ECET-PHYSICS - solutions

CIVIL-2023

51) $\rightarrow$ $F = \frac{b-x}{at}$ Homogeneity principle $\rightarrow$ All terms have same UNITS [3]

$F \rightarrow$ force
$x \rightarrow$ distance
$t \rightarrow$ time
$\frac{b}{a} \rightarrow$?

$$F = \frac{b}{at} - \frac{x}{at}$$

Force = Force - Force.

$\therefore$ Force $= \frac{b}{a \times time} \longrightarrow \frac{b}{a} \rightarrow$ Force $\times$ time.

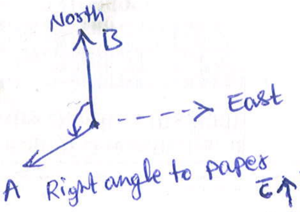
$\rightarrow kg \times \frac{m}{sec^2} \times sec$

$\frac{b}{a} \rightarrow kg \times \frac{m}{sec} \longrightarrow$ Momentum.

52) $\rightarrow$ $\mu_s > \mu_k > \mu_r$ [2]

static > Dynamic > Rolling.

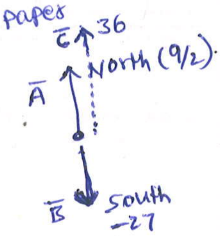
53) $\rightarrow$ [2]



54) $\rightarrow$ $\bar{A} = \frac{9}{2}$ to North [3].

$\bar{B} = -6\bar{A} = -6 \times \frac{9}{2}$
$= -27$

$\bar{C} = 8\bar{A} = 8 \times \frac{9}{2}$
$= 36$



-27 towards South, 36 towards North

55) $\theta = 2t + 3t^2$, $\omega = \left(\frac{d\theta}{dt}\right)_{t=2} = (2+6t)_{t=2} = 2+6(2)$ [4]

$\omega = 14$ Radians/second.

56) $a = \frac{dv}{dt}$ $v = 40 m/s$ constant velocity. [3]

$\frac{dv}{dt} = 0 \rightarrow a = 0\ ms^{-2}$

57) Hooke's Law $\rightarrow$ stress $\propto$ strain [2]

stress = K. strain.

$\frac{F}{A} = K \cdot \frac{\Delta l}{l} \Rightarrow$ F = same force, l = same length.

$r_1 : r_2 = 1:3$

$\Delta l_1 : \Delta l_2 = ?$

$\therefore \Delta l \propto \frac{1}{A} \Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{A_2}{A_1} = \frac{\pi r_2^2}{\pi r_1^2}$

$\frac{\Delta l_1}{\Delta l_2} = \left(\frac{3}{1}\right)^2 = \frac{9}{1} \longrightarrow 9:1$

58) Stream line flow (Laminar) $\rightarrow$ velocity is constant. [3]

Turbuline flow $\rightarrow$ velocity of particles varies.

59) $\rightarrow$ Mayor's equation $C_p - C_v = R$ [1]

60) $\rightarrow$ When air comes from a Football, heat is absorbed by outer particles in outside the Football - it results temperature falls. [1]

$\rightarrow$ Escaping air feels cold.

61) $V_2 = 2V_1$ [3]

$T_1 = 0^\circ C = 273\,K$

$R = 8.31 \times 10^7\ erg\ mol^{-1} \cdot K^{-1}$

$= 8.31\ Joule \cdot mol^{-1} \cdot K^{-1}$

$dw = ?$

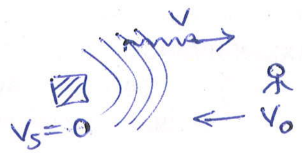
$dw = 2.3026\ RT \log_{10} V_2/V_1$

$= 2.3026 \times 8.31 \times 273 \times \log_{10} 2$

$= 2.3026 \times 8.31 \times 273 \times 0.3010$

$dw = 1572.3$ Joule.

63) [1]



$n' = \left(\frac{V+V_0}{V}\right) n$

$n' = 2n,\ V_0 = ?$

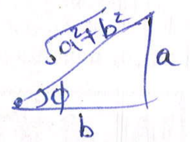
$\Rightarrow 2n = \left(\frac{V+V_0}{V}\right) \times n$

$\Rightarrow 2 = \frac{V+V_0}{V} \Rightarrow V_0 = V$

64) $y = a \sin\omega t + b \cos\omega t$ [1]

$y = \sqrt{a^2+b^2}\left[\frac{a}{\sqrt{a^2+b^2}} \sin\omega t + \frac{b}{\sqrt{a^2+b^2}} \cos\omega t\right]$

$= \sqrt{a^2+b^2}\left[\sin\omega t \cos\phi + \cos\omega t \sin\phi\right]$



$y = \sqrt{a^2+b^2} \sin(\omega t + \phi)$

65) The periodic Time (T) of simple pendulum is observed for different lengths (L). If a graph of $\log_{10} L$ against $\log_{10} T$ is plotted. The slope of the graph will be – [4]

$g = 4\pi^2 \times \frac{l}{T^2}$

$L = \left(\frac{g}{4\pi^2}\right) \times T^2$

$\log_{10} L = 2\log_{10} T + \log(g/4\pi^2)$

$y = mx + c$ slope $m = 2$.

66) $r\omega = 0.12$ [3]

$r\omega^2 = 0.48$

$T = ?$

$\omega = \frac{0.48}{0.12} = 4 \Rightarrow \frac{2\pi}{T} = 4$

$\Rightarrow T = \frac{\pi}{2} = \frac{3.14}{2} = 1.57$ sec.

69) $M_1 : M_2 = 2 : 1$ [4]

$m_1 : m_2 = 1 : 2$

$2l_1 : 2l_2 = ?$

$M = 2l \times m$

$\frac{M_1}{M_2} = \frac{2}{1} \Rightarrow \frac{2l_1\, m_1}{2l_2\, m_2} = \frac{2}{1}$

$\Rightarrow \frac{2l_1}{2l_2} \times \frac{1}{2} = \frac{2}{1}$

$\Rightarrow 2l_1 : 2l_2 = 4 : 1$

71) There are three equal resistors, how many different combinations of these resistors are possible. [1]

4 combinations Possible.