# 25-07-2021 SHIFT-1 PHYSICS MEMORY BASED

1. A body of mass 2 kg and linear velocity 4 m/s collides elastically need on with another body at rest. After collision body of mass 2 kg starts moving with velocity 1 m/s then what will the velocity of center of mass of system?

1) 1.5 m/s 2) 0.5 m/s 3) 3.5 m/s 4) 2.5 m/s

Ans: 4

Sol: From linear momentum conservation

$2\times4+0=2\times1+m_2v_2$

From the definition of elastic collision

$v_2-v_1=e(u_1-u_2)$

$v_2-1=1(4-0)$

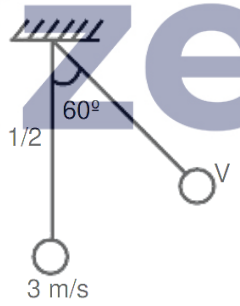
$v_2=5$

$8=2+m_2\times5$

$m_2=6/5$

$V_{cm}=\frac{m_1v_1+m_2v_2}{m_1+v_2}=\frac{2\times4+0}{2+\frac{6}{5}}=2.5m/s$

2. A simple pendulum of length 1/2m gas initial speed 3 m/s when pendulum mass is at lowermost point. What will be the speed of pendulum mass, when string of pendulum makes an angle of $60^0$ with vertical?




1) 2 m/s 2) 4 m/s 3) 6 m/s 4) 8 m/s

Ans: 1

Sol: $\frac{1}{2}mu^2=\frac{1}{2}mv^2+mgl(1-\cos60^0)$

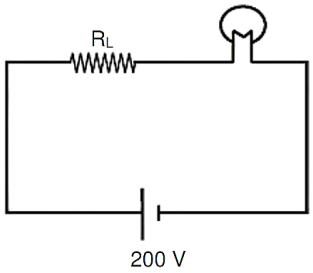
$u^2=v^2+2gl(1-\cos60^0)$

$9=v^2+20\times1/2\times1/2$

$9=v^2+5$

$v=2m/s$

3. A bulb has rated power 200 W and rated voltage 100 V. This bulb is connected in circuit as shown in figure. What should be value of load resistance $R_L$ so that bulb works at rated voltage?



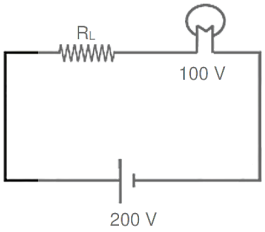

1) $25\Omega$ 2) $50\Omega$ 3) $75\Omega$ 4) $100\Omega$

Ans: 2

Sol: $P=\frac{V^2}{R}$

$200=\frac{(100)^2}{R}$

$R=50\Omega$




Current through bulb

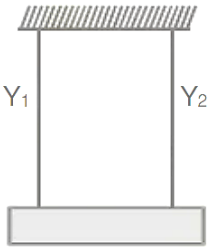
$i=\frac{100}{50}\Rightarrow 2A$

$V_L=100$

$R_L=\frac{100}{2}=50\Omega$



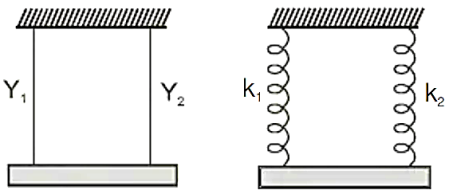
4. Two geometrical identical wires have young modules $Y_1$ and $Y_2$ then find equivalent young modules:




1) $Y_1+Y_2$ 2) $\frac{Y_1+Y_2}{2}$ 3) $\frac{Y_1Y_2}{Y_1+Y_2}$ 4) $\sqrt{Y_1Y_2}$

Ans: 2

Sol:

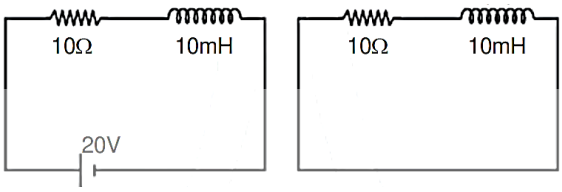


$$K_{eq} = K_1 + K_2$$

$$\frac{Y2A}{\ell} = \frac{Y_1 A}{\ell} + \frac{Y2A}{\ell}$$

$$Y = \frac{Y_1 + Y_2}{2}$$

5. Battery is connected to a resistor and a inductor for a long time as shown in figure, then battery is removed & short circuited. Find the current in the circuit after 1 ms after battery get removed:




1) 1.32 A 2) 0.44 A 3) 0.65 A 4) 0.74 A

Ans: 4

Sol: $i_0 = \frac{20}{10} = 2A$

$$i = i_0 e^{-Rt/L}$$

$$= 2 \times e^{-\frac{10\times10^{-3}}{10\times10^{-3}}} = \frac{2}{e} = 0.74A$$

6. A particle of mass 4m at rest splits into two particle of mass 3m and m. If both the masses have different velocities then find ratio of their De-Broglie wavelength?

1) 1 : 1 2) 1 : 2 3) 2 : 1 4) 1 : 3

Ans: 1

Sol: $\lambda = \frac{h}{P}$

Here momentum is same for both

$$\frac{\lambda_{2m}}{\lambda_m} = \frac{1}{1}$$

7. An electron, a proton and an alpha particle are get accelerated by giving same K.E., then which of the following is correct about De-Broglie wavelength.

1) $\lambda_e < \lambda_p < \lambda_\alpha$ 2) $\lambda_e > \lambda_p > \lambda_\alpha$ 3) $\lambda_e = \lambda_p < \lambda_\alpha$ 4) $\lambda_e = \lambda_p > \lambda_\alpha$

Ans: 2

Sol: $\lambda = \frac{h}{\sqrt{2mK.E.}} \Rightarrow \lambda \propto \frac{1}{\sqrt{m}}$

$m_\alpha > m_p > m_e$

So $\lambda_e > \lambda_p > \lambda_\alpha$

8. A ball of mass m is thrown towards wall in two different situation,

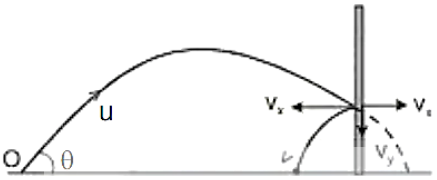
(i) Ball strikes perpendicular to wall (ii) Ball strikes at an angle of $45^0$ to wall

What will be ratio of impulse in two cases?

1) 2 : 1 2) 1 : 1 3) 1 : 2 4) 3 : 1

Ans: 2

Sol:




During elastic collision with vertical wall, velocity in vertical direction remains constant and component velocity along horizontal direction become opposite after collision.

So, change in momentum,

$\Delta P = 2mu\cos\theta$ in each case

So, $\frac{\Delta P_1}{\Delta P_2} = \frac{2mu\cos\theta}{2mu\cos\theta} = 1:1$

9. Photons of wavelength 400 nm strikes on a material with energy 1000 J in 10 sec. What will be no. of electron leaving the material in one second?

1) $5\times10^9$ 2) $5\times10^{16}$ 3) $5\times10^{13}$ 4) $5\times10^{10}$

Ans: 2

Sol: Energy $= N\times\frac{hc}{\lambda}$

$1000 = \frac{12400}{4000}\times N\times1.6\times10^{-19}$

$N = \frac{1000\times4}{12400\times1.6\times10^{-19}}$

So, number of electron leaving from material in 1 sec $= \frac{N}{10} = 5\times10^{16}$

10. A radioactive nuclei of initial number of active nuclei $N_0$. Decays $N_0/4$ active nuclei in time $t_1$ and decays to $N_0/2$ active nuclei in time $t_2$. Find the ratio between $t_1$ and $t_2$?

1) 0.42 2) 0.55 3) 0.62 4) 0.75

Ans: 1

Sol: $N = N_0e^{-\lambda t}$

$\frac{3N_0}{4} = N_0e^{-\lambda t_1}$

$t_1 = \frac{\ell n\frac{4}{3}}{\lambda}; t_2 = \frac{\ell n2}{\lambda}$

$$\frac{t_1}{t_2}=\frac{\ell n\frac{4}{3}}{\ell n2}=\frac{2\ell n2-\ell n3}{\ell n2}=2-\frac{1.098}{0.693}=2-1.58=0.42$$

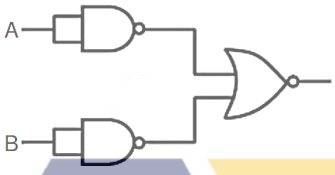
11. For an ideal gas, $C_v$ is the specific heat at constant volume and $C_p$ is the specific heat at constant pressure. If at some temperature $T_p$, they are related as $C_p-C_v=R$ and for some other temperature $T_Q$. They are related as $C_p-C_v=1.1R$, then which is correct

1) $T_p>T_Q$ 2) $T_Q>T_p$ 3) $T_p=T_Q$ 4) can't say

Ans: 1

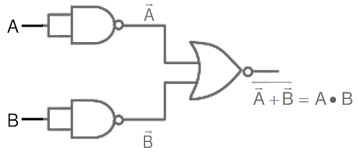
Sol: At high temperature gas behaves has ideal gas.

12. Find equivalent circuit

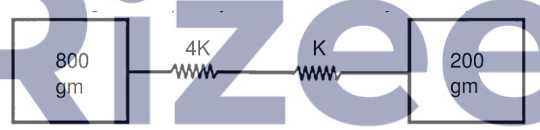



1) NOR 2) OR 3) AND 4) NAND

Sol:




13. Two block of mass 800 gm and 200 gm are attached by two springs of spring constant 4 K and K in series as shown in figure. Find angular frequency of oscillation of system? (Value of K=20 N/m)




1) 10 rad/s 2) 16 rad/s 3) 12 rad/s 4) 14 rad/s

Ans: 1

Sol: $T=2\pi\sqrt{\frac{\mu}{k_{eq}}}$

$$\mu=\frac{m_1m_2}{m_1+m_2}\Rightarrow\frac{200\times800}{200+800}=160g=0.16kg$$

$$K_{eq}=\frac{k_1k_2}{k_1+k_2}=\frac{4k\times k}{4k+k}=\frac{4}{5}k\times20=16\frac{N}{m}$$

$$T=2\pi\sqrt{\frac{0.16}{16}};T=\pi/5\sec.$$

$$\omega=\frac{2\pi}{T}=10rad/s$$

14. A conducting loop of radius 0.1 m has a time variable magnetic field $B(t)=\frac{4}{100}\left[1-\frac{t}{100}\right]$. Find energy dissipated till magnetic filed becomes zero if resistance of loop is $0.01\Omega$.

1) $16\times10^{-7}J$ 2) $8\times10^{-7}J$ 3) $4\times10^{-7}J$ 4) $2\times10^{-7}J$

Ans: 1

Sol; $\varepsilon=\left|-A\frac{dB}{dt}\right|$

$\varepsilon=\pi(0.1)^2\times\frac{4}{100}\times\frac{1}{100}$

$\varepsilon=4\pi\times10^{-6}v$

When $B=0,t=100$

Energy $=\frac{\varepsilon^2}{R}\times t=\frac{\left(4\pi\times10^{-6}\right)^2}{10^{-2}}\times100=16\pi^2\times10^{-8}=16\times10^{-7}J$

15. An electric field of a wave propagating as $E=E_0\cos\left(kz-5.6\times10^3t\right)$ reflecting from mirror at z=a, then

1) $\lambda=5.6m$

2) $f=5.6\times10^3Hz$

3) Equation of reflecting wave $E=E_0\cos\left(kz-5.6\times10^3t\right)$

4) Equation of reflecting wave $E=-E_0\cos\left(kz+5.6\times10^3t\right)$

Ans: 4

Sol: $w=5.6\times10^3$

$2\pi f=5.6\times10^3$

$f=\frac{5.6\times10^3}{2\pi}=\frac{5.6\times10^3}{2\times3.14}=891.7Hz$

$C=f\lambda$

$\lambda=\frac{c}{f}=\frac{3\times10^8}{891.7}=3.36\times10^5m$

Reflecting wave

$E=E_0\cos\left(-kz-5.6\times10^3+\pi\right)$

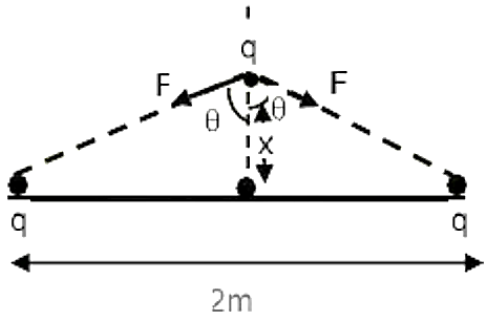
$E=-E_0\cos\left(kz+5.6\times10^3+\pi\right)$

16. Two similar charge of magnitude q are fixed at distance of 2m. And another opposite charge of same magnitude is brought at center point between two charges and given a slight displacement along equatorial direction and released then angular frequency of oscillations of opposite charge will be?(Value of $q^2=10C^2$) (Mass of opposite charge 0.2 gram)

1) $3\times10^{7}\,rad/s$ 2) $3\times10^{5}\,rad/s$ 3) $3\times10^{-5}\,rad/s$ 4) $3\times10^{6}\,rad/s$

Ans: 1

Sol:




Net force on charge is

$F_{net}=2F\cos\theta$ Here $F=\dfrac{kq^2}{\left(1+x^2\right)}$

$$F_{net}=\frac{2kq^2}{\left(1+x^2\right)}.\frac{x}{\sqrt{1+x^2}}$$

$$F_{net}=\frac{2kq^2x}{\left(1+x^2\right)^{3/2}}\because x<<1, sox^2<<<1$$

$$F_{net}=2kq^2x$$

$$ma=2kq^2x$$

$$a=\frac{2kq^2x}{m}$$

$$\omega=\sqrt{\frac{2kq^2}{m}}=\sqrt{\frac{2\times9\times10^{9}\times10}{2\times10^{-4}}}=3\times10^{7}\,rad/\sec$$

17. Water drops are falling from a tap in regular interval of time. A drop falls from the tap and after 4 second of falling, the drop is 34.3 m away from next drop. Then drops are falling at rate of (Use g=9.8m/s$^2$)

1) 1 drop in 1 sec 2) 1 drop in 7 sec 3) 1 drop in 5 sec 4) 1 drop in 6 sec

Sol: Let next drop after t sec distance travelled by Ist drop in 4 sec. is $S_1=\dfrac{1}{2}at^2=78.4m$ (t should be less then 4 sec) distance travelled by succeeding drop in 4-t sec

$$S_2=\frac{1}{2}a\left(4-t\right)^2$$

$$S_1-S_2=34.3$$

$$78.4-4.9\left(4-t\right)^2=34.3$$

$$\left(4-t\right)^2=9$$

$4-t=3$

$t=1\text{sec}$

18. In YDSE, distance between the slits are varied as $d=a+b\sin\omega t$. What will be difference between maximum and minimum fringe width?

1) $\frac{2bD\lambda}{a^2-b^2}$ 2) $\frac{4bD\lambda}{a^2-b^2}$ 3) $\frac{3bD\lambda}{a^2+b^2}$ 4) $\frac{5bD\lambda}{a^2+b^2}$

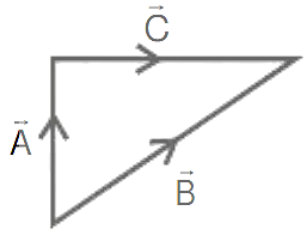
Ans: 1

Sol: Fringe width= $\frac{D\lambda}{d}$

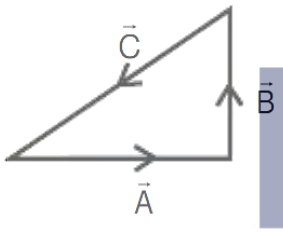
$$\beta=\frac{D\lambda}{(a+b\sin\omega t)}$$

$$\beta_{\max}-\beta_{\sin}\Rightarrow\frac{D\lambda}{a-b}-\frac{D\lambda}{a+b}\Rightarrow D\lambda\left[\frac{a+b-a+b}{a^2+b^2}\right]=\frac{2bD\lambda}{a^2-b^2}$$

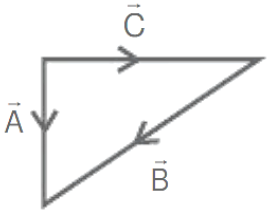
19. Match the following column.

(i) 

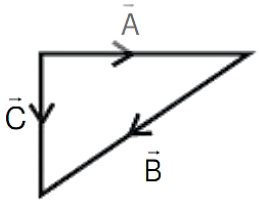

(a) $\vec{C}-\vec{A}-\vec{B}=0$

(ii) 


(b) $\vec{A}-\vec{C}-\vec{B}=0$

(iii) 


(c) $\vec{B}-\vec{A}-\vec{C}=0$

(iv) 


(d) $\vec{A}+\vec{B}+\vec{C}=0$

1) (I) c ; (II) d ; (III) b ; (IV) a

2) (I) d ; (II) c ; (III) b ; (IV) a

3) (I) c ; (ii) d ; (III) a ; (IV) b

4) (I) b ; (II) d ; (III) a; (IV) c

Ans: 1

Sol: (I) $\vec{A}+\vec{C}=\vec{B}$

(II) $\vec{A}+\vec{B}+\vec{C}=0$

(III) $\vec{A}-\vec{B}-\vec{C}=0$

(IV) $\vec{A}+\vec{B}-\vec{C}=0$

20. In a parallel plate capacitor distance between the plates is 'd'. If dielectric of variable permeability is filled as:

$\varepsilon(X)=\varepsilon_0+kx \quad ;0<x\le d/2$

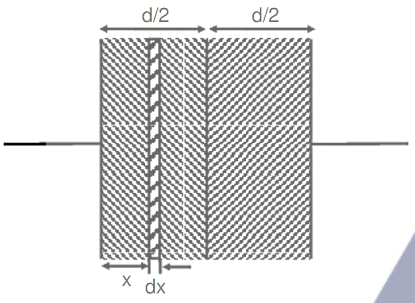
$\varepsilon(X)=\varepsilon_0+k(d-x) \quad ;d/2<x\le d$

Find capacitance?

1) $\frac{1}{Ak}\times\ell n\frac{\varepsilon_0+\frac{kd}{2}}{\varepsilon_0}$ 2) $\frac{1}{Ak}\times 2\ell n\frac{\varepsilon_0+\frac{kd}{2}}{\varepsilon_0}$ 3) $\frac{1}{Ak}\times\ell n\frac{\varepsilon_0-\frac{kd}{2}}{\varepsilon_0}$ 4) $\frac{1}{Ak}\times 2\ell n\frac{\varepsilon_0-\frac{kd}{2}}{\varepsilon_0}$

Ans: 2

Sol:




$\frac{1}{C_{eq}}\Rightarrow\int\frac{dx}{A\varepsilon}$

$\Rightarrow\int_0^{d/2}\frac{dx}{A(\varepsilon_0+kx)}+\int_{d/2}^{d}\frac{dx}{A[\varepsilon_0+k(d-x)]}$

$\Rightarrow\frac{1}{A}\left\{\frac{1}{k}\left[\ell n(\varepsilon_0+kx)\right]_0^{d/2}+\frac{1}{k}\left[\ell n(\varepsilon_0+k(d-x))\right]_{d/2}^{d}\right\}$

$\Rightarrow\frac{1}{Ak}\times 2\ell n\frac{\varepsilon_0+\frac{kd}{2}}{\varepsilon_0}$

21. The position of an object varies as $\vec{R}=10\lambda\beta t^2\hat{i}+5\beta(t-5)\hat{j}$. Find time at which angular momentum becomes same as that of at t=0, about origin?

1) 10 sec 2) 12 sec 3) 15 sec 4) 17 sec

Ans: 1

Sol: $\vec{R}=10\lambda\beta t^2\hat{i}+5\beta(t-5)\hat{j}$

$\vec{v}=20\lambda\beta t\hat{i}+5\beta\hat{j}$

$\vec{L} = m\left(\vec{r} \times \vec{v}\right)$

$\vec{L} = m\left(10\lambda\beta t^2\hat{i} + 5\beta\left(t-5\right)\hat{j}\right) \times \left(0\lambda\beta t\hat{i} + 5\beta\hat{j}\right)$

at $t = 0, \vec{L} = 0$

At any time t

$\vec{L} = m\left(50\lambda\beta^2 t\hat{k} - 100\lambda\beta^2\left(t-5\right)\right)\hat{k}$

$0 = 50m\lambda\beta^2[t - 2\left(t-5\right)\hat{k}$

$\Rightarrow t - 2t + 10 = 0$

$\Rightarrow t = 10\,\text{sec}$

22. A message signal $x_m = 10\sin\left(2\pi \times 10^5 t\right)$ is amplitude modulated with carrier signal $x_c = 20\sin\left(2\pi \times 10^7 t\right)$ then find the half of band width.

1) 100 KHz 2) 50 KHz 3) 200 KHz 4) 0 KHz

Ans: 1

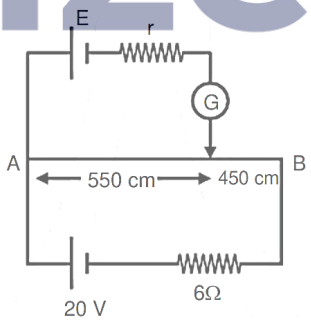
Sol: Band width $=2f_m$

$\therefore$ Half of bandwidth$=f_m$

$= 10^5\,Hz$

$= 100KHz$

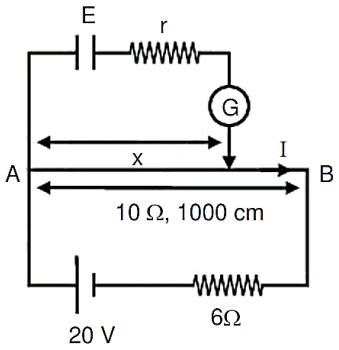
23. Circuit shown is in the balanced state in which galvanometer shows non-deflection. Given that wire AB gas $0.01\Omega/cm$ of resistance. Find maximum possible value of voltage that can be measured by this se up.




1) 10.5 V 2) 12.5 V 3) 13.5 V 4) 15.5 V

Ans: 2

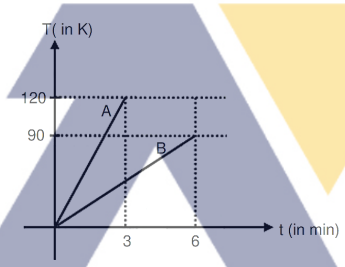
Sol: At zero deflection




The maximum value of E that can be measured $=V_{AB}$

$$V_{AB}=\frac{20}{10+6}\times 10=12.5V$$

24. The temperature vs time graph for two different gases A and B having same number of moles is as shown in figure. If heat is supplied by same rate both the gases, then find the ratio of specific heat capacity of both the gases?




Ans: 1

Sol: $Q=nC\Delta T$

$$\frac{dQ}{dt}=nC\frac{dT}{dt}$$

Rate of heat is same for both gases

So, $n_1C_1\left(\frac{dT}{dt}\right)_1=n_2C_2\left(\frac{dT}{dt}\right)_2$

$$\frac{C_1}{C_2}=\frac{\left(\frac{dT}{dt}\right)_2}{\left(\frac{dT}{dt}\right)_1}=\frac{\frac{90}{6}}{\frac{120}{3}}=\frac{90\times 3}{120\times 6}=\frac{3}{8}$$

25. For a magnetic material, the relative change in magnetic susceptibility is equal to $2.2\times10^{-4}$. Find the percentage change in magnetic field?

1) 0.012 2) 0.025 3) 0.022 4) 0.028

Ans: 3

Sol: $\mu_r=1+\chi$

$\Delta\mu r=\Delta\chi$

Also $B\propto\mu r$

$B = k\mu r$ (k=constant)

$$\% \text{ change } = \frac{\Delta B}{B} \times 100 = \frac{k(\Delta \mu_r)}{k\mu_r} \times 100$$

$$= \frac{2.2 \times 10^{-4}}{1} \times 100 = 0.022\%$$

26. A ray incident at an angle $30^0$ on the interface of diamond and vacuum from the diamond side then which of following is incorrect (given $\mu_{diamond} = 2.42$)

1) The incident of ray will get refracted

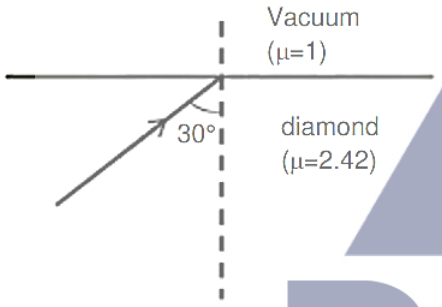
2) The ray will not get refracted if incident at $53^0$

3) The ray will get refracted if incident at $22^0$

4) There is always TIR for angle greater then $30^0$

Ans: 1

Sol:




Critical angle $C = \sin^{-1}\left(\frac{1}{2.42}\right) = 24.4^0$

Given incident angle $30^0 > C$

So there is TIR at interface

27. A monoatomic gas filled in a piston cylinder arrangement, its temperature changes from $T_1$ to $T_2$ and length of gas column changes from $L_1$ to $L_2$, against atmosphere. Then the ratio of $T_1 / T_2$ :

1) $\left(\frac{L_2}{L_1}\right)^{2/3}$ 2) $\left(\frac{L_1}{L_2}\right)^{2/3}$ 3) $\left(\frac{L_2}{L_1}\right)$ 4) $\left(\frac{L_1}{L_2}\right)$

Ans: 4

Sol: $PV = nRT$

at constant atmospheric pressure

$$\frac{T_1}{T_2} = \frac{v_1}{v_2}$$

$$\frac{T_1}{T_2} = \frac{AL_1}{AL_2}$$

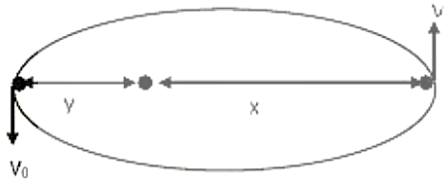
$$\frac{T_1}{T_2}=\frac{L_1}{L_2}$$

28. A particle is revolving around a planet with maximum distance x and minimum distance y. If maximum velocity of particle is $v_0$ then find minimum velocity of particle:

1) $\frac{v_0 x}{y}$ 2) $\frac{v_0 y}{x}$ 3 $\frac{v_0 x^2}{y^2}$ 4) $\frac{v_0 y^2}{x^2}$

Ans: 2

Sol:




By angular momentum conservation

$$mv_0 y = mvx$$

$$v=\frac{v_0 y}{x}$$

29. A radioactive material of mass number 198 decays with half-life of 3 days. If initial amount of radioactive material is 2 mg, then its initial activity will be?

1) $1626\times10^5\,dps$ 2) $1626\times10^{10}\,dps$ 3) $1626\times10^8\,dps$ 4) $1626\times10^6\,dps$

Ans: 2

Sol: No. of nuclei $=\frac{m}{M}.N_A=\frac{2\times10^{-3}}{198}\times6.02\times10^{23}$

$$A_0=\lambda N_0=\frac{0.693}{3\times24\times60\times60}\times\frac{2\times10^{-3}}{198}\times6.02\times0^{23}$$

$1625\times10^{-8}\times10^{18}$

$1626\times10^{18}\,dps$

30. Based on given statement choose the correct option

Statement I: For a disc situated in x-y plane. The radius of gyration is same for x-axis, y-axis and z-axis.

Statement II: In case of rigid body motion there is no change in shape and mass.

1) Statement 1 & 2 both are true

2) Statement-1 & 2 both are true statemenr-2 is correct explant of statement-1

3) Statement-1 is false statement-2 is true

4) Statement-2 is true statement-1 is false.

Ans: 3