BUSS 230: Managerial Economics
Spring 2011-2012
Assignment 3 Solution

Question 1 (8 points)

a) $MR = MC$

$210 - 5Q = 3Q^2 - 20Q + 60$

$3Q^2 - 15Q - 150 = 0$

$Q^2 - 5Q - 50 = 0$

$(Q - 10)(Q + 5) = 0$

$Q = 10 \; or \; Q = -5 \; (reject)$

Therefore output $Q = 10$.

$Q = 84 - 0.4\,P$

$P = 210 - 2.5\,Q = 210 - 2.5 \times 10 = \$185$

b) Calculate the firm's total profit at the above determined price and output levels

$TP = TR - TC$

$TP = PQ - TC$

$TP = PQ - (Q^3 - 10\,Q^2 + 60\,Q + 1{,}000)$

$TP = 185 \times 10 - (10^3 - 10 \times 10^2 + 60 \times 10 + 1000) = 250$

c) If the fixed cost increased to 1200, the MC doesn't change and therefore the optimal Q and P won't change. However, the TP will decrease by 200 and thus the TP will be equal to 50 dollars.

d) New firms can enter the market, which is likely if firms are earning a positive economic profit in the short-run. New firms will be attracted by these profit opportunities and will choose to enter the market. The entry of new firms leads to an increase in the supply of differentiated products, which causes the firm's market demand curve to shift to the left. As more firms enter the market, the firm's demand curve will continue shifting to the left until it is just tangent to the average total cost curve at the profit maximizing level of output . At this point, the firm's economic profits are zero, and there is no longer any incentive for new firms to enter the market. Thus, in the long-run, the competition brought about by the entry of new firms will cause each firm in a monopolistically competitive market to earn normal profits, just like a perfectly competitive firm.

Question 2 (6 points)

		Firm 2	
		Advertize	Don't Advertize
Firm 1	Advertize	5 , 3	6, 5
	Don't Advertize	4,5	2,3

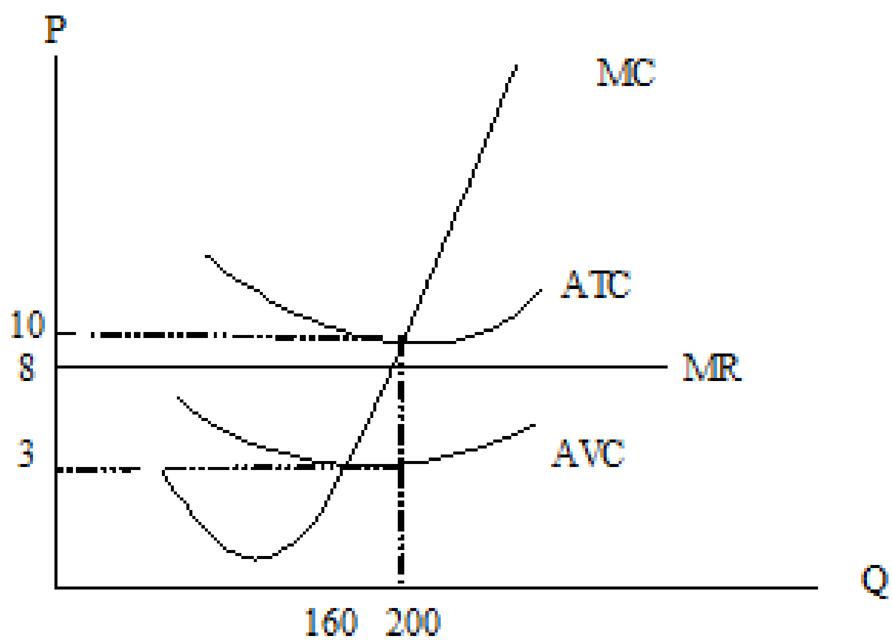
a) Firm 1 has a dominant strategy which is to advertize
Firm 2 doesn't have a dominant strategy.

b) The Nash Equilibrium is for Firm 1 to advertize and for Firm 2 to not advertize. Therefore, Firms 1 and 2's profits will be 6 and 5 respectively.

c) No it is not a prisoners' dilemma as both firms are better off using the strategy which is for Firm 1 to advertize and Firm 2 to not advertize.

Question 3 (12 points)

Assume "Crystal Picture Film" company operates in a perfectly competitive market for movie production.



a) The demand faced "Crystal Picture Film" is $D = MR = P = \$8$ since the company operates in a perfectly competitive market.

b) The market price of a movie P = $8.

c) The supply of "Crystal Picture Film" is the part of MC curve that is above the shut down point.

d) The breakeven point for "Crystal Picture Film" is where MC intersects ATC at Q=200.

e) The shutdown point for "Crystal Picture Film" is where MC intersects AVC at Q=160.

f) Profit is maximum where $MR = MC$ at Q=200. From the figure, "Crystal Picture Film" is breaking even. Therefore, short-run economic profit is zero. "Crystal Picture Film" will operate in the short-run to minimize its losses since $P > AVC$.

Question 4 (12 points)

a) $TC = 8{,}000 + 0.50Q$ so $MC = 0.50$

b) $P = -0.025Q + 6$

$TR = PQ = -0.025Q^2 + 6Q$

so $MR = -0.05Q + 6$

c) Profit $= \pi = TR - TC = -0.025\,Q^2 + 5.5Q - 8{,}000$

d) Profit maximized when

$$\frac{d\pi}{dQ} = -0.05Q + 5.5 = 0$$

so Q = 110 at $P = -0.025 \times 110 + 6 = \$3.25$

Total profit:

$$\pi = -0.025\,(110)^2 + 5.5 \times 110 - 8{,}000 = \$-7{,}697.5\ (loss)$$

e) $MR = MC$ so $-0.05Q + 6 = 0.50$ so Q =110, same result as in the profit maximizing method.

f) The assumed market structure in this problem is that of a perfect competition.

Question 5 (8 points)

a) Ocida is a monopoly, so profit is maximized when $MR = MC$.

$P = -0.0333Q + 3$

$TR = PQ = -0.0333Q^2 + 3Q$

so $MR = -0.0667Q + 3$

$TC = 5 - 2Q + 0.02Q^2$

$MC = -2 + 0.04Q$

$MR = MC$

$-0.0667Q + 3 = -2 + 0.04Q$

so Q =47 and P=\$1.43

Total profit :

$$\pi = TR - TC = -0.0333Q^2 + 3Q - 5 + 2Q - 0.02Q^2 = \$112.$$

b) Ocida and Lorca form an equal market-sharing cartel.

Demand faced by each firm = half the market demand

so $Q' = 45 - 15P'$ or $P' = -0.0667Q' + 3$

$MR' = -0.1333Q' + 3$

For Ocida $MR' = MC_1$, so $-0.1333Q_1 + 3 = -2 + 0.04Q_1$

Solving for Q_1 yields a value of 28.85.

Substitute in $Q' = 45 - 15P'$ yields P_1=\$1.08.

Total profit = $\pi = TR - TC = -0.0667Q^2 + 3Q - 5 - 2Q + 0.02Q^2 = \$67.2$

Similarly for Lorca, $MR' = MC_2$

$-0.12Q + 3 = -4 + 10Q$

Solving for Q_2 yields a value of 0.69 and a corresponding value for P of \$2.954.

Total profit = $\pi = TR - TC = -0.0667Q^2 + 3Q - 10 + 4Q - 5Q^2 = \$ - 7.59$ (a loss). Lorca has therefore no incentive to enter the market.

c) To maximize profit, set $MR = \sum MC$

$MC_1 = -2 + 0.04Q_1$ so $Q_1 = 25\, MC_1 + 50$

$MC_2 = -4 + 0.18Q_2$ so $Q_2 = 5.556MC_2 + 22.22$

Therefore, $Q = 30.556 \sum MC + 72.22$

hence $\sum MC = 0.0327Q - 2.364$

Setting $MR = \sum MC$

$-0.0667Q + 3 = 0.0327Q - 2.364$

Solving for Q yields 54. Substituting Q in the demand equation, we obtain a market price of \$1.20.

Plugging the value of Q into the equation of MR gives us a value of:

$MR = -0.0667Q + 3 = -0.0667 \times 54 + 3 = -0.60$

For Ocida:

$MR = MC_1$ so $-0.60 = -2 + 0.04Q$ therefore $Q_1 = 35.$

$$\pi_1 = TR_1 - TC_1 = (PQ_1) - \left(5 - 2Q_1 + 0.02{Q_1}^2\right)$$
$$= (1.2 \times 35) - (5 - 2 \times 35 + 0.02 \times (35)^2) = \$82.50$$

For Lorca:

$MR = MC_2$ so $-0.60 = -4 + 0.18Q$ therefore $Q_2 = 19$.

$$\pi_2 = TR_2 - TC_2 = (\ PQ_2) - \left(10 - 4Q_2 + 0.09{Q_2}^2\right)$$
$$= (\ 1.2 \times 19) - (10 - 4 \times 19 + 0.09 \times (19)^2) = \$56.31$$

d) Lorca will do better in the second market.

Question 6 (8 points)

a) $P = 500 - Q_F - Q_C$

$MR_F = 500 - 2Q_F - Q_C$

$MR_C = 500 - Q_F - 2Q_C$

b) $MR_F = MC_F$

$500 - 2Q_F - Q_C = 4$

$-2Q_F = 4 + Q_C - 500$

$$Q_F = \frac{(496 - Q_C)}{2} = 248 - \frac{Q_C}{2}$$

$MR_C = MC_C$

$500 - Q_F - 2Q_C = 2$

$-2Q_C = 2 + Q_F - 500$

$$Q_C = \frac{(498 - Q_F)}{2} = 249 - \frac{Q_F}{2}$$

c) $2Q_F = 496 - Q_C$

$2Q_C = 498 - Q_F$

$2Q_F + Q_C = 496$

$Q_F + 2Q_C = 498$

Solving the two equations simultaneously yields:

Q_F= 164.67 & Q_C = 166.67

d) $P = 500 - Q_F - Q_C$

$P = 500 - 164.67 - 166.67 = 168.66$

Question 7 (10 points)

a) $Q_{BE}(Firm\ 1) = \frac{TFC}{(P-AVC)} = \frac{40}{(20-10)} = 4$

$$Q_{BE}(Firm\ 2) = \frac{TFC}{(P-AVC)} = \frac{70}{(20-9)} = 6.36$$

$$Operating\ leverage\ (Firm\ 1) = \frac{40}{10} = 4$$

$$Operating\ leverage\ (Firm\ 2) = \frac{70}{9} = 7.77$$

b) Since Firm 2 has a higher leverage, we would expect its breakeven point to be higher because of higher overheard costs.

c) $DOL\ 1\ (Q = 7) = \frac{7\times(20-10)}{7\times(20-10)-40} = 2.33$

$$DOL\ 1\ (Q = 8) \ = \ \frac{8 \times (20 - 10)}{8 \times (20 - 10) - 40} \ = \ 2.00$$

$$DOL\ 2\ (Q = 7) \ = \ \frac{7 \times (20 - 9)}{7 \times (20 - 9) - 70} \ = \ 11.00$$

$$DOL\ 2\ (Q = 8) \ = \ \frac{8 \times (20 - 9)}{8 \times (20 - 9) - 70} \ = \ 4.89$$

d) Since Firm 2 has a higher operating leverage, its degree of operating leverage would be larger.

e) Q = 7 is closer to the breakeven point than Q =8.

Question 8 (8 points)

Payoff Matrix		
	400	300
400	(20,20)	(10,60)
300	(60,10)	(15,15)

a) If Hallmart charges $400, Bullseye will charge $300
If Hallmart charges $300, Bullseye will charge $300
Therefore, Bullseyes optimal strategy is to charge $300
If Bullseye charges $400, Hallmart will charge $300
If Bullseye charges $300, Hallmart will charge $300
Therefore, Hallmarts optimal strategy is to charge $300.

b) The Nash Equilibrium is where each store charges $300.

c) As shown in Part (a), the dominant strategy for each store is to charge a price of $300.

d) Although each store will follow its dominant strategy and set a price of \$300, they would each do better by cooperating and charging a price of \$400. One of the problems that might arise is that one of the stores might cheat and lower its price to gain a higher payoff.

Question 9 (16 points)

From the demand function:

$Q = 200 - 5P$ or $P = 40 - 0.2Q$

Obtain the marginal revenue function $MR = 40 - 0.4Q$

The marginal cost for the two firms in this industry is:

$MC_1 = 5 + 0.125Q_1$

$MC_2 = 5 + 0.5Q_2$

Rewrite the marginal cost functions:

$Q_1 = 8MC_1 - 40$

$Q_2 = 2MC_2 - 10$

Therefore $Q = 10 \sum MC - 50$ or $\sum MC = 5 + 0.1Q$

Also, the total cost functions can be obtained by integrating the marginal cost functions without a constant since the fixed cost is equal to zero.

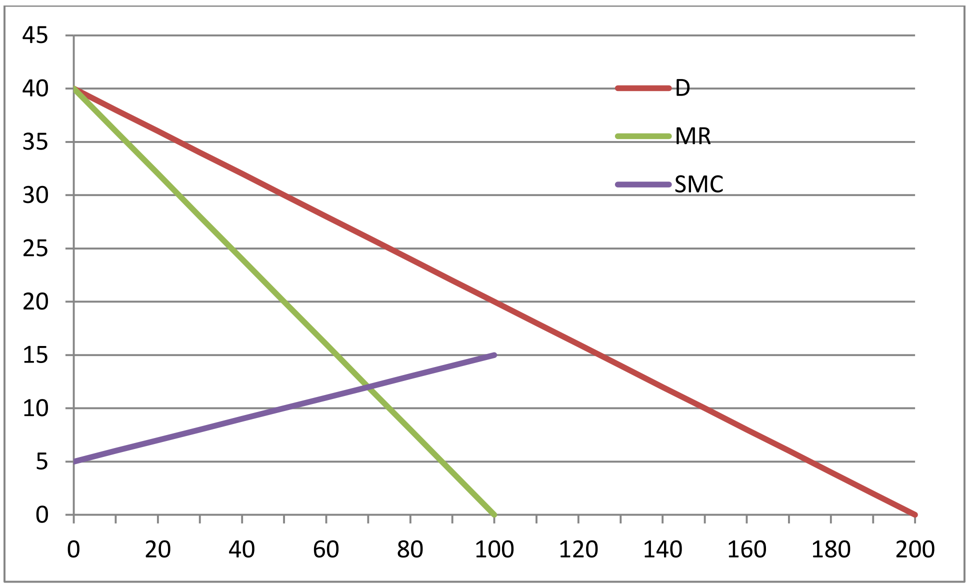
$TC_1 = 5Q_1 + 0.0625{Q_1}^2$ so $ATC_1 = 5 + 0.0625Q_1$

$TC_2 = 5Q_2 + 0.25{Q_2}^2$so $ATC_2 = 5 + 0.25Q_2$

a) As can be seen from the figure below, the optimal production for the cartel is 70 units. This is obtained at the intersection of the marginal revenue (*MR*) and the marginal cost (*ΣMC*) curves.

$$MR = 40 - 0.4Q = \sum MC = 5 + 0.1Q$$

Solving the equation yields Q =70 (as can be seen in the graph).



At Q = 70, $P = 40 - 0.4Q = \$26$

And $MR = 40 - 0.4Q = 40 - 0.4 \times 70 = 12$

Setting $MC_1 = MR = 12$,

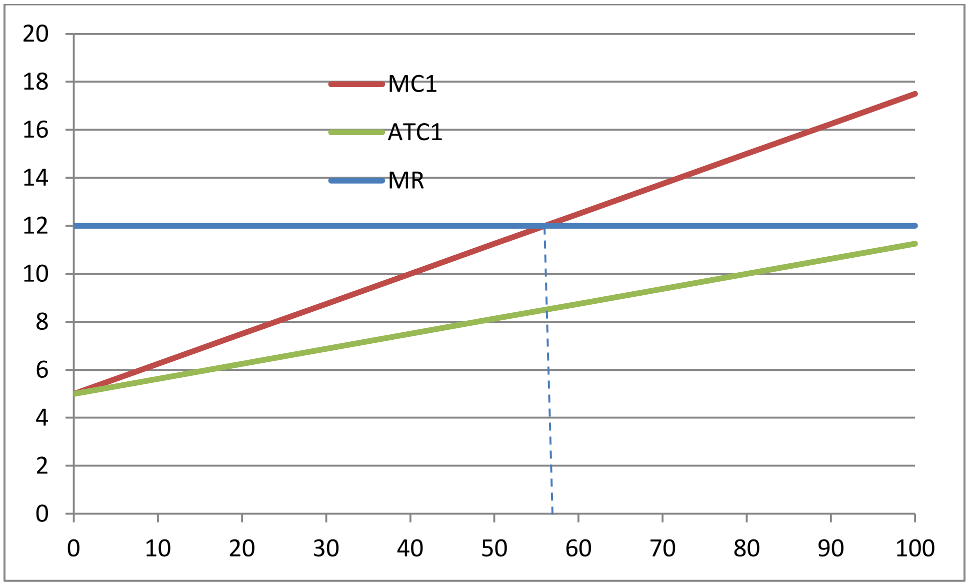
$MC_1 = 5 + 0.125Q_1 = 12$

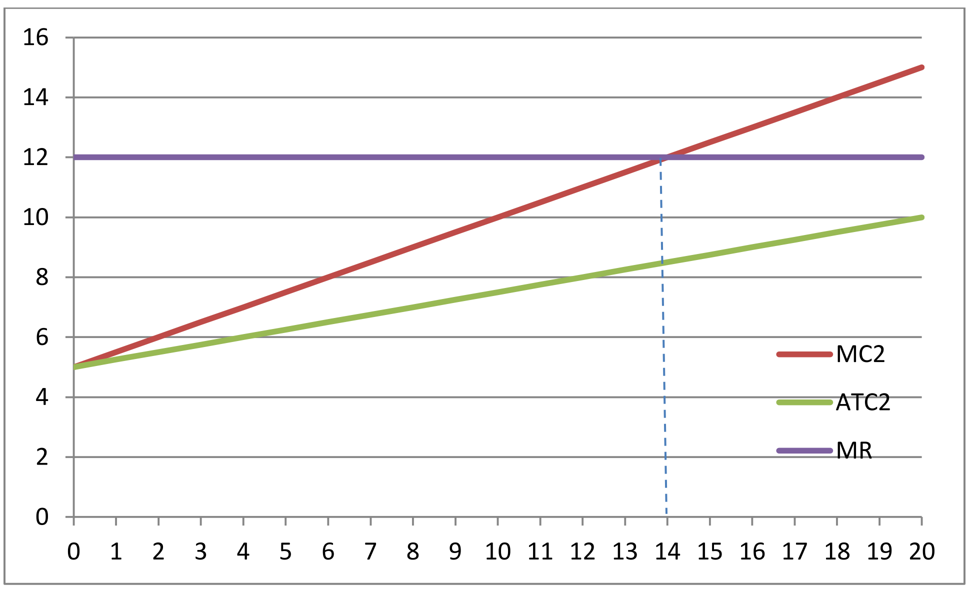
Solving this equation yields $Q_1 = 56$.

Similarly, setting $MC_2 = MR = 12$,

$MC_2 = 5 + 0.5Q_2 = 12$

Solving this equation yields Q_2 = 14. $(Q_1 + Q_2 = Q = 70)$





b) $ATC_1 = 5 + 0.0625Q_1 = 5 + 0.0625 \times 56 = \$8.5$

Per unit profits for firm 1 = $P - ATC_1 = \$26 - \$8.5 - \$17.5$

Total profits for firm 1 = $\pi_1 = \$17.5 \times 56 = \$980$

$ATC_2 = 5 + 0.25Q_2 = 5 + 0.25 \times 14 = \$8.5$

Per unit profits for firm 2 = $P - ATC_2 = \$26 - \$8.5 - \$17.5$

Total profits for firm 2 = $\pi_2 = \$17.5 \times 14 = \$245$

$\pi = \pi_1 + \pi_2 = \$980 + \$245 = \$1{,}225.$

c) The market demand function is $Q = 200 - 5P$. The half-share market faced by each duopolist is then $Q' = 100 - 2.5P$ or $P' = 40 - 0.4Q$. $MR' = 40 - 0.8Q$.

Setting $MR' = MC_1$

$40 - 0.8Q_1 = 5 + 0.125Q_1$

$$Q_1 = \frac{(40 - 5)}{(0.8 + 0.125)} = 38$$

And $P_1 = 40 - 0.4 \times 38 = \$24.80$

Setting $MR' = MC_2$

$40 - 0.8Q_2 = 5 + 0.5Q_2$

$$Q_2 = \frac{(40 - 5)}{(0.8 + 0.5)} = 41$$

And $P_2 = 40 - 0.4 \times 41 = \$23.60$

Total output of the industry = $Q = Q_1 + Q_2 = 38 + 41 = 79.$

d) Profit for firm 1 = $\pi_1 = (P_1 - ATC_1)Q_1$

$ATC_1 = 5 + 0.0625Q_1 = 5 + 0.0625 \times 38 = \$7.375$

$\pi_1 = (P_1 - ATC_1)Q_1 = (\$24.80 - \$7.375) \times 38 = \$662$

Profit for firm 2 = $\pi_2 = (P_2 - ATC_2)Q_2$

$ATC_2 = 5 + 0.0625Q_2 = 5 + 0.25 \times 41 = \$15.25$

$\pi_2 = (P_2 - ATC_2)Q_2 = (\$23.60 - \$15.25) \times 41 = \$342$

$\pi = \pi_1 + \pi_2 = \$662 + \$342 = \$1{,}004.$

Question 10 (12 points)

a) $Q = 240 - 20P$

$$D_T = \frac{240 - Q}{20} = 12 - 0.05Q$$

$MR_T = 12 - 0.1Q$

$\mathrm{D_L} = D_T - \Sigma MC_F$

$D_L = 10 - 0.0375Q$

$MR_L = 10 - 0.075Q$

$MC_T = \Sigma MC_F + MC_L$

$\Sigma MC_{\mathrm{F}} = 4 + 0.15\mathrm{Q}$ so

$$Q = \frac{\Sigma MC_{\mathrm{F}} - 4}{0.15} = 6.667\Sigma MC_{\mathrm{F}} - 26.67$$

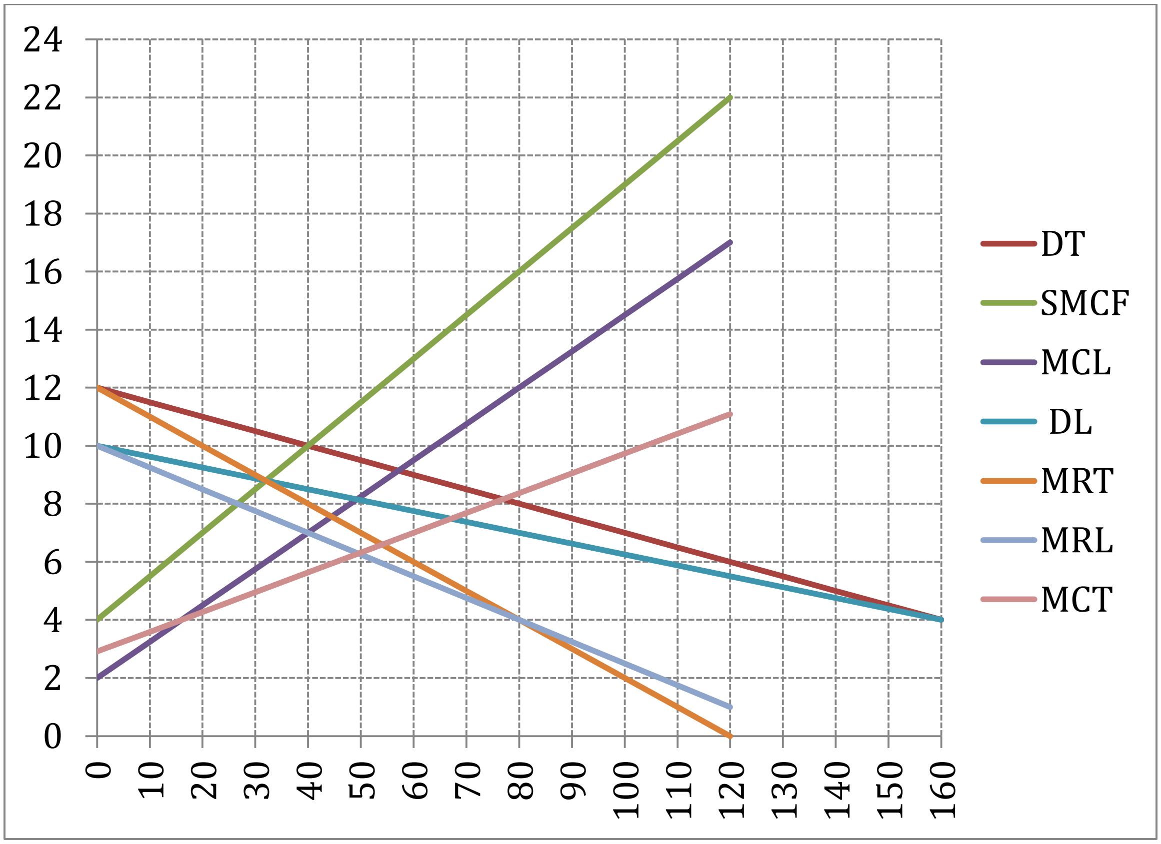
$MC_L = 2 + 0.125Q$ so

$$Q = \frac{MC_{\mathrm{L}} - 2}{0.125} = 8MC_L - 16$$

Horizontal summation of $\Sigma MC_{\mathrm{F}}$and MC_L gives:

$Q = 14.667MC_T - 42.67$

$MC_T = 2.91 + 0.0682Q$



b) Setting $MC_L = MR_L$

$2 + 0.125Q = 10 - 0.075Q$

Solving the equation yields a value of $Q_L = 40$. Plugging $Q_L = 40$ into the leader's demand function gives a price of $10 - 0.0375Q_L = \$8.50$.

From the equation for MC_F, when the price is \$8.50, the followers will produce

$$Q_F = \frac{8.5 - 4}{0.15} = 30.$$

At price $P = \$8.50$, the total demand is

$$Q_T = 240 - 20P = 240 - 20 \times 8.5 = 70 = Q_L + Q_F$$

c) Setting MR_T = MC_T, we get:

$$12 - 0.1Q_T = 2.91 + 0.0682Q_T$$

Solving the equation yields Q_T = 54. Plugging this value into the market demand function D_T gives us a market price of

$$P = 12 - 0.05Q = 12 - 0.05 \times 54 = \$9.30$$

And a marginal revenue of

$$MR_T = 12 - 0.1Q = 12 - 0.1 \times 54 = 6.60$$

Setting MC_L = MR_T, we can solve for Q_L:

$$2 + 0.125Q_L = 6.60$$

Solving the equation yields a value of Q_L = 36.8, say 37.

Setting ΣMC_F = MR_T, we can solve for Q_L:

$$4 + 0.15Q_F = 6.60$$

Solving the equation yields a value of Q_F = 17.33, say 17. Verify that Q_L + Q_F = Q_T.