

$$r_i = 10 \text{ mm}$$

Initial

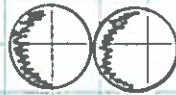


$$\begin{aligned} m_c &= 1g \\ g_c &= 2nc \\ R_c &= 1 \text{ mm} \\ v_{c,i} &= 0 \end{aligned}$$



$$\begin{aligned} m_D &= 2g \\ g_D &= -1nc \\ R_D &= 1 \text{ mm} \\ v_{D,i} &= 0 \end{aligned}$$

$$r_f = 2 \text{ mm}$$



$$v_c \quad v_D$$

Final

Conserve energy $i \rightarrow f$:

$$\Delta E_{\text{mech}} = \Delta K + \Delta U = W_{nc} = 0$$

$$U_i = K \frac{g_c g_D}{r_i}$$

$$U_f = K \frac{g_c g_D}{r_f}$$

So

$$(K_f - K_i) + (U_f - U_i) = 0$$

$$\left(\frac{1}{2} m_c v_c^2 + \frac{1}{2} m_D v_D^2 \right) + \left(\frac{K g_c g_D}{r_f} - \frac{K g_c g_D}{r_i} \right) = 0$$

$$\frac{1}{2} m_c v_c^2 + \frac{1}{2} m_D v_D^2 + K g_c g_D \left(\frac{1}{r_f} - \frac{1}{r_i} \right) = 0 \quad (1)$$

Conserve x -comp momentum $i \rightarrow f$:

$$P_{ix} = P_{fx}$$

$$0 = m_c v_c - m_D v_D$$

$$\text{So } v_D = \frac{m_c}{m_D} v_c \quad (2)$$

Subst. eqn'n (2) \rightarrow eqn'n (1):

$$\frac{1}{2} m_c v_c^2 + \frac{1}{2} m_D \left(\frac{m_c}{m_D} v_c \right)^2 + K g_1 g_2 \left(\frac{1}{r_f} - \frac{1}{r_i} \right) = 0$$

$$m_c v_c^2 + \frac{m_c^2}{m_D} v_c^2 = 2 K g_1 g_2 \left(\frac{1}{r_i} - \frac{1}{r_f} \right)$$

So:

$$v_c = \left[\frac{2 K g_1 g_2 \left(\frac{1}{r_i} - \frac{1}{r_f} \right)}{\left(m_c + \frac{m_c^2}{m_D} \right)} \right]^{1/2}$$

$$= 0.0979 \text{ m/s}$$

$$\underline{v_c = 9.79 \text{ cm/s}}$$

and $v_D = \frac{m_c v_c}{m_D} = \underline{4.90 \text{ cm/s}}$