PART (A) : PHYSICS

Answer Key & Solution

1. (A or C or D)

$\Delta V = \vec{v}_F - \vec{v}_L = 10\sqrt{2}\hat{i} - 10\sqrt{2}\hat{j}$

$= 10\sqrt{2}\left(\hat{i} - \hat{j}\right)$

2. (B)

$W.D = \vec{F} \cdot \vec{d}$

$= \left(\vec{F}_1 + \vec{F}_2\right) \cdot \vec{d}$

$= \left[\left(2\hat{i} - 5\hat{j} + 6\hat{k}\right) + \left(-\hat{i} + 2\hat{j} - \hat{k}\right)\right] \cdot \left(2\hat{i} + 4\hat{j} - \hat{k}\right)$

= – 15 units.

3. (C)

$T = 2\pi\sqrt{\frac{L}{g}}$

$\frac{\Delta T}{T} = \frac{1}{2}\frac{\Delta L}{L} + \frac{1}{2}\frac{\Delta g}{g}$

$= \frac{1}{2} \times 2 + \frac{1}{2} \times 4 = 3\%$

4. (C)

5. (B)

6. (A)

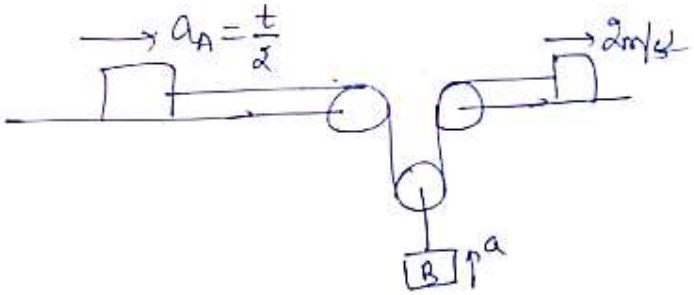
$mg - T = ma_C$

$3T = ma_A$

$4T = ma_B$

$3a_A + 4a_B = a_C \Rightarrow a_B = \frac{2g}{13}$

7. (C)



$-a_A - a - a + a_C = 0$

$2a = 2 - \frac{t}{2}$

$a = 1 - \frac{t}{4}$

$\frac{dv}{dt} = 1 - \frac{t}{4}$

$\int_0^v dv = \int_0^t \left(1 - \frac{t}{4}\right) dt$

$v = t - \frac{t^2}{8} = 0$

$t = 8\,\text{sec}$

8. (A)

$v_x = 3\,\text{m/sec}$

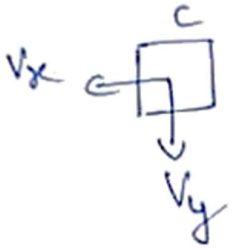
Applying constraint

$-3 - 3 + 1 + 1 + V_y = 0$

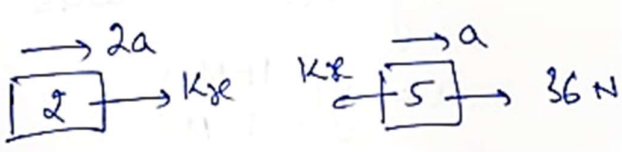
$V_y = 4\,\text{m/sec}$

$|V_C| = \sqrt{4^2 + 3^2}$

$= 5\,\text{m/sec}$



9. (D)



$Kx = 2(2a)$

$36 - Kx = 5a$

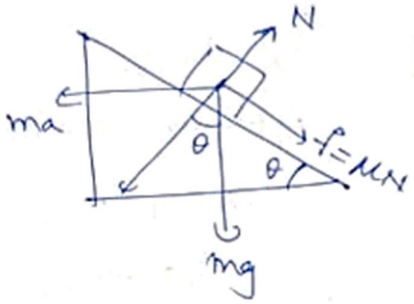
$36 = 9a \Rightarrow a = \dfrac{36}{9} = 4\ \text{m/s}^2$

$Kx = 4 \times 4 = 16\ \text{m}$

$\Rightarrow x = 0.16\ \text{m}$

$= 16\ \text{cm}$

10. (B)



$N = mg\cos 45 + ma\sin 45$

$f + mg\sin 45 = ma\cos 45$

$a = g\left(\dfrac{1+\mu}{1-\mu}\right)$

11. (B)

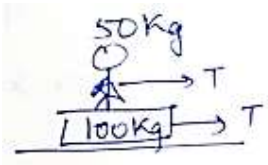
Solved example in HCV.

12. (A)

$2T = (100+50)a_x$

$2 \times 100 = 150 \times a$

$a = \dfrac{4}{3}\ \text{m/s}^2$



For man

$T - f = 50a$

$f = \dfrac{100}{3}\ \text{N}$

13. (B)

When $x = R$ $\quad y = 0$

$0 = 12R - \dfrac{3}{4}R^2 \Rightarrow R = 16\ \text{m}$

14. (C)

$u_x = v_x = 6\,\text{m/sec}$

$v_y^2 - u_y^2 = 2(-g)h \Rightarrow u_y = 2\sqrt{3}\,\text{m/sec}$

$\tan\theta = \dfrac{u_y}{u_x} = \dfrac{2\sqrt{3}}{6} = \dfrac{1}{\sqrt{3}}$

$\theta = 30^\circ$

15. (B)

$v_y^2 = u_y^2 + 2a_y S_y$

$(3u)^2 = u^2 + 2(-g)(-H)$

$H = \dfrac{4u^2}{g}$

16. (A, C, D)

From $t = 0$ to $t = 24$

Area $= 70 = x_2 - x_1 = x_2 - (-16)$

$x_2 = 54\,\text{m}$

From $t = 0$ to $t = 18$ and $t = 0$ to $t = 30$

Area $= 52 = x_2 - (-16)$

$x_2 = 36\,\text{m}$

17. (A, D)

$6\,mg - 8T = 6\,ma_2$

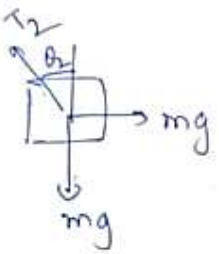
$T - mg = ma_1$

$a_1 = 8a_2 \Rightarrow a_2 = -g/35$

$a_1 = -8g/35$ and $V_1 = 8\,V_2$

18. (B, C, D)

For C

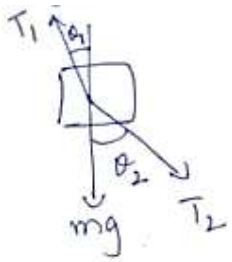


$T_2 \sin\theta_2 = mg$

$T_2 \cos\theta_2 = mg$

$\tan\theta_2 = 1 \Rightarrow \theta_2 = 45^\circ$

For B



$T_1 \sin\theta_1 = T_2 \sin\theta_2$

$T_2 \cos\theta_2 + mg = T_1 \cos\theta_1$

$\tan\theta_1 = \frac{1}{2}$

& $T_2 = \sqrt{5}\, mg$

19. (A, B)

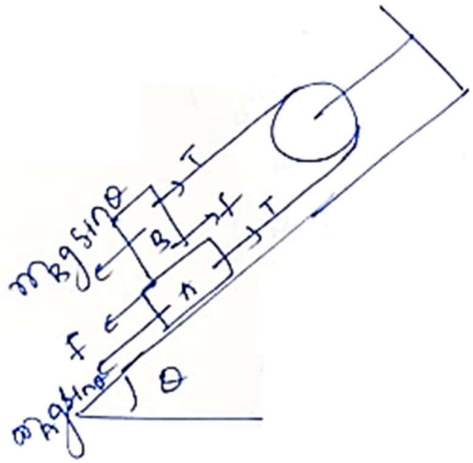
$m_B > m_A$

$m_B g \sin\theta = f + T$

$-m_A g \sin\theta \pm f = -T$

$(m_B - m_A) g \sin\theta = 2F$

$F = \frac{(m_B - m_A) g \sin\theta}{2}$



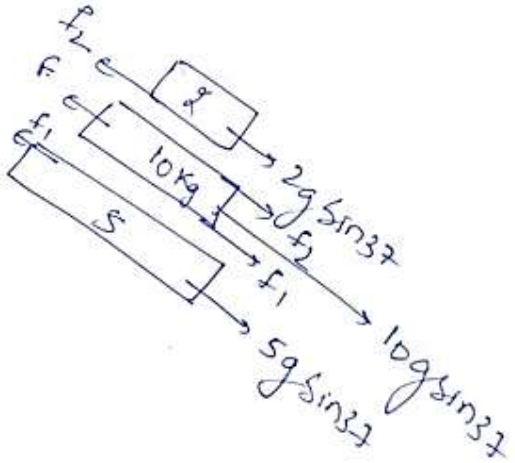
And make sure $f < f_L$

$\frac{(m_B - m_A) g \sin\theta}{2} \le \mu m_B g \cos\theta$

$\mu \ge \frac{(m_B - m_A) g \tan\theta}{2m_B}$

If $m_A = m_B \Rightarrow f = 0$

20. (A, C)



$f_{1L} = 0.5(120\cos 37)$

$= 48\,\text{N}$

Friction between 5 & 10 kg

Block will be 30 N (static)

$f_1 = 30\,\text{N}$

$f_{2L} = 0.8 \times 20 \cos 37 = 12.8\,\text{N}$

$f_2 = 12\,\text{N}$

$F - f_1 - f_2 - 60 = 0$

$F = 102\,\text{N}$