Name: _____ KEY _____

100 points total. Answer each question in the space provided.

1. (10 pts.) Caterpillar's CEO just announced his resignation, as both Caterpillar and other heavy construction equipment manufacturers like Komatsu have underperformed the market for the past five years. Many analysts place the blame on depressed world commodity markets for things like aluminum, copper, iron ore, etc., which has occurred as economies in North America, Europe, and Asia have slowed. Use supply and demand analysis to explain what is going on and why Caterpillar's CEO decided to step down. First analyze the market for a commodity like iron ore, which is used to make steel. Then analyze the market for construction/mining equipment, which is used in iron ore mines.
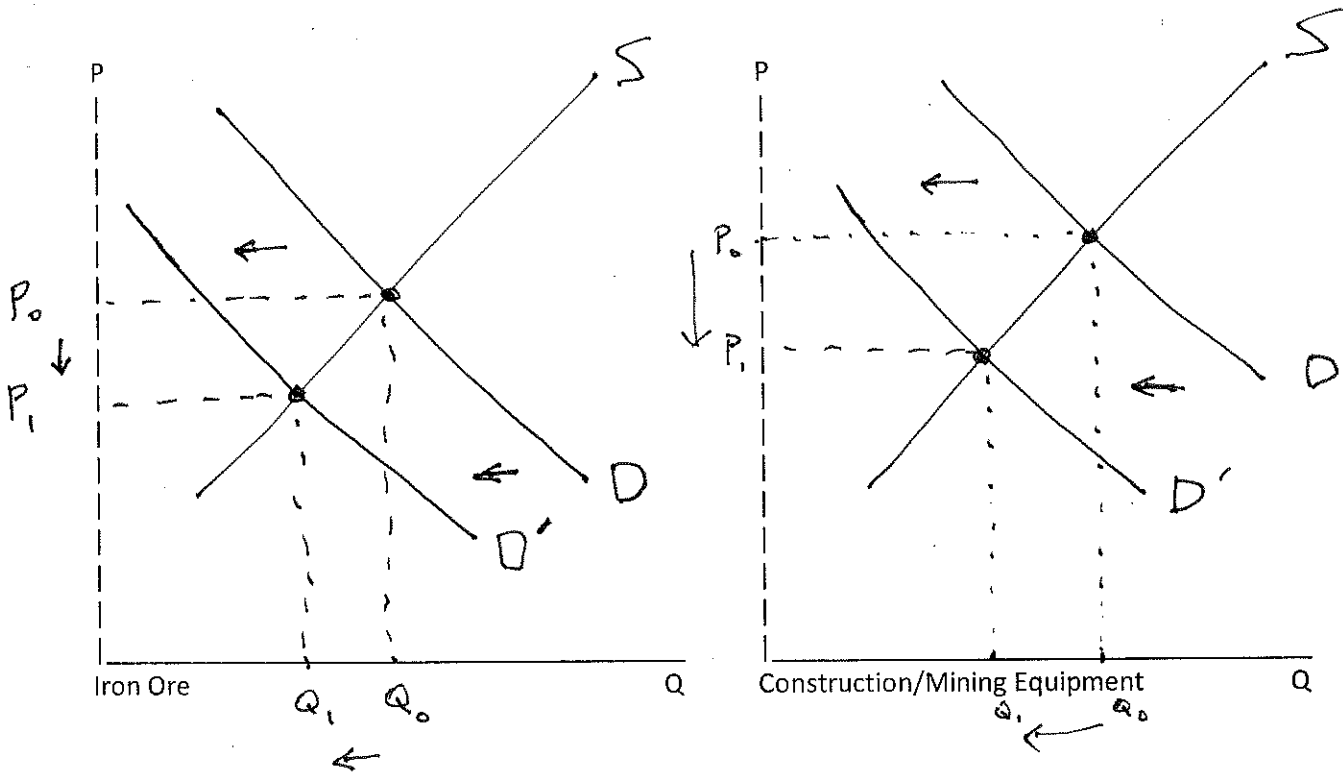
As world economies "slow", the demand for commodities like aluminum, copper, and iron ore will decline. The demand curve for iron ore shifts to the left, leading to a lower equilibrium price and lower equilibrium quantity. Construction and mining equipment are used as inputs in the production of commodities like iron ore, hence the demand for such equipment is derived from the demand for iron ore. When the demand for iron ore decreases, the demand for construction and mining equipment also declines. A reduction in the demand for such equipment leads to lower price and quantity in that market. Bad times for Caterpillar and Komatsu.

2. (5 pts.) Good weather and record corn and soybean harvests spell bad times for Midwestern farmers. Farm incomes derived from the sale of crops have dropped significantly from previous years when the size of the harvest was smaller. Explain how this could happen.

Farm incomes = total revenue from crop sales = P * Q . An increase in supply leads to a greater output and a lower price in the market for corn and for soybeans. Pertinent question is: is the relative drop in price greater than the relative increase in output? If it is, then total revenues will fall. If demand for corn and soybeans is inelastic, then an increase in output and drop in price will lead to reduced farm incomes.

3. (10 pts.) Between 2007 and 2010, average household incomes fell from $54,000 to $51,000. Annual sales of high-end houseboats declined from 2,400 to 1,500. Compute income elasticity of demand for houseboats. What type of good are houseboats?

$$\mathcal{E}_I = \frac{\% \Delta Q_D}{\% \Delta Income} = \frac{\dfrac{Q_1 - Q_0}{\frac{1}{2}(Q_1 + Q_0)}}{\dfrac{I_1 - I_0}{\frac{1}{2}(I_1 + I_0)}}$$

$$\mathcal{E}_I = \frac{\dfrac{24 - 15}{\frac{1}{2}(24 + 15)}}{\dfrac{54 - 51}{\frac{1}{2}(54 + 51)}} = \frac{\dfrac{9}{39}}{\dfrac{3}{105}} = 8.08$$

The relative decline in quantity demanded of houseboats is roughly eight times as great as the relative decline in household incomes. A positive income elasticity means houseboats are a normal good, and an income elasticity greater than one means that they are a luxury good.

4. (10 pts.) As manager of a Lay's potato chip factory, you must decide whether to install a mechanical air dryer on the production line. Your engineers explain to you that they can reduce the time it takes to fry a potato chip and hence the company's natural gas bill by installing a drying rack and blowing air over the potato slices as they move through the production line. You must decide whether this is cost effective. Briefly explain the factors you would consider and how you would make such a decision.

$$\frac{MP_K}{V} \gtreqless \frac{MP_{energy}}{P_{energy}} \quad ??$$

The extra capital equipment is intended to replace energy (natural gas) in making potato chips. Will more money spent on capital be more than offset by reduced energy expenditures? That can be determined conceptually by comparing the marginal product of capital divided by the price per unit of capital to the marginal product of energy divided by the price per unit of energy.

5. (10 pts.) Why is the short-run average total cost curve always U-shaped? What is the economic significance of the bottom portion of the U?

AFC + AVC = SRATC. When the rate of output is low, fixed costs per unit decline rapidly as output expands. When the rate of output expands beyond the point of diminishing marginal returns, variable costs per unit begin to rise. Since average total cost is the sum of the two effects, it will always be U-shaped. The "bottom" of the U indicates the range of output where per unit costs reach their minimum, given the fixed plant size. That is the range over which the given plant is designed to operate, i.e. the designed operating capacity of the plant.
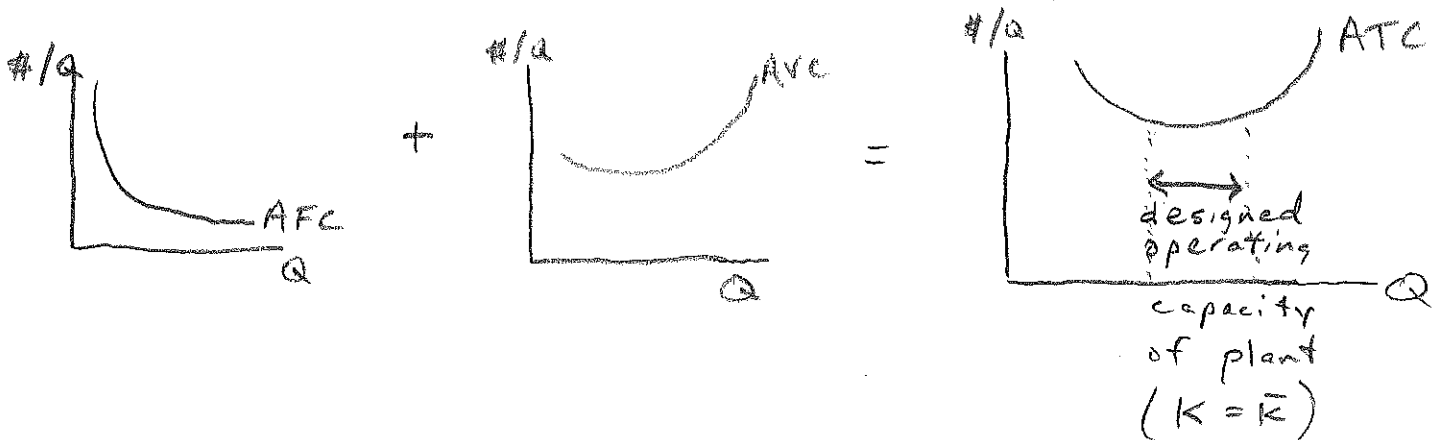
6. (15 pts.) Your niece, who dropped out of college and currently delivers sandwiches for Jimmy John's (earning $24,000 per year), approaches you for business advice. She has the opportunity to buy a craft brewery from a friend who wants to quit being the owner/manager, sell out, and go get an MBA so she can earn the big bucks. Annual sales revenues for the brewery are $240,000, and annual accounting costs are:

Ingredients (grains, hops, yeast, bottles, etc.)	$50,000
Leased brewing and bottling equipment	$45,000
Licenses, utilities, taxes	$36,000
Hourly workers	$60,000
Advertising	$15,000

Explicit Costs: $206,000

The sale of the brewery would include the building and land where the brewery is located, the brand name trademark and associated goodwill, and the customer list. The asking price is $100,000, which your niece would take out of her investment account where it has been averaging a 7% return. What is your advice? Hint: This is not a one-word answer. You should help her calculate the economic profitability of this venture.

Annual revenues and costs:
Total revenue = $240,000
Total explicit costs = $206,000
Accounting profits = $34,000
Implicit Costs:
     Opportunity cost of her time = what she could earn in her next best alternative, $24,000 at JJ's.
     Opportunity cost of her $100,000 = what she could earn if she kept in the mutual fund, $7,000.
Economic profit = Total Revenue – total explicit costs – total implicit costs = $3,000

If quits her job at JJ's and takes $100,000 out of savings to buy the brewery, she will have $3,000 more at the end of each year than if she stays in her current situation. Sounds like a good plan.

7. (15 pts.) A firm produces output (Q) using inputs labor (L) and capital (K). It can select from three different plant sizes corresponding to K=3, 6, and 9. When different amounts of L are combined with a fixed amount of K, output varies as follows:
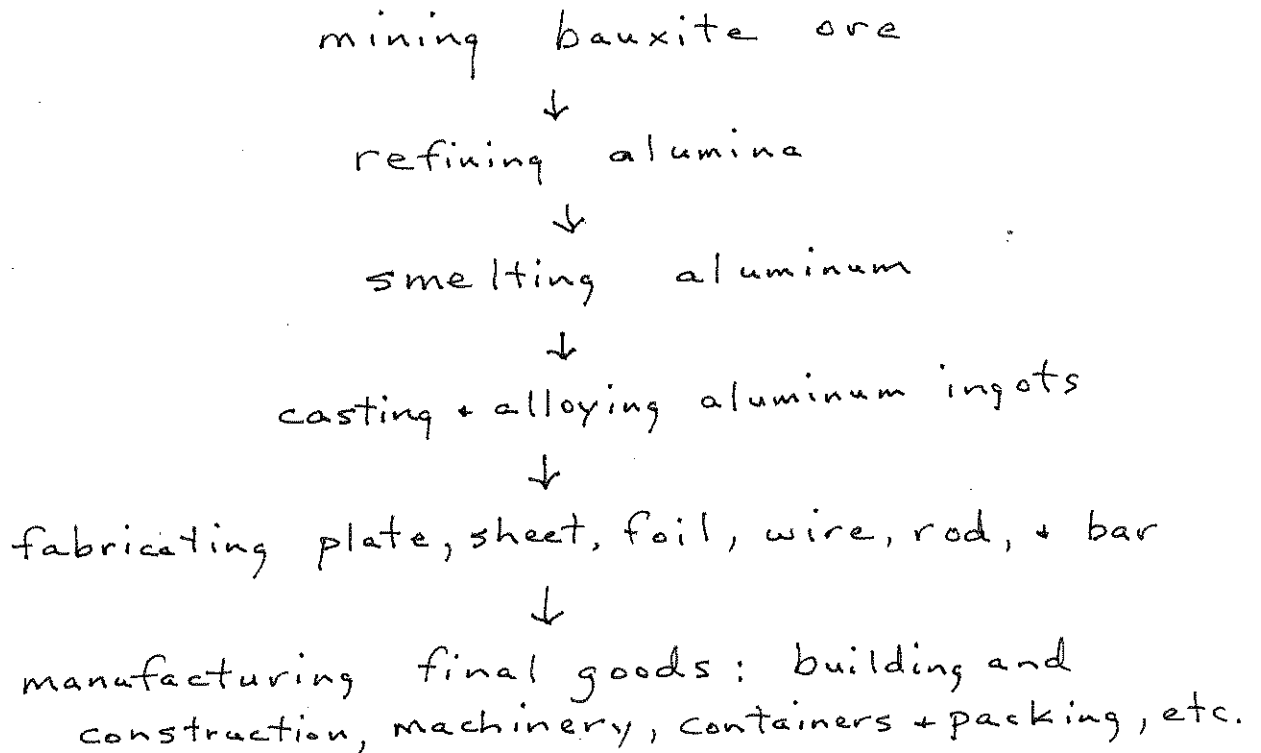
K	3	3	3	6	6	6	9	9	9
L	4	6	12	6	8	17	9	12	21
Q	6	9	12	12	17	21	15	21	25

If the per unit price of labor is $10 and the per unit price of capital is also $10, draw the SRATC curves corresponding to K=3, 6, and 9. Carefully label each point. Also illustrate the LRAC curve for this firm and explain whether it experiences economies or diseconomies of scale.

| Q	6	9	12	12	17	21	15	21	25
TC	70	90	150	120	140	230	180	210	30
ATC	11.67	10	12.50	10	8.23	10.95	12	10	12
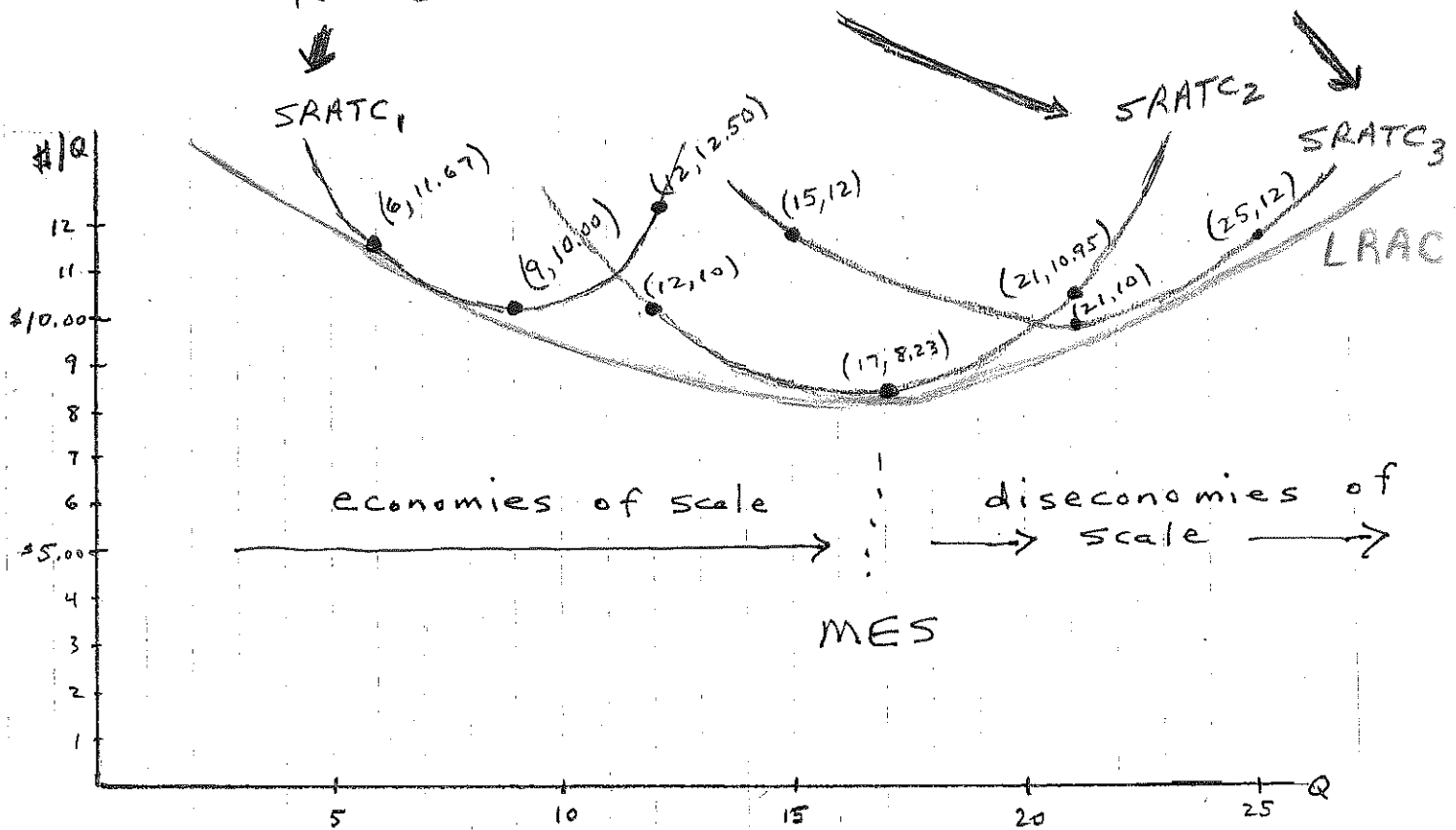
8. (10 pts.) Describe the vertical chain of production in the aluminum industry. A chart/diagram might be helpful.

mining   bauxite   ore

↓

refining   alumina

↓

smelting   aluminum

↓

casting + alloying   aluminum ingots

↓

fabricating   plate, sheet, foil, wire, rod, + bar

↓

manufacturing   final goods : building and construction, machinery, containers + packing, etc.

9. (5 pts.) Alltech and ABInbev both produce and sell beer. Alltech's annual production is two orders of magnitude smaller than ABInbev's. Why might the per can cost of producing Budweiser (ABInbev) be lower than the per can cost of producing Kentucky Ale (Alltech)?

There are a number of reasons why economies of scale might occur in brewing beer, but one obvious one is the cube-square rule and the physical properties of production. A-B uses gigantic vats for brewing Budweiser, while Alltech uses much smaller vats to brew Kentucky Ale. Another factor is that there are some setup costs for each batch of beer that must be borne no matter how many barrels are brewed. Per can costs for A-B will be lower than for Alltech because of both of these factors.
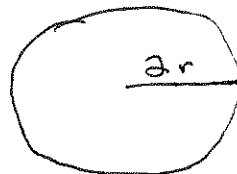
circumference: $2\pi r$ $4\pi r$:   doubles

area: πr^2 $4\pi r^2$:   quadruples

10. (5 pts.) Write an algebraic expression that explains why Philadelphia Cream Cheese was given to Kraft Heinz and not Mondelez International when Kraft Foods broke into the two separate companies in 2011. Let X represent Philadelphia Cream Cheese, Y represent Kraft Heinz brands like Oscar Mayer, Velveeta, Kool-Aid, Jell-O, and Ore-Ida, and Z represent Mondelez brands like Cadbury, Oreos, Nabisco, Tang, and Ritz. Briefly explain the cost concept that you are representing.

When the cost of producing two products together is lower than the cost of producing the two products separately, there are economies of scope.
Since the combined company was split into two separate companies, it must be the case that:

$$C(Y, Z) > C(Y, 0) + C(0, Z)$$

Since Philadelphia Cream Cheese was given to Kraft Heinz instead of to Mondelez International, it must be the case that:

$$C(X, Y) < C(X, Z)$$

11. (5 pts.) The University of Kentucky's legal department uses in-house attorneys who are UK employees for some of the University's legal needs, and relies on outside law firms for other legal needs. Malpractice lawsuits against the UK Hospital, which occur infrequently, are almost always outsourced. Does that seem efficient to you? Explain.

Skilled attorneys who specialize in malpractice lawsuits would likely be severely underutilized if they were employees of the University of Kentucky, since UK faces a malpractice case very infrequently. If such attorneys were employed by a large law firm that had multiple clients, their workloads could be evened out so that they were more efficiently utilized. Market acquisition of such an input is efficient because markets are able to aggregate uncorrelated demands.