Problem 9-40

Angular momentum is conserved.

$\therefore I_1 \omega_1 = I_2 \omega_2$

$I_1 = \frac{1}{2} M R^2$ (turntable, from Table 9-1)

and $I_2 = \frac{1}{2} M R^2 + \underset{\text{putty}}{m} R^2 = \left(\frac{M}{2} + m\right) R^2$

$$\omega_1 = 33\tfrac{1}{3} \frac{\text{rev}}{\text{min}} \times \frac{2\pi \text{ rad}}{1 \text{ rev}} \times \frac{1 \text{ min}}{60 \text{ s}} = 3.49_1 \text{ rad/s}$$

$$\therefore \omega_2 = \frac{I_1}{I_2} \omega_1 = \frac{\frac{1}{2} M R^2}{\left(\frac{M}{2} + m\right) R^2} \omega_1 = \frac{0.100}{0.200} 3.49_1$$

$$= 1.745 \text{ rad/s}$$

$$\Delta KE = \frac{1}{2} I_2 \omega_2^2 - \frac{1}{2} I_1 \omega_1^2$$

$$= \frac{1}{2}\left[\left(\frac{M}{2} + m\right) R^2 \omega_2^2 - \left(\frac{1}{2} M R^2\right) \omega_1^2\right]$$

$$= \frac{1}{2}\left[(0.200)(0.105)^2 (1.745)^2 - (0.100)(0.105)^2 (3.49_1)^2\right]$$

$$= -3.36 \times 10^{-3} \text{ J}$$