1.   (10 pts.) Let $S_1 = \{3,6,9\}$ and $S_2 = \{a,b\}$. Is $\{(3,a),(6a),(9,a)\}$ a function from S_1 to S_2. Why or why not? Explain.

2.   (10 pts.) Suppose that the domain of the function $y = x^2 - x + 1$ is the set $\{x \mid 0 \le x \le 1\}$. Find the range of the function and express it as a set.

3.   (10 pts.) Solve $x^3 + 3x^2 - x - 3 = 0$.

4.   (20 pts.) A national-income model is given:

$$Y = C + I_o + G_o$$
$$C = a + b(Y - T) \qquad (a > 0, 0 < b < 1)$$
$$T = t_o C \qquad\qquad (0 < t_o < 1)$$

Here, Y, C and T are endogenous; and I_o, G_o and t_o are exogenous.

1)   Find the equilibrium national income.
2)   In this model, is the multiplier always greater than one? Why or why not?

5.   (10 pts.) A company earns before-tax profits of $100,000. It has agreed to contribute 10 percent of its after-tax profits to the Red Cross Relief Fund. It must pay a state tax of 5 percent of its profit (after the Red Cross donation) and a federal tax of 40 percent of its profits (after the donation and state taxes are paid). How much does the company pay in state taxes?

6.   (10 pts.) Let $X = (1,1)'$. Find $A = I_2 - X(X'X)^{-1}X'$. Show that A is not invertible.

7.   (10 pts) For which value of k does $A = \begin{bmatrix} 1 & 2 & 4 \\ 3 & 1 & 6 \\ k & 3 & 2 \end{bmatrix}$ fail to be invertible?

8.   (10 pts.) Assume $\det \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} = 5$. Find $\det \begin{bmatrix} -a & -b & -c \\ 2d & 2e & 2f \\ -g & -h & -i \end{bmatrix}$.

9.   (10 pts.) Evaluate det(A), where $A = \begin{bmatrix} 1 & 2 & 0 & 9 \\ 2 & 3 & 4 & 6 \\ 1 & 6 & 0 & -1 \\ 0 & -5 & 0 & 8 \end{bmatrix}$.