

ALE-01: Required Math Skills

Note: You may NOT use Maple

- 1) Solve the following ordinary differential equation, with k , s and q constant.

$$\frac{d}{dx}(kT(x)) + sx - q = 0 \quad , \quad T(x_L) = T_A$$

- 2) Differentiate the following function N_{11} with respect to x . Be sure to clearly show the chain rule.

$$N_{11} = \zeta_1 \quad \text{where} \quad \zeta_1 = 1 - \frac{\bar{x}}{l_e} \quad \text{and} \quad \bar{x} = x - x_L$$

- 3) Integrate the following expression by parts, where k is constant.

$$\int_0^L \Phi(x) \left[-\frac{d}{dx} \left(k \frac{dT^N(x)}{dx} \right) \right] dx$$

- 4) Put the following matrix *assembly* in the form $\mathbf{Ax} = \mathbf{b}$. Then simplify for $l_{e,12} = l_{e,23} = l_e$, $k_{12} = k_{23} = k$, and $s_{12} = s_{23} = s$.

$$\left(\frac{k_{12}}{l_{e,12}} \begin{bmatrix} 1 & -1 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{Bmatrix} Q_1 \\ Q_2 \\ Q_3 \end{Bmatrix} + \frac{k_{23}}{l_{e,23}} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & -1 \\ 0 & -1 & 1 \end{bmatrix} \begin{Bmatrix} Q_1 \\ Q_2 \\ Q_3 \end{Bmatrix} \right) - \frac{1}{2} \left(\begin{Bmatrix} l_{e,12}s_{12} \\ l_{e,12}s_{12} \\ 0 \end{Bmatrix} + \begin{Bmatrix} 0 \\ l_{e,23}s_{23} \\ l_{e,23}s_{23} \end{Bmatrix} \right) = \begin{Bmatrix} 0 \\ 0 \\ 0 \end{Bmatrix}$$