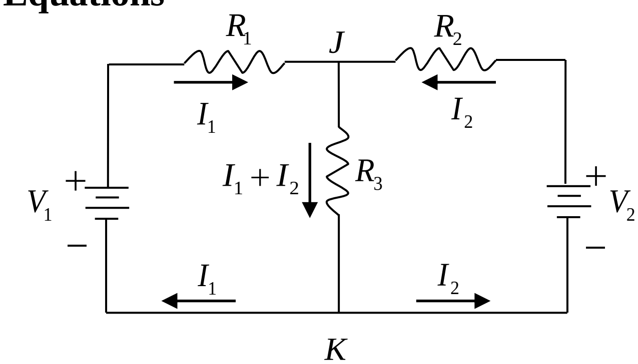
**ENGR 1990 Engineering Mathematics**
**Homework #6 – 2D Vectors and Simultaneous Equations**

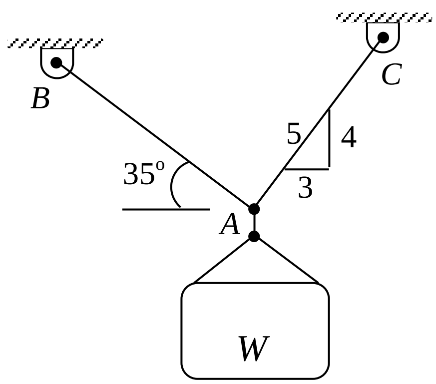


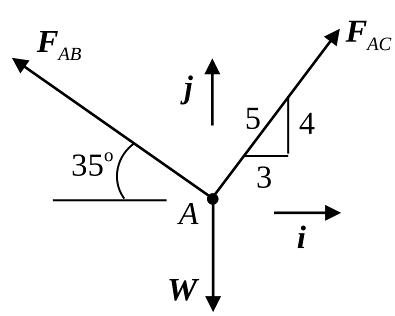

1. For the double-loop DC circuit shown, the currents $I_1$ and $I_2$ can be found by solving the following simultaneous equations.

$$\boxed{\begin{aligned}(R_1+R_3)I_1+(R_3)I_2&=V_1\\(R_3)I_1+(R_2+R_3)I_2&=V_2\end{aligned}}$$

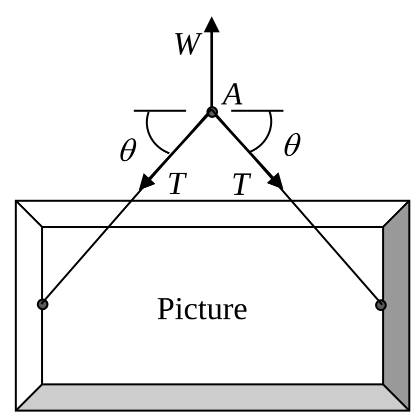
Given the resistances $R_1 = 8(\Omega)$, $R_2 = 10(\Omega)$, and $R_3 = 5(\Omega)$, and the voltages $V_1 = 12$ (volts), and $V_2 = 24$ (volts), find the currents $I_1$ and $I_2$ using (a) Gaussian elimination (substitution), (b) Cramer's rule, and (c) matrix inversion. Compare the results.

2. Given the weight $W = 1000$ (lbs), find $\boldsymbol{F}_{AB}$ and $\boldsymbol{F}_{AC}$ the forces in the supporting wires by setting the sum of the forces to zero at *A*, using (a) Gaussian elimination (substitution), (b) Cramer's rule, and (c) matrix inversion. Compare the results.




3. The figure shows a picture hanging on a wall at point *A*. The weight of the picture is *W*. Assuming the picture wire is aligned symmetrically (at an angle $\theta$ to the horizontal), find the tension *T* in the wire as a function of the weight *W* and angle $\theta$. How does the tension change as the picture wire is shortened, moving *A* closer to the picture frame? What is the limiting value of *T*?



4. The diagram shows a simple truss that is connected to the ground with a pin support at $A$ and a pin and roller support at $C$. Free body diagrams of the truss and the pin at B are also shown. Using the free body diagram of the ***truss***, find (a) the moment of the force $\boldsymbol{P}$ about point $A$, (b) the force $\boldsymbol{C}$ so the sum of the moments of forces $\boldsymbol{A}$, $\boldsymbol{P}$, and $\boldsymbol{C}$ about $A$ is zero, and (c) the $X$ and $Y$ components of the force $\boldsymbol{A}$ so the sum of the forces $\boldsymbol{A}$, $\boldsymbol{P}$, and $\boldsymbol{C}$ is zero. Using the free body diagram of ***pin*** $B$, (d) find a set of simultaneous equations you can solve for the magnitudes of forces $\boldsymbol{F}_{AB}$ and $\boldsymbol{F}_{BC}$ by setting $\boldsymbol{P}+\boldsymbol{F}_{AB}+\boldsymbol{F}_{BC}=\boldsymbol{0}$, and (e) solve the simultaneous equations using Cramer's rule.