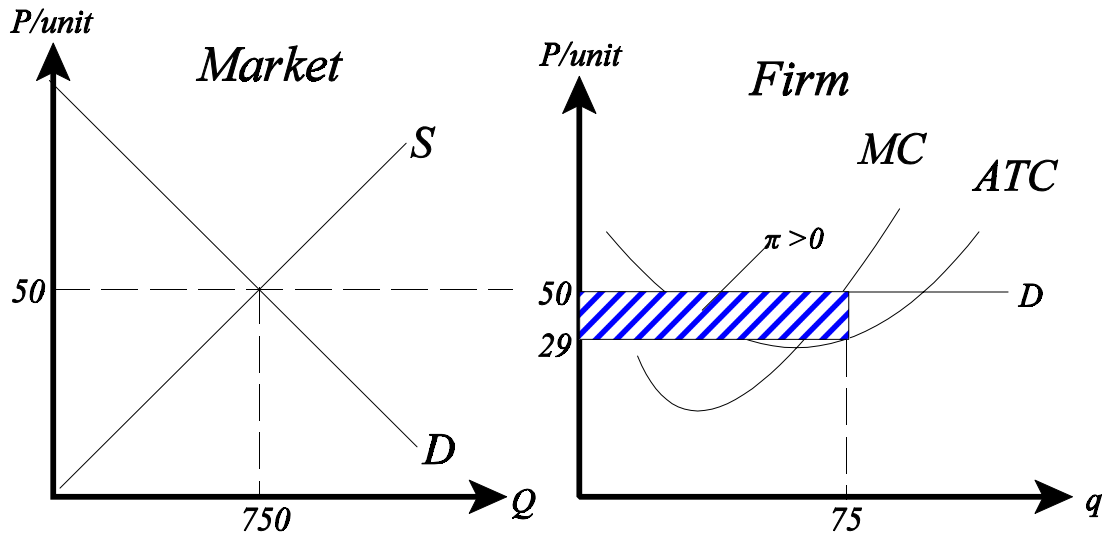


**Problem Set #10-Key**

Sonoma State University  
Economics 305-Intermediate Microeconomic Theory

Dr. Cuellar

- (1) Consider the following perfectly competitive market in which:  
The industry demand is given by  $Q = 1000 - 5P$ .  
The typical firm's total cost is given by  $TC(q) = 300 + \frac{q^2}{3}$ . Assume this represents both the short run and long run costs of the firm.
- (a) Derive the formula for average total cost.  $ATC = TC/q = \frac{300}{q} + \frac{q}{3}$
- (b) Derive the formula for average variable cost.  $AVC = VC/q = q/3$ .
- (c) Derive the formula for marginal cost.  $MC = \frac{\partial TC}{\partial q} = \frac{2q}{3}$
- (d) At what level of output is average total cost minimized? ATC is minimized when  $ATC = MC$ .  $\frac{300}{q} + \frac{q}{3} = \frac{2q}{3}$ . Solving for q, ATC is minimized when  $q = 30$ .
- (e) What is the per unit cost of the output at which average total cost is minimized.  $ATC(30) = \$20$  per unit cost.
- (f) What is the shut down price for the representative firm?  
The firm should shut down when price is less than minimum AVC. AVC is at its minimum when  $AVC = MC$ .  
Setting  $AVC = MC$  and solving for q,  $q/3 = 2q/3$  produces  $q = 0$ .  
Plugging the  $q = 0$  into the AVC function will give you AVC at  $q = 0$ ,  $AVC(0) = 0$ . The firm should shut down if price falls to zero.
- (g) Derive the individual firm's supply curve,  $s_i(P)$ .  
The supply curve for the representative firm "i" is the MC curve above minimum AVC. The firm chooses its output by setting  $MR = MC$ , but for competitive firms,  $MR = P$ , so to get the firm's supply curve set  $P = 2q/3$  and solve for q.  
The firm's supply curve is  $s_i(P) = 3P/2$ .
- (h) Suppose there are 10 firms currently serving this market. Derive the market supply curve,  
 $S(P) = \sum_i^n s_i(P)$ . If the firms have identical costs then  $S(P) = ns_i(P)$ .  
 $10(3P/2) \Rightarrow S(P) = 15P$ .
- (i) Set market supply equal to market demand and derive equilibrium price and quantity.  
Setting  $S = D$ ,  $15P = 1000 - 5P$ . Solving for P and Q produces  $P^* = 50$ ,  $Q^* = 750$ .
- (j) At the equilibrium price derived in part (i), what is the profit maximizing output of each firm? Plug in  $\$50.00$  into the firm's supply function,  $s_i(50) = 3(50)/2 = 75$ . Each firm produces 75 units.



- (k) What is the typical firm's profit or loss?  
 Profit per unit is defined as  $\pi/q = P - ATC$ , so at a market price of \$50 and a per unit cost of  $ATC(50) = \$29$ ,  $\pi/q = 50 - 300/75 - 75/3 = \$21$  per unit profit. Each firm earns a total profit of  $\pi = (21)(75) = \$1,575.00$ .
- (l) Show graphically the short run equilibrium for the market and a representative firm.  
 Graph shown above.
- (m) Explain the long run adjustment process.  
 Positive profits will induce firms into the market shifting out the supply curve and reducing price and profits. Firms will continue to enter until profits equal zero and  $P =$  minimum ATC.
- (n) Derive the long run equilibrium price and quantity.  
 Positive profits will induce firms into the market shifting out the supply curve and reducing price and profits. Firms will continue to enter until profits equal zero and  $P =$  minimum ATC. From 1 (d) and (e) we know that minimum ATC occurs when each firm produces  $q = 30$  units at  $P = \$20$ , so this is this long run equilibrium price. At a price of  $P = \$20$ , market demand  $Q = 1000 - 5(20) = 900$ . Long run equilibrium price and quantity  $P^* = \$20$ ,  $Q^* = 900$ .
- (o) How many firms will serve this market in the long run?  
 Total output is 900 units, with each firm producing 30 units, so  $900/30 = 30$  firms will serve this market.
- (p) Show graphically the long run equilibrium for the market and a representative firm.  
 Graph shown below.

