

$$\textcircled{1} \quad -f s_{cm} = -\frac{1}{2} M v_{cm}^2 \quad W_f = -\frac{1}{2} M v_{cm}^2 + \Delta E_{int, block}$$

$$\textcircled{2} \quad F_{ext} s_{cm} = \frac{1}{2} M v_{cm}^2 \quad F_{ext} s = \frac{1}{2} M v_{cm}^2 + K_{rot}$$

$$\textcircled{3} \quad (Mg \sin \theta - f) s_{cm} = \frac{1}{2} M v_{cm}^2 \quad Mg s_{cm} \sin \theta = \frac{1}{2} M v_{cm}^2 + K_{rot}$$

$$\textcircled{4} \quad (N - Mg) s_{cm} = \frac{1}{2} M v_{cm}^2 \quad -Mg s_{cm} = \frac{1}{2} M v_{cm}^2 + \Delta E_{int}$$

$$\textcircled{5} \quad (a) \quad v_{cm} = 0.84 \text{ m/s} \quad (b) \quad \Delta E_{int} = -17.6 \text{ J}$$

$$\textcircled{6} \quad (a) \quad v_{cm} = 2.13 \text{ m/s} \quad (b) \quad \Delta E_{int, siren} = -14.3 \text{ J}; \quad \Delta E_{int, Jim} = -17.6 \text{ J}$$

$$\textcircled{7} \quad (a) \quad \Delta E_{int} = +1.1 \text{ J} \quad (b) \quad s_{cm} = 0.18 \text{ m}$$