Question 2

$$\delta \mathcal{E} = P_1 \delta u_1 + P_1 \delta u_2$$

$$\delta \mathcal{U} = F_1 \delta e_1 + F_2 \delta e_2$$

$$P_1 \delta u_1 + P_1 \delta u_2 = F_1 \delta e_1 + F_2 \delta e_2$$

$$e_1 = \frac{\sqrt{3}}{2} u_1 - \frac{1}{2} u_2$$

$$\dot{e}_2 = - u_2$$

$$\delta e_1 = \frac{\sqrt{3}}{2} u_1 - \frac{1}{2} u_2 \qquad \delta e_2 = - \delta u_2$$

$$F_1 \left(\frac{\sqrt{3}}{2} \delta u_1 - \frac{1}{2} \delta u_2 \right) + F_2 (- \delta u_2) = P_1 \delta u_1 + P_1 \delta u_2$$

$$\left(\frac{\sqrt{3} F_1}{2} - P_1 \right) \delta u_1 + \left(- \frac{F_1}{2} - F_2 \right) \delta u_2 = 0$$

$$F_1 = \frac{2P}{\sqrt{3}} \qquad \qquad - \frac{P}{\sqrt{3}} - F_2 = 0$$

$$F_2 = - \frac{P}{\sqrt{3}}$$

Principal of virtual work

$$\sum \delta P_i v_i = \sum \delta F_j e_j$$

$$\delta P_1 u_1 = \delta F_1 e_1 + \delta F_2 e_2 = \left[\frac{2P}{\sqrt{3}} \left(\frac{2}{\sqrt{3}} \right) + \left(\frac{-P}{\sqrt{3}} \right) \left(\frac{1}{\sqrt{3}} \right) \right] \frac{L}{AE}$$

$$u_1 = \frac{5PL}{3AE}$$

$$\delta P_2 u_2 = \delta F_1 e_1 + \delta F_2 e_2 = \left[\left(\frac{2P}{\sqrt{3}} \right)(0) + \left(\frac{-P}{\sqrt{3}} \right)(-1) \right] \frac{L}{AE}$$

$$= \frac{PL}{\sqrt{3} AE}$$

$$u_{12} = \sqrt{ \left(\frac{5PL}{3AE} \right)^2 + \left(\frac{PL}{\sqrt{3} AE} \right)^2 }$$

$$= \frac{\sqrt{28} \; PL}{3 AE}$$