

Place your name on the back of this sheet of paper and nowhere else. Staple your answers face up on the front of this sheet of paper. Failure to follow these directions will cost you 1 point. If you use double-sided printing or print on the back of scrap paper, I will give you one additional point.

**Show all work for all questions.**

$$A = \begin{bmatrix} 2 & 3 & 1 \\ 4 & -1 & -2 \\ 0 & 5 & -3 \end{bmatrix}, B = \begin{bmatrix} 10 & 5 & 2 \\ -1 & 0 & 1 \\ 4 & -2 & 6 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}, D = [10 \quad 20 \quad 30], E = \begin{bmatrix} 4 \\ 6 \\ 8 \end{bmatrix}$$

1) (10 points each) Use the matrices above to answer the following:

- A) What is  $AB$ ?
- B) What is  $BA$ ?
- C) What are  $DE$  and  $ED$ ?
- D) What is  $3A - B$ ?
- E) What is  $CA$ ?
- F) What is  $AA$ ?

2) (15 points) Suppose that each dollar's worth of energy (E) requires 20¢ of energy and 30¢ of machinery (M). Each dollar's worth of machinery requires 40¢ of energy, 10¢ of machinery, and 10¢ of food (F). Each dollar's worth of food requires 10¢ of energy, 10¢ of machinery and 25¢ of food. Write the Leontief Input-Output Matrix stating how you found it.

3) (25 points) Suppose that 80% of the people in Pittsburgh at the beginning of the year end in Pittsburgh while 10% move to Wheeling and 10% move to Bethany. 70% of those who start in Wheeling stay in Wheeling and the rest move to Pittsburgh. 75% of those who start in Bethany stay in Bethany while 20% move to Pittsburgh and 5% move to Wheeling. Set up the population matrix briefly stating how you found it. Suppose that at the beginning of the year, 1000 people live in Pittsburgh, 500 live in Wheeling, and 100 live in Bethany. According to this model, how many people will be in each location in 1 year and in 2 years? Use matrix multiplication to answer this question.