottom at a rate of n pebbles/s. Each pebble has a mass m. If the pebbles collide with the box such that they immediately come to rest after collision, then the scale reading at time t after the pebbles begin to fill the box is [neglect piling up of pebbles]

A. mnt

B. $mn\left[\sqrt{2gh}+gt\right]$

C. mngt

D. zero

Answer: B

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3. A particle of mass m is suspended from a ceiling through a string of length L. The particle moves in a horizontal circle of radius r. Find a. the speed of the particle and b. the

tension in the string. Such a system is called a conical pendulum.

A.

$$v = \frac{2r\sqrt{g}}{(L^2 - r^2)^{1/2}} \text{ and } T = \frac{3mgL}{(L^2 - r^2)^{1/2}}$$

B.

$$v = \frac{r\sqrt{g}}{(L^2 - r^2)^{1/4}} \text{ and } T = \frac{mgL}{(L^3 - r^3)^{1/3}}$$

C.

$$v = \frac{3r\sqrt{g}}{(L^2 - r^2)^{1/2}} \text{ and } T = \frac{mgL}{(L^2 - r^2)^{1/2}}$$

D.

$$v = \frac{r\sqrt{g}}{(L^2 - r^2)^{1/4}} \text{ and } T = \frac{mgL}{(L^2 - r^2)^{1/2}}$$

Answer: D

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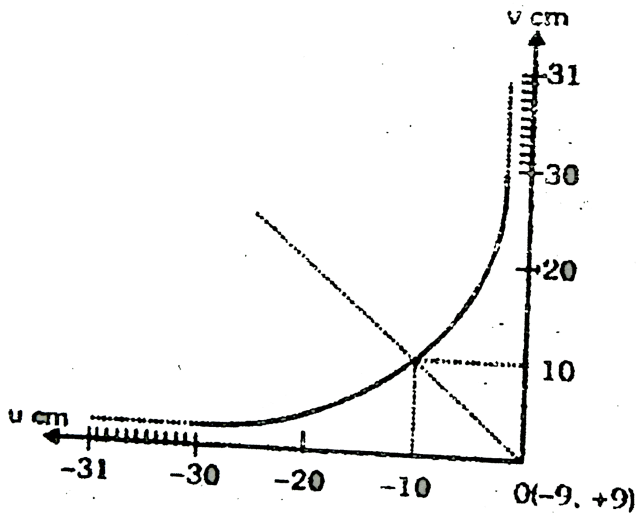
4. Graph of position of image vs position of point object from a convex lens is shown. Then, focal length of the lens is



A. $(0.50 \pm 0.05)cm$

B. $(5.00 \pm 0.05)cm$

C. $(0.50 \pm 0.10)cm$

D. $(5.00 \pm 0.10)cm$

Answer: B

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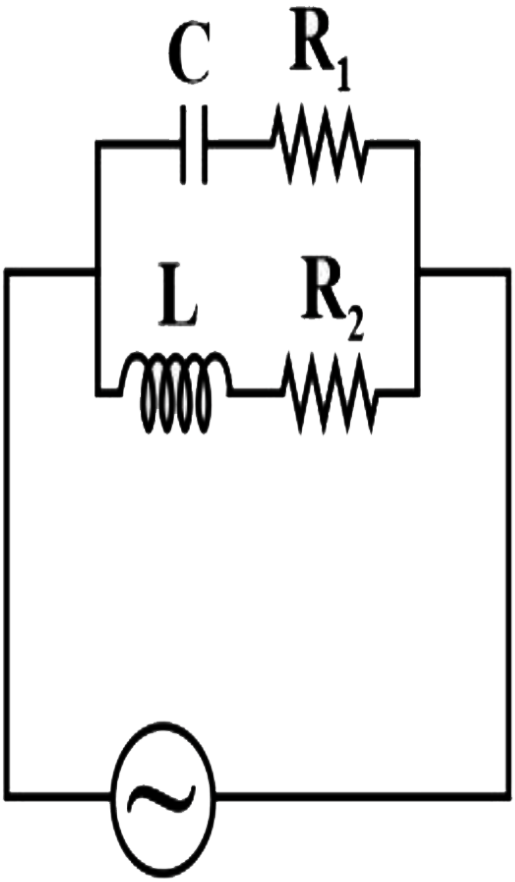
5. In the given circuit the R.M.S values of voltages across the capacitor C, inductor L and resistor R_1 are 12V, 10V and 5 V respectively.

Then the peak voltage across R_2 is



A. $7\sqrt{2}V$

B. $\sqrt{69}V$

C. $\sqrt{138}V$

D. none of these

Answer: C

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6. Two long coaxial cylindrical metal tubes (inner radius a, outer radius b) stand vertically in a tank of dielectric oil (of mass density ρ , dielectric constant K). The inner one is maintained at potential V and the outer one is

grounded. To what equilibrium height (h) does the oil rise in the space between the tubes? [Assume this height (h) as an equilibrium height]

A. $\frac{\varepsilon_0 2V^2(K-1)}{g\rho(b^2-a^2)1n\left(\frac{b}{a}\right)}$

B. $\frac{\varepsilon_0 2V^2(K-1)}{\rho(b^2-a^2)g1n\left(\frac{b}{a}\right)}$

C. $\frac{4\varepsilon_0 2V^2(K-1)}{g\rho(b^2-a^2)1n\left(\frac{b}{a}\right)}$

D. $\frac{6\varepsilon_0 2V^2(K-1)}{\rho(b^2-a^2)g1n\left(\frac{b}{a}\right)}$

Answer: B

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7. Using the conservation laws, demonstrate that the total mechanical energy of a planet of mass m moving around the Sun along an ellipse depends only on its semi-major axis a. Find this energy as a function of a.

A. $-\frac{GM_s m}{2a}$

B. $\frac{GM_s m}{2a}$

C. $\frac{GM_s m}{3a}$

D. $-\frac{GM_s m}{3a}$

Answer: A

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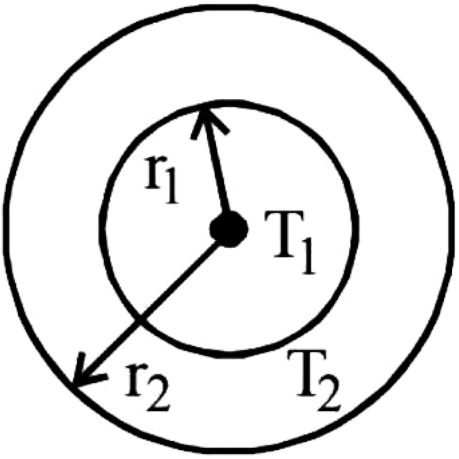
8. The figure shows a system of two concentric spheres of radii r_1 and r_2 are kept at temperature T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres is

proportional to



A. $\frac{r_1 r_2}{(r_2 - r_1)}$

B. $(r_2 - r_1)$

C. $\frac{(r_2 - r_1)}{r_1 r_2}$

D. $\ln\left(\frac{r_2}{r_1}\right)$

Answer: A

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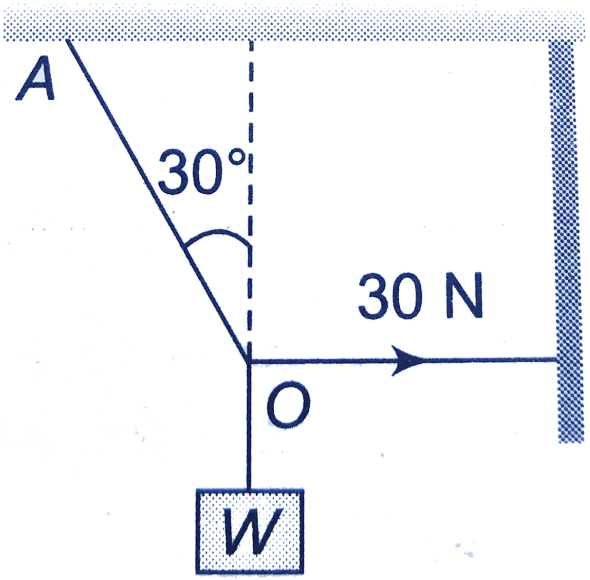
9. As shown in figure the tension in the horizontal cord is $30N$. The weight W and tension in the string OA in Newton are



A. $30\sqrt{3}, 30$

B. $30\sqrt{3}, 60$

C. $60\sqrt{3}, 30$

D. None of the above

Answer: B

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10. Find the decay constant of $.^{55} Co$ radio nuclide if its activity is known to decrease $4\,\%$ per hour. The decay product is non-radioactive.

A. $1.1 \times 10^{-5} s^{-1}$

B. $1.10 \times 10^{-2} s^{-1}$

C. $1.1 \times 10^{-2} s^{-1}$

D. $1.09 \times 10^{-5} s^{-1}$

Answer: A

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11. The equation of a simple harmonic progressive wave is given by y = A sin

$(100\pi t - 3x)$. Find the distance between 2 particles having a phase difference of $\frac{\pi}{3}$.

A. $\frac{\pi}{9}m$

B. $\frac{\pi}{18}m$

C. $\frac{\pi}{6}m$

D. $\frac{\pi}{3}m$

Answer: A

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12. The potential energy of a particle varies as .

$U(x) = E_0$ for $0 \leq x \leq 1$

$= 0$ for $x > 1$

for $0 \leq x \leq 1$ de- Broglie wavelength is λ_1 and for $x > 1$ the de-Broglie wavelength is λ_2. Total energy of the particle is $2E_0$. find $\frac{\lambda_1}{\lambda_2}$.

A. $\sqrt{(3)}$

B. $\sqrt{(7)}$

C. $\sqrt{(2)}$

D. $\sqrt{(5)}$

Answer: C

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13. A sphere of radius $0.1m$ and mass $8\pi\ kg$ is attached to the lower end of a steel wire of length $5.0m$ and diameter $10^{-3}m$. The wire is suspended from $5.22m$ high ceiling of a room . When the sphere is made to swing as a simple pendulum, it just grazes the floor at its lowest point. Calculate the velocity of the sphere at

the lowest position . Young's modulus of steel is $\left(1.994 \times 10^{11} N/m^2\right)$.

A. $7.7ms^{-1}$

B. $4.4ms^{-1}$

C. $2.2ms^{-1}$

D. $8.8ms^{-1}$

Answer: D

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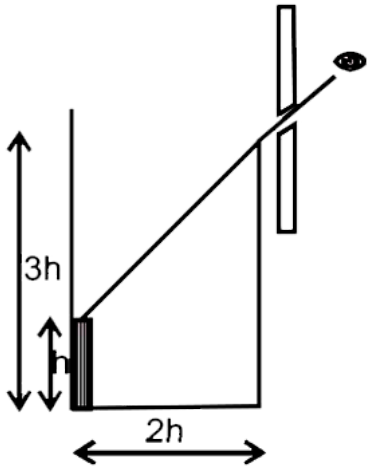
14. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is



A. $\frac{5}{2}$

B. $\sqrt{\frac{5}{2}}$

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

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

Answer: B

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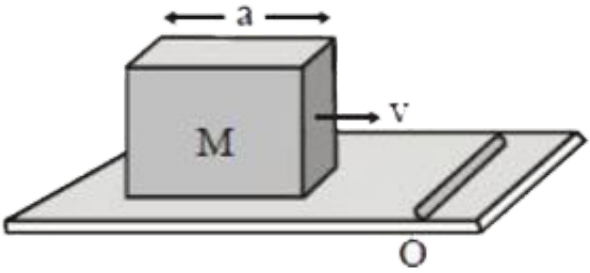
15. A cubical block of side a is moving with velocity v on a horizontal smooth plane as shown. It hits a ridge at point O. The angular

speed of the block after it hits O is:



A. $\frac{3v}{4a}$

B. $\frac{3v}{2a}$

C. $\frac{\sqrt{3}v}{\sqrt{4}a}$

D. Zero

Answer: A

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16. A particular semiconductor in equilibrium has $1 \times 10^{16} cm^{-3}$ donor atoms, $1.1 \times 10^{17} cm^{-3}$ acceptor atoms. If the intrinsic carrier density (n_i) of the semiconductor is $10^{12} cm^{-3}$, then the electron density in it will be

A. $10^{16} cm^{-3}$

B. $10^{12} cm^{-3}$

C. $1.1 \times 10^{17} cm^{-3}$

D. $10^7 cm^{-3}$

Answer: D

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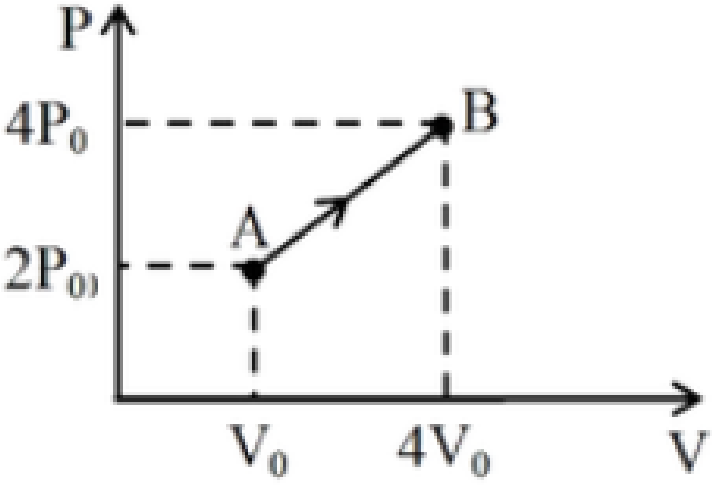
17. One mole of monatomic ideal gas undergoes the process $A \to B$, as in the given $P - V$ diagram . The specific heat for

this process is



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

B. $\frac{15R}{7}$

C. $\frac{30R}{7}$

D. $\frac{20R}{7}$

Answer: B

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18. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period T, then, which of the following does not change with time ?

A. $\frac{aT}{v}$

B. $aT + 2\pi v$

C. $a^2T^2 + 4\pi^2v^2$

D. aT

Answer: A

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19. An open pipe is in resonance in $2nd$ harmonic with frequency f_1. Now one end of the tube is closed and frequency is increased to f_2 such that the resonance again ocuurs in nth harmonic. Choose the correct option

A. $n = 3,\ f_2 = \frac{3}{4} f_1$

B. $n = 3,\ f_2 = \frac{5}{4} f_1$

C. $n = 5,\ f_2 = \frac{5}{4} f_1$

D. $n = 5,\ f_2 = \frac{3}{4} f_1$

Answer: C

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20. A $0.5kg$ block slides from the point A on a horizontal track with an initial speed $3m/s$ towards a weightless horizontal spring of

length $1m$ and force constant $2N/m$. The part AB of the track is frictionless and the part BC has the coefficient of static and kinetic friction as '0.22' and 0.20 respectively. If the distances AB and BD are $2m$ and $2.14m$ respectively, find total distance through which the block moves before it comes to rest completely. `(g=10 m//s^(2)).

A. 2.5 m

B. 4.42 m

C. 4.24 m

D. 2.44 m.

Answer: C

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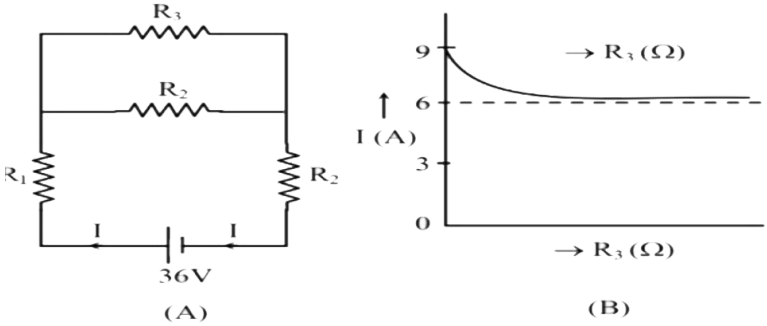
21. In the circuit shown in the figure (A), R_3 is a variable resistance



As the value R_3 is changed, current I though

the cell varies as shown. Obvioulsy, the variation is asymptotic, i.e. $I \to 6A$ as $R_3 \to \infty$. Resistance R_1 and R_2 are, respectively

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22. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational modes , the total internal energy of the system is

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23. A long straight wire carrying current of $30A$ is placed in an external uniform magnetic field of induction $4 \times 10^4 T$. The magnetic field is acting parallel to the direction of current. The magnetic of the resultant magnetic induction in tesla at a point $2.0cm$ away form the wire is

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24. A ball is projected form the ground at an angle of 45° with the horizontal surface .It reaches a maximum height of 120 m and return to the ground .upon hitting the ground for the first time it loses half of its kinetic energy immediately after the bounce the velocity of the ball makes an angle of 30° with the horizontal surface .The maximum height it reaches after the bounce in metres is _____

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25. In a double slit experiment ,the separation between the slits is $d = 0.25cm$ and the distance of the screen $D = 100$cm from the slits .if the wavelength of light used in $\lambda = 6000Å$and $I_0$is the intensity of the central bright fringe.the intensity at a distance $x = 4 \times 10^{-5}$in form the central maximum is-

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