

Place your name on the back of this sheet of paper and nowhere else. Staple your answers 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 calculations and all work on all questions.**

1) (15 points) Suppose an inverse demand curve is given by  $P(Q) = 40 - 2Q$ . The total revenue function is given by  $TR(Q) = P(Q) \cdot Q$ . Use the product rule to find the  $MR(Q)$  function. Then multiply  $P(Q) \cdot Q$  to get the  $TR(Q)$  as just a function of  $Q$ , without  $P$ . Use that to find the  $MR$  function. Notice that both methods give the same result.

2) (15 points) Suppose the total cost function is given by  $TC(Q) = Q^3/3 - 20Q^2 + 500Q + 10$ . Find the marginal cost function. Find the output which minimizes the marginal cost. State how you found the minimum point.

3) (10 points) Suppose the cost function is given by  $C(Q) = 10 \cdot L(Q) + 15$  and the production function is given by  $Q = 3L^{2/3}$ . Use the inverse function rule to find  $C'$ .

4) (5 points each) Find the marginal utility function for the following utility functions.

A)  $U(Q) = \ln(4Q)$

B)  $U(Q) = 30Q^{2/3}$

C)  $U(Q) = 10Q^{1/2} + 6Q^{1/3}$

D)  $U(Q) = 48Q^{1/2}$  where  $Q = I/8$ . Find marginal utility of income, i.e.,  $dU/dI$ .

E)  $U(Q) = (6Q^{3/2} + 1)/(Q + 2)$

5) (15 points) Suppose the GDP at time  $t$  is given by  $Y(t) = 100e^{-0.3t}$ . If the current time is  $t = 20$ , then what is the current GDP? What year was the base year? How can you tell? Find the growth rate of GDP as a percent of GDP.

6) (10 points each) For each of these profit functions, find the profit maximizing output and the profit at that point.

A)  $\Pi = -Q^2 + 18Q + 100$

A)  $\Pi = -10Q^2 + 400Q + 300$