55. (a) We use constant acceleration kinematics. If down is taken to be positive and a is the acceleration of the heavier block, then its coordinate is given by $y = \frac{1}{2}at^2$, so

$$a = \frac{2y}{t^2} = \frac{2(0.750 \text{ m})}{(5.00 \text{ s})^2} = 6.00 \times 10^{-2} \text{ m/s}^2.$$

The lighter block has an acceleration of 6.00×10^{-2} m/s^2 upward.

(b) Newton's second law for the heavier block is $m_h g - T_h = m_h a$, where m_h is its mass and T_h is the tension force on the block. Thus,

$$T_h = m_h(g - a) = (0.500 \text{ kg})\left(9.8 \text{ m/s}^2 - 6.00 \times 10^{-2} \text{ m/s}^2\right) = 4.87 \text{ N}.$$

(c) Newton's second law for the lighter block is $m_l g - T_l = -m_l a,$ where T_l is the tension force on the block. Thus,

$$T_l = m_l(g + a) = (0.460 \text{ kg})\left(9.8 \text{ m/s}^2 + 6.00 \times 10^{-2} \text{ m/s}^2\right) = 4.54 \text{ N}.$$

(d) Since the cord does not slip on the pulley, the tangential acceleration of a point on the rim of the pulley must be the same as the acceleration of the blocks, so

$$\alpha = \frac{a}{R} = \frac{6.00 \times 10^{-2} \text{ m/s}^2}{5.00 \times 10^{-2} \text{ m}} = 1.20 \text{ rad/s}^2.$$

(e) The net torque acting on the pulley is $\tau = (T_h - T_l)R$. Equating this to $I\alpha$ we solve for the rotational inertia:

$$I = \frac{(T_h - T_l)R}{\alpha} = \frac{(4.87 \text{ N} - 4.54 \text{ N})\left(5.00 \times 10^{-2} \text{ m}\right)}{1.20 \text{ rad/s}^2} = 1.38 \times 10^{-2} \text{ kg} \cdot \text{m}^2.$$