Homework #16

1) Two disks are mounted (like a merry-go-round) on low-friction bearings on the same axle and can be brought together so that they couple and rotate as one unit. The first disk, with rotational inertia 3.30 kg · m^2 about its central axis, is set spinning counterclockwise at 450 rev/min. The second disk, with rotational inertia 6.60 kg · m^2 about its central axis, is set spinning counterclockwise at 900 rev/min. They then couple together. (a) What is their angular speed after coupling? If instead the second disk is set spinning clockwise at 900 rev/min, what are their (b) angular speed and (c) direction of rotation after they couple together?

2) The Sun's mass is 2.0×10^{30} kg, its radius is 7.0×10^5 km, and it has a rotational period of approximately 28 days. If the Sun should collapse into a white dwarf of radius 3.5×10^3 km, what would its period be if no mass were ejected and a sphere of uniform density can model the Sun both before and after?

3) The displacement from equilibrium of a particle is given by $x(t) = A\cos\left(\omega t - \frac{\pi}{3}\right)$. Which, if any, of the following are equivalent expressions:

a) $x(t) = A\cos\left(\omega t + \frac{\pi}{3}\right)$;

b) $x(t) = A\cos\left(\omega t + \frac{5\pi}{3}\right)$;

c) $x(t) = A\cos\left(\omega t + \frac{\pi}{6}\right)$;

d) $x(t) = A\cos\left(\omega t - \frac{5\pi}{6}\right)$

4) In a block and spring system $m = 0.250$ kg and $k = 4.00\frac{\text{N}}{\text{m}}$. At $t = 0.150$ s s, the velocity is $v = -0.174\frac{\text{m}}{\text{s}}$ and the acceleration $a = +0.877\frac{\text{m}}{\text{s}^2}$. Write an expression for the displacement as a function of time, $\underline{x}$(t). (Hint, remember that the inverse tan function only returns the principal value, but there is a secondary value as well.)

5) A 60.0 g block attached to a horizontal spring is held at 8.00 cm from its equilibrium position and released at $t = 0$. Its period is 0.900 s. Find: (a) the displacement x at 1.20 s; (b) the velocity when $x = -5.00$ cm; (c) the acceleration when $x = -5.00$ cm; (d) the total energy.

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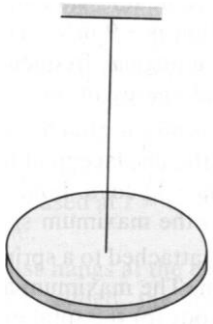
6) A wire has a torsional constant $\kappa = 2.00$ N·m/rad. A solid disk of radius $R = 5.00$ cm and mass $M = 100.$ g is suspended at its center as shown in the figure. What is the frequency of torsional oscillations?



7) The total energy of a block and spring system is 0.200 J. The mass of the block is 120 g and the spring constant is 40. N/m. Find: (a) the amplitude; (b) the maximum speed; (c) the displacement from equilibrium when the speed is 1.30 m/s; (d) the maximum acceleration.

8) A uniform rod of mass *M* and length *L* 1.20 m oscillates about a horizontal axis at one end. What is the length of the simple pendulum that would have the same period? The rotational inertia is $\frac{ML^2}{3}$.