The Problem – Part I

• The industry demand curve for widgets is
  \[ Q = 600 - 10P. \]

• Forty plants produce widgets with costs
  \[ 27 + 3q^2 \]

• Find \( P, Q \) and \( \pi \)

Demand and Supply

• We know industry demand
  \[ Q = 600 - 10P \]

• We must find industry supply. The cost function is
  \[ 27 + 3q^2 \]
We know industry demand:
\[ Q = 600 - 10P \]

We must find industry supply. The cost function is:
\[ 27 + 3q^2 \Rightarrow MC = 6q \]

Each firm produces where MC = P:
\[ 6q = P \]

Industry supply is then forty times that or:
\[ Q = 40P/6 \]

Finding Industry Supply

\[ q = \frac{P}{6} \]

• Industry Supply is then forty times that or

\[ Q = 40\frac{P}{6} \]

• Equate Demand and Supply

\[ D = S = 40\frac{P}{6} \]

Finding Price

\[ D = S = 40\frac{P}{6} \]

\[ 600 - 10P = 40\frac{P}{6} \]

\[ 3600 - 60P = 40P \]

\[ 3600 = 100P \]

\[ P = 36 \]
Finding Quantity

\[ 600 - 10P = \frac{40P}{6} \quad Q = 600 - 10P \]
\[ 3600 - 60P = 40P \quad Q = 600 - 10(36) \]
\[ 3600 = 100P \quad Q = 600 - 360 \]
\[ 100P = 3600 \quad Q = 240 \]
\[ P = 36 \]

Finding Each Firm’s Output

\[ 600 - 10P = \frac{40P}{6} \quad Q = 600 - 10P \]
\[ 3600 - 60P = 40P \quad Q = 600 - 10(36) \]
\[ 3600 = 100P \quad Q = 600 - 360 \]
\[ 100P = 3600 \quad Q = 240 \]
\[ P = 36 \]
\[ q = \frac{Q}{40} \]
\[ q = 6 \]

Profits

\[ P = 36 \]
\[ q = 6 \]

\[ \pi = PQ - C \]
Profits
\[ P = 36 \]
\[ q = 6 \]
\[ \pi = PQ - C \]
\[ PQ = (36)(6) = 216 \]
\[ C = 27 + 3q^2 \]
\[ C = 27 + 3(6)^2 \]
\[ C = 135 \]

Profits
\[ P = 36 \]
\[ q = 6 \]
\[ \pi = PQ - C \]
\[ PQ = (36)(6) = 216 \]
\[ C = 27 + 3q^2 \]
\[ C = 27 + 3(6)^2 \]
\[ C = 135 \]

The Problem – Part II

• Suppose other firms may open a (single) plant. Same cost function.

• Find, P, Q, N, q, and \( \pi \).
Finding Long Run Marginal Cost

- We know that in the long run, the price will be at the minimum of the firm’s AC curve. Let’s find that.

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- The cost function is 
  \[ C = 27 + 3q^2 \]

  \[ AC = \frac{C}{q} \]
Finding Long Run Marginal Cost

- The cost function is
  \[ C = 27 + 3q^2 \]
  \[ AC = \frac{C}{q} \]
  \[ AC = \frac{27 + 3q^2}{q} \]

\[ AC = \frac{27}{q} + 3q \]

Finding Long Run Marginal Cost

\[ AC = \frac{27}{q} + 3q \]

\[ MC = AC \]

\[ C = 27 + 3q^2 \]

\[ MC = 6q \]

\[ 6q = \frac{27}{q} + 3q \]

\[ 3q = \frac{27}{q} \]
Finding Long Run Marginal Cost

\[ 6q = \frac{27}{q} + 3q \]

\[ 3q^2 = 27 \]

\[ 3q = \frac{27}{q} \]

Finding Long Run Marginal Cost

\[ q^2 = 9 + 3q \]

\[ 3q^2 = 27 \]

\[ q = 3 \]

Finding Long Run Marginal Cost

AC when \( q = 3 \)

\[ AC = \frac{27}{q} + 3q \]

\[ AC = \frac{27}{3} + 3(3) = 18 \]

Finding Long Run Marginal Cost

\( q = 3 \)

\[ AC = 18 \]

\[ P = 18 \]

Total Output
Total Output

$AC = 18$

$P = 18$

\[ Q = 600 - 10P \]

Total Output

$AC = 18$

$P = 18$

\[ Q = 600 - 10P \]

\[ Q = 600 - 10(18) = 600 - 180 = 420 \]

Total Output

$AC = 18$

$P = 18$

\[ Q = 420 \]

\[ q = 3 \]

Total Output

$AC = 18$

$P = 18$

\[ Q = 420 \]

\[ q = 3 \]

\[ N = 140 \]

End