**Circuit components**

- **R** (resistor) \( \frac{V}{I} \) (Ohm's Law)
  - Units: ohms \( \Omega \)

- **G** (conductance) \( \frac{I}{V} \) (Conductance)
  - Units: mhos \( \Omega^{-1} \)
  - Slope = \( \frac{I}{V} \)

- **C** (capacitor) \( \frac{V}{I} \) (Linear capacitor)
  - Units: farads \( F \)
  - \( I = \frac{dQ}{dt} = C \frac{dV}{dt} \)

- **L** (inductor) \( \frac{V}{I} \) (Linear inductor)
  - Units: henrys \( H \)
  - \( V = L \frac{dI}{dt} \)

**Independent sources**

1) **Voltage source**
   - \( V_s \) (Ideal)

2) **Current source**
   - \( I_s \) (Ideal)

**Dependent sources (Controlled Sources)**

- **VCCS** (Voltage Controlled Voltage Source)
  - \( v_2 = A \cdot v_1 \)

- **CCVS** (Current Controlled Voltage Source)

- **CCCS** (Current Controlled Current Source)
**KCL** algebraic sum of currents flowing into a node is 0

\[ l_1 + l_2 - l_3 - l_4 - l_5 = 0 \]
\[ -l_1 - l_2 + l_3 + l_4 + l_5 = 0 \]
\[ l_1 + l_2 = l_3 + l_4 + l_5 \]

**KVL** algebraic sum of voltage drops around a loop is zero

\[ v_2 + v_3 - v_1 = 0 \]

Analysis methods
- nodal analysis
- mesh analysis

1) Identify meshes (identify nodes)

2) The mesh current is the unknown quantity (KCL) (node voltage)

3) Write KVL for each mesh

**Mesh 1:** \[ v_1 + v_2 - 5 = 0 \]

**Mesh 2:** \[ v_3 + v_4 - v_2 = 0 \]

4) Use Ohm's law to write \( v_1, v_2, v_3, v_4 \) in terms of \( l_1 \) and \( l_2 \) (the mesh currents)

\[ 2l_1 + 6(l_1 - l_2) - 5 = 0 \]
\[ 2l_2 + 4l_2 - 6(l_1 - l_2) = 0 \]
\[ + 6(l_2 - l_1) \]
**Source transformations**

\[ V_s \quad \frac{V_s}{R_s} \quad \frac{V_s}{R_s} \]

**Superposition Theorem (applies to linear circuits only)**

**Thevenin’s Equivalent**

\[ V_{in} = V_{th} \]

\[ R_{th} = \frac{V_{in}}{I_t} \]

\[ R_{th} = \frac{6}{8} \]

\[ = 2Ω + (2Ω || 6Ω) \]