

Problem Set 1

PPHA 32400 Microeconomics and Public Policy I
Winter 2026

Instructions

- (i) This problem set is due **Friday, Jan 16th, at 11:59pm.**
 - Late problem sets will not be accepted.
- (ii) This problem set is divided into two parts:
 - Part I includes *ungraded* practice problems that students can optionally complete to deepen their understanding of the material. **Do not submit your answers.**
 - Part II includes *graded* problems. **You have to submit your answers.** You are allowed to collaborate in small groups for this part. However, **each student must submit their own individual write-up.** Your submission should reflect your personal understanding of the material, and therefore must be written in your own words. Please show your work, including calculations and clear, legible diagrams.
- (iii) **Submit Part II electronically on Gradescope as a PDF:**
 - Your solutions must be submitted as typewritten PDF files. Examples of software that can be used includes Microsoft Word (which has a built-in equation editor) or LaTeX, a typesetting software.
 - To create diagrams, we recommend using a tablet, online software, or even drawing the diagram (neatly!) by hand and then add to your file using a camera or scanner.
 - Ensure that you tag your questions on Gradescope.
 - Each improperly tagged question will be subject to a penalty equal to 10% of the question's value.

Part I: Practice Problems (Do NOT submit answers)

1. Consider a perfectly competitive firm in a market where the price of a good is \$20.

- I The firm can sell any number of units of this good for \$20.
- II The marginal revenue earned by this firm is \$20.
- III The firm cannot charge prices above \$20 while selling $q > 0$.

Which of the above statements are true?

- (a) Only I
- (b) Only II
- (c) Only III
- (d) Only I and II
- (e) Only I and III
- (f) Only II and III
- (g) I, II, and III
- (h) None of the statements are true.

1g

(I) is true – since the firm has no market power, the price will never fall below \$20. In other words the demand curve for this firm is perfectly elastic at the market price. (*Note that there is an edge case where the firm produces a quantity equal to the market demand at \$20, at which point it is producing all the units demanded in that market and producing more units will lower the price. We will be ignoring this edge case in our class.*)

(II) is true – a perfectly competitive firm's marginal revenue is the market price.

(III) is true – if the firm attempts to raise prices, consumers will buy the good from another firm instead, thus its sales will fall to $q = 0$.

2. Consider a perfectly competitive firm with marginal cost function $MC(q) = 40 + 2q$. The price in the market is p .

- (a) Suppose the firm is already in the market. What is the optimal level of production for this firm?
 The firm will maximize output when

$$MC = p \Rightarrow 40 + 2q = p \Rightarrow q = \frac{1}{2}p - 20$$

Note that for positive values of q

$$q > 0 \Rightarrow \frac{1}{2}p - 20 > 0 \Rightarrow p > 40$$

so at prices below 40, the optimal output is zero.

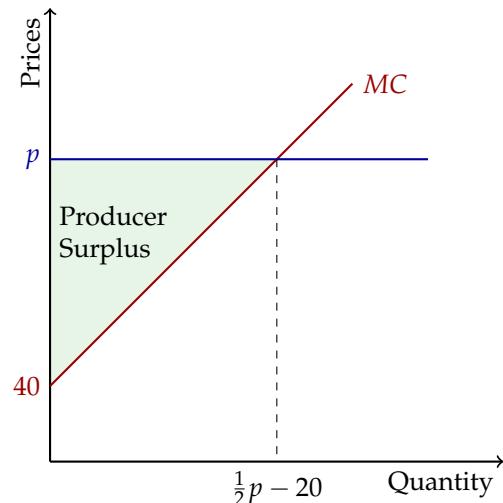
- (b) What is the producer surplus PS earned by this firm, as a function of p ? (*Hint: You might want to draw a diagram for this question.*)

Recall that the producer surplus is the area below the price, and above the marginal cost. Since the MC function is linear, it is area of the

triangle. Given $p > 40$

$$\begin{aligned} PS(p) &= \frac{1}{2} \times \text{Height} \times \text{Breadth} \\ &= \frac{1}{2} \times (p - 40) \times \left(\frac{1}{2}p - 20\right) \\ &= \left(\frac{1}{2}p - 20\right) \times \left(\frac{1}{2}p - 20\right) \\ &= \frac{1}{4}p^2 - 20p + 400 \end{aligned}$$

For simplicity we will leave this as $PS(p) = (\frac{1}{2}p - 20)^2$ (see the second last line in the solution) but the solutions to the subsequent questions will be same even if you do not do this.



- (c) Consider the situation before the firm enters the market. Suppose that fixed costs are $FC = 100$. Will the firm enter the market if $p = 50$? Will the firm enter the market if the price is $p = 70$? (Hint: the firm will enter the market if profits are positive i.e. $\pi > 0$. Profits are $\pi = PS - FC$.)

When the price is $p = 50$ the producer surplus is

$$PS(50) = \left(\frac{1}{2}(50) - 20\right)^2 = (25 - 20)^2 = 5^2 = 25$$

which is less than the fixed cost of 100, so the firm will not enter the market.

When the price is $p = 70$ the producer surplus is

$$PS(70) = \left(\frac{1}{2}(70) - 20\right)^2 = (35 - 20)^2 = 15^2 = 225$$

which is greater than the fixed cost of 100, so the firm will enter the market

- (d) Consider a situation before the firm enters the market. Suppose that fixed costs are $FC = 100$. What is the producer surplus when $p = 60$? What is the supply function $q(p)$ of this firm? When the price is $p = 60$ the producer surplus is

$$PS(60) = \left(\frac{1}{2}(60) - 20\right)^2 = (30 - 20)^2 = 10^2 = 100$$

which is exactly equal to the fixed cost. The firm is indifferent between entering the market and not entering the market.

Given this, the supply function is

$$q(p) = \begin{cases} 0, & p < 60 \\ \frac{1}{2}p - 20, & p \geq 60 \end{cases}$$

3. A perfectly competitive firm is observed producing $q = 25$ when the price is $p = 350$ and producing $q = 50$ when the price is $p = 400$. Assuming that the firm has a linear marginal cost function, what is the marginal cost function? (Hint: recall that $MC = p$ when the firm is maximizing producer surplus.)

The firm has a linear marginal cost function of the form $MC = mq + c$ where m is the slope and c is the intercept.

When optimizing, we know that the firm produces $MC = p$, which means that $p = mq + c$.

One can solve this by plugging in the two observations and solving the system of linear equations

$$350 = 25m + c$$

$$400 = 50m + c$$

which gives us $m = 2$ and $c = 300$.

(You may also use the equation for a straight line ($m = \frac{y_2 - y_1}{x_2 - x_1}$ and $c = y_1 - mx_1$) which will give you the same answer.)

Part II Problems (Submit your answers)

This section is meant to build on the lessons you learn by attempting Part I; we therefore strongly recommend that you attempt Part I before attempting this section.

For each of the answers below, make a good faith attempt to answer each question and sub-question to the best of your ability. Provide complete answers and show your work, including explanations and derivations where appropriate. Failure to explain your answers or show your derivations may be penalized.

1. Consider a profit-maximizing firm with a marginal cost function given by $MC(q) = 10 + q$. It is a perfectly competitive firm i.e. it is a price-taker. The market price is p .
 - (a) Consider a situation where the firm is already in the market. What is the optimal quantity to produce? (*Hint: the optimal quantity will be a function of p .*)
 - (b) Consider a situation where the firm is already in the market. Depict the marginal cost curve graphically, with the quantity produced on the x-axis and the prices/costs on the y-axis. Label the intercepts, as well as the optimal quantity. Label the producer surplus. Assume that the firm is already in the market. What is the producer surplus earned by the firm? You may assume that $p > 10$. (*Hint: The producer surplus will be a function of p .*)
 - (c) Consider a situation where the firm is deciding whether to enter the market or not. Suppose that the fixed cost is $FC = 50$. What is the price below which the firm will not enter the market. (*Hint: the firm will enter the market if its profit π is positive. Profit is producer surplus minus the fixed cost i.e. $\pi = PS - FC$*)
 - (d) If the fixed cost is $FC = 50$ (as it was in the previous question) what is the firm's supply function? Depict it graphically, with the price on the y-axis, and quantity on the x-axis. Label any kinks in the curve.