HW5-15 Soln)

Let’s let up be positive y for mass 1 and to the right be positive x. For mass 2, down is positive and to the right is positive y. We’ve used the fractured co-ordinate system.

NII:

Mass One

$$\text{x:}\ +T - F_{fK} = M_1 a_x$$

$$\text{y:}\ +F_N - gM_1 = M_1 a_y = 0 \quad \rightarrow \quad F_N = gM_1$$

Mass Two

$$\text{x:}\ -T + gM_2 = M_2 a_x$$

$$\text{y:}\ \ \text{No Forces}$$

and

$$F_{fK} = \mu_K F_N$$

Then,

$$\mu_K = \frac{F_{fK}}{F_N} = \frac{T - M_1 a_x}{gM_1} = \frac{gM_2 - M_2 a_x - M_1 a_x}{gM_1} \quad .$$

We need to know ax. Try kinematic equation (3):

x_i = 0 (why not?)

x_f = +2.2 m

v_{xi} = 0

v_{xf} = ?

a_x = ? ←

t = 3 seconds

$$x = x_i + v_{xi}t + \tfrac{1}{2}a_x t^2$$

$$a_x = \frac{2\big((x - x_i) - v_{xi}t\big)}{t^2} = \frac{2\big((2.2 - 0) - 0\big)}{3^2} = 0.49\ \text{m/s}^2$$

Then,

$$\mu_K = \frac{gM_2 - M_2a_x - M_1a_x}{gM_1} = \frac{10(5) - 5(0.49) - 15(0.49)}{10(15)} = 0.27\,.$$