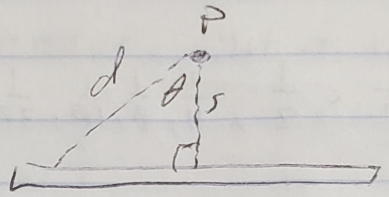
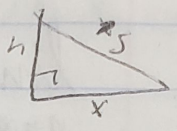
1.

$$E = \int_{-\frac{1}{2}L}^{\frac{1}{2}L} \frac{4QK}{L^2} \frac{|x|}{(x^2+h^2)}$$




$s = \sqrt{x^2+h^2}$ $\qquad \sqrt{h^2+x^2}$

$$E = \frac{4K}{L^2} \int \frac{Q}{x^2+h^2} |x| \qquad \frac{4KQ}{L^2} \int \frac{|x|}{x^2+h^2} dx$$

$$= \frac{4KQ}{L^2} \left( \frac{\ln(x^2+h^2)}{2|x|} \right) \Bigg|_{-\frac{L}{2}}^{\frac{L}{2}} \qquad \left[ \frac{\ln\left(\frac{L}{2}\right)^2 + h^2}{2\left|\frac{L}{2}\right|} \right] - \left[ \frac{\ln\left(\frac{-L}{2}\right)^2 + h^2}{2\left|\frac{-L}{2}\right|} \right]$$

$$\frac{4KQh^2}{L^2} \left( \frac{\left(\ln\left(\frac{L}{2}\right)^2 + 1\right) - \left(\ln\left(\frac{L}{2}\right) + 1\right)}{2\left|\frac{L}{2}\right|} \right)$$

2.

$$\frac{N}{C} = \frac{N m^2 C}{C^2 \, m^2} \qquad \text{yes}$$

3.

$$\lambda = \frac{Q}{L^2} |x| \qquad E = \int_0^L \frac{K \, dQ}{L^2 r^2} |x| \qquad r = s + \frac{L}{2} + |x|$$

$$\frac{4KQ}{L^2} \int_0^L \frac{|x|}{r^2} dx \qquad \int \frac{|x|}{\left(s + \frac{L}{2} + |x|\right)^2} dx \Rightarrow \text{calculator}$$

$$\frac{2KQ}{L^2} \cdot \left( (2s+L)\ln(2s+L) + (-2s-L)\ln(2s-L) - 2L \right)$$

4.

$$\frac{N}{C} = \frac{N m^2 C}{m^2} \cdot m \qquad \text{yes}$$

5.

$K = 100 \text{ N/m}$ → $x = 0.1 \text{ m}$

compressed $0.1 \text{ m}$ $\quad m_1 = 1 \text{ kg} \quad m_2 = 2 \text{ kg}$

$E_s = \frac{1}{2} K x^2 \qquad \mu = 0$

1 ⟷ 2

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$m_1 v_{1f} = -m_2 v_{2f}$$

$$v_{1f} = \frac{-m_2 v_{2f}}{m_1} \qquad \frac{v_{1f}}{v_{2f}} = -\frac{m_2}{m_1}$$

$$\frac{1}{2} K x^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

$$K x^2 = m_1 \left( \frac{m_2 v_{2f}}{m_1} \right)^2 + m_2 v_{2f}^2 \qquad m_1 \cdot \frac{m_2^2 v_{2f}^2}{m_1^2} + m_2 v_{2f}^2 = K x^2$$

$$m_1 K x^2 = m_2^2 v_{2f}^2 + m_2 v_{2f}^2 \qquad m_1 K x^2 = (m_2^2 + m_2) v_{2f}^2$$

$$v_{2f} = \sqrt{\frac{m_1 K x^2}{m_2^2 + m_2}} = 3.7 \text{ m/s} = v_{2f}$$

$$7.3 \text{ m/s} = v_{1f}$$