**Problem Set 8 Solution Key**

**PPA 723**

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**Answer 1. Calculation of final payoffs**

|  |  |  |  |
| --- | --- | --- | --- |
| **No. of Cows** | **Milk Produced** | **Cost** | **payoff**  |
| **Herder 1** | **Herder 2** | **Total**  | **Total** | **Herder 1 share** | **Herder 2 share** | **Herder 1** | **Herder 2**  | **Herder 1**  | **Herder 2**  |
| **(A)** | **(B)** | **C= (A+B)** | **(D)** | **E=(A/C)\*D** | **F=(B/C)\*D** |  **G= 1\*A** |  **H= 1\*B** | **E-G** | **F-H** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 5 | 0 | 5 | 0 | 1 | 0 | 4 |
| 0 | 2 | 2 | 8 | 0 | 8 | 0 | 2 | 0 | 6 |
| 1 | 0 | 1 | 5 | 5 | 0 | 1 | 0 | 4 | 0 |
| 1 | 1 | 2 | 8 | 4 | 4 | 1 | 1 | 3 | 3 |
| 1 | 2 | 3 | 9 | 3 | 6 | 1 | 2 | 2 | 4 |
| 2 | 0 | 2 | 8 | 8 | 0 | 2 | 0 | 6 | 0 |
| 2 | 1 | 3 | 9 | 6 | 3 | 2 | 1 | 4 | 2 |
| 2 | 2 | 4 | 9 | 4.5 | 4.5 | 2 | 2 | 2.5 | 2.5 |

Final Payoff Matrix

|  |  |
| --- | --- |
|   | **Herder 2** |
| **0** | **1** | **2** |
| **Herder 1** | **0** | 0,0 | 0,4 | 0,6 |
| **1** | 4,0 | 3,3 | 2,4 |
| **2** | 6,0 | 4,2 | 2.5,2.5 |

1. Best Response Strategies

For Herder 2

If Herder 1 has 0 cows, herder 2 chooses 2 cows

If Herder 1 has 1 cow, herder 2 still chooses 2 cows

If Herder 1 has 2 cows, herder 2 still chooses 2 cows

For Herder 1

If Herder 2 has 0 cows, herder 1 chooses 2 cows

If Herder 2 has 1 cow, herder 1 still chooses 2 cows

If Herder 2 has 2 cows, herder 1 still chooses 2 cows

1. The outcome of the game is both herders choose to place 2 cows in the common pasture with the resultant payoff of 2.5 each. Both have dominant strategies.
2. Calculation of New payoffs

|  |  |  |
| --- | --- | --- |
| **No. of Cows** |  **Initial payoff**  | **New Payoffs**  |
| **Herder 1** | **Herder 2** | **Total**  | **Herder 1**  | **Herder 2**  | **Herder 1**  | **Herder 2** |
| **(A)** | **(B)** | **C= (A+B)** | **D** | **F** | H=D+1\*B | G= F-1\*B |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 4 | 1 | 3 |
| 0 | 2 | 2 | 0 | 6 | 2 | 4 |
| 1 | 0 | 1 | 4 | 0 | 4 | 0 |
| 1 | 1 | 2 | 3 | 3 | 4 | 2 |
| 1 | 2 | 3 | 2 | 4 | 4 | 2 |
| 2 | 0 | 2 | 6 | 0 | 6 | 0 |
| 2 | 1 | 3 | 4 | 2 | 5 | 1 |
| 2 | 2 | 4 | 2.5 | 2.5 | 4.5 | 0.5 |

New payoff matrix

|  |  |
| --- | --- |
|   | **Herder 2** |
| **0** | **1** | **2** |
| **Herder 1** | **0** | 0,0 | 1,3 | 2,4 |
| **1** | 4,0 | 4,2 | 4,2 |
| **2** | 6,0 | 5,1 | 4.5,0.5 |

1. Best Response Strategies

**For Herder 2**

If Herder 1 has 0 cows, herder 2 chooses 2 cows

If Herder 1 has 1 cow, herder 2 is indifferent between 1 or 2 cows

If Herder 1 has 2 cows, herder 2 chooses 1 cow

**For Herder 1**

If Herder 2 has 0 cows, herder 1 chooses 2 cows

If Herder 2 has 1 cow, herder 1 still chooses 2 cows

If Herder 2 has 2 cows, herder 1 still chooses 2 cows

1. While Herder 1 has a dominant strategy, Herder 2 does not. But Herder 2 knows that Herder 1 will always place 2 cows, herder 2 will then choose his best response which is 1 cow. (2,1) with payoffs (5,1). This is a Nash Equilibrium
2. Total payoff in Nash equilibrium are higher than in dominant strategy outcome (6>5)
3. While there has been a pareto improvement since the total payoff has increased but here at loss by herder 1 and gain by herder 2
4. & i) If each herder is allowed one cow each, then the pay offs would be (4,2) where the total payoff is equal to the tenure reform policy.

**Ques 2 a)** Here payoffs of the coal burning plant are unaffected by the level of clothesline used by laundry, but the payoff of the laundry gets reduced if there is high level production by coal. Hence Coal plant imposes a negative externality on the laundry firm.

b) The nash equilibrium is high production by coal and low level of clothes line by laundry with the payoff of (14,2) respectively

c)If laundry has a first mover advantage, then there would not be any change since both have their dominant strategies.

Ques 3 Demand Curve: P= 100-Q

 Supply Curve: P=10+Q

1. In case of perfect competition, DD=SS

100-Q=10+Q

2Q=90

Q=45

P=55

1. MCE =0.5\*Q

Social cost curve (Social Cost curve): P= 10+Q+0.5\*Q

 New Equilibrium at DD=SCC

 100-Q=10+1.5 Q

 90=2.5Q

 Q=36

P= 64

1. Let the per unit pigovian tax be t

Method1: at Q = 36,

MCE=0.5\*Q= 18

Therefor, t=MCE= 18

Method 2: at Q=36, Total price or SCC should be 64

* 64= 10+ Q + t
* 64 = 10+36 +t
* t = 64-46 = 18
1. No it does not matter where we place the tax and the tax burden is shared among the producers and the consumers.
2. Incase of a monopoly

 MR=MC

 100-2Q=10+Q

 Q= 30, P=70

f)



|  |  |  |
| --- | --- | --- |
|  | PC | MONOPOLY |
| PS | 1012.5 | 1350 |
| CS | 1012.5 | 450 |
| NEGATIVE EXTERNALITY | 506.25 | 225 |
| TOTAL SOCIAL WELFARE (PS+CS-EXT) | 1518.75 | 1575 |