Choose any four of the following five problems. If you write on more than four of them, cross out the one you do not choose to have graded. (25 points each)

Problem A.

Suppose a monopoly firm has the following demand and short-run total cost curves:

$$Q = 100 - P$$

$$STC = 250 + 180Q - 13Q^2 + \frac{1}{3}Q^3$$

1. At what output and price will the firm maximize total revenue?

$$P = 100 - Q; \quad MR = 100 - 2Q$$

$$MR = 0 \text{ at } Q = 50, \quad P = 100 - 50 = 50$$

$$TR = 50 \times 50 = 2500$$

2. At what output and price will the firm maximize total profit?

$$MC = MR$$

$$180 - 25Q + Q^2 = 100 - 2Q$$

$$-Q^2 + 25Q - 80 = 0$$

$$(-Q+20)(Q-4) = 0$$

$$Q = 20; \quad P = 50$$

3. Compare the maximum profit obtainable with the profit that the firm would have if it chose a revenue-maximizing strategy. (Show calculations.)

at $T_{max}$,

$$\Pi = 1400 - 250 - 3500 + 5200 - 25 \times 6.67 = 283.33$$

at $TR_{max}$,

$$\Pi = 2500 - 250 - 9000 + 32500 - 41,646.67 = -15,914.67$$
Problem B.

1. Complete the following table, given that $L$ is labor units, $Q$ is units of output, and that $P_L$, the price of a unit of labor is fixed. Assume that $L$ is the only variable input.

<table>
<thead>
<tr>
<th>MP</th>
<th>L</th>
<th>Q</th>
<th>STC</th>
<th>AFC</th>
<th>AVC</th>
<th>TVC</th>
<th>MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>240</td>
<td>---</td>
<td>---</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>20</td>
<td>440</td>
<td>12</td>
<td>10</td>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>60</td>
<td>440</td>
<td>4</td>
<td>6.67</td>
<td>400</td>
<td>5.47</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>90</td>
<td>840</td>
<td>2.47</td>
<td>6.67</td>
<td>600</td>
<td>4.47</td>
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<tr>
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<td>110</td>
<td>1040</td>
<td>2.18</td>
<td>7.27</td>
<td>800</td>
<td>10</td>
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<tr>
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<td>125</td>
<td>1240</td>
<td>1.92</td>
<td>8</td>
<td>1000</td>
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<tr>
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<td>30</td>
<td>135</td>
<td>1440</td>
<td>1.78</td>
<td>8.89</td>
<td>1200</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>35</td>
<td>140</td>
<td>1640</td>
<td>1.71</td>
<td>10</td>
<td>1400</td>
<td>140</td>
</tr>
</tbody>
</table>

2. Suppose this firm operates in a perfectly competitive market and faces a going price for its product of $12. Which of the output levels in the table will it choose in order to maximize profit. (Do not interpolate Q.)

\[ Q = 110 \]

3. How much will the firm's profit be at the level above?

\[ \pi = 1320 - 1040 = 280 \]

4. State the general condition for profit maximization, and explain how your answer to (2) relates to it.

\[ MR = MC \text{ or } MR = 0 \]

after \( Q = 110 \); \( MC > MR \).
Problem D.

Suppose a perfectly competitive firm has the following total cost function for the short run:

\[ STC = 300 + 80Q - 3Q^2 + \frac{1}{3}Q^3 \]

1. Determine its profit maximizing or loss minimizing output for the short run, given that the market price of its product is $152 per unit.

\[ MC = MR \]

\[ 80 - 6Q + Q^2 = 152 \]

\[ -Q^2 + 6Q + 72 = 0 \]

\[ (-Q + 12)(Q + 6) = 0 \]

\[ Q = 12 \]

2. What will be the firm's short-run profit or loss?

\[ TR = 152(12) = 1824 \]

\[ TC = 300 + 940 - 432 + 576 = 1404 \]

\[ \Pi = 1824 - 1404 = \$420 \]

3. Now disregard the above cost function and suppose its long-run total cost is:

\[ LTC = 150Q - 3Q^2 + 0.05Q^3 \]

Do the following:

a) Write an equation for long-run average cost.

\[ LAC = \frac{150 - 3Q + 0.05Q^2}{Q} \]

b) Indicate the firm's long-run price, quantity sold, and profit, assuming the industry is in long-run equilibrium.

At min LAC, with no tendency for entry or exit, \( P = LAC \).

Then also \( \frac{dLAC}{dQ} = 0 = -3 + 1Q \)

\[ Q = 30 \]

\[ P = 150 - 90 + 45 = 105 = LAC \]

\[ \Pi = 0 \]

NOTE:

Problem E is multiple choice questions and is not on reserve.