Ag Bus 313
Midterm 1
5/2/19
Section 1
Dr. Hurley

General Instructions: This exam is worth **100 points**. You must provide your own paper. You are allowed one 3x5 note card written on one side for the exam. This note card can have anything on it but if it is larger than 3x5 you will get a zero on the exam. You are allowed to use a calculator. You must show all your work when appropriate to get credit. This includes showing all applicable formulas you use. No cell phones, music players (ipods), or tablets are allowed to be in your possession during the exam. If you are caught with any of these devices, you will receive a zero on the exam. ***Any exam material left visible and unattended, or visible and on the ground will be thrown out by the professor when discovered.***

1. If your average physical product (APP) is equal to 20 using 6 inputs, what do you expect to happen to your current APP when your marginal physical product (MPP) is 2 when you move to 9 inputs? What is your new APP given this new MPP? Please show how you found your answer. **(10 points)**

2. What is the short-run decision rule for producing an output? Please explain. **(5 points)**

3. Suppose your goal this year is to produce 2,800 bushels of organic corn. Suppose your production technology has the following relationship for producing bushels of corn $Q = f(L,T) = LT$ where Q is the number of bushels of corn you produce, L is the number of labor hours you utilize, and T is the number of tractor hours you utilize. You know that the cost per hour of labor is \$14 and the cost per hour of tractor time is \$200. Assume that you are a cost minimizing producer. **(10 points)**

   a) How much money will you need to ask from your banker to achieve your goal? (Note: when given your particular production function, the optimal amount of input formulas are $L = \sqrt{Q\frac{p_T}{p_L}}$ and $T = \sqrt{Q\frac{p_L}{p_T}}$, where p_L is the cost of labor and p_T is the cost of tractor time.)

   b) Please sketch a graph of this solution. Include the isoquant and iso-cost line.

4. Solve x_2 as a function of x_1: **(5 Points)**

   $4 + 3x_1^{-3/2}\, x_2^{7/5} = 4 + 81x_1^{3/2}\, x_2^{-8/5}$

5. Solve the following for Y_2 as a function of Y_1: **(5 Points)**

$$\frac{Y_1^3}{216} + \frac{Y_2^3}{46656} = 1000$$

6. Using the three equations, get Y_2 as a function of Y_1 (Please do not represent your answer in decimals.): **(10 Points)**

   $Y_1 = 3x_1^{1/3}$
   $Y_2 = 6x_2^{1/3}$
   $x_1 + x_2 = 125$

7. Solve for Y_1: **(10 Points)**

$$\frac{14Y_1^{3/4}}{(32500 - 4Y_1^3)^{1/4}} = \frac{7}{2}$$

8. Using limits, find the general slope of the following: **(10 Points)**

   $y = f(x) = 10x^2 + 20x + 2020$

9. Please find the derivative of the following functions: **(5 Points)**
   a) $y = f(x) = x^{-5} + 2x^{-3} + 21x^{-1/3} + 567$
   b) $y = f(x) = (x^2+2x+1)(x^3 + 3x^2 + 3x + 1)$ (Use the Product Rule)
   c) $y= f(x) = (12x^{-1/3} - 2x^2 + 4)^{-1/2}$ (Use either Generalized Power Rule or the Chain Rule)

10. Find the first order and second order (this includes the cross partial derivatives) partial derivatives of the following functions with respect to **<u>x_2</u>**: **(5 Points)**[1]

    $y = f(x_1,x_2) = 30x_1^5 + 7x_2^3 + 54x_1^{1/2}x_2^{1/3} + (729x_1x_2)^{1/3}$

11. Use the first order conditions to find the critical points of the function. Use the second order conditions to show whether the critical points are maximum, minimum, or saddle points (point of inflection). Are the critical points relative or absolute extrema? Please explain. **(10 Points)**

    a) $y = f(x) = 3x^3 - 225x + 250$

12. Minimize $f(x_1,x_2) = 70x_1 + 140x_2$ subject to the constraint $686 = g(x_1,x_2) = 2x_1^{1/4}x_2^{1/2}$. Solve this problem using the Lagrange Method **<u>or</u>** by changing it into an unconstrained maximization problem. **(15 Points)**

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[1] The derivatives for the function $f(x_1,x_2)$ are $\frac{\partial y}{\partial x_2}, \frac{\partial^2 y}{\partial x_2^2}$ *and* $\frac{\partial^2 y}{\partial x_2 \partial x_1}$