PD chap. 10 quiz 12-27, 22

1. A flywheel is initially rotating at 20 rad/s and has a constant angular acceleration. After 9.0 s it has rotated through 450 rad. Its angular acceleration is:

A) 3.3 rad/s B) 4.4 rad/s C) 6.7 rad/s D) 11 rad/s E) 48 rad/s

1. C. $\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2 \Rightarrow 450 = 20\times 9 + \frac{1}{2}\alpha 9^2$

$\Rightarrow 270 = \frac{1}{2}\alpha \cdot 81 \Rightarrow \alpha = 6.7$ rad/s

2. Two wheels are identical but wheel B is spinning with twice the angular speed of wheel A. The ratio of the magnitude of the radial acceleration of a point on the rim of B to the magnitude of the radial acceleration of a point on the rim of A is:

A) 1 B) 2 C) 1/2 D) 4 E) 1/4

2. D $a_r = R\omega^2$ $\frac{a_{rB}}{a_{rA}} = \frac{\omega_B^2}{\omega_A^2} = 4$

3. A playground merry-go-round has a radius of 3.0 m and a rotational inertia of 600 kg·m². It is initially spinning at 0.80 rad/s when a 20-kg child crawls from the center to the rim. When the child reaches the rim the angular velocity of the merry-go-round is:

A) 0.62 rad/s B) 0.73 rad/s C) 0.77 rad/s D) 0.91 rad/s E) 1.1 rad/s

3. A.

initial $I_i = 600$ ∵ the child is at the center

final $I_f = 600 + mR^2 = 600 + 20\times 3^2 = 780$

L is conserved. ∴ $L_i = I_i\omega_i = 600\times 0.8 = I_f\omega_f = 780\times\omega_f$

∴ $\omega_f = 480/780 = 0.62$ rad/s

4. A thin rod of length L has a density that increases along its length, $\rho = \rho_0 x$. What is the rotational inertia of the rod around its less dense end?

A) $ML^2/12$ B) $ML^2/6$ C) $ML^2/3$ D) $ML^2/2$ E) ML^2

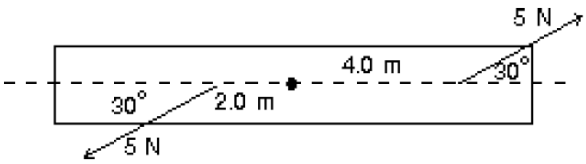
4. D.

total mass $m = \int_0^L \rho\, dx = \int_0^L \rho_0 x\, dx = \frac{\rho_0 L^2}{2}$

$I = \int dm\, x^2 = \int x^2 \rho\, dx = \int_0^L \rho_0 x^3 dx = \frac{\rho_0 L^4}{4}$

$= \frac{1}{2} ML^2$

5. A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque about the pivot is:



A) 0 N·m B) 5.0 N·m C) 8.7 N·m D) 15 N·m E) 26 N·m

5. D. $\tau = 5 \sin 30^\circ \times 4m + 5 \sin 30^\circ \times 2\, m = 15$

6\. 86. A certain wheel has a rotational inertia of 12 kg·m^2. As it turns through 5.0 rev its angular velocity increases from 5.0 rad/s to 6.0 rad/s. If the net torque is constant its value is:

A) 0.015 N·m B) 0.18 N·m C) 0.57 N·m D) 2.1 N·m E) 13 N·m

6. D. $\tau = I\alpha$. $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

$\Rightarrow 6^2 = 5^2 + 2\alpha(5\times 2\pi) \Rightarrow \frac{36-25}{20\pi} = \alpha = \frac{11}{20\pi}$

$\therefore \tau = 12 \times 11/20\pi = 2.1$

7\. A thin-walled hollow tube rolls without sliding along the floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about an axis through its center of mass) is:

A) 1 B) 2 C) 3 D) 1/2 E) 1/3

7. A. for a hollow tube $I = MR^2$

$K_T/K_R = \frac{1}{2}mv_{cm}^2 / \frac{1}{2}I\omega^2 = \frac{mR^2\omega^2}{MR^2\omega^2} = 1$

8\. The second arm of a big clock is with length of 1 m and mass of 1 kg. If the second arm is a thin uniform rod, find the rotational energy of the second arm.

A) $\frac{\pi^2}{6000}$ J B) $\frac{\pi^2}{1200}$ J C) $\frac{\pi^2}{5400}$ J D) $\frac{\pi^2}{2400}$ J E) $\frac{\pi^2}{7200}$ J

8. C. for stick rotate about one end $I = \frac{1}{3}ML^2 = \frac{1}{3}$

$K_R = \frac{1}{2}I\omega^2 = \frac{1}{2}\cdot\frac{1}{3}\times(2\pi/60)^2 = \pi^2/5400$