AP-ECET-2025 - PHYSICS SOLUTIONS (common)

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CIVIL Engg & EEE

51) power $P \propto F^x V^y L^z$

power $= \frac{W}{t} \rightarrow$ watt $\rightarrow \frac{kg\, m^2}{sec^2} \rightarrow M^1L^2T^{-3}$

Force $F = ma \rightarrow$ Newton $\rightarrow kg \times \frac{m}{sec^2} \rightarrow M^1L^1T^{-2}$

Length $\rightarrow$ metre $\rightarrow M^0L^1T^0$, velocity $\rightarrow m/sec \rightarrow M^0L^1T^{-1}$

$$[M^1L^2T^{-3}] = \text{Constant} \times [M^1L^1T^{-2}]^x \times [L^1T^{-1}]^y \times [L^1]^z$$

[1]

$$[M^1L^2T^{-3}] = [M^x][L^{x+y+z}][T^{-2x-y}]$$

Compare the powers on bothside.

$x = 1$, $x+y+z = 2$, $-2x-y = -3$

$1+1+z = 0$ $\quad -2-y = -3$

$z = 0.$ $\quad y = 1.$

$\therefore P \propto F^1 V^1 L^0$

52] Torque = Force × radius $\rightarrow kg \times m^2/sec^2$

Momentum = mass × velocity $\rightarrow kg \times \frac{m}{sec}$ } ≠

[3]

Surface Tension $= \frac{\text{Force}}{\text{Length}} \rightarrow kg/sec^2$

Tension $\rightarrow kg \times m/sec^2$ } ≠

Pressure $= \frac{\text{Force}}{\text{Area}} \rightarrow kg/m \times sec^2$

Modulus of elasticity $= \frac{\text{stress}}{\text{strain}} = \frac{\text{Force/Area}}{\text{strain}} \rightarrow \frac{kg/m \times sec^2}{1}$ } = ✓

Force constant $= \frac{\text{Force}}{\text{displacement}} \rightarrow kg/sec^2$

planck constant $= \frac{\text{energy}}{\text{frequency}} \rightarrow \frac{kg \times m^2/sec^2}{1/sec} \rightarrow kg \times \frac{m^2}{sec}$ } ≠

53] $\bar{A} + \bar{B} = \bar{C}$ and $A^2 + B^2 = C^2$

[3]

↳ Apply parallelogram Law $|\bar{A}+\bar{B}| = |\bar{C}|$

$$\sqrt{A^2+B^2+2AB\cos\theta} = \sqrt{C^2}$$

$$A^2+B^2+2AB\cos\theta = C^2$$

$$\cancel{C^2} + 2AB\cos\theta = \cancel{C^2} \rightarrow 2AB\cos\theta = 0 \rightarrow \theta = 90^\circ$$

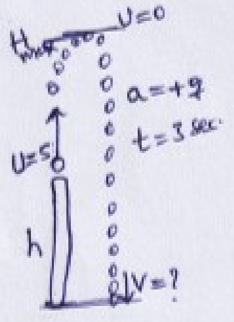
54) rectangle $\bar{B}$ $\boxed{90^\circ}$ $\bar{A}$ $\rightarrow$ Area $|\bar{A}\times\bar{B}| = |\bar{A}||\bar{B}|\sin 90^\circ$

[1]

$$|\bar{A}\times\bar{B}| = \sqrt{3^2+4^2} \times \sqrt{1^2+3^2} \times (1)$$

$$= \sqrt{25} \times \sqrt{10}$$

$$= 5\sqrt{10}$$

55) 

final velocity to reach ground from Max height is

$$v^2 - u^2 = 2aS$$

$u=0$, $a = +g = +10$, $S = h + H_{max}$

[3]

$$v^2 - 0 = 2gS \rightarrow v = \sqrt{2gS}$$ ✓

here $H_{max} = \frac{u^2}{2g} = \frac{5^2}{2\times10} = \frac{25}{20} = \frac{5}{4}$

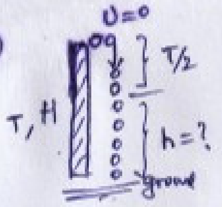
Tower height $h = -ut + \frac{1}{2}gt^2 = -5\times3 + \frac{1}{2}(10)(3)^2$

$= -15 + 45$

$h = 30$

$$\therefore v = \sqrt{2gS} = \sqrt{2\times10\times\left(\tfrac{5}{4}+30\right)}$$

$$v = \sqrt{20\times\frac{125}{4}} = \sqrt{5\times125} = \sqrt{25\times25} = 25\ m/sec.$$

56) 

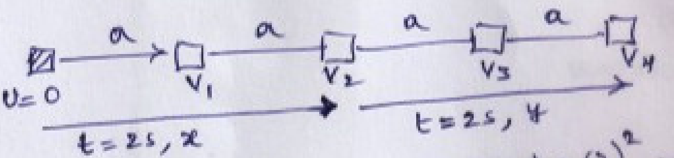
$S = Ut + \frac{1}{2}at^2$ [3]

$H = 0 + \frac{1}{2}gT^2 \longrightarrow$ Total T seconds.

in $\frac{T}{2}$ secs $\rightarrow$ distance moved from height is $= \frac{1}{2}g\left(\frac{T}{2}\right)^2$

$= \frac{1}{2}g\,T^2/4 \rightarrow \frac{H}{4}$

$\therefore$ height of the body from ground $h = H - \frac{H}{4} = \frac{3H}{4}$

57) 

[3]

$S = Ut + \frac{1}{2}at^2 \longrightarrow x = 0 + \frac{1}{2}a(2)^2 \longrightarrow x = 2a$

$x + y = 0 + \frac{1}{2}a(4)^2$

$x + y = 8a \longrightarrow 2a + y = 8a$

$\longrightarrow y = 6a \longrightarrow \underline{y = 3x}.$

[1]

58) 

n balls per sec $\rightarrow$ frequency

time $t = \frac{1}{n}$ secs. $\quad V = U + at \rightarrow 0 = U - gt \rightarrow t = \frac{U}{g}$

$\rightarrow \frac{1}{n} = \frac{U}{g} \rightarrow U = \frac{g}{n}$

$V^2 - U^2 = 2aS \rightarrow 0 - U^2 = -2gh$

$\rightarrow h = \frac{U^2}{2g} = \frac{(g/n)^2}{2g} = \frac{g}{2n^2}$

59) $F = ma, \; a = -g(\sin\theta + \mu\cos\theta)$ [2]

'a' increases.

$\therefore |F| = mg(\sin\theta + \mu\cos\theta).$

60) $S = Ut + \frac{1}{2}gt^2 \rightarrow l = 0 + \frac{1}{2}g(4)^2 \rightarrow l = 8g.$ [2]

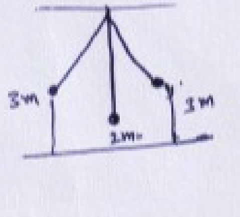
$S = 0 + \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2S}{g}}$ now $S = \frac{l}{4} = 2g \longrightarrow t = \sqrt{\frac{2\times 2g}{g}} = 2$ sec.

61) $W = \Delta K.E = \frac{1}{2}mV^2 - \frac{1}{2}mU^2 = \frac{1}{2}m(V^2 - U^2)$ [1]

$m = 2\,kg, \; U = \sqrt{3^2+4^2} = 5, \quad V = \sqrt{6^2+2^2} = \sqrt{40}$

$\therefore \quad \Delta K.E = \frac{1}{2}\times 2 \times (40 - 25) = 15$ Joules.

[3]

62) 

$\left.\begin{array}{l} h_1 = 2m. \\ h_2 = 3m \end{array}\right\} \Delta h = 1m..$

At middle $\rightarrow$ Max K.E = Min P.E

$\rightarrow$ K.E gained = P.E loss [energy conservation]

$\rightarrow \frac{1}{2}mv^2 = mgh$

$\rightarrow v = \sqrt{2gh} = \sqrt{2g\times 1} = \sqrt{2\times 9.8} = \sqrt{17.6}$ m/sec

63) $\eta = \frac{O/P}{I/P} \rightarrow 80\% = \frac{P_{out}}{P_{in}}$ [3]

$\rightarrow \frac{80}{100} = \frac{1000}{P_{in}} \longrightarrow P_{in} = \frac{1000\times 100}{80}$

$= \frac{10000}{8} = 1250$ Watts.

64) $T = 2\pi\sqrt{\frac{l}{g}} \longrightarrow T \propto \frac{1}{\sqrt{g}}$ [4]

$\longrightarrow \frac{T_2}{T_1} = \sqrt{\frac{g_1}{g_2}}$ Now $g_2 = g_1/2$

$\longrightarrow T_2 = \sqrt{\frac{g_1}{g_1/2}}\, T_1 \longrightarrow T_2 = \sqrt{2}\, T_1$

Seconds pendulum $T_1 = 2\,sec \longrightarrow \therefore T_2 = 2\sqrt{2}$ sec.

65) $V = \omega\sqrt{A^2 - x^2}$, $V_{max} = A\omega$ [4]

find x, at $\frac{V_{max}}{2} \longrightarrow \frac{V_{max}}{2} = \omega\sqrt{A^2 - x^2}$

$\longrightarrow \frac{A\omega}{2} = \omega\sqrt{A^2 - x^2}$

$\longrightarrow \frac{A^2}{4} = A^2 - x^2 \longrightarrow x^2 = A^2 - \frac{A^2}{4} = \frac{3A^2}{4}$

$\longrightarrow x = \frac{\sqrt{3}A}{2}$

66) $x = 3\sin 2t + 4\cos 2t$ [4]

General SHM form $\longrightarrow x = A\sin(2t + \phi)$

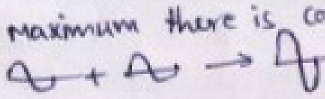
$x = A\sin 2t\cos\phi + A\cos 2t\sin\phi$

$\therefore A\cos\phi = 3$, $A\sin\phi = 4 \implies A^2(1) = 3^2 + 4^2$

$\implies A = \sqrt{25} = 5$

67) Intensity of sound $I \propto A^2$ [3]

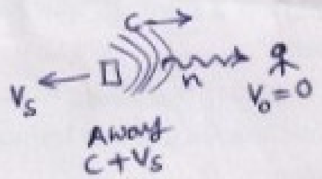
At maximum there is constructive interference produces beats.



i.e $\implies I \propto (2A)^2$

$\implies I \propto 4A^2 \longrightarrow$ 4 times increase.

68) [3]

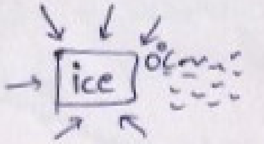


$n' = \left(\frac{c}{c + V_s}\right) n$

$= \left(\frac{340}{340 + 30}\right) \times 800$

$= \frac{340 \times 800}{370} = 735$ HZ.

69) [2]



work by Surrounding on system
(+ve) (Atmosphere) (ice)

70) Thermodynamic 1st Law for compressed gas is [1]

$dQ = du + dw = dU + P\,dv = dU + P(V_2 - V_1)$

$100 = dU + 50(4 - 10)$

$100 = dU + (-300) \longrightarrow dU = 400$ Joule.

71) $V_1 = 10$ litre ideal gas [1]

$P_1 = 760$ mm of Hg.

V_2 = added 9 litre evacuated vessel

$= 10 + 9 = 19$ litre gas.

$P_2 = ?$

$P_1 V_1 = P_2 V_2$

$P_2 = \frac{P_1 V_1}{V_2} = \frac{760 \times 10}{19}$

$P_2 = 400$ mm of Hg

72)  Jar with water (full)
its temperature is decreased to $0^\circ C \longrightarrow$ Freeze. (water into ice) [4]
$\longrightarrow$ Jar will break.

73)
$P_1 = 90 + 10 = 100$ m
$P_2 = 10$ m
$V_2 = - V_1$

$P_1 V_1 = P_2 V_2 \Rightarrow 100 V_1 = 10 V_2$ [3]
$\Rightarrow V_2 = 10 V_1 \longrightarrow$ 10 times

74) internal parts can be ~~vei~~viewed by the principle of [4]
Total internal Reflection.

75) $\lambda = 5000\,A^\circ = 5000 \times 10^{-10} = 5 \times 10^{-7}$ m [1]
$W = 1.9$ eV
$K.E = ?$

$h\vartheta = h\vartheta_0 + K.E$
$\frac{hc}{\lambda} = W + K.E$
$\frac{6.625 \times 10^{-34} \times 3 \times 10^{8}}{5 \times 10^{-7}}$ Joule $= 1.9$ eV $+ K.E$
$\frac{3.975 \times 10^{-19}}{1.6 \times 10^{-19}}$ eV $= 1.9$ eV $+ K.E$
2.484 eV $= 1.9$ eV $+ K.E$
$K.E = 0.584$ eV

$\boxed{\text{ECE \& MECH}}$

ECE-51) $P = \frac{F}{A} \rightarrow \frac{Kg \times m/s^2}{m^2} \rightarrow \frac{Kg}{m \times sec^2} \longrightarrow \frac{1}{1 \times (60)^2} \Longrightarrow \frac{1}{3600}$ N/m² [3]

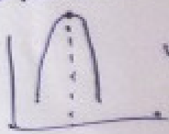
ECE-52) Impulse $\rightarrow$ Force × time $\rightarrow [M^1 L^1 T^{-2}] \times [T^1] \rightarrow [M^1 L^1 T^{-1}]$ [3]

ECE-53) $|\bar{A} \times \bar{B}| = \sqrt{3}\, \bar{A} \cdot \bar{B}$ then $|\bar{A} + \bar{B}| = ?$ [1]
$\cancel{AB} \sin\theta = \sqrt{3}\, \cancel{AB} \cos\theta$
$\tan\theta = \sqrt{3}$
$\theta = 60^\circ$

$|\bar{A} + \bar{B}| = \sqrt{A^2 + B^2 + 2AB\cos 60^\circ}$
$= \sqrt{A^2 + B^2 + 2AB \times \frac{1}{2}}$
$= \sqrt{A^2 + B^2 + AB}$

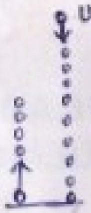
54) Try for common factor. [1]
$\bar{A} = 6\hat{i} + 8\hat{j} = 2(3\hat{i} + 4\hat{j}) \longrightarrow \bar{A} = 2\bar{x}$
$\bar{c} = 5.1\hat{i} + 6.8\hat{j} = 1.7(3\hat{i} + 4\hat{j}) \longrightarrow \bar{c} = 1.7\bar{x}$
$\therefore \bar{A}$ & $\bar{c}$ are parallel.

55) $x = 9t^2 - t^3$ [3]
velocity $v = 18t - 3t^2 \longrightarrow$ Parabola
at $t = 3$ sec it has Max velocity.



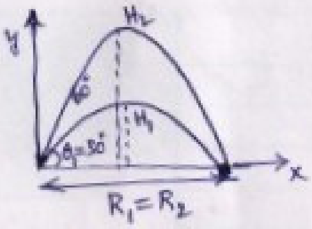
$t = 0 \rightarrow v = 0$
$1 \rightarrow v = 15$
$2 \rightarrow v = 24$
$t = 3 \rightarrow v = 27$ Max
$4 \rightarrow v = 24$
$5 \rightarrow v = 15$
$6 \rightarrow v = 0$

~~$V_{max} = 18 \times 3 - 3(3)^2$~~
here the displacement $x = 9(3)^2 - (3)^3 = 81 - 27 = 54$ m

56) 

$V = U + at \rightarrow up \rightarrow V_1 = 40 - gt$ } velocities after 't' sec.
$down \rightarrow V_2 = 0 + gt$ [2]

$V_1 = V_2 \rightarrow 40 - gt = gt$
$2gt = 40, \; g = 10\, m/s^2$
$t = \frac{40}{20} = 2$ sec

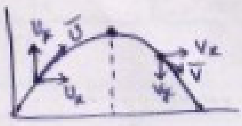
57) 

$R_1 = R_2 \rightarrow$ is possible for $\underset{\theta_2}{60°}$ & $\underset{\theta_1}{30°}$ [4]

$\hookrightarrow \frac{U_1^2 \sin 2\theta_1}{g} = \frac{U_2^2 \sin 2\theta_2}{g}$
$U_1^2 \cancel{\sin 60°} = U_2^2 \cancel{\sin 120°} \rightarrow U_1^2 = U_2^2$

and $H_2 = \frac{U_2^2 \sin^2\theta_2}{2g} = 102 \rightarrow \frac{U_2^2}{2g} \times \frac{3}{4} = 102 \rightarrow \frac{U_1^2}{2g} = \frac{408}{3}$
$\rightarrow \frac{U_2^2}{2g} = \frac{408}{3}$

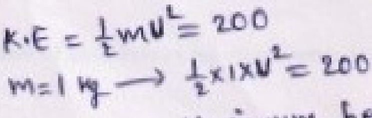
$\therefore H_1 = \frac{U_1^2 \sin^2\theta_1}{2g} = \frac{408}{3} \times \sin^2 30° =$
$= \frac{408}{3} \times \frac{1}{4} = \frac{102}{3} = 34$ m.

58) 

$\bar{U} = U_x \hat{i} + U_y \hat{j} = U\cos\theta \hat{i} + U\sin\theta \hat{j}$ [1]
$\bar{V} = V_x \hat{i} + V_y \hat{j} = U\cos\theta \hat{i} + (U\sin\theta - gt)\hat{j}$
No gravity along x-axis.

perpendicular $\bar{U} \cdot \bar{V} = 0 \rightarrow U_x V_x + U_y V_y = 0$
$\rightarrow U^2\cos^2\theta + U\sin\theta(U\sin\theta - gt) = 0$
$\rightarrow U^2(\cos^2\theta + \sin^2\theta) - U\sin\theta \times gt = 0$
$\rightarrow U^2 = U\sin\theta \times gt$
$\rightarrow t = \frac{U}{g\sin\theta}$

59) [1]
Front wheel $\rightarrow$ Friction is backward
Rear wheel $\rightarrow$ " " Forward

60) 

[2]
$F = ma, \; a = \mu g = 0.5 \times 10 = 5$
$F = (4+2) \times 5 = 30$ Newton.

61) Power $= \frac{W}{t} = \frac{mgh}{t} \rightarrow \frac{m}{t} = \frac{P}{gh} = \frac{10^6 \text{ watt}}{10 \times 10 \text{ m}\; m/sec^2} = 10^4$ kg/sec [2]

62) $K.E = \frac{1}{2}mU^2 = 200$ [3]
$m = 1\,kg \rightarrow \frac{1}{2} \times 1 \times U^2 = 200 \rightarrow U^2 = 400 \rightarrow U_x = 20\, m/s$ horizontal velocity.
Maximum height $H_m = \frac{U_y^2}{2g} \Rightarrow 20 = \frac{U_y^2}{2 \times 10} \rightarrow U_y^2 = 400 \rightarrow U_y = 20$ m/s vertical velocity.

$\therefore$ $U\cos\theta = 20$, $U\sin\theta = 20$ } $\rightarrow U^2(\cos^2\theta + \sin^2\theta) = 20^2 + 20^2$
$\rightarrow U^2(1) = 800$
$\rightarrow U = \sqrt{800} = \sqrt{400 \times 2} = 20\sqrt{2}$ m/sec.

(or) $U = \sqrt{U_x^2 + U_y^2} = \sqrt{20^2 + 20^2} = 20\sqrt{2}$ m/sec.

63) $P=\frac{W}{t}=\frac{\Delta K.E}{t}=\frac{\frac{1}{2}m(v^2-u^2)}{t}$ [2]

$$=\frac{\frac{1}{2}\times 2.05\times10^6\times(25^2-5^2)}{5\times60}$$

$$=\frac{2.05\times10^6\times600}{600}\rightarrow 2.05\times10^6 \text{ Watt.}\rightarrow 2.05 \text{ MW.}$$

64) $n=\frac{1}{2\pi}\sqrt{\frac{g}{l}}\rightarrow n\propto\sqrt{T}\rightarrow\frac{n_1}{n_2}=\sqrt{\frac{T_1}{T_2}}$ now $T_2=T_1+21\%\,T_1=1.21\,T_1$ [2]

$$\rightarrow\frac{100}{n_2}=\sqrt{\frac{T_1}{1.21T_1}}\rightarrow\frac{100}{n_2}=\frac{1}{1.1}\Rightarrow n_2=110\text{ Hz}$$

∴ beats $\Delta n=|n_1\sim n_2|=|100-110|=10$ Hz

[4]

65) $\left.\begin{array}{l}v_{max}=r\omega=1\\ a_{max}=r\omega^2=4\end{array}\right\}\ \omega=4\rightarrow\ \therefore r\omega=1$

$$r=\frac{1}{\omega}=\frac{1}{4}=0.25$$

[3]

66) $n_1=\frac{1}{4}\rightarrow T_1=4$ sec for length l_1 $\rightarrow T=2\pi\sqrt{l/g}$

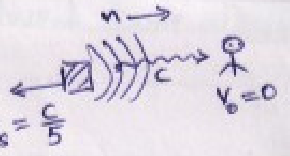
$n_2=\frac{1}{3}\rightarrow T_2=3$ sec " " l_2

$$\left.\begin{array}{l}4=2\pi\sqrt{\frac{l_1}{g}}\rightarrow l_1=\frac{16g}{4\pi^2}\\ 3=2\pi\sqrt{\frac{l_2}{g}}\rightarrow l_2=\frac{9g}{4\pi^2}\end{array}\right\}\ l_1-l_2=\frac{7g}{4\pi^2}$$

Now T for l_1-l_2 is $T=2\pi\sqrt{\frac{l_1-l_2}{g}}=2\pi\sqrt{\frac{7g}{g\times4\pi^2}}$

$$T=2\pi\sqrt{\frac{7}{4\pi^2}}=\sqrt{7}\text{ sec.}$$

[4]

67) 

$n'=\left(\frac{c}{c+v_s}\right)n$ here $n=\frac{c}{\lambda_s}$, $n'=\frac{c}{\lambda'}$ or $\frac{c}{\lambda_{observer}}$

$$\frac{c}{\lambda'}=\left(\frac{c}{c+\frac{c}{5}}\right)\times\frac{c}{\lambda}$$

$$\frac{c}{\lambda'}=\frac{5c}{6c}\times\frac{c}{\lambda}\rightarrow\frac{1}{\lambda'}=\frac{5}{6\lambda}$$

$$\rightarrow\lambda'=\frac{6\lambda}{5}=\frac{6\times50}{5}=60\text{cm.}$$

[4]

68) Good sound → low Reverberation

[2]

69) $P_2=P_1+0.5\%\,P_1=P_1+0.005\,P_1=1.005\,P_1$

$T_2=T_1+2$

$$\frac{P_1}{T_1}=\frac{P_2}{T_2}\Rightarrow\frac{P_1}{T_1}=\frac{1.005P_1}{T_1+2}$$

$$\Rightarrow T_1+2=1.005\,T_1\rightarrow T_1=\frac{2}{0.005}=\frac{2000}{5}=400\text{ K}$$

$$\Rightarrow 0.005\,T_1=2\rightarrow T_1=400\text{ K}-273\text{ K}=127^\circ\text{C}$$

[1]

70) Expansion → P, V changes
→ T is constant.

71) Specific heat $C_V = 0.075$ cal/gm/K [1]

Molar specific heat $C_{V(mol)} = 3$ cal/mol/K

$M C_V = 3 \rightarrow M = \frac{3}{0.075} = 40$ gm/mole

$M = \frac{40 \text{ gm/mole}}{6.023 \times 10^{23} \text{ molecules/mole}}$

$\underline{M = 6.64 \times 10^{-23} \text{ gm.}}$

[2]

72) for diatomic gas $\gamma = \frac{C_P}{C_V} = \frac{2}{5}$.

[3]

73) $\eta = \frac{W}{Q_H} = \frac{1}{10} \rightarrow \frac{10}{Q_H} = \frac{1}{10} \rightarrow Q_H = 100$ Joules.

workdone $W = 10$ J, $Q_H = Q_C + W$

$100 = Q_C + 10 \rightarrow Q_C = 90$ Joule.

74) $h\nu = W + K.E$ [4]

$2.5 = 1.5 + \frac{1}{2} m v_1^2 \rightarrow \frac{1}{2} m v_1^2 = 1$ eV

$3.5 = 1.5 + \frac{1}{2} m v_2^2 \rightarrow \frac{1}{2} m v_2^2 = 2$ eV

$\Rightarrow \frac{v_1^2}{v_2^2} = \frac{1}{2} \rightarrow v_1 : v_2 = 1 : \sqrt{2}$

[2]

75) critical angle $i = i_c$, $\underline{r = 90^\circ}$.