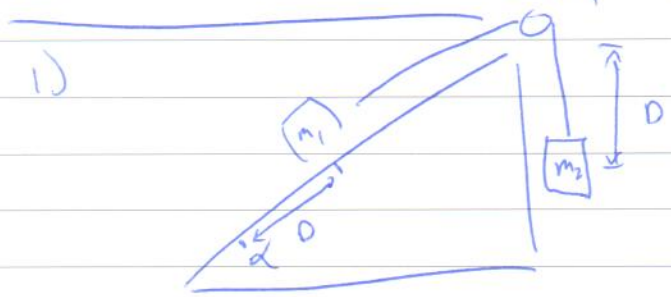


Sept 15/2016

Worksheet 1.3: Solutions

1)



Find t .

Use conservation of energy.

(1) $\Delta K.E. + \Delta P.E. = 0$ Starts @ rest!

$$\Delta K.E. = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2 - 0$$

$$v_{1f} = v_{2f} = v \Rightarrow \boxed{\Delta K.E. = \frac{1}{2} v^2 (m_1 + m_2)}$$

$$\Delta P.E. = -m_1 \sin \alpha D g + m_2 D g$$

$$\therefore (1) \Rightarrow \frac{1}{2} v^2 (m_1 + m_2) - m_1 \sin \alpha g t + m_2 D g = 0$$

$$v_f = v_i + at \Rightarrow a = \frac{v}{t}$$

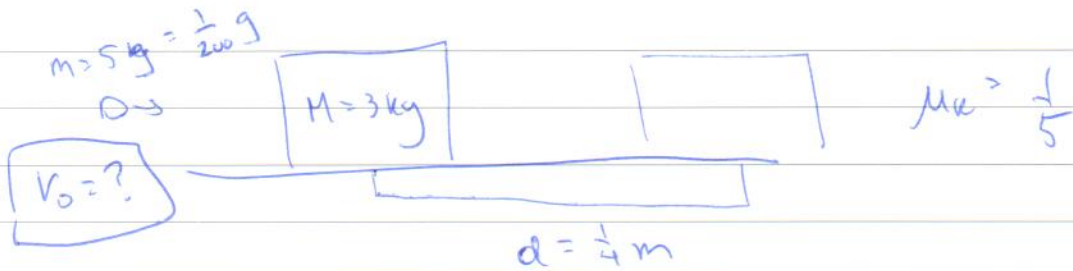
$$D = v t + \frac{1}{2} a t^2 = \frac{1}{2} v t$$

$$\therefore t = \frac{2D}{v}$$

$$v = \sqrt{\frac{2Dg(m_1 \sin \alpha - m_2)}{m_1 + m_2}}$$

$$\therefore t = \frac{2D(m_1 + m_2)}{v g (m_1 \sin \alpha - m_2)}$$

2) Bullet Problem



Phase 1: Bullet sticks in block. (no cons. of E)

$$P_{in} = P_{fin} \Rightarrow v_0 m = v_1 (m+M)$$

(\hookrightarrow final speed of (bullet + block).)

$$\therefore v_1 = \left(\frac{m}{m+M} \right) v_0 \quad (1)$$

Phase 2: (Bullet + Block) slide along table. (no cons. of \vec{p})

$$\Delta K.E. + \Delta P.E. = \Delta E_{nc.}$$

\checkmark \downarrow \downarrow \downarrow

$$-\frac{1}{2} (m+M) v_1^2 + 0 = - \underbrace{\mu_k (m+M) g d}_{= N} \quad \left(\begin{array}{l} \text{energy is lost due to friction.} \\ \text{N} \\ \text{(m+M)g} \end{array} \right)$$

$$\therefore v_1^2 = 2 \mu_k g d = \left(\frac{m}{m+M} \right)^2 v_0^2 \quad (1)$$

$$\therefore v_0 = \left(\frac{m+M}{m} \right) \sqrt{2 \mu_k g d} = 595 \text{ m/s}$$