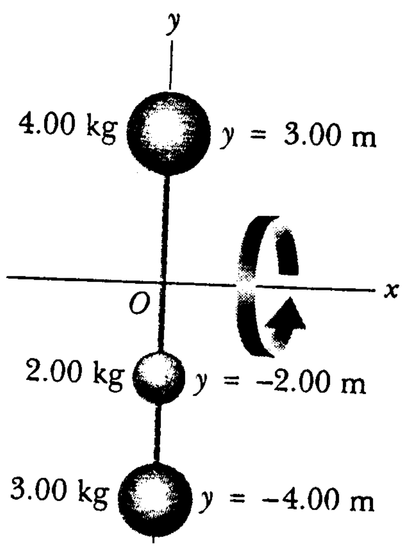
Three particles are connected by rigid rods of negligible mass lying along the y axis (Fig. P10.19). If the system rotates about the x axis with an angular speed of 2.00 rad/s, find (a) the moment of inertia about the x axis and the total rotational energy evaluated from $\frac{1}{2}I\omega^2$ and (b) the linear speed of each particle and the total energy evaluated from $\Sigma\frac{1}{2}m_i v_i^2$.



(a) $I = \sum m_i r_i^2 = 4 \times 9 + 2 \times 4 + 3 \times 16 = \boxed{92 \text{ kg m}^2}$

(b) $K = \frac{1}{2} I \omega^2 = \frac{1}{2} \times 92 \times (2)^2 = \boxed{184 \text{ J}}$

(c) $v_1 = \omega r_1 = (2)(3) = 6 \text{ m/s}$

$v_2 = \omega r_2 = (2)(2) = 4 \text{ m/s}$

$v_3 = \omega r_3 = (2)(4) = 8 \text{ m/s}$

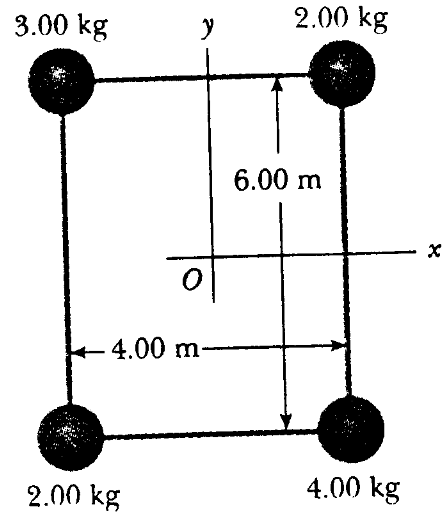
$K_1 = \frac{1}{2} m_1 v_1^2 = 72 \text{ J}$

$K_2 = \frac{1}{2} m_2 v_2^2 = 16 \text{ J}$

$K_3 = \frac{1}{2} m_3 v_3^2 = 96 \text{ J}$

Sum = 184 J

The four particles in Figure P10.17 are connected by rigid rods of negligible mass. The origin is at the center of the rectangle. If the system rotates in the *xy* plane about the *z* axis with an angular speed of 6.00 rad/s, calculate (a) the moment of inertia of the system about the *z* axis and (b) the rotational energy of the system.

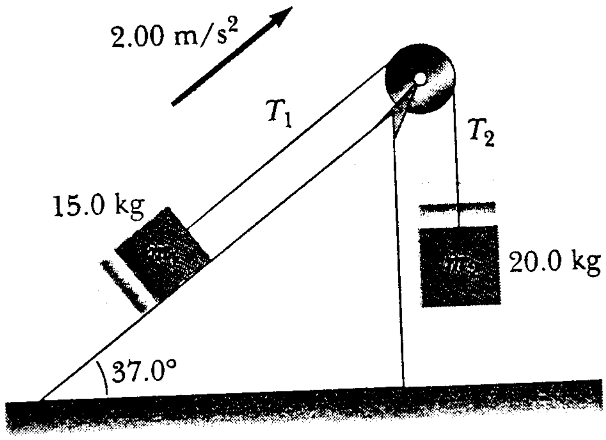


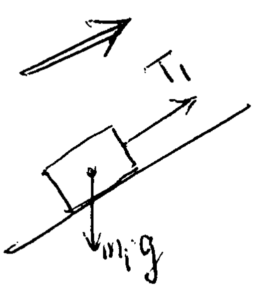
(a) $I = \sum m_i r_i^2$ $\qquad r = \sqrt{3^2 + 2^2} = \sqrt{13}$ m

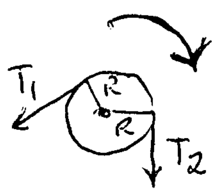
$I = (3 + 2 + 2 + 4)(13) = \boxed{143 \text{ kg m}^2}$

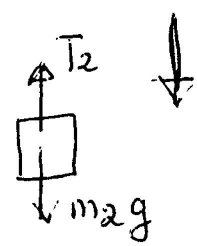
(b) $K = \frac{1}{2} I \omega^2 = \frac{1}{2}(143)(6)^2 = \boxed{2.6 \times 10^3 \text{ J}}$

The blocks shown in Figure 10.51 are connected by a string of negligible mass passing over a pulley of radius R and moment of inertia I. The block on the incline is moving up with a constant acceleration of magnitude a. (a) Determine T_1 and T_2, the tensions in the two parts of the string, and (b) find the moment of inertia of the pulley.









$$T_1 - m_1 g \sin\theta = m_1 a \quad \text{— (1)} \quad \Longrightarrow \quad T_1 = m_1(g\sin\theta + a) = 118\text{N}$$

$$-T_2 + m_2 g = m_2 a \quad \text{— (2)} \quad \Longrightarrow \quad T_2 = m_2(g - a) = 156\text{ N}$$

$$T_2 R - T_1 R = I\alpha = \frac{Ia}{R} \quad \text{— (3)}$$

$$(3) \Longrightarrow \quad I = \frac{(T_2 - T_1)R^2}{a} = 1.19$$