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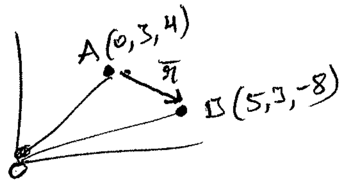
51) $\frac{L}{P} = \frac{mvr}{mv} = r \rightarrow$ Dimensions $[M^0L^1T^0]$ [2]

52) $1\,fm = 10^{-15}$ meter [3]

53) 

$\bar{r} = \overline{AB} = \overline{OB} - \overline{OA}$

$= (5-0)\hat{i} + (3-3)\hat{j} + (-8-4)\hat{k}$ [3]

$\bar{r} = 5\hat{i} - 12\hat{k}$

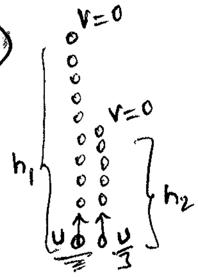
distance $|\bar{r}| = \sqrt{5^2+12^2} = 13$

54) parallel → same ratios in All directions. [2]

$\frac{6}{5} = \frac{x}{-6} = \frac{-2}{-y} \Rightarrow x = \frac{-36}{5}, \; y = \frac{5}{3}$

55) $a = \frac{v}{t} \rightarrow t = \frac{v}{a} = \frac{3U/4}{a}$ [1]

$t = \frac{3U}{4a}$

56) 

$H_{max} = \frac{U^2}{2g}$ [1]

$h_1 = \frac{U^2}{2g}, \quad h_2 = \frac{(U/3)^2}{2g} = \frac{U^2}{9(2g)} \Rightarrow h_2 = \frac{h_1}{9}$ [1]

57) $R = 4\sqrt{3}\, H_{max} \rightarrow \frac{U^2 \sin 2\theta}{g} = 4\sqrt{3} \times \frac{U^2 \sin^2\theta}{2g}$

$\rightarrow 2\sin\theta\cos\theta = 2\sqrt{3} \times \sin^2\theta$

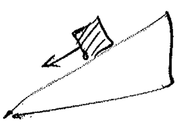
$\rightarrow \cos\theta = \sqrt{3}\sin\theta \rightarrow \tan\theta = \frac{1}{\sqrt{3}} \rightarrow \theta = 30^\circ$ [3]

58) $R = 30, \; \theta = 15^\circ$

$R = ?, \; \theta = 45^\circ$

$R = \frac{U^2 \sin 2\theta}{g} \rightarrow R \propto \sin 2\theta$

$\frac{R_1}{R_2} = \frac{\sin 2(15^\circ)}{\sin 2(45^\circ)} \rightarrow \frac{30}{R_2} = \frac{1/2}{1} \Rightarrow R_2 = 60\,m$ [4]

59) 

$a = g(\sin\theta - \mu\cos\theta)$ decreases. [3]

60) $\alpha = \lambda$ both are same. [4]

61) Work done $W = FS\cos\theta$, mass of wall is infinite (very large)

so, it does not moved.

$S = 0 \rightarrow W = 0 \rightarrow$ workdone by the ball. [3]

62) Power $P_0 = F \times V \longrightarrow P_0 = \frac{1}{2} A \rho v^2 \times v$

$P_0 = \frac{1}{2} A \rho v^3$

Pressure $P = \frac{F}{A} = \frac{1}{2}\rho v^2$

$F = \frac{1}{2} A \rho v^2$

A → pipe Area

ρ → density (water)

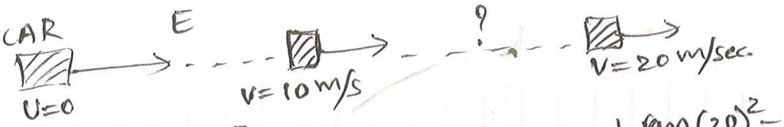
v → flow rate (velocity).

Power of Motor $P_0 \propto v^3$

To obtain thrice water, the velocity → $3v$

∴ power $P_0 \rightarrow (3v)^3 \rightarrow 27 v^3$

becomes 27 times.

63) 

[2]

$W = \Delta K.E$

$W = \frac{1}{2}mV^2 - \frac{1}{2}mU^2$

$E_1 = \frac{1}{2}m(10)^2 - \frac{1}{2}m(0)^2$

$E_1 = 50\,m$

$E_2 = \frac{1}{2}m(20)^2 - \frac{1}{2}m(10)^2$

$E_2 = 200m - 50m$

$= 150m$

$E_2 = 3\times 50m = \underline{3E_1}$.

64) Time period with variable lengths $T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{l}+\frac{1}{R}\right)}}$ [1]

$l = \infty \longrightarrow T = 2\pi\sqrt{\frac{1}{g\left(0+\frac{1}{R}\right)}} \longrightarrow T = 2\pi\sqrt{\frac{R}{g}}$.

65) [4]

$V = W\sqrt{A^2 - x^2} \longrightarrow V = \frac{2\pi}{T}\sqrt{A^2 - x^2}$

$V = \frac{2\times 3}{3}\sqrt{5^2 - 4^2} = 2\sqrt{9} = 2\times 3 = 6\,cms^{-1}$

66) [1]

$V_{max} = AW$

$V = \alpha W$

$\underline{A = \alpha}$

$x = \frac{\alpha}{2}, V_2 = ?$

$V_2 = W\sqrt{A^2 - x^2}$

$= \omega\sqrt{\alpha^2 - \left(\frac{\alpha}{2}\right)^2} = W\sqrt{\frac{3\alpha^2}{4}}$

$V_2 = \frac{\sqrt{3}}{2}W\alpha = \frac{\sqrt{3}}{2}V = \underline{0.866\,V}$.

67) Here sounded on a car, and asked echo as heard by the car. [1]
so there is two calculations.

$n' = \left(\frac{V \pm V_0}{V \mp V_s}\right)n$

$n' = \left(\frac{V+V_0}{V}\right)n = \left(\frac{330+18}{330}\right)\times 1000$

$n' = \frac{348}{330}\times 1000 = 1054$ Hz.

Now $n'' = \left(\frac{V}{V-V_s}\right)\times n = \left(\frac{330}{330-18}\right)\times 1054 = \frac{330}{312}\times 1054$

$n'' = 1114.8$ Hz $= 1115$ Hz.

[2]

68) open window is perfect sound Absorber

69) [1]

$P^2V = \text{constant}$

$PV^{1/2} = \text{constant} \longrightarrow PV^{\gamma} = \text{constant} \longrightarrow \gamma = \frac{1}{2}$

similarly $TV^{\gamma-1} = \text{constant} \longrightarrow \frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$

$\longrightarrow \frac{T_0}{T_2} = \left(\frac{2V_0}{V_0}\right)^{\frac{1}{2}-1} \longrightarrow \frac{T_0}{T_2} = 2^{-1/2} = \frac{1}{\sqrt{2}}$

$\longrightarrow T_2 = \sqrt{2}\,T_0$

[1]

70) ideal gas $PV = nRT \longrightarrow R$ = Universal gas constant
$R = 8.314$ for any gas.

71) For mono atomic gas $C_V = \frac{f}{2}R$, f = degrees of freedom [3]
$f = 3$ translational Motion.

$C_V = \frac{3}{2}R$

and $C_P - C_V = R \longrightarrow C_P = \frac{3}{2}R + R = \frac{5}{2}R$

specific heat ratio $\frac{C_P}{C_V} = \gamma \longrightarrow \gamma = \frac{5/2\,R}{3/2\,R}$

$\gamma = \frac{5}{3}$

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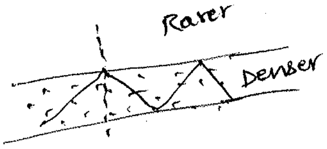
72) work done is more in isothermal process because in isothermal, the heat is given by surrounding for workdone. [2]
in Adiabatic, heat = constant

73) $Q \propto m$ $\rightarrow Q = c\,m\,dT$ [4]
$Q \propto dT$ $\rightarrow Q = 830 \frac{J}{kg.°C} \times \frac{1}{2}\ kg \times 60°C$
$\rightarrow Q = 415\ J \times 60 = 24900\ J.$

74) [1]



Denser to rarer &
$i > i_c$