1. (20%) Determine the currents through the various branches of the electrical network in the figure using the **Gauss-Jordan elimination** operation.
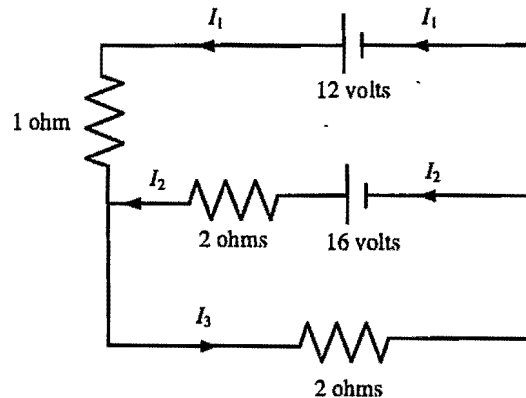
2. (15%) The following stochastic matrix P gives the probabilities for a certain region of college- and noncollege-educated households having at least one college-educated child. By college-educated we understand that at least one parent is college educated, while by noncollege-educated we mean that neither parent is college-educated. If there are currently 300,000 college-educated households and 750,000 noncollege-educated households, what is the predicted distribution for two generation hence?

$$P = \begin{bmatrix} 0.9 & 0.25 \\ 0.1 & 0.75 \end{bmatrix} \begin{matrix} \text{college educated} \\ \text{noncollege educated} \end{matrix}$$

3. (15%) Let the set $\{v_1, v_2, v_3\}$ be linearly independent in R^3. Let c be a nonzero scalar. Prove that the set $\{v_1, v_1 + cv_2, v_3\}$ are also linearly independent.

4. (9%) Explain the definitions for these terms; (a) a priori, (b) a posteriori, (c) the sample space of the experiment.

5. (16%) We may model the arrival of telephone calls with a Poisson probability density function. Suppose that the average rate of calls is 10 per minute. What is the probability that less than three calls will be received in the first six seconds? in the first six minutes?

6. (10%) Suppose two random variables are related such that $Y = aX^2$. Assume that $p_Y(y)$ is even about the origin. Show that $\rho_{XY} = 0$.

7. (15%) A Gaussian random variable with zero mean ($\mu = 0$) and variance σ^2 is applied to a device that has only two possible outputs, zero or one. The output zero occurs when the input is negative, and the output one occurs when the input is zero or positive. What is the output probability density function? Rework the problem when $\mu = 0.5$ and $\sigma = 1$.