PHYSICS

BOOKS - JEE ADVANCED PREVIOUS YEAR

JEE (ADVANCE) 2020

Section 1

1. A large squre container with thin transparent vertical walls and filled with water

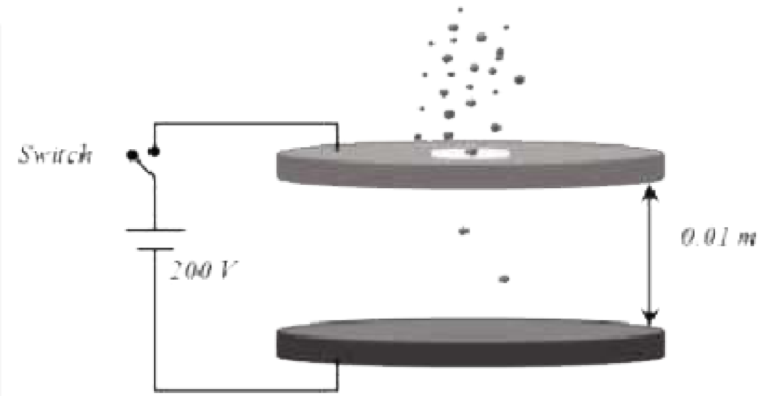
(refractive index $\frac{4}{3}$) is kept on a horizontal table . A student holds a thin straight wire vertically inside the water 12cm from one of its corners, as shown schematically in the figure . Looking at the inside the water 12 cm from one of its corners, as shown schematically in the figure . Looking at the wire from this corner, another student sees two images of the wire , located symmetrically on each side of the line of sight as shown. THe separation (in cm) between these images is ______ .

Watch Video Solution

2. A train with cross - sectional are S_t is moving with speed v_i inside a long tunnel cross - sectional area $S_0(S_0 - 4S_l)$. Assme that almost all the air (density ρ) in front of the train back between its sides and the wall of the tunel. Also the air flow with respect to the train is steady and laminar . Take the ambient pressure and that inside the train to be p_0. If the pressure in the region between the sides of the train and the tunnel wall is p , then $p_0 - p = \frac{7}{2N}\rho v_t^2$ .Then value of N is ________

Watch Video Solution

3. Two large circular discs separated by a distance of 0.01 m are connected to a battery via a switch a shown in the figure. Charged oil drops of density $900 kgm^{-3}$ are releasd through a tinly hole at the centre of the top disc . Once some oil drops achieve terminal velocity , the swith is closed to apply a voltage of 200 V across the disc. As a result an oil drop of radius 8×10^{-7} m stops moving vertically and floats between the discs. The number of electrons present in this oil drop is _______. (neglect the buoyancy force, take acceleration due to gravity $= 10ms^{-2}$ and charge on an electron (e) $= 1.6 \times 10^{-9}(C)$



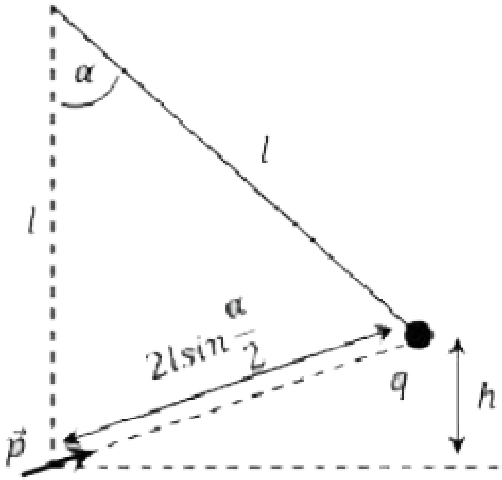
Watch Video Solution

4. A hot air balloon is carrying some passengers , and a few sandbage of mass 1kg each so that its total mass is 480 kg . Its effective volume giving the balloon its buoyancy is V. The balloon rises to a new equilibrium height close to 150 m with its volume remining unchange . If the variation of the density of air with height h from the ground is $\rho(h) = \rho_o e$, where $\rho_0 = 1.25 kgm^{-3}$

hu = 6000 m, the vlaue of N is ____________ .

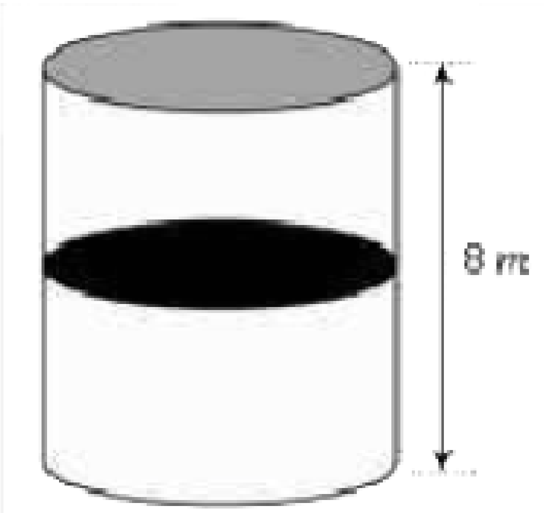
Watch Video Solution

5. A point charge q of mass m is suspended vertically by a string of length l . A point dipole of dipole moment p is now brought towards q from inifinty so that charge moves aways. The final equilibrium position of the system including the direction of the dipole , the angles and distance is shown in the figure below . If the work done in brining the dipole to this position is N $\times$ (mgh) . where g is the acceleration due to gravity , then the value of N is ______ . (Note that for three coplanar forcess keeping a point mass in equilibrium $\frac{F}{\sin\theta}$ is the same for all forces, where F is any one of the forces and θ is the angle between the other two forces).



Watch Video Solution

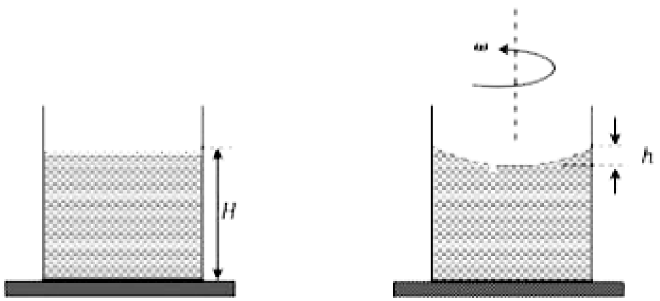
6. A thermally isolated cylindrical closed vessel of height 8 m is kept vertically . It is divided into two equal parts by a diathermic (perfect conductor) frictionless partition of mass 8.3 kg . Thus the partition is held initially at a distance of 4 m from the top , as shown in the schematic figure below . Each o the two parts of the vessel contians 0.1 mole of an ideal gas at temperature 300 K. The partition is now released and moves without any gas leaking from one part of the vessel to the other . When equilibrium is reached, the distance of the parition form one part of the vessel to the otehr . When equilibrium is reached the distacne of the partition from the top (in w) will be ______(take the accelearation due to gravity = 10 ms^{-2} and the universal gas constant $= 8.3 J$ mol^(-1) K^(-1)`).



Watch Video Solution

Section 2

1. A beaker of radius r is filled with water (refractive index $\frac{4}{3}$) up to a height H as shown in the figure on the left. The beaker is kept on a horizontal table rotating with angular speed ω. This makes the water surface curved so that the difference in the height of water level at the centre and the circumference of the beaker is h $(h < < H, h < < r)$ as shown in the figure on the right . Take this surface to be approximately spherical with a radius of curvalture R . Which of the following is/are correct ? (g is acceleration due to gravity)



A. $R=\dfrac{h^2+r^2}{2h}$

B. $R=\dfrac{3r^2}{2h}$

C. Apparent of depth of the bottom of the beaker is close to $\dfrac{3H}{2}\left(1+\dfrac{\omega^2H}{2g}\right)^{-1}$

D. Aperent depth of the bottom of the beaker is close to $\dfrac{3H}{4}\left(1+\dfrac{\omega^2H}{4g}\right)^{-1}$

Answer: AD

Watch Video Solution

2. A student skates up a ramp that makes an angle 30° with the horizontal . He/she starts (as shown in the figure) at the bottom of the ramp with speed v_0 and wants to turn around over a semicicular path xyz of radius R during which he/she reaches a maximum height h (at point) form the ground as shown in the figure . Assume that the energy loss is negligble and the force required for this turn at the highest point is provided by his / her weight only. Then (g is the acceleration due to gravity).

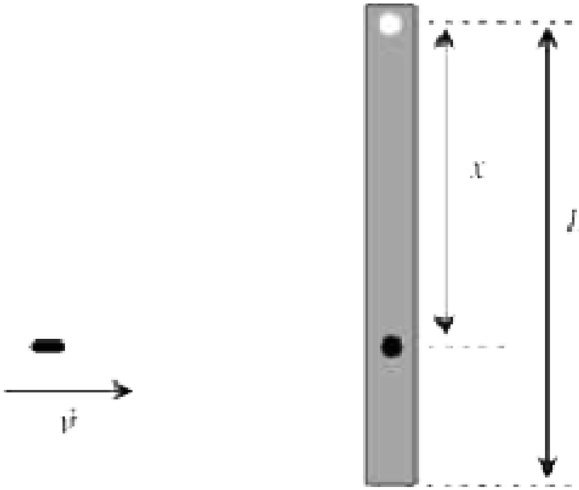
- $v_0^2 - 2gh = \frac{1}{2} gR$
- $v_0^2 - 2gh = \frac{\sqrt{3}}{2} gR$
- the centripetal force required at points x and z is zero
- the centripetal force required is maximum at points x and z

Answer: A,D

Watch Video Solution

3. A rod of mass m and length L , pivoted at one of its ends, is hanging vertically . A bullet of the same mass moving at speed v strikes the rod horizontally a a distance x from its pivoted end and gets embedded in it. The combined system now rolates with rotates with angular speed ω about the pivot . The maximum angular speed

ω_M is achieved for $x = x_m$. Then .



A. $\omega = \dfrac{3vx}{L^2 + 3x^2}$

B. $\omega = \dfrac{12vx}{L^2 + 12x^2}$

C. $x_M = \dfrac{1}{\sqrt{3}}$

D. $\omega_M = \dfrac{v}{2L}\sqrt{3}$

Answer: A,C,D

Watch Video Solution

4. In an X - ray tube , electrons emitted from a filament (cathode) carrying current hit a target (anode) at a distance d form the cathode. The target is kept at a potential V higher than the cathode resulting in emission of continuous of and charateristic X - rays. It the filament current I is decreased to $\frac{I}{2}$, the potential difference V is increaed to 2v, and the separation distance d is reduuced to $\frac{d}{2}$,then

A. The cut off wavelenghth will reduced to half, and the wavelenghts of the characteristi c X - rays wil reminan the same

B. the cut - off wavelength as well as the wavelenght of the characteristic X - rays will remain the same

C. the cut -off wavelenght will reduced to half , and the intensities of all the X - rays wil decrease

D. the cut - off wavelength will become two time larger, and the intensity of all the X - rays wil decrease

Answer: A,C

Watch Video Solution

5. Two identical non - conducting solid spheres of same and charge are suspended in air form a common point by two non - conducing massless string of same length . At equilibrium the angle between the strings is α. The spheres are now immersed in a dielectric liquid of density $800kgm^{-3}$ and dielectric constant 21. If the angle between the spheres remains the same after the immersion , then

A. electric force between the spheres reamins unchanged

B. electic force between the sphere reduce

C. mass density of the spheres is $840 kgm^{-3}$

D. the tension in the string holding the spheres remains unchanged

Answer: A,C

Watch Video Solution

6. Starting at time t = 0 from the origin with speed $1 ms^{-1}$, a particle follows a tow - dimensional trajectory in the x - y plane so that its coordinates are related by the equation $y = \frac{x^2}{2}$. The x and y components of its acceleration are denoted by a_x and a_y respectively . Then, the incorrect statement is:

A. $a_x = 1ms^{-2}$ implies that when the particle is at the origin $a_y = 1ms^{-2}$

B. $a_x = 0$ implies $a_y = 1ms^{-2}$ at all times

C. at $t = 0$ the paritcles velcoity points in the x - direction

D. $a_x = 0$ implies that at 1 = 1s the angle

between the particle 's velocity and the x

aixs is 45°

Answer: A

Watch Video Solution

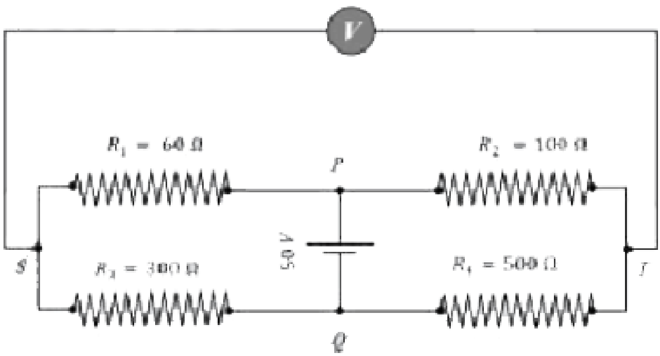
Section 3

1. A spherical bubbles inside water has radius R .

Take the pressuere in the bubbled and the water pressure to be pv. The bubble now gets compressed radially in an adiabatic manner so that its raduis becomes (R - a) . For $a < < R$ the magnitude of the work done in the process is given by $(4\pi poRa^2)$X. where X is a a constant and $y = C_p / C_v = 41 / 30$. The value of X is

Watch Video Solution

2. In the balanced condition , the values of the resistance of the fourarms of a Wheatstone bridge are shown in the figure below. The resistance R_3 has temperature coefficinet $0.0004^\circ C^{-1}$. If the temperature of R_3 increased by 100° C , the voltage developed between S and T will be _____volt.



Watch Video Solution

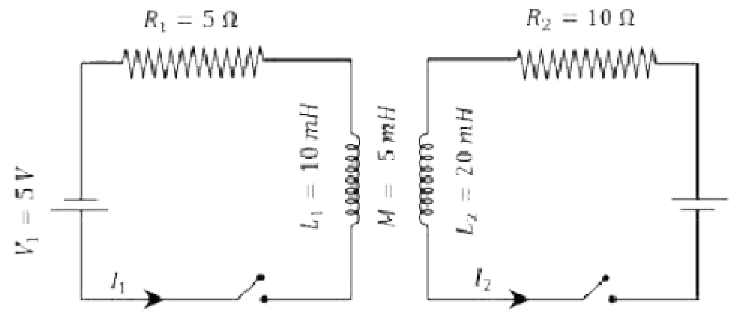
3. Two capacitor with capacitance values $C_1 = 2000om10pF$ and $C_2 = 3000 \pm 15pF$ are connected in series. The voltage applied across this combination is $V = 5.00 \pm 0.02V$. The percenntage arror in the calculation

Watch Video Solution

4. A cubical solid aluminium (bulk modulus $= -V\frac{dp}{dV} = 70Gpa$) block has adge length of 1m on the surface of the earth. It is kept on the floor of a 5 km deep ocean. Taking the average density of water and the acceleration due to gravity to be $10^3 kgm^{-3}$ and $10ms^{-2}$, respectively, the change in the adge length of the block in mm is __________ .

Watch Video Solution

5. The inductors of the two LR circuits are placed next to each other , as shown in the figure . The values of the self-inductance of the inductors , resistances , mutual - inductance and applied voltages are specified in the given circuit . After both the switches are closed simultaneously , the total work done by the batteries against the induced EMF in the inductors by the time the currents react their steady state values is ________m]



Watch Video Solution

6. A container with 1 kg of water in it kept in sunlight , which causes the water to get warmer than the surroundings . The average energy per time per unit area received due to the sunlight is $700 W m^{-2}$ and it is absorbed by the water over an effective area of $0.05 m^2$. Assuming that the heat loss from the water to the surroundings is governed by Newton's law of cooling , the difference (in $^\circ C$) in the temperature of water and the surroundings after a long time will be ________ . (Ignore effect of the container, and take constant for Newton's law of cooling = $0.001 s^{-1}$, Heat capacity of water = 4200 $J kg^{-1} K^{-1}$)

Watch Video Solution