PHYSICS 6A - MWF SESSION
FINAL SOLUTIONS FORM A

(1) $\alpha = a/R$ $\quad I\alpha = TR \leftarrow$ torque

$I\frac{a}{R} = TR \Rightarrow a = TR^2/I$

$ma = mg - T$, $\frac{mTR^2}{I} = mg - T$ $\quad \boxed{T = \frac{mg}{1 + mR^2/I}}$

$T = \frac{0.375 \cdot 9.8}{1 + \frac{0.375\ 0.26^2}{0.0125}} N = \underline{\underline{1.21 N}}$

(A)

(2) Work is area under F vs x curve _ $W = 100 J$ [C]

(3) Conservation of angular momentum

$L = I\omega = mr^2\omega$

If r is reduced by a factor 2, ω increases by a factor 4 [B]

(4) Time taken $t = \frac{d}{V_H} = \frac{82}{20}$ sec $= 4.1$ sec

$h = \frac{1}{2}gt^2 = \frac{1}{2}\,9.8 \cdot 4.1^2 m = 82.4$ sec [D]

(5) [A] Because $F = ma$ and a is the same

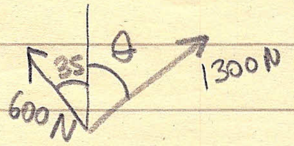
(6) $v^2 = 2ad \Rightarrow$ [D]

(7) $F=-kx \quad k = F/x = \frac{4}{8}\ N/cm = \frac{1}{2}\ N/cm$

$\Delta U = \frac{1}{2}k\left(x_1^2 - x_2^2\right) = W$

$= \frac{1}{2}\,0.5\left(13^2 - 8^2\right)\ Ncm = 26\ Ncm = 0.26\ J$ **[B]**

(8) The horizontal components must cancel out



$600 \times \sin 35 = 1300 \sin\theta$

$\sin\theta = \frac{600 \sin 35}{1300} = 0.264 \quad \theta = 15.3^\circ$ **[A]**

(9) **[D]**

(10) $m_B g = m_A g \sin\theta \qquad m_B = m_A \sin\theta = 3kg \sin 30 = 1.5kg$ **[A]**

(11) Angular speed does not depend on r **[D]**

(12) **[E]**

(13) $a = V^2/R = \frac{25}{0.5}\ m/s^2 = 50\ m/s^2$ **[D]**

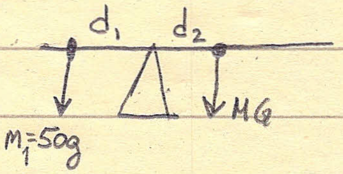
(14) $V^2 = 2ad \Rightarrow a = V^2/2d$

$F = ma = \frac{mv^2}{2d}$ But $F = \mu_k mg$

$\mu_k mg = \frac{mV^2}{2d} \qquad \mu_k = \frac{V^2}{2gd} = \frac{3^2}{2 \cdot 9.8 \cdot 4} = 0.115$ **[C]**

(15) Conservative force, work independent of path [B]

(16)



$d_1 = 90 - 61.3 = 28.7 cm$

$d_2 = 61.3 - 50 = 11.3 cm$

$m_1 d_1 = M d_2 \qquad M = \frac{m_1 d_1}{d_2} = \frac{50 \cdot 28.7}{11.3} g = 127g$ [A]

(17) $F = ma = 500 \; 1.3 \; N = 650 \; N$ [C]

(18) First find the K.E., at the bottom

$\frac{1}{2} m v_0^2 = mgh = mgL \sin 30 \qquad (L = 8m)$

The KE at the bottom is then equal to work done by frictional force $\mu_k mgd$ (d = [B]

$\mu_k mgd = mgL \sin 30 \qquad d = \frac{L \sin 30}{\mu_k} = \frac{8 \sin 30}{0.4} m = 10m$

(19) [C]

(20) $F_{TOTAL} = \frac{\Delta p}{\Delta t} \qquad \Delta p > 0$ (even if v is constant, mass is increasing, so p increases)

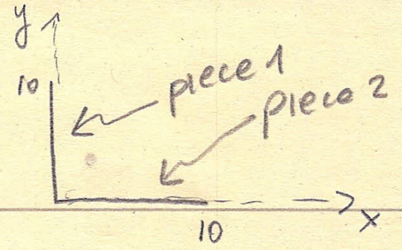
$F_{TOTAL} = F - W > 0 \Rightarrow F > W$ [B]

(21) Right = positive Left = negative

$P = m_A v_A - m_B v_B = 0.45 \; 0.85 - 0.3 \; 1.12 = +0.0465 \; kgm/s$ [A]

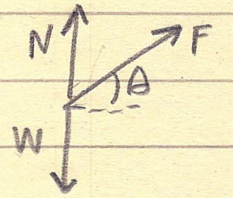
(22) v constant $\rightarrow a = 0 \rightarrow F_{Tot} = 0 \rightarrow T = W$ [A]

(23)



X_{CM} for Piece 1 is $X=0$
X_{CM} for Piece 2 is $X=5cm$
They have the same mass, so X_{CM} for total wire is $X_{CM}=2.5cm$
Similarly $Y_{CM}=2.5cm$ $\quad d=\sqrt{X_{CM}^2+Y_{CM}^2}=3.5cm$ **B**

(24) FBD



The total vertical force is zero **C**
$N+F\sin\theta=mg$
$N=mg-F\sin\theta=40\cdot 9.8-10\sin 43=385N$

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

$$\alpha=\frac{\omega^2-\omega_0^2}{2(\theta-\theta_0)}=\frac{(78^2-22^2)(2\pi/60)^2}{2\cdot 320\left(\frac{2\pi}{360}\right)}\frac{rad}{s^2}$$

$$\alpha=\frac{5600\ 4\pi^2/3600}{640\ (2\pi)/360}=\frac{6.22\pi}{3.55}\frac{rad}{sec^2}=5.5\frac{rad}{s^2}$$ **B**

(26) x horizontal, y vertical
$F_x=0 \quad F_y=-F_3+F_1\sin 30+F_2\sin 30=70N(2\sin 30-1)=0$ **E**

(27) $K_T=\frac{1}{2}mV^2 \quad K_{ROT}=\frac{1}{2}I\omega^2=\frac{1}{2}MR^2\frac{V^2}{R^2}=\frac{1}{2}MV^2$ **C**

(28) $T=\frac{2\pi}{\omega}=\frac{2\pi}{1.52}sec=4.13\ sec$ **A**

(29) $a = \frac{v^2}{R} = \omega^2 R$ T = 1 day $T = \frac{2\pi}{\omega}$ $\omega = \frac{2\pi}{T}$

$a = \frac{4\pi^2}{T^2} R = \frac{4\pi^2}{(24 \cdot 60 \cdot 60)^2} 6.38 \cdot 10^6 \; m/s^2 = 0.0337 \; m/s^2$ **C**

(30) It's accelerating down, so $T < W_2$ **C**

(31) **D**

(32) **B** Because I for the configuration at right is smaller

(33) **A** (Cons of angular momentum)

(34) Work done on the ball = $F \cdot d = 600 \cdot 0.2 = 120 J$

This work is the same as the original K of the ball

$\frac{1}{2} m v^2 = W$ $m = \frac{2W}{v^2} = \frac{2 \cdot 120}{40^2} kg = 0.15 kg$

B