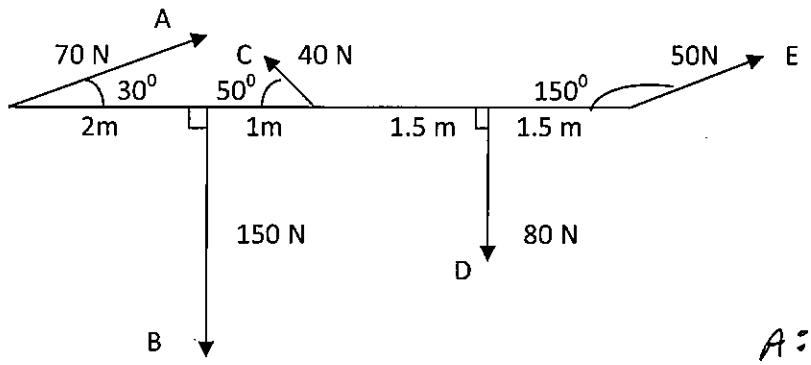
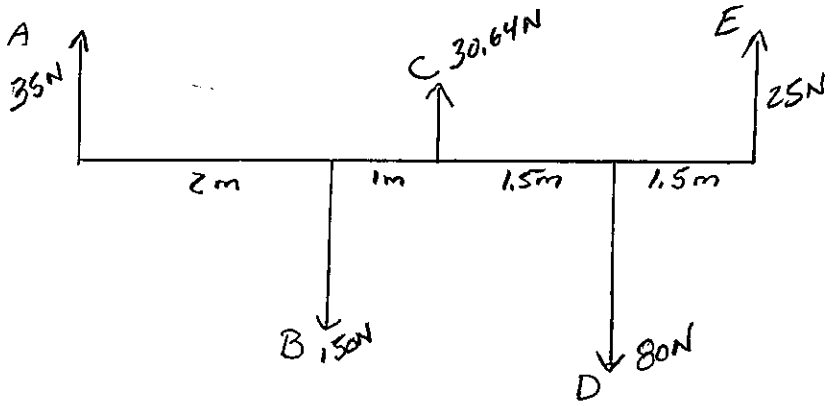
Unit 8: Rotary Motion Quiz / 45 Name: _____
Pre-Quiz A-D Date: _____ Period_____

Directions: Show all your work!! and label all your units.

1. a) Find the torques exerted on the rod in the diagram below for each lettered force. Assume the axis of rotation is about the 150 N. 10 pts. [A =70 Nm , B =0 Nm, C = 30.64 Nm, D= 200 Nm, E = 100 Nm]



Re-Draw using perpendicular Forces
Calculate perpendicular Forces, Then Torque.



A: $\cos 60° = \frac{y}{70N}$ $y = 35N$ $\tau = 35N \cdot 2m = 70 N\cdot m$

B: 0 N·m - No Lever arm

C: $\cos 40° = \frac{y}{40N}$ $y = 30.64N$ $\tau = 30.64N \times 1m = 30.64 N\cdot m$

D: $80N \times 2.5m = 200 N\cdot m$

E: $\cos 60° = \frac{y}{50N}$ $y = 25N$ $\tau = 25N \times 4m = 100 N\cdot m$

2. A diver can reduce their moment of inertia by a factor of about three (3) when changing from the straight position (Pike) to the tuck position. If they make two rotations in 1.1 sec when in the tuck position, what is their angular speed (rev/s) when in the straight position? 10 pts. [0.61 rev/sec]

(Pike) Straight Tuck

$L_1 = L_2$

$I_1 \omega_1 = I_2 \omega_2$

$I_1 \neq I_2$

$I_1 = 3I_2$

$\omega_2 = \frac{2 rev}{1.1 sec} = 1.82 \frac{rev}{sec}$

$\omega_1 = ?$

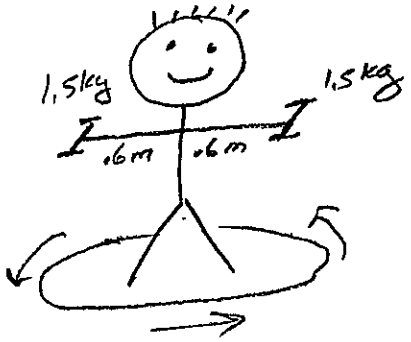
$\therefore \quad I_1\omega_1 = I_2\omega_2$

$3I_2\omega_1 = I_2\omega_2$

$3\omega_1 = 1.82 \frac{rev}{sec}$

$\omega_1 = 0.61 \frac{rev}{sec}$

3. A student stands on a rotating platform which has frictionless bearings. She has a 1.5 kg object in each hand, held 0.6 m from the axis of rotation of the system. The system is initially rotating at 5 rpm. Assume that the moment of inertia of the platform + student remains constant at 1.9 kg m^2. Determine the angular velocity (ω) of the system in radians per second, if the objects in her hands are brought toward her body to a distance of 0.3 m from the axis of rotation. 10 pts [0.71 rad/sec]



$L_1 = L_2$

$I_1 \omega_1 = I_2 \omega_2$

$R_1 = .6m$ $\quad R_2 = .3m$

$$\begin{bmatrix} 1.9\,kg\cdot m^2 \\ + \\ mR_1^2 \\ + \\ mR_1^2 \end{bmatrix} \cdot 0.52\,\frac{rad}{sec} = \begin{bmatrix} 1.9\,kg\cdot m^2 \\ + \\ mR_2^2 \\ + \\ mR_2^2 \end{bmatrix} \cdot \omega_2$$

$\omega_1 = 5\,\frac{rev}{min} \times \frac{6.28\,rad}{1\,rev} \times \frac{1\,min}{60\,sec}$

$\omega_1 = 0.52\,\frac{rad}{sec}$

$2.98\,kg\cdot m^2 \cdot 0.52\,\frac{rad}{s} = 2.17\,kg\cdot m^2 \cdot \omega_2$

$0.71\,rad/s = \omega_2$

4. A 600 gram wheel that has a moment of inertia of 0.067 kg m^2 is initially turning at 60 rev/s. It coasts to rest after 300 revolutions. How large is the torque that slowed it? 10 pts. [-2.52 N m]

600g = .6kg

$I = 0.067\,kg\cdot m^2$

$\tau = I \cdot \alpha$

$\omega_0 = 60\,\frac{rev}{sec} \times \frac{6.28\,rad}{1\,rev} = 376.8\,\frac{rad}{sec}$

$\tau = 0.067\,kg\cdot m^2 \cdot -37.68\,\frac{rad}{s^2}$

$\omega_f = 0\,rad/sec$

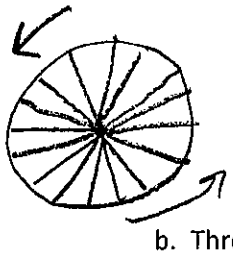
$\theta = 300\,rev \times \frac{6.28\,rad}{1\,rev} = 1884\,rad$

$\tau = -2.52\,kg\cdot\frac{m}{s^2}$

$\alpha = \frac{\omega_f^2 - \omega_0^2}{2\theta} = -37.68\,rad/s^2$

5. A roulette wheel originally turning at 8.0 rev/sec coasts to rest in 25 sec.

a. What was the acceleration of the wheel? 3 pts. [-2.01 rad/s^2]



$\omega_0 = 8\,\frac{rev}{sec} \times \frac{6.28\,rad}{1\,rev} = 50.24\,\frac{rad}{sec}$

$\omega_f = 0\,rad/sec$

$t = 25\,sec$ $\quad \alpha = ?$

$\alpha = \frac{\omega_f - \omega_0}{t}$

$\alpha = \frac{0 - 50.24\,rad/s}{25\,sec}$

$\alpha = -2.01\,rad/s^2$

b. Through how many revolutions did it turn in the process? 2 pts. [628 rad] 100 rev

$\theta = ?$

$s = v_0 t + \frac{1}{2} a t^2$

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ $\quad -628$

$\theta = 50.24\,\frac{rad}{sec}(25\,sec) + \frac{1}{2}\left(-2.01\,\frac{rad}{s^2}\right)(25\,sec)^2$

$\theta = 628\,rad \times \frac{1\,rev}{6.28\,rad} = 100\,rev$