Problem Set #8 Name: KEY
PAI 897
Professor John McPeak

1) Consider two herders. Each herder can choose to place 0, 5, 10, or 15 cows on a common pasture. The cows produce milk that the herders sell for $1 per liter. Total milk production and revenue is a function of aggregate herd size. Each animal costs $1 in labor costs per day when on the common pasture.

Total Cows	Total Milk (1L=1$)	Profit = ($1*L) – ($1*total cows)
0	0 L	$0
5	10 L	$5
10	20 L	$10
15	30 L	$15
20	36 L	$16
25	40 L	$15
30	44 L	$12

The profit to each herder is their share of the total herd on the pasture minus the private cost for the labor for their herd. For example, if herder 1 and 5 cows and herder 2 has 10 cows the 15 cows produce $30 worth of milk, herder 1 gets (5/15)*$30 - $5 = $5 and herder 2 gets (10/15)*$30-$10 = $10.

		Herder 2							
Herder 1		0		5		10		15	
	0	$0	$0	$0	$5	$0	$10	$0	$15
	5	$5	$0	$5	$5	$5	$10	$4	$12
	10	$10	$0	$10	$5	$8	$8	$6	$9
	15	$15	$0	$12	$4	$9	$6	$7	$7

a) Define the full set of best response strategies for each herder.

If H1 0, H2 15
If H1 5, H2 15
If H1 10, H2 15
If H1 15, H2 15

If H2 0, H1 15
If H2 5, H1 15
If H2 10, H1 15
If H2 15, H1 15

b) What is the outcome of this game and what is this type of solution called?

H1 puts 15, gets $7 Nash equilibrium.
H2 puts 15, gets $7

c) Describe one policy that could be used to arrive at a Pareto optimal outcome in a Pareto improving way compared to the outcome you found for part b.

Restrict the number of cows to 10 each to arrive at H1 puts 10, gets $8 and H2 puts 10, gets $8.

2) Assume you are given the following matrix of profit for two firms. The firms choose a level of production. The left hand side payoff (profit) is to the coal burning plant, the right hand side payoff is to the laundry.

		Laundry that uses clotheslines		
Coal burning plant		None	Low	High
	None	0, 0	0, 12	0, 11
	Low	10, 0	10, 10	10, 8
	High	14, 0	14, 2	14, 1

a) Does the payoff matrix indicate that both firms are imposing a negative externality on each other, one firm is imposing a negative externality on the other, or that there is no negative externality imposed by either firm on the other? Explain your answer.

Coal is imposing a negative externality on Laundry since payoffs to laundry decrease as coal plant production level increases. Laundry is not imposing an externality on coal plant since coal plant payoff does not change with laundry level.

b) What is the Nash equilibrium outcome of this game in terms of levels of production and payoffs if each firm plays their best response strategy?

Coal plant plays High, gets 14
Laundry plays Low, gets 2

c) Does a policy that gives the Laundry first mover status lead to the socially efficient outcome? Why or why not?

No, the decision by coal plant to play High does not change based on what Laundry does, so no benefit in this case to having first mover status

3) Market structure, externalities, and taxation. The inverse demand curve is given as p=100-q. The supply curve is p=10+q.

a. What is the equilibrium price quantity pair if the market structure is perfectly competitive?

$100 - q = 10 + q$

$90 = 2q$

$q^{pc} = 45 \qquad p^{pc} = 100 - 45 = 55 \qquad (p^{pc}, q^{pc}) = (\$55, 45)$

b. What is the socially optimal equilibrium price quantity pair if production of the good imposes an externality defined by $MC^E = 0.5*q$?

$100 - q = (10 + q) + \frac{1}{2}q \qquad (p^{so}, q^{so}) = (\$64, 36)$

$90 = 2\frac{1}{2} \cdot q$

$90 = \frac{5}{2} q$

$\frac{2}{5} \cdot 90 = \frac{2}{5} \cdot \frac{5}{2} \cdot q \qquad q^{so} = 36 \quad p^{so} = 100 - 36 = 64$

c. What Pigouvian tax can be defined as a specific tax on producers in the perfectly competitive market to arrive at the socially optimal price- quantity pair?

$p^{so} = 64 = 10 + q^{so} + T$ -or- $T = MC^E(q^{so})$

$64 = 10 + 36 + T \qquad T = \frac{1}{2} q^{so}$

$64 - 46 = T \qquad = \frac{1}{2} 36$

$T = \$18 \qquad = \$18$

d. In terms of economic efficiency, does it matter whether we place this tax on consumers or producers? Why does it matter or why does it not matter?

No, it does not matter in terms of economic efficiency. The outcome is the same.

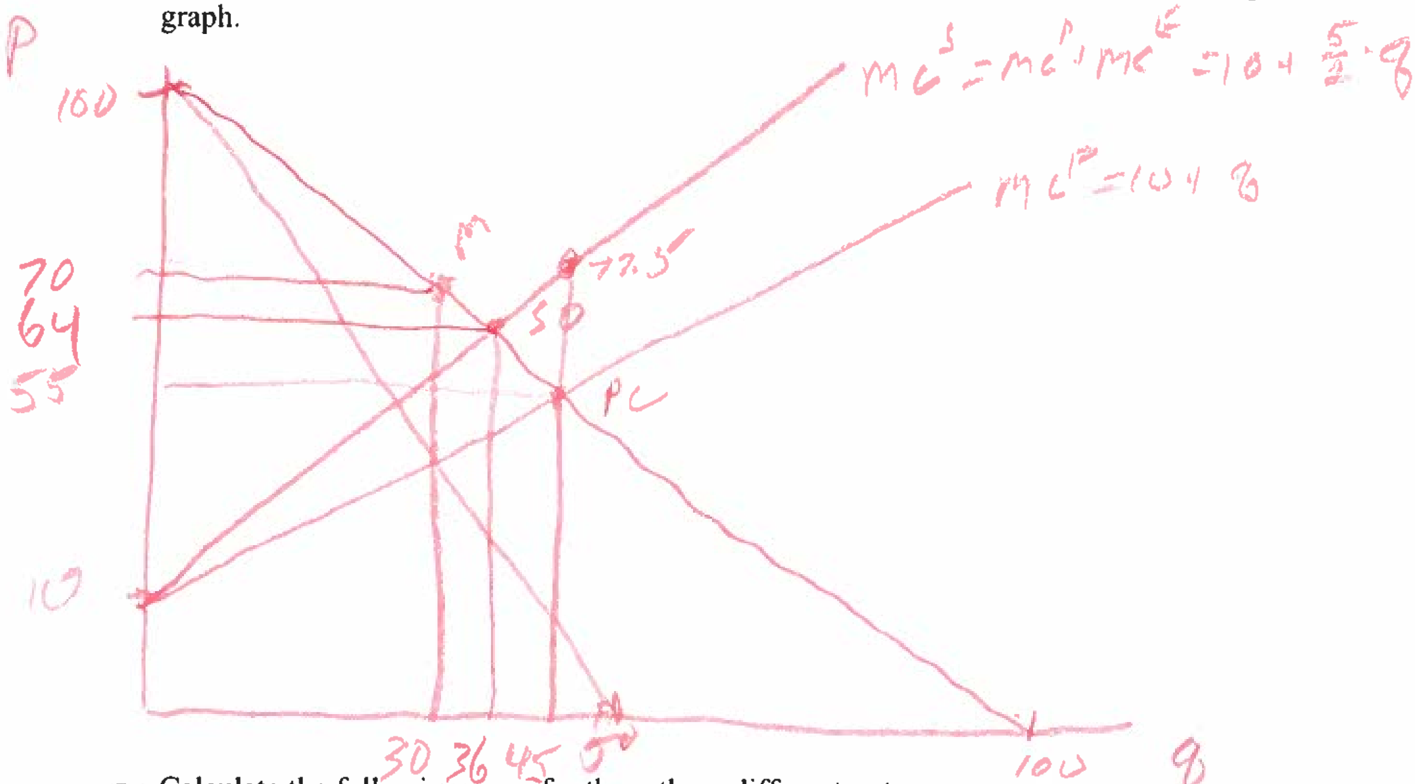
e. What is the equilibrium price quantity pair if the market structure is a monopoly?

$MR = 100 - 2q \qquad (p^m, q^m) = (\$70, 30)$

$100 - 2q = 10 + q$

$90 = 3q \quad q^m = 30 \qquad p^m = 100 - 30 = 70$

f. Draw the Perfectly Competitive, Socially Optimal, and Monopoly outcomes on a single graph.



g. Calculate the following areas for these three different outcomes.

	Perfectly Competitive	Socially Optimal	Monopoly
Consumer Surplus	$\frac{1}{2} \cdot 45 \cdot 45 = 1012.5$	$\frac{1}{2} 36 \cdot 36 = 648$	$\frac{1}{2} 30 \cdot 30 = 450$
Producer Surplus	$\frac{1}{2} \cdot 45 \cdot 45 = 1012.5$	$18 \cdot 36 + \frac{1}{2} 36 \cdot 36 = 1296$	$30 \cdot 30 + \frac{1}{2} 30 \cdot 30 = 1350$
Negative Externality	$\frac{1}{2} 22.5 \cdot 45$ 506.25	$\frac{1}{2} 18 \cdot 36 = 324$	$\frac{1}{2} 15 \cdot 30 = 225$
Total Social Welfare	1518.75	1620	1575

h. What is the size of deadweight loss in the perfectly competitive market?

$\frac{1}{2} 22.5 \cdot 9 = 101.25$ -or-

$$\begin{array}{r} 1620.00 \\ -1518.75 \\ \hline 101.25 \end{array}$$