Final Exam - Review

Dec 9 / 11:

① $t = \frac{10}{2} + \frac{(-10)}{(-1)}\ s = 15\ s$.

2. $[W] = [F][d] = \frac{[m][L][L]}{[T]^2}$

$= \frac{BC^2}{D^2}$

3) $\vec{d} = \vec{r}_2 - \vec{r}_1$

$= 2.0\hat{i} + 0.4\hat{j} - 1.0\hat{k}\ m$

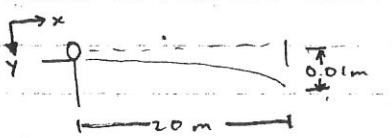
$\vec{F} = 0.5t + 1.0\hat{k}\ N$

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

$= 2.0(0.5) - 1.0(1.0)$

$= 0\ J$

7)



$V_{oy} = 0$ $a_y = 9.8\ m/s^2$

$V_{ox} = ?$ $y = 0.01m$

$t = ?$

① $y = V_{oy}t^0 + \frac{1}{2}a_y t^2$

$t = \sqrt{\frac{2y}{a_y}}$

$= \sqrt{\frac{2(0.01)}{9.8}}$

$t = 0.0452\ s$

② $x = V_{ox}t + \frac{1}{2}a_x t^2$

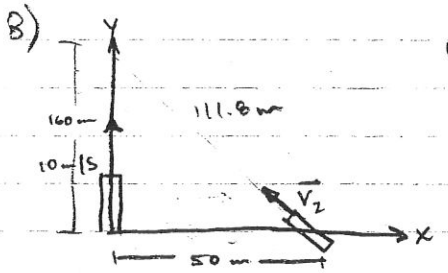
$V_{ox} = \frac{x}{t}$

$= \frac{20}{0.0452}$

$= 442.72\ m/s$

$V_{ox} \approx 443\ m/s$

8)



① $y = 10 \times 10\ m$

$= 100\ m$

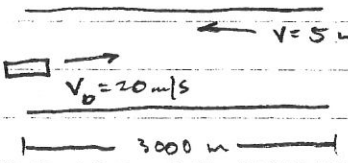
② $\sqrt{100^2 + 50^2}$

$= 111.8\ m$

③ $V_2 = \frac{111.8}{10}\ m/s$

$V_2 = 11\ m/s$

9)



① $V_{rel_{up}} = 20 - 5$

$= 15\ m/s$

② $t = \frac{d}{V_{rel_{up}}}$

$= \frac{3000}{15}$

$t_u = 200\ s$

③ $V_{rel_d} = 20 + 5$

$= 25\ m/s$

$t_d = \frac{d}{V_{rel_d}}$

$= \frac{3000}{25}$

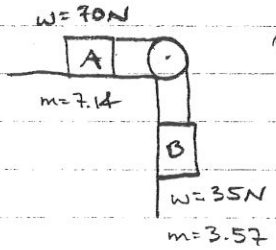
$t_d = 120\ s$

④ $t = t_u + t_d$

$= 200 + 120$

$t = 320\ s$

11)

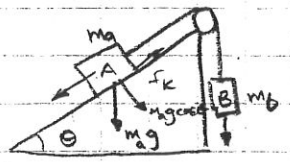


① $a = \frac{F_{Net}}{m_t}$

$= \frac{35}{10.7}$

$a = 3.27\ m/s^2$

12)



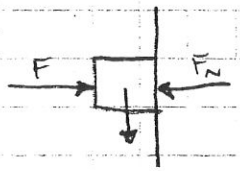
① $m_a \sin\theta = 6$ $m_B = 2$ ② $f_k = \mu_k m_a g \cos\theta$ ③ $a = \frac{F_{NET}}{m_t}$

$= \frac{m_a g \sin\theta - m_b g - \mu_k m_a g \cos\theta}{m_a + m_b}$

$a_a = 1.35 \text{ m/s}^2$ up

m_a

13)



① $f_{smax} = F_N \mu_s$
$= 10(0.8) N$
$= 8 N$

② $F_g = 0.5(9.8)$
$= 4.9 N$

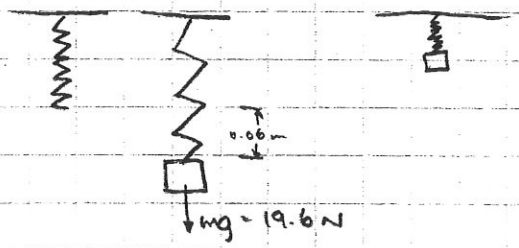
③ No motion
$F_a = F_g < f_{smax}$

$F = F_N$

$m = 0.5 \text{ kg}$

0

14)



① $k = \frac{19.6}{0.06}$

$k = 317 \text{ N/m}$

② $W_{sp} = \frac{1}{2} k (x_f^2 - x_i^2)$
$= \frac{1}{2} 317 (0.04^2 - 0.06^2)$
$= 0.317$

$W_{sp} \approx 0.33 \text{ J}$

15) ① $E_T = \frac{1}{2} m v_{max}^2 = \frac{1}{2} k x_{max}^2$

$E_T = \frac{1}{2} m v^2 + \frac{1}{2} k x^2$

$\frac{1}{2} k x_{max}^2 = \frac{1}{2} m v^2 + \frac{1}{2} k x^2$

$= 0.5(0.5)^2 + 80(0.04)^2$

$= 0.253$

$x_{max} = \sqrt{\frac{0.253}{80}}$

$x_{max} = 0.056 \text{ m}$

$= 5.6 \text{ cm}$

16) ① [A] [B]

$P_i = P_f$

$0 = m_A V_A + m_B V_B$

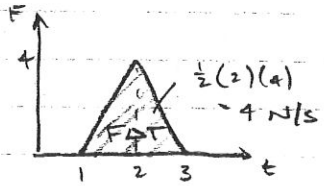
$V_A = -\frac{m_B}{m_A} V_B$

$= -\frac{70}{110}(0.5)$

$V_A = -0.3182 \text{ m/s}$

$V_A = 0.32 \text{ m/s}$

17) ① $F\Delta t = m\Delta V$ ② $\Delta V = \frac{F\Delta t}{m}$



$= \frac{4 \text{ N/s}}{5 \text{ kg}}$

$\Delta V = 0.8 \text{ m/s}$

18) $\alpha = ?$

$\omega_0 = 2.0 \text{ rad/s}$

$\theta_0 = 0$

$\theta = 5 \text{ rev} \times \frac{2\pi \text{ rad}}{1 \text{ rev}}$

$= 10\pi \text{ rad}$

$\theta = 31.42 \text{ rad}$

$t_0 = 0 \text{ s} \quad t = 2 \text{ s}$

① $\theta - \theta_0 = \frac{1}{2}(\omega_0 + \omega)t$

$\omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

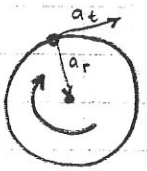
$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

② $\alpha = \frac{2[(\theta - \theta_0) - \omega_0 t]}{t^2}$

$= 2\frac{[(31.42) - (2)(2)]}{4}$

$\alpha = 13.7 \text{ rad/s}^2$

19)



$\alpha = 4 \text{ rad/s}$

$r = 0.2 \text{ m}$

$a_T = 1.2 \text{ m/s}^2$

$a_r = \frac{v^2}{r}$

$a_T = \sqrt{a_r^2 + a_t^2}$

$a_t = \alpha r$

① $a_T^2 = a_r^2 + a_t^2$

$a_T^2 = \frac{v^4}{r^2} + \alpha^2 r^2$

$V = \sqrt[4]{(a_T^2 - \alpha^2 r^2) r^2}$

$V = 0.42 \text{ m/s}$

OR

① $a_t = 4(0.2)$

$= 0.8 \text{ m/s}^2$

$a_T = 1.2 \text{ m/s}^2$

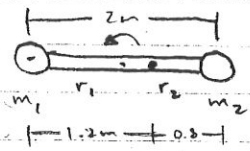
② $a_r = \sqrt{a_t^2 - a_T^2}$

$= 0.89$

③ $V = \sqrt{0.89(0.2)}$

$V = 0.42 \text{ m/s}$

20)



① $x_{cm} = \frac{m_1 r_1 + m_2 r_2}{m_1 + m_2}$

$= \frac{0.2(0) + 0.3(2)}{0.5}$

$= \frac{0.6}{0.5}$

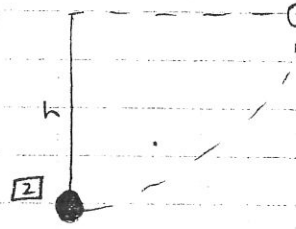
$x_{cm} = 1.2\ m$

② $I_o = m_1 r_1^2 + m_2 r_2^2$

$= 0.2(1.2)^2 + (0.3)(0.8)^2$

$I_o = 0.48\ kgm^2$

21)



$L = I\omega$

$KE = \frac{1}{2} I\omega^2$

① $I = mr^2$

$= 4(2)^2$

$I = 16\ kgm^2$

② $KE_1 + PE_1 = KE_2 + PE_2$

$mgh = \frac{1}{2} I \omega_2^2$

$\omega_2 = \sqrt{\frac{2mgh}{I}}$

$= \sqrt{\frac{2(4)(9.8)(2)}{16}}$

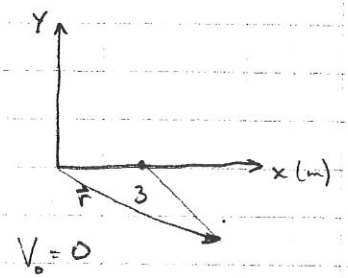
$\omega_2 = 3.13\ rad/s$

③ $L = I\omega_2$

$= 16(3.13)$

$L = 50\ kgm^2/s$

22)



① $\vec{\tau} = \vec{r} \times \vec{F}$

$\vec{F} = m\vec{a}$

$r = \vec{r}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2$

$= 3\hat{i} + 0.5(4\hat{i} - 3\hat{j})2^2$

$= 3\hat{i} + 8\hat{i} - 6\hat{j}$

$\vec{r} = 11\hat{i} - 6\hat{j}$

② $\vec{F} = m\vec{a}$

$= 2(4\hat{i} - 3\hat{j})$

$\vec{F} = 8\hat{i} - 6\hat{j}\ N$

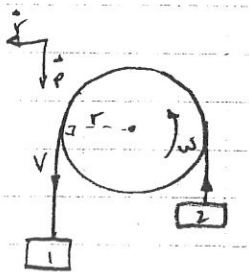
③ $\vec{\tau} = \vec{r} \times \vec{F}$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 11 & -6 & 0 \\ 8 & -6 & 0 \end{vmatrix}$$

$= -66 + 48$

$\vec{\tau} = -18\hat{k}\ Nm$

23)



① $l_1 = m_1 rv$

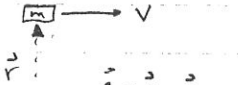
$l_2 = m_2 rv$

$l_p = I\omega$

$= \frac{Iv}{r}$

$l_T = m_1 vr + m_2 vr + \frac{Iv}{r}$

$l_T = (m_1 + m_2)vr + \frac{Iv}{r}$

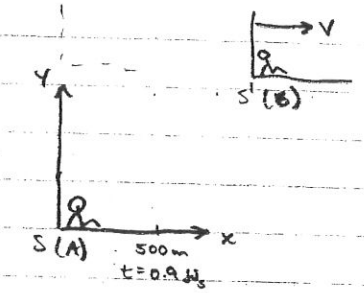


$\vec{l} = \vec{r} \times \vec{p}$

$|l| = |r||p| \sin\theta$

$= rmv$

24)



① $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$

$= \frac{1}{\sqrt{1 - 0.9^2}}$

$\gamma = 2.29$

② $x' = \gamma(x - vt)$

$t' = \gamma\left(t - \frac{vx}{c^2}\right)$

③ $x' = 2.29\left(500 - 0.9 \times (3 \times 10^8)(0.9 \times 10^{-6})\right)$

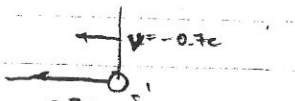
$x' = 589 \text{ m}$

④ $t' = 2.29\left(0.9 \times 10^{-6} - \frac{0.9(500)}{3 \times 10^8}\right)$

$= -1.4 \times 10^{-6} \text{ s}$

$= -1.4 \ \mu\text{s}$

25)



① $u = \frac{u' + v}{1 + \frac{vu'}{c^2}}$

$u' = \frac{u - v}{1 - \frac{vu}{c^2}}$

② $u' = \frac{0.7c - (-0.7c)}{1 - \frac{(-0.7c)(0.7c)}{c^2}}$

$= \frac{1.4}{1.49} c$

$u' = 0.94c$