HW8

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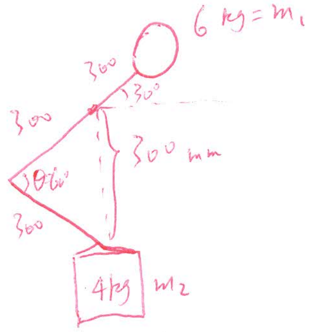

The 4kg block first move downward, then move upward. It halts when $\theta = 180°$. change of potential energy is converted to kinetic energy.

$$300\,mm \times m_2 \times g - m_1 \times g \times 150\,mm = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 \times (v_2 = 0)^2$$

$$\therefore \quad 0.3m \times 4 \times 9.8N - 6 \times 9.8N \times 0.15m = \frac{1}{2} \times 6 \times v_1^2.$$

$$v_1^2 = 0.98 \qquad v_1 = \sqrt{0.98}\ m/s = 0.9899\ m/s$$

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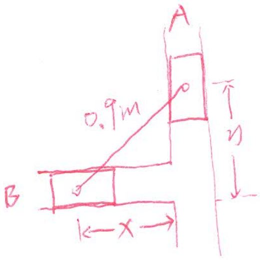
$$x^2 + y^2 = 0.9^2 \Rightarrow 2x\dot{x} + 2y\dot{y} = 0 \Rightarrow 2xv_x + 2yv_y = 0 \quad ①$$



$$y_0 = \frac{0.9}{\sqrt{2}} = 0.636396m$$

$$mgy_0 = mgy + \frac{1}{2}m\dot{y}^2 + \frac{1}{2}m\dot{x}^2 \quad ② \quad \text{conservation of mechanical energy}$$

$$② \Rightarrow mg(y_0 - y) = \frac{1}{2}m(v_x^2 + v_y^2)$$

$$① \Rightarrow v_x = -\frac{yv_y}{x} \qquad v_y = -\frac{xv_x}{y}$$

$$\therefore mg(y_0 - y) = \frac{1}{2}m\left(v_x^2 + \frac{x^2}{y^2}v_x^2\right) = \frac{m}{2}\left(\frac{x^2+y^2}{y^2}\right)v_x^2 = \frac{m}{2} \times \frac{0.9^2}{y^2}v_x^2$$

$$\therefore v_x = \frac{y\sqrt{2g(y_0 - y)}}{0.9} = \frac{0.4243 \times \sqrt{2 \times 9.8 \times (0.636396 - 0.4243)}}{0.9}\ m/s = 0.9612\ m/s$$

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a). $f = u_k mg\cos 50°$

Change of kinetic energy is equal to work done by environment.

$$(mg\sin 50° \times \Delta S - f \times \Delta S) - (\frac{1}{2}k\Delta X_a^2 - \frac{1}{2}k\Delta X_0^2) = \frac{1}{2}mv_a^2 - \frac{1}{2}mv_0^2$$

$\Delta S = 100\ mm$ $\Delta X_0 = 25\ mm$ $\Delta X_a = \Delta X_0 + 2\Delta S = 225\ mm$ $\Delta X_0 = 25\ mm$ $v_0 = 0.3\ m/s$ $k = 200\ N/m$

~~98 × sin 50° × 0.1 − 0.15 × 98 × cos~~

$$\therefore 98 \times \sin 50° \times 0.1 - 0.15 \times 98 \times \cos 50° \times 0.1 - \frac{200}{2}(0.225^2 - 0.025^2)$$

$$= \frac{1}{2} \times 10 \times (v_a^2 - 0.3^2)$$

$$\therefore 7.5068 - 0.94521 - 5 = 5 \times (v_a^2 - 0.3^2) \Rightarrow v_a = 0.634\ m/s$$

b). $(mg\sin 50° \times \Delta S_b - f\Delta S_b) - (\frac{1}{2}k \cdot \Delta X_b^2 - \frac{1}{2}k\Delta X_0^2) = -\frac{1}{2}mv_0^2$

$\Delta X_0 + 2\Delta S_b = \Delta X_b$

$$98 \times 0.766 \times \Delta S_b - 0.15 \times 98 \times 0.643 \times \Delta S_b - \frac{200}{2}(\Delta X_b^2 - \Delta X_0^2) = -\frac{1}{2}mv_0^2$$

($\Delta X_0 = 0.025$)

$$\Delta X_b^2 = (\Delta X_0 + 2\Delta S_b)^2 = (0.025 + 2\Delta S_b)^2$$

$$65.6159\Delta S_b - 100\ (0.025^2 + 4\Delta S_b^2 + 0.1\Delta S_b - 0.025^2) = -\frac{1}{2} \times 10 \times v_0^2 = -5 \times 0.3^2$$

$$-400\Delta S_b^2 + 55.6159\Delta S_b + 0.45 = 0$$

$$\therefore \Delta S_b = 146.708\ mm.$$