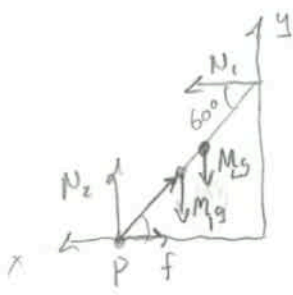


#1



$$F_y = -M_1g + N_2 + M_2g = 0$$

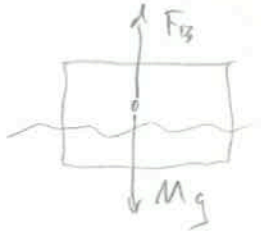
$$F_x = f - N_1 = 0; \tau_P = \sin(30^\circ) \left(\frac{L}{4} M_1g + \frac{L}{2} M_2g \right) - N_1 l \sin(60^\circ) = 0$$

$$N_1 = f \quad r_1 = \frac{1}{4}L \quad R = \frac{1}{2}L$$

$$0 = \tau_P \Rightarrow \frac{1}{2}gK \left(M_1 \frac{1}{4} + M \frac{1}{2} \right) = N_1 K \frac{\sqrt{3}}{2} \Rightarrow N_1 = \frac{g}{\sqrt{3}} \left(M_1/4 + M/2 \right)$$

$N_1 = f = 170N$ [D]

#2



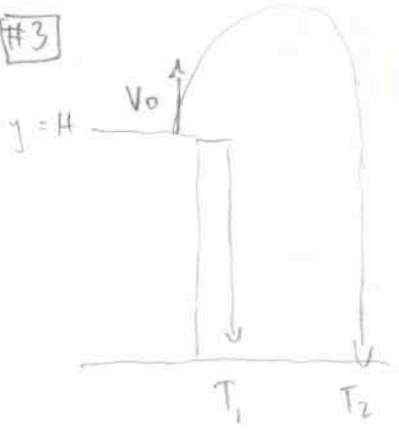
$$F_{B03} = \rho_w g V_{sub} = F_{grav} = Mg = \rho_o V_o g$$

$$\rho_o = \rho_w \left(\frac{V_{sub}}{V_o} \right) = \left(\frac{35}{100} \right) 1 g/cm^3 =$$

$$0.35 g/cm^3 = \boxed{350 kg/m^3}$$

[A]

#3



$$y_1(t) = H - \frac{1}{2}gt^2 \Rightarrow T_1 = \left(\frac{2H}{g} \right)^{1/2} = 4.5 \text{ sec}$$

$$y_2(t) = H + V_0t - \frac{1}{2}gt^2 \quad \text{For } T_2:$$

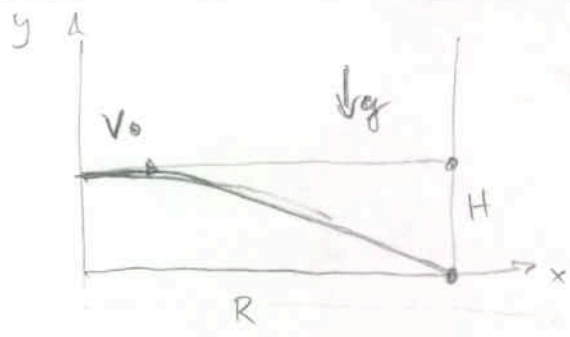
$$\frac{1}{2}gT_2^2 - V_0T_2 - H = 0$$

$$T_2 = \frac{V_0 \pm \left(V_0^2 + 4H(\frac{1}{2}g) \right)^{1/2}}{g} = \frac{V_0 \pm \left(V_0^2 + 2Hg \right)^{1/2}}{g}$$

$$T_2 = \frac{V_0 + \left(V_0^2 + 2Hg \right)^{1/2}}{g} = 6.3 \text{ sec} \Rightarrow \boxed{\Delta T = 1.8 \text{ sec}}$$

[E]

#4



$$H = 10 \text{ cm} = 0.01 \text{ m}$$

$$R = 100 \text{ m}$$

$$V_x = \text{const.}; \quad x(t) = V_0t + x_0 + \frac{1}{2}at^2$$

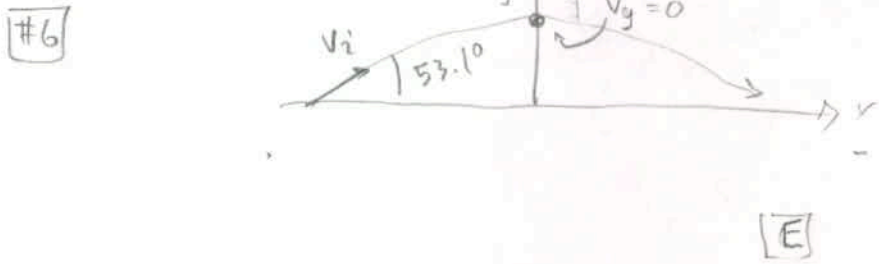
$$y(t) = 0 = H - \frac{1}{2}gt^2 \Rightarrow T = \left(\frac{2H}{g} \right)^{1/2}$$

$$T = 0.05 \text{ s}$$

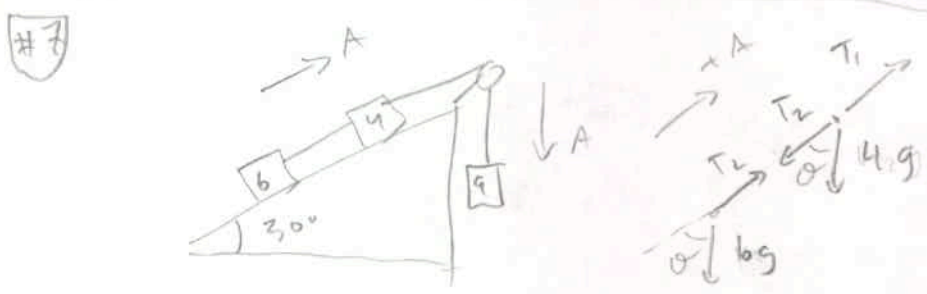
$$x(T) = R = V_0T \Rightarrow V_0 = \frac{R}{T} = R \left(\frac{g}{2H} \right)^{1/2} = \boxed{700}$$

[D]

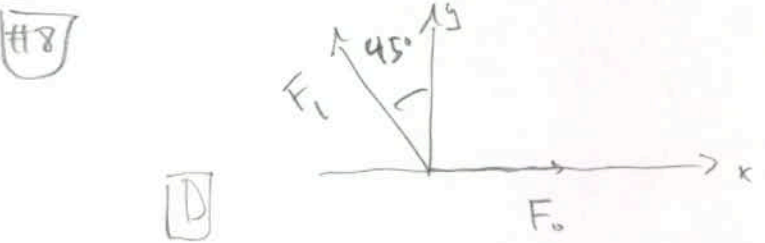
#5 $\Gamma = I\alpha \Rightarrow I = \Gamma/\alpha = \boxed{54 \text{ kg}\cdot\text{m}^2}$ [C]



$v_{iy}^2 = 2gh$ w/ $v_{iy} = v_i \sin(53.1^\circ)$
 $h = \frac{(v_i \sin(53.1)) ^2}{2g} = \boxed{44.7 \text{ m}}$



$9A = 9g - T_1$, $6A = T_2 - 6g \frac{1}{2}$; $4A = T_1 - T_2 - 2g$
 $T_2 = 6A + 3g$; $4A = T_1 - 6A - 3g - 2g = T_1 - 6A - 5g \Rightarrow T_1 = 4A + 6A + 5g$
 $T_1 = 10A + 5g$. $9A = 9g - 10A - 5g \Rightarrow 19A = 4g \Rightarrow \boxed{A = 2.1 \text{ m/s}^2}$ [D]



[D]

$\vec{A} = \frac{\vec{F}}{m}$
 $F_x = F_0 - F_1 \sin(45^\circ)$
 $F_x = -1242$
 $F_y = F_1 \sin(45^\circ) = 4242$
 $\leftarrow F = \sqrt{F_x^2 + F_y^2}$

$A = \frac{F}{m} = \boxed{2.2 \frac{\text{m}}{\text{s}^2}}$

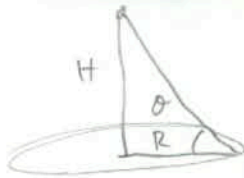


[E]

$A = 2 \text{ m/s}^2$
 $v_f^2 = 2Ad \Rightarrow d = \frac{v_f^2}{2A} = \boxed{193 \text{ m}}$

#10 $a = \frac{\Delta v}{\Delta t} = \frac{v_f}{t}$; $v_f^2 = 2ad = 2 \frac{v_f}{t} d \Rightarrow v_f = \frac{2d}{t} = \boxed{5.1 \text{ m/s}}$ [C]

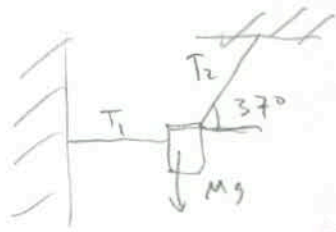
#11



$$C = 2\pi R; H = \tan(\theta) R = \tan(15^\circ) \frac{C}{2\pi} = \boxed{3.4 \text{ m}}$$

D

#12



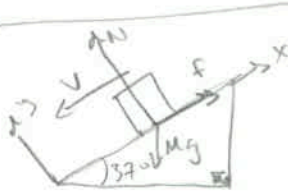
$$T_1 = T_2 \cos(37^\circ)$$

$$T_2 \sin(37^\circ) = Mg \Rightarrow T_1 = \frac{\cos(37^\circ)}{\sin(37^\circ)} Mg =$$

$$T_1 = \cot(37^\circ) Mg = \boxed{6635 \text{ N}}$$

B

#13



$$F_x = 0 \Rightarrow Mg \sin(37^\circ) = f = \mu Mg \cos(37^\circ)$$

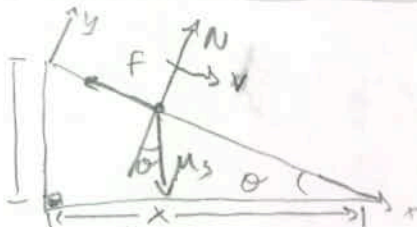
$$\mu = \tan(37^\circ) = \boxed{.75}$$

B

$$\#14 \quad W = a \int_{x_1}^{x_2} x^{1/2} dx = \frac{a}{3/2} x^{3/2} \Big|_{x_1}^{x_2} = \frac{2a}{3} (6^{3/2} - 3^{3/2}) = \boxed{60 \text{ J}}$$

B

#15

 $\theta = 37^\circ$ $h_i = 10$ 

$$f = \mu N = \mu mg \cos(\theta)$$

$$\theta = \tan^{-1}\left(\frac{10}{100}\right) = 5.7^\circ$$

$$R = 100 = (h_i^2 + x^2)^{1/2}$$

$$W_f = -fd = \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i)$$

$$-fd + \frac{1}{2} m v_i^2 + mg h_i = \frac{1}{2} m v_f^2$$

$$v_f^2 = \left[\frac{2}{m} (-d \mu mg \cos(\theta) + \frac{1}{2} m v_i^2 + mg h_i) \right]^{1/2}$$

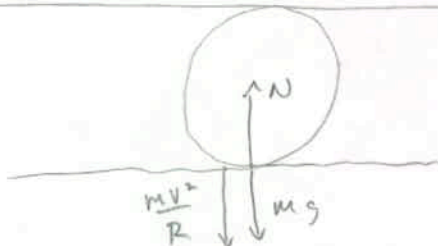
$$v_f = \boxed{11 \text{ m/s}}$$

D

$$\#16 \quad W = Fd = \Delta T = \frac{1}{2} m (v_f^2 - v_i^2) = Fd = 4 \times 10^5 \text{ J} \Rightarrow v_f = (W + \frac{1}{2} m v_i^2)^{1/2} = \boxed{25.8 \text{ m/s}}$$

E

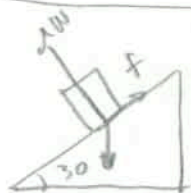
#17



$$N = mg + \frac{m v^2}{R} = m \left(g + \frac{v^2}{R} \right) = \boxed{4.7 \times 10^4 \text{ N}}$$

C

#18



$$F_x = 0 \Rightarrow f = mg \sin(30) = \frac{1}{2} mg = \boxed{25 \text{ N}}$$

E

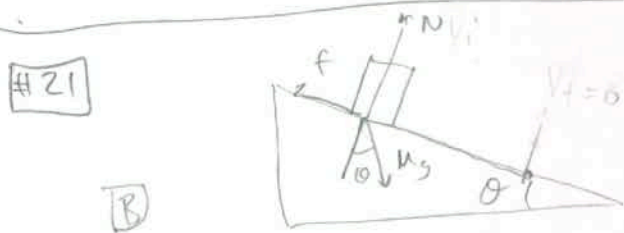
#19 $m_1 = 3, v_1 = 1.2, u_1 = 0.3; u_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1 \Rightarrow \frac{u_1}{v_1} = \frac{m_1 - m_2}{m_1 + m_2} \Rightarrow$

$\left(\frac{u_1}{v_1}\right)(m_1 + m_2) = m_1 - m_2 \Rightarrow m_2 \left(\frac{u_1}{v_1} + 1\right) = m_1 \left(1 - \frac{u_1}{v_1}\right) \Rightarrow m_2 = m_1 \frac{(1 - u_1/v_1)}{(1 + u_1/v_1)}$

$m_2 = \frac{(1 + u_1/v_1)}{(1 - u_1/v_1)} m_1$ [$u_1 < 0$, reverts]; $m_2 = 5 \text{ kg}$
E



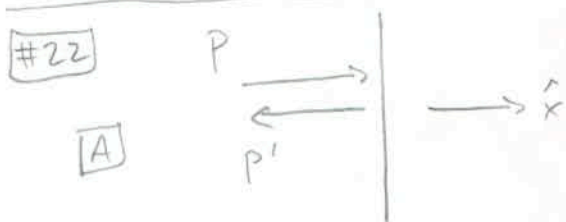
$V = \frac{m_1 v_1}{m_1 + m_2} = 0.462 \frac{\text{m}}{\text{s}}$
 $\frac{KE'}{KE} = \frac{6923}{30000} = 0.23 \Rightarrow \boxed{23\%}$
C



$a_x = (g \sin(30^\circ) - \mu g) \cos(30^\circ)$

$v_i^2 = 2 a_x d \Rightarrow$

$d = \frac{v_i^2}{2 a_x} = \boxed{145 \text{ m}}$



$\Delta p = p' - p = -mv - mv = -2mv$
 $\Delta p = -30 \text{ kg} \left(\frac{\text{m}}{\text{s}}\right)$

#23 $\Gamma = 0 \Rightarrow L = I\omega = L' = I'\omega' \Rightarrow \frac{I'}{I} = \frac{\omega}{\omega'} = \boxed{0.42}$

C