Part I: Multiple Choice Questions:

Question	Answer
1	D
2	B
3	B
4	A
5	C
6	C
7	A
8	D
9	C
10	D
11	D
12	C
13	B
14	C
15	A
16	A
17	C
18	C
19	A
20	B

Part II:
I answered questions: 2. (supply side) and 3. (Monopoly, Duopolies, game theory)

2. Supply side:
a)
The minimum price necessary for the firm to earn nonnegative profits is when $\frac{\partial AC}{\partial q} = 0$, so:

$$AC = \frac{TC}{q} = \frac{32}{q} + 2q$$
$$\frac{\partial AC}{\partial q} = -32q^{-2} + 2 = 0$$
$$2 = 32q^{-2}$$
$$0{,}0625 = q^{-2}$$
$$q = 4$$

Then the price will be:
$$AC = \frac{32}{4} + 2 * 4 = \mathbf{16}$$
To conclude, the minimum price necessary for the firm to earn nonnegative profits is **16**.

b)
To derive the market supply curve, I first find MC:
$$MC = 4q$$
We know that individual firms' supply is p=MC, so the individual supply per firm is:
$$p = 4q$$
$$q = 0{,}25p$$
And we have 400 identical firms in the market, making the total market supply:
$$\boldsymbol{Q_s} = 400 * \left(q(p)\right) = \mathbf{100}\boldsymbol{p}$$

c)
We know that in the long run the equilibrium price and quantity is found where MC=AC=P, therefore I'll find where MC=AC:
$$MC = \frac{\partial TC}{\partial q} = 3q^2 - 32q + 109$$
$$AC = \frac{TC}{q} = q^2 - 16q + 109$$

$$MC = AC$$
$$3q^2 - 32q + 109 = q^2 - 16q + 109$$
$$2q^2 - 16q = 0$$
$$2q^2 = 16q$$
$$2q = 16$$
$$\boldsymbol{q} = \mathbf{8}$$
And then I find price by inserting q=8 into the AC function:
$$\boldsymbol{p} = AC = 8^2 - 16 * 8 + 109 = \mathbf{45}$$

d)

First, I find the total quantity:

$$Q = 2050 - 10 * 45 = 1600$$

Then I can calculate the number of firms in the market in the long-run equilibrium:

$$\boldsymbol{n} = \frac{Q}{q} = \frac{1600}{8} = \mathbf{200}$$

e)

She can not just increase her prices, because then people will buy elsewhere, and then she won't be able to sell the same quantity.

She would be indifferent from staying or exiting the market, but I will say that if she's already in the market she should stay, until she will experience a **loss**.

3. Monopoly, Duopolies, Game Theory.

a)

To determine P and Q, I first find MC and MR:

$$MC = \frac{\partial C}{\partial q} = 2q + 90$$
$$MR = 180 - 4Q$$

Then I set MC=MR:

$$MC = MR$$
$$2Q + 90 = 180 - 4Q$$
$$6Q = 90$$
$$\boldsymbol{Q} = \mathbf{15}$$

And then I find the price:

$$\boldsymbol{P} = 180 - 2 * 15 = \mathbf{150}$$

So, price is **150** and quantity is **15**.

To, find the deadweight loss I first calculate P and Q if the market were perfect, and I find the MR for the quantity of 15:

$$180 - 2Q = 2q + 90$$
$$90 = 4q$$
$$q = 22{,}5$$
$$p = 180 - 2 * 22{,}5 = 130$$
$$MR_{monopoly} = 180 - 4 * 15 = 120$$

The deadweight loss caused by monopoly, compared to perfect competition is then:

$$\boldsymbol{DWL} = \frac{(150 - 120) * (22{,}5 - 15)}{2} = \mathbf{112{,}5}$$

b)
As they set prices simultaneously we are dealing with a Bertrand duopoly. As we have the demand functions I first set up the profit function for Peter:

$$\pi_p = p_p * q_p - AC * q_p$$

Then I substitute in for q_p:

$$\pi_p = p_P * (420 - 2p_P + p_A) - 0$$

Then I find the marginal profits and set it equal to 0:

$$\frac{\partial \pi_p}{\partial p_P} = 420 - 4p_P + p_A = 0$$

$$4p_p = 420 + p_A$$

$$p_P = 105 + 0{,}25p_A$$

Now, I do the same thing for Alicia:

$$\pi_A = p_A * q_A - AC * q_A$$

Then I substitute in for q_A:

$$\pi_A = p_A * (420 - 2p_A + p_P) - 0$$

Then I find the marginal profits and set it equal to 0:

$$\frac{\partial \pi_A}{\partial p_A} = 420 - 4p_A + p_P = 0$$

$$4p_A = 420 + p_P$$

$$p_A = 105 + 0{,}25p_P$$

Then I use the best response functions found and solve for p_P and p_A:

$$p_P = 105 + 0{,}25(105 + 0{,}25p_P)$$

$$\frac{15}{16}p_P = 131{,}25$$

$$\boldsymbol{p_P = 140}$$

In this case p_A will be the same:

$$\boldsymbol{p_P = p_A = 140}$$

Then I find the quantity produced, by using their demand functions and insert p:

$$\boldsymbol{q_P} = 420 - 2 * 140 + 140 = \boldsymbol{280}$$

$$\boldsymbol{q_A} = 420 - 2 * 140 + 140 = \boldsymbol{280}$$

c)
Now, I have new demand curves so I do the same as in b).
Then I substitute in for q_p:

$$\pi_p = p_P * (200 - 2p_P + 0{,}5p_A) - 0$$

Then I find the marginal profits and set it equal to 0:

$$\frac{\partial \pi_p}{\partial p_P} = 200 - 4p_P + 0{,}5p_A = 0$$
$$4p_p = 200 + 0{,}5p_A$$
$$p_P = 50 + \frac{1}{8}p_A$$

Now, I do the same thing for Alicia:

Then I substitute in for q_A:

$$\pi_A = p_A * (600 - 1{,}5p_A + 1{,}5p_P) - 0$$

Then I find the marginal profits and set it equal to 0:

$$\frac{\partial \pi_p}{\partial p_P} = 600 - 3p_A + 1{,}5p_P = 0$$
$$3p_A = 600 + 1{,}5p_P$$
$$p_A = 200 + 0{,}5p_P$$

Then I use the best response functions found and solve for p_P and p_A:

$$p_P = 50 + \frac{1}{8}(200 + 0{,}5p_P)$$
$$\frac{15}{16}p_P = 75$$
$$\boldsymbol{p_P = 80}$$

And for Alicia p_A will be:

$$p_A = 200 + 0{,}5\left(50 + \frac{1}{8}p_A\right)$$
$$\frac{15}{16}p_A = 225$$
$$\boldsymbol{p_A = 240}$$

Then I find the quantity produced, by using their demand functions and insert p:

$$\boldsymbol{q_P} = 200 - 2 * 80 + 0{,}5 * 240 = \mathbf{160}$$
$$\boldsymbol{q_A} = 600 - 1{,}5 * 240 + 1{,}5 * 80 = \mathbf{360}$$

d)

First, I look at it from the sight of Peter:

If Alicia chooses '*No seating*' then Peter's best response will be to provide '*seating*'.

If Alicia chooses '*Seating*' then Peter's best response will be to provide '*No seating*'.

If we look at it from the sight of Alicia:

If Peter chooses '*No seating*' then Alicia's best response will be to provide '*No seating*'.

If Peter chooses '*Seating*' then Alicia's best response will be to provide '*seating*'.

This Is also shown in the matrix below (the answer is marked in a box)

		Peter	
		No seating	*Seating*
Alicia	*No seating*	$\boxed{2}$, 0	1, $\boxed{2}$
	Seating	0, $\boxed{7}$	$\boxed{6}$, 6

The mixed strategy equilibrium is calculated below:

Peters's expected payoff if choosing 'No seating':

$$\theta_{A,No\ seating} * 2 + \left(1 - \theta_{A,No\ seating}\right) * 1$$

Peter's expected payoff if choosing 'seating':

$$\theta_{A,No\ seating} * 0 + \left(1 - \theta_{A,No\ seating}\right) * 6$$

We set them equal to each other:

$$\theta_{A,No\ seating} * 2 + \left(1 - \theta_{A,No\ seating}\right) * 1$$
$$= \theta_{A,No\ seating} * 0 + \left(1 - \theta_{A,No\ seating}\right) * 6$$

$$\theta_{A,No\ seating} + 1 = -6\theta_{A,No\ seating} + 6$$
$$7\theta_{A,No\ seating} = 5$$
$$\boldsymbol{\theta_{A,No\ seating}} = \frac{\mathbf{5}}{\mathbf{7}}$$

For Alicia we do the same:

Alicia's expected payoff if choosing 'No seating'':

$$\theta_{P,No\ seating} * 0 + \left(1 - \theta_{P,No\ seating}\right) * 7$$

Alicia's expected payoff if choosing 'Seating':

$$\theta_{P,No\ seating} * 2 + \left(1 - \theta_{P,No\ seating}\right) * 6$$

We set them equal to each other:

$$\theta_{P,No\ seating} * 0 + \left(1 - \theta_{P,No\ seating}\right) * 7$$
$$= \theta_{P,No\ seating} * 2 + \left(1 - \theta_{P,No\ seating}\right) * 6$$

$$-7\theta_{P,No\ seating} + 7 = 6 - 4\theta_{P,No\ seating}$$

$$3\theta_{P,No\ seating} = 1$$
$$\boldsymbol{\theta_{P,No\ seating}} = \frac{\mathbf{1}}{\mathbf{3}}$$

So, these results mean that the probability that Alicia choose '*No seating*' is $\frac{\mathbf{5}}{\mathbf{7}}$ and therefore the probability that Alicia is choosing '*Seating*' is $\frac{\mathbf{2}}{\mathbf{7}}$.

The probability that Peter choose '*No seating*' is $\frac{\mathbf{1}}{\mathbf{3}}$ and therefore the probability that Peter is choosing '*Seating*' is $\frac{\mathbf{2}}{\mathbf{3}}$.