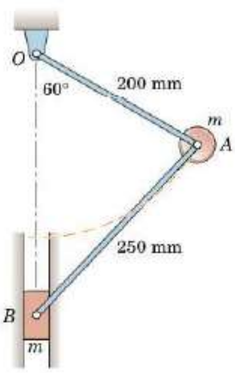
Semester I (2019-2020)

Potential Energy

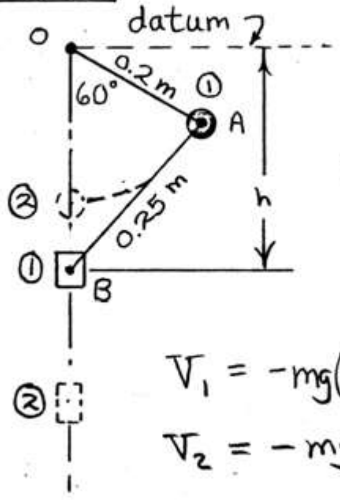
Additional examples

P. 3/160: The small bodies A and B each of mass m are connected and supported by the pivoted links of negligible mass. If A is released from rest in the position shown, calculate its velocity v_A as it crosses the vertical centerline. Neglect any friction.



Problem 3/160

3/160



$$T_1 + V_1 = T_2 + V_2$$

$$T_1 = 0$$

$$T_2 = \frac{1}{2} m v_A^2$$

Note that

$$h = 0.2\cos 60^\circ + \sqrt{0.25^2 - (0.2\sin 60^\circ)^2}$$

$$= 0.280 \text{ m}$$

$$V_1 = -mg(0.2\cos 60) - mg(0.280) = -0.380mg$$

$$V_2 = -mg(0.2) - mg(0.45) = -0.650mg$$

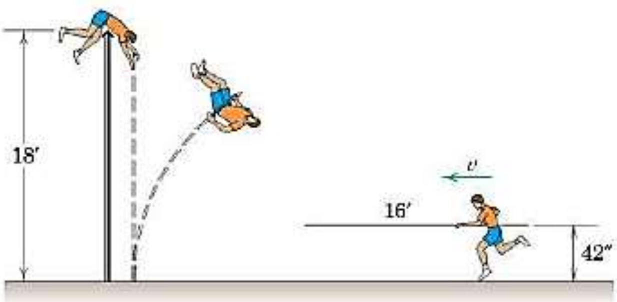
So

$$-0.380mg = \frac{1}{2} m v_A^2 - 0.650mg$$

$$v_A = 2.30 \text{ m/s}$$

P. 3/171: A 175-lb pole vaulter carrying a uniform 16-ft, 10-lb pole approaches the jump with a velocity *v* and manages to barely clear the bar set at a height of 18 ft. As he clears the bar, his velocity and that of the pole are essentially zero.

Calculate the minimum possible value of v required for him to make the jump. Both the horizontal pole and the center of gravity of the vaulter are 42 in. above the ground during the approach



3/171 $U'_{1-2} = 0$ so $T_1 + V_{g_1} = T_2 + V_{g_2}$

Take datum $V_g = 0$ at ground level.

$T_1 = \frac{1}{2}\frac{175+10}{32.2}v^2 = 2.87v^2$, $T_2 = 0$

$V_{g_1} = (175+10)\frac{42}{12} = 648$ ft-lb

$V_{g_2} = 175(18) + 10(8) = 3230$ ft-lb

So $2.87v^2 + 648 = 0 + 3230$

$v = 30.0$ ft/sec or 20.4 mi/hr