Write your name on the cover of the test booklet and nowhere else. Enclose this sheet with the booklet. Failure to follow these directions will cost you 1 point. The test has 100 points (to be scaled up to 225 points) and is scheduled to take 50 minutes. Therefore, expect to spend 1 minute for every 2 points. For example, a 12-point question should take 6 minutes. I can give some extra time.

Show all work for all questions.

1) (16 points) Suppose the production of $1 of energy uses $0.20 of energy and $0.10 of raw materials and the production of raw materials use $0.30 of energy and $0.10 of raw materials. Setup the Leontief Input-output matrix. <u>Briefly</u> state how you set it up. Suppose you want to sell $200 of energy and $1700 of raw materials. Set up the matrix equation which will enable you to find how much of each you need to produce. Solve the problem using either Cramer's Rule or finding the inverse of the matrix.

2) (26 points) Solve this system by finding A^{-1} and using it. $X + Y = 30$, $5X - Z = 0$, $Y + 2Z = 120$.

3) (10 points) Solve this system using Cramer's Rule. $3X - Y = 0$, $2X + Y = 50$.

Questions 4 - 9 are all worth 12 points. Answer **FOUR** of them.

4) Suppose a production function was given by $Q(H, L, K) = 24H^{1/2}L^{1/4}K^{1/3}$. If you wanted to replace skilled labor with unskilled labor, what is the marginal rate of technical substitution? I.e., what is $-\partial L/\partial H$? Find the value for when you have 16 skilled workers, 64 unskilled workers, and 27 units of capital.

5) Suppose you wanted to do a positive monotonic transformation of the utility function for balls and racquets is $U(B, R) = 14B^{1/2}R^{1/3}$. What is the transformation you would do? Prove it is a valid transformation. Give me the equation for the new equation as a function of B & R.

6) Suppose your utility function for books and music is given by $U(B, M) = 24B^{1/2}M^{1/3}$ and your expenditures on books and music as a function of income are given by $B = I^{1/3}$ and $M = I^{1/4}$. Find the equation for your marginal utility of income.

7) Suppose the profit function as a function of the prices of desks and chairs is given is given by $\Pi(P_d, P_c) = 8P_d + 4P_c - P_dP_c$. Find the Hessian matrix $\mathbf{H}\Pi$.

8) Suppose $F(W, X, Y, Z) = W^3 + 4WX^4 + 3Y^2 + \ln(YZ)$. Find ∇F.

9) Suppose your utility function was given by $U(G, J, V) = (G + J + V)^{1/2}$. Totally differentiate this equation. In other words, find dU.