Problem №1 Marginal costs of production are given by the following function:

$$MC(Q) = \begin{cases} 4 - Q & Q \leq 2 \\ 2Q - 2 & Q > 2 \end{cases}$$

(a) *Plot the marginal cost curve.*

(b) *Give the expressions for $VC(Q)$ and $AVC(Q)$.*

(c) *Plot $AVC(Q)$ on the plot from (a).*

(d) *Give the expression for the supply curve of this firm.*

(e) *Is it possible to find a different $MC(Q)$ function that gives rise to the same supply curve? If yes, give an example. If no—prove it.*

Problem №2 Consider a country in which farmers can grow marijuana. There is a big mass $M = 1$ million of land units. One unit of land can produce 1 unit (1 pound) of marijuana, but the cost of doing so is different across those units. It costs \$10 to grow marijuana on the worst unit of land and \$2 to grow it on the best unit of land. The distribution of costs is uniform, so that the fraction of land units with costs below some value x is $F(x) = \frac{x-2}{8}$. The demand for marijuana is given by $D(p) = \frac{1}{16}(14 - p)$.

The government considers two alternative ways to regulate the marijuana market. The first is to allow competition in the market, but to levy taxes on marijuana. The second one is to establish a government monopoly. We are going to compare these two alternatives.

(a) *Suppose that every unit of land in the country belongs to a separate farmer. Suppose that the market price of marijuana is p. Which farmers will choose to grow marijuana? What is the total amount supplied, $S(p)$? Do a sanity check: is everybody supplying when the price is 10? Is anybody supplying when the price is 2?*

(b) *If the government introduces a tax of \$$t$ per pound of marijuana, and the market price is p, then consumers will pay $p + t$ per unit of marijuana. Equilibrium price $p^*(t)$ will then satisfy $S(p) = D(p + t)$. Find equilibrium price and quantity.*

(c) *Tax revenue of the government is $T(t) = tq^*(t)$. Suppose that the government is choosing the tax rate to maximize tax revenue. Which rate would it choose? How much money would it collect? What is the equilibrium consumption of marijuana?*

(d) *Now suppose that all marijuana production in the country belongs to the government. Suppose that the government monopoly is producing q units of marijuana. What is the marginal cost*

$MC(q)$ of producing an additional unit? Again, do a sanity check.

(e) *Find the price that the monopoly would charge for marijuana. What is the profit of the monopoly? What is the equilibrium output?*

(f) *Is legalization and taxation of marijuana (part (c)) preferred to a state monopoly (part (e)) by*

1. *the government which cares about how much money it raises?*
2. *by the anti-marijuana lobby which cares about the consumption of marijuana?*
3. *by the consumers who care about consumer surplus?*

Problem №3 A monopolist is facing a demand curve $Q(p) = 2d - 2p$, where $d > 0$ is a parameter. Its main factory is characterized by $TC(q) = \frac{1}{2}q^2 + 1$. Monopolist is subject to a capacity constraint of 1, i.e. the monopolist can't produce more than 1 unit on one factory.

(a) *Find values of d for which the monopolist produces at her capacity level.*

(b) *Are there values of d such that the monopolist is producing at her capacity if she can perfectly price-discriminate, but she is below the capacity if she is restricted to uniform pricing?*

(c) *Suppose now that the monopolist can open a second factory with the same total cost function as the first one (notice that she will incur additional fixed cost in this case). Price discrimination is prohibited. Are there values of d such that the firm is producing at capacity, but doesn't want to open a second factory?*

Problem №4 There are two groups of customers in the market. Demand of group number 1 is $Q_1(p) = 3 - 0.5p$, and demand of group number 2 is $Q_2(p) = 5 - 2p$. The market is served by a monopolist with $MC = 1$.

(a) *Write down the market demand function (remember that demand function should be well-defined for all possible prices). Plot it.*

(b) *Derive the $MR(Q)$ for the market demand and plot it on the graph from above.*

(c) *What price will the monopolist charge if she cannot price discriminate? Find the corresponding consumer surpluses for both groups.*

(d) *Now suppose that the monopolist can set different prices for different groups. What prices will she choose? Find the corresponding consumer surpluses for both groups.*

(e) *Who wins and who loses when discrimination is allowed? How does total welfare change?*

Problem №5 Consider the following excerpt from an article published in the The Economist on April 22, 2017:

> Air fares are higher per seat mile in America than in Europe. When costs fall, consumers in America fail to enjoy the benefits. The global price of jet fuel—one of the biggest costs for airlines—has fallen by half since 2014. That triggered a fare war between European carriers, but in America ticket prices have hardly budged... This happy combination of low fares and reasonable service [in Europe] has a simple explanation: competition.

Let us focus on a hypothetical carrier that dominates one particular airport and think of it as a local monopolist*. The goal of this exercise is to practice to translate real world phenomena into economic models.

(a) *How would you go about modeling a decrease in the price of fuel in the standard monopoly model?*

(b) *The article says that ticket prices in America have hardly budged as a result of the shock to fuel prices. Do prices change after the decrease of fuel prices in the model you formulated in (a)? Explain briefly.*

(c) *Come up with a reasonable twist to the model which would ensure that the airline doesn't cut its price in response to a fuel price decrease.*

(d) *You want to model demand for flights in the US. You are choosing between two functional forms: linear demand and demand with constant price elasticity. Which model is better at reproducing the response of fares to fuel price changes described in the article?*

*U.S. airports increasingly dominated by 1 or 2 carriers