#1612972

Topic: Gas Laws

2 mole ideal He gas and 3 mole ideal H_2 gas at constant volume find out C_v of mixture

A $\frac{21R}{10}$

B $\frac{11R}{10}$

C $\frac{21R}{5}$

D $\frac{11R}{5}$

Solution

The given mixture of two moles of monoatomic gas mixed with three mole of diatomic gas can be given as

$$C = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

$$= \frac{2 \times \frac{3}{2}R + 3 \times \frac{5}{2}R}{2 + 3}$$

$$= \frac{3R + 15\frac{R}{2}}{5} = \left(\frac{21R}{10}\right)$$

#1613008

Topic: Atomic Spectra and Spectral Series

He^+ is in n^{th} state.It emits two successive photons of wavelength $103.7nm$ and $30.7nm$, to come to ground state the value of n is:

A 4

B 5

C 6

D 7

Solution

To find the wavelength in eV we must multiply the given formula by 1240

Thus we get,

$$E_{total} = \left(\frac{1240}{103.7} + \frac{1240}{30.7}\right)eV = 52.34eV$$

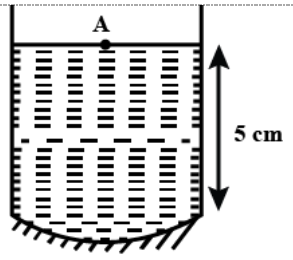
$$52.34eV = 13.6 \times 4\left(1 - \frac{1}{n^2}\right)$$

$n^2 = 25$

$n = 5$

#1613013

Topic: Refraction at Spherical Surfaces



Water is filled in a container upto a height of $5cm$.There is a concave mirror of radius of curvature 40cm .A person just above the surface observes images of $'A'$.The distance

image from water surface is ($\mu_{water} = 1.33$):

A $8.8cm$

B $7.8cm$

C $6.8cm$

D $5.4cm$

Solution

Reflection from mirror

$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-5}=\frac{1}{20} \quad \because (f=-20cm)$

$v=\frac{20}{3}cm$

Refraction from water surface,

$\frac{\mu_2}{v}-\frac{\mu_1}{u}=0$

$\frac{1}{v}-\frac{1.33}{-\left(\frac{35}{3}\right)}=0$

$v=-\frac{35}{3\times 1.33}=-8.8cm$

#1613020

Topic: Specific Heat Capacities

m_1 gram of ice at -10^o and m_2 gram of water at 50^oC are mixed in insulated container.if in equilibrium state we get only water at 0^oC then latent heat ice is:

A $\frac{50m_2}{m_1}+5$

B $\frac{50m_2}{m_1}-5$

C $\frac{50m_2}{m_1}+50$

D $\frac{50m_2}{m_1}-50$

Solution

heat taken by ice = heat given by water

$m_1\ S_{ice}(10)+m_1=m_2S_w(50)$

$\Rightarrow \frac{m_1}{2}\times +m_1L_f=m_2\times 50$

$\Rightarrow 5+L_f=50\frac{m_2}{m_1}$

$\Rightarrow L_f=\frac{50m_2}{m_1}-5$

#1613056

Topic: Moment of Inertia of Common Bodies

Mass per unit area of a disc of inner radius 'a' and outer radius 'b' is given by $\left(\frac{\sigma_0}{r}\right)$, r distance from center. Its radius of gyration w.r.t. axis of rotation passing through center and perpendicular to plane is

A $\sqrt{\frac{b^4-a^4}{3(b^2-a^2}}$

B $\sqrt{\frac{b^3-a^3}{3(b-a)}}$

C $\sqrt{\frac{b^3-a^3}{5(b-a)}}$

D $\sqrt{\frac{b^4 - a^4}{5(b^2 - a^2}}$

Solution

$I = \int dm.\, r^2$

$I = \int_a^b \frac{\sigma_0}{r} 2\pi r dr.\, r^2$

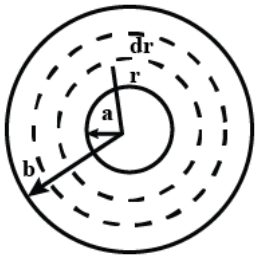
$I = \sigma_0 2\pi \left(\frac{b^3 - a^3}{3}\right)$

$M = \int_a^b dm = {}_a^b[\frac{\sigma_0}{r} 2\pi r dr] = \sigma_0 2\pi(b - a)$

$I = MK^2$

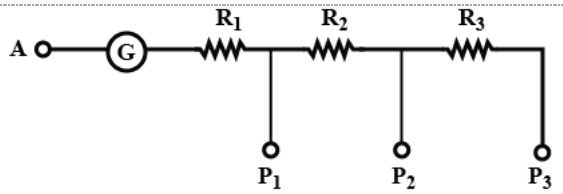
$\sigma_0 2\pi \left(\frac{b^3 - a^3}{3}\right) = \sigma_0 2\pi(b - a)K^2$

$K = \sqrt{\frac{b^3 - a^3}{3(b - a)}}$



#1613100

Topic: Resistance and Resistivity



A galvanometer has 50 division,current per unit deflection id $20\mu A$ and resistance of coil of galvanometer is 100Ω. Find the value of resistance R_1, R_2 and R_3 if its range as a voltmeter when used between A and P_1, is $(0, -2V)$ between A and P_2 is $(0 - 10V)$ and between A and P_3 is $(0 - 20V)$

A $1900\Omega, 800\Omega, 10000\Omega$

B $1900\Omega, 4000\Omega, 8000\Omega$

C $19000\Omega, 8800\Omega, 12000\Omega$

D $12000\Omega, 8800\Omega, 19000\Omega$

Solution

$I_G = 20 \times 50\mu A = 1mA$

$I_G(100 + R_1) = 2$

$R_1 = 1900\Omega$

$I_G(100 + R_1 + R_2) = 10V$

$R_2 = 8000\Omega$

$I_G(100 + R_1 + R_2 + R_3) = 20$

$R_3 = 10000\Omega$

#1613104

Topic: Basics of Projectile Motion

Two projectiles are thrown with same speed in such a way that their ranges are equal.If the time of flight for the two projectiles are t_1 and t_2 the value of $t_1 t_2$ in terms of range 'R' and 'g' is

A $\frac{R}{g}$

B $\frac{2R}{g}$

C $\frac{R}{2g}$

D $\frac{R}{4g}$

Solution

$t_1 = \frac{2u\sin\theta_1}{g}$

$t_2 = \frac{2u\sin\theta_2}{g}$

$t_1 t_2 = \frac{4u^2}{g^2}\sin\theta_1\sin\theta_2$ $\because$ range are equal

$\theta_2 = 90^o - \theta_1$

$\because t_1 t_2 \frac{2}{g}\frac{2u^2\sin\theta_1\cos\theta_1}{g} = \frac{2R}{g}$

#1613113

Topic: Magnetic Moment

A dipole is placed at the origin such that its dipole moment is $p\hat{i}$. The electric field and potential at (0, d, 0) respectively are:

A $\frac{p}{4p\varepsilon_0 d^3}\hat{i}, 0$

B $\frac{-p}{4p\varepsilon_0 d^3}\hat{i}, 0$

C $\frac{2p}{4p\varepsilon_0 d^3}\hat{i}, 0$

D $\frac{-2p}{4p\varepsilon_0 d^3}\hat{i}, 0$

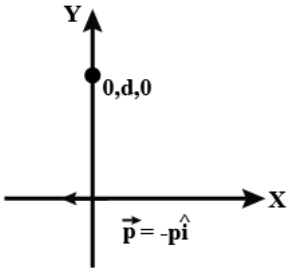
Solution

Clearly it is the axial position

$\vec{E} = -\frac{k\vec{p}}{r^3} = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}\hat{i}$

put $r = d$

$\vec{E} = -\frac{p}{4\pi\varepsilon_0 d^3}\hat{i} \Rightarrow V = 0$



#1613114

Topic: Musical sound and scale

Submarine A is going with speed of 18km/hr. Submarine B is chasing A with speed of 27 km/hr.It sends frequency of $500Hz$ and hears after reflection from A. The perceived frequency is:

A $500Hz$

B $502Hz$

C $498Hz$

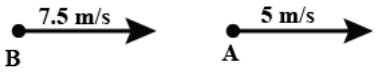
D $504Hz$

Solution

By using Doppler effect,

Frequency received by A, $f_A = f_0\left(\frac{1500-5}{1500-7.5}\right)$

Frequency of reflected sound perceived by $B = f_A\left(\frac{1500+7.5}{1500+5}\right) = 500\left(\frac{1500-5}{1500+7.5}\right)\left(\frac{1500+7.5}{1500+5}\right) = 501.699 \cong 502Hz$



#1613121

Topic: Electric Field

The electric field is space given by $\vec{E} = E_0\sin(\Omega t + 6y - 8z)\hat{n}$ then the direction of propagation of light wave is

A $\frac{-3\hat{j}-4\hat{k}}{5}$

B $\frac{-3\hat{j}+4\hat{k}}{5}$

C $\frac{-3\hat{j}-4\hat{k}}{5}$

D $\frac{3\hat{j}-4\hat{k}}{5}$

#1613140

Topic: Resistance and Resistivity

Dimension of resistance R in terms of u_0 & ε_0 are

A $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

B $\sqrt{\frac{\varepsilon_0}{\mu_0}}$

C $\frac{\varepsilon_0}{\mu_0}$

D $\frac{\mu_0}{\varepsilon_0}$

Solution

$[\mu_0] = [M^1L^2T^{-2}A^{-2}]$

$[R] = [ML^2T^{-3}A^{-2}]$

$[R] = [\varepsilon_0]^a[\mu_0]^b$

$[ML^2T^{-3}A^{-2}] = [M^{-a}L^{-3a}T^{4a}A^{2a}M^bL^{2b}T^{-2b}A^{-2b}]$

$2a - 2b = -2$

$a - b = -1$.....(1)

$4a - 2b = -3$.....(2)

$2a - 2b = -2$ .....(3)

$2a = -1$

$a = -\frac{1}{2}, b = \frac{1}{2}$

$R \rightarrow [R] = \left[\sqrt{\frac{\mu_0}{\varepsilon_0}}\right]$

#1613143

Topic: Interference

In YDSE when slab of thickness t and refractive index μ is placed in front of one slit then central maxima shifts by one fringe width. Find out t in terms of λ and μ

A $\frac{\lambda}{(2\mu-1)}$

B $\frac{2\lambda}{(2\mu - 1)}$

C $\frac{\lambda}{(\mu - 1)}$

D $\frac{2\lambda}{(2\mu + 1)}$

Solution

when a film of thickness t and refractive index μ is introduced in the path of one of the source of light ,then fringe shift occur as optical path difference changes

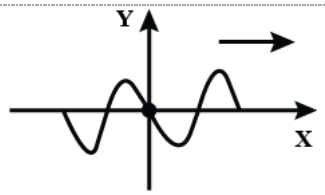
$\Delta y = (\mu - 1)\frac{tD}{d}$

And, $\beta = \frac{\lambda D}{d}$

So, $t = \frac{\lambda}{(\mu - 1)}$

#1613153

Topic: Waves on a String



A wave is propagating in positive x - direction . A time $t = 0$ its snapshot is taken as shown .If the wave equation is $y = A\sin(\omega t - kx + \phi)$, then ϕ is

A $\phi = 0$

B $\phi = \pi$

C $\phi = \frac{\pi}{2}$

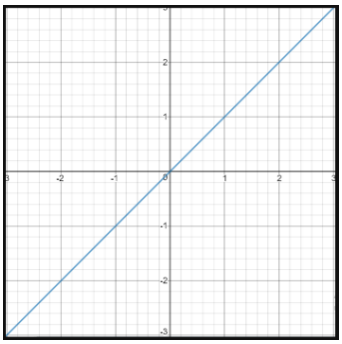
D $\phi = 3\pi/2$

Solution

At $t = 0$, the phase of particle at $x = 0$ is 0

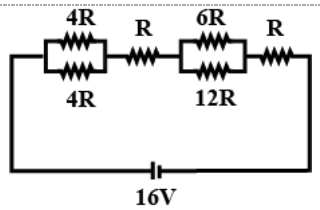
$\therefore \phi = 0$

Thus the graph will be in the straight line passing through the origin.



#1613157

Topic: Resistance and Resistivity



If the power dissipated in the circuits is $4W$ then the value of R is :

A 4Ω

B 8Ω

C 16Ω

D 12Ω

Solution

As $P = \frac{V^2}{R}$,

futher solving it we get,

$Reg = \frac{V^2}{P} = \frac{16^2}{4} = 64\Omega$

$2R + R + 4R + R = 64$

$8R = 64$

$R = 8\Omega$

#1613164

Topic: Basics of Projectile Motion

Equation of trajectory of ground to ground projectile is $y = 2x - 9x^2$.Then the angle of projection with horizontal and speed of projection is:($g = 10m/s^2$)

A $\tan^{-1}(2), \frac{5}{3}m/s$

B $\tan^{-1}(3), \frac{5}{3}m/s$

C $\tan^{-1}(2), \frac{2}{3}m/s$

D $\tan^{-1}(3), \frac{2}{3}m/s$

Solution

$y = 2x - 9x^2$ .....Equ 1

$y = x\tan\theta - \frac{1}{2}\frac{gx^2}{u^2\cos^2\theta}$ Equ2

comparing these two equations we get,

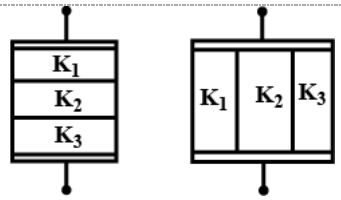
$\tan\theta = 2$

$\frac{g}{2u^2\cos^2\theta} = 9$

$\frac{10(1+4)}{2u^2} = 9 \Rightarrow u^2 = \frac{10 \times 5}{2 \times 9} \Rightarrow u = \frac{5}{3}m/s$

#1613172

Topic: Dielectrics in capacitors



Two parallel plate capacitors are filled with dielectrics and connected separately across same potential difference as shown in figure.their plate area is A and separation between plates is $'d'$.then the ration of energy stored is:

A $\frac{9K_1K_2K_3}{(K_1K_2 + K_2K_3 + K_3K_1)(K_1 + K_2 + K_3)}$

B $\frac{5K_1K_2K_3}{(K_1K_2 + K_2K_3 + K_3K_1)(K_1 + K_2 + K_3}$

C $\frac{6K_1K_2K_3}{(K_1K_2 + K_2 + K_3 + K_3 + K_1)(K_1 + K_2 + K_3)}$

D $\frac{3K_1K_2K_3}{(K_1K_2 + K_2K_3 + K_3K_1)(K_1 + K_2 + K_3)}$

Solution

$$\frac{1}{C_1} = \frac{\frac{d}{3}}{K_1\varepsilon_0 A} + \frac{\frac{d}{3}}{K_2\varepsilon_0 A} + \frac{\frac{d}{2}}{K_3\varepsilon_0 A} s$$

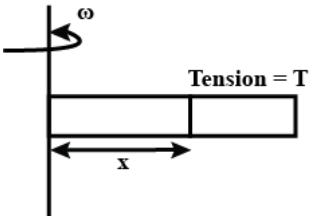
$$C_1 = \frac{3K_1K_2K_3\varepsilon_0 A}{d(K_1K_2 + K_2K_3 + K_3K_1}$$

$$C_2 = \frac{(K_1 + K_2 + K_3)\varepsilon_0 A}{3d}$$

$$\frac{E_1}{E_2} = \frac{\frac{1}{2}C_1V^2}{C_2V^2} = \frac{9K_1K_2K_3}{(K_1K_2 + K_2K_3 + K_3K_1)(K_1 + K_2 + K_2)}$$

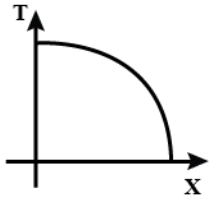
#1613179

Topic: Torque

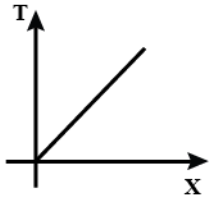


A uniform rod of length l is rotating with constant angular speed ω as shown in figure .Choose the graph which correctly shows the variation of T with X

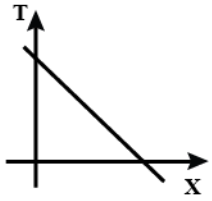
A



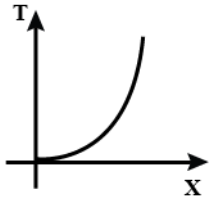
B



C



D



Solution

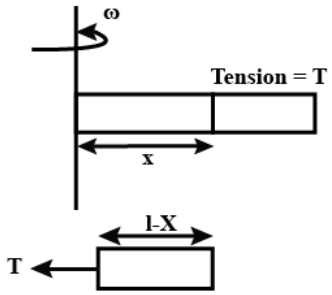
By using the concept of Rotational motion on body ,

tension can be given as:

$T = \frac{m}{l}(l-x)\omega^2\left(x + \frac{l-x}{2}\right)$

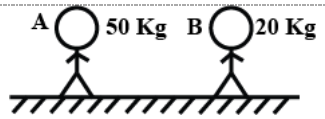
$T = \frac{m}{l}(\omega^2)\frac{(l-x)(l+x)}{2}$

$T = \frac{m\omega^2}{2l}(l^2 - x^2)$



#1613184

Topic: Elastic Collisions in One-Dimension



Two men A and B of mass $50kg$ and $20kg$ respectively are at rest on a frictionless surface as shown in figure.If A pushes B with relative velocity 0.7 m/s then find velocity of A just after the push

A $0.2m/s$

B $1m/s$

C $5m/s$

D $4m/s$

Solution

$P_i = 0$

$P_f = 20(0.7 - V) - 50(V)$

$20(0.7 - v) = 50V$

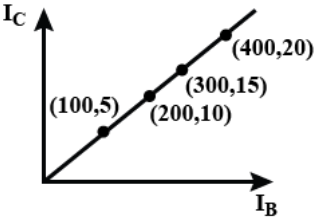
$14 - 20v = 50V$

$14 = 70V$

$V = \frac{14}{70} = 0.2m/s$

#1613192

Topic: Basics of AC



Graph between output current (I_C) and input current (I_B) for common emitter of $n-p-n$ transistor is given in the figure.if input resistance is $100k\Omega$. Find the out voltage gain an power gain are

A $2 \times 10^4, 4 \times 10^5$

B $3 \times 10^4, 9 \times 10^6$

C $6 \times 10^4, 8 \times 10^6$

D $8 \times 10^4, 2 \times 10^6$

Solution

Current gain $(\beta) = \frac{\Delta I_c}{\Delta I_B} = \left(\frac{200-100}{10-5}\right) = \frac{100}{5} = 20$

Voltage gain $(A_v) = \beta \times \frac{R_{out}}{R_{in}} = 20 \times \frac{100 \times 10^3}{100} = 20 \times 10^3$

Power gain $= A_v \times \beta = 20 \times 10^3 \times 20 = 4 \times 10^5$

#1613196

Topic: Magnetic field

A point charge is moving in a circular path of radius $10cm$ with angular frequency 40π rad/s.The magnetic field produced by it at the center is $3.8 \times 10^{-10} T$. T then the value of charge is :

A $3\mu c$

B $4\mu c$

C $1\mu c$

D $9\mu c$

Solution

$B = \frac{\mu_0}{4\pi}\frac{qv}{r^2}\sin\theta$

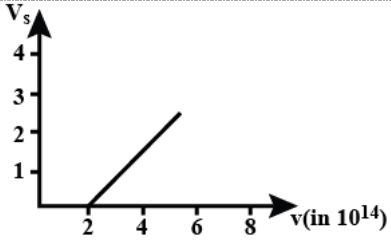
$B = 10^{-7}\frac{q\omega r}{r^2}$

$= 3.8 \times 10^{-10} = 10^{-7}.\ q \times 40\ P$

$q = 3\mu c$

#1613205

Topic: Stopping Potential and Einstein's Photoelectric Equation



Graph between stopping potential and frequency of photon is given in figure.

Find out work function metal`

A 0.82

B 0.92

C 0.72

D 0.62

Solution

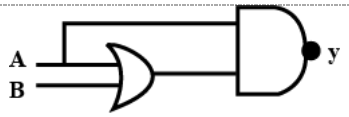
$v_{th} = 2 \times 10^{14} Hz$

$W = \frac{hv_{th}}{e}(inev)$

$W = \frac{6.63 \times 10^{-34} \times 2 \times 10^{14}}{1.6 \times 10^{19}} = 0.82eV$

#1613210

Topic: Logic Gates



Logic gate for inpute A an B is given in figure .

Which table is correct for given gates system:

A

A	B	Y
0	0	0
1	0	1
0	1	0
1	1	1

B

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

C

A	B	Y
0	0	1
1	0	0
0	1	1
1	1	0

D

A	B	Y
0	0	1
1	0	1
0	1	0
1	1	0

Solution

Output of OR gate $C = A + B$

$y = (A + B).\ A$

#1613211

Topic: Diffraction

If aperture diameter of the lens of a telescope is $1.25 m$ and wavelength of light used is $5000 \mathring{A}$ its resolving power is

A 2.05×10^6

B 2.5×10^5

C 4.1×10^5

D 4.1×10^6

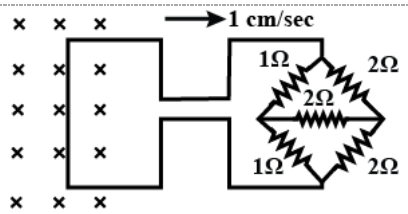
Solution

$$\text{resolving power} = \frac{d}{1.22\lambda} = \frac{1.25 \times 10^{10}}{1.22 \times 500}$$

$$\Rightarrow 2.049 \times 10^6$$

#1613212

Topic: Magnets



A square wire of resistance 1.3Ω and side 1cm its moving in uniform magnetic field $B = 1T$ with speed $1cm/sec$ as shown in figure the the currnet in loops is:

A $41\mu A$

B $54\mu A$

C $61\mu A$

D $31\mu A$

Solution

$E = BVl = 1 \times 10^{-2} \times 10^{-2} = 10^{-4} Volt$

$R_{eq} = \frac{4}{3} + 1.3 = 1.33 + 1.3 = 1.63\Omega$

$I = \frac{10^{-4}}{1.63} = 61\mu A$