∂ 8.3 figure it out

Assume that the pickle industry is perfectly competitive and has 150 producers. One hundred of these producers are "high-cost" producers, each with a short-run supply curve given by $Q_{hc} = 4P$. Fifty of these producers are "low-cost" producers, with a short-run supply curve given by $Q_{lc} = 6P$. Quantities are measured in jars and prices are dollars per jar.

a. Derive the short-run industry supply curve for pickles.

b. If the market demand curve for jars of pickles is given by $Q^d = 6{,}000 - 300P$, what are the market equilibrium price and quantity of pickles?

c. At the price you found in part (b), how many pickles does each high-cost firm produce? Each low-cost firm?

d. At the price you found in part (b), determine the industry producer surplus.

e. Recalculate producer surplus using calculus and show that the solution is the same as in part (d). (*Hint*: Remember how producer surplus is calculated in the Appendix to Chapter 3.)

f. Write the short-run industry supply curve as a function of the number of high-cost firms (N_{hc}) and the number of low-cost firms (N_{lc}).

g. Suppose that the number of high-cost firms in the pickle industry decreases to 25. What is the number of low-cost firms under this new scenario that would support the original equilibrium found in part (b)?

Solution:

a. To derive the industry short-run supply curve, we need to sum each of the firm short-run supply curves horizontally. In other words, we need to add each firm's quantity supplied at each price. Since there are 100 high-cost firms with identical supply curves, we can sum them simply by multiplying the firm supply curve by 100:

$$Q_{HC} = 100Q_{hc} = 100(4P) = 400P$$

Similarly, we can get the supply of the 50 low-cost firms by summing their individual supply curves or by multiplying the curve of one firm by 50 (since these 50 firms are assumed to have identical supply curves):

$$Q_{LC} = 50Q_{lc} = 50(6P) = 300P$$

The short-run industry supply curve is the sum of the supply by high-cost producers and the supply of low-cost producers:

$$Q^S = Q_{HC} + Q_{LC} = 400P + 300P = 700P$$

b. Market equilibrium occurs where quantity demanded is equal to quantity supplied:

$$Q^D = Q^S$$
$$6{,}000 - 300P = 700P$$
$$1{,}000P = 6{,}000$$
$$P = \$6$$

The equilibrium quantity can be found by substituting $P = \$6$ into either the market demand or supply equation:

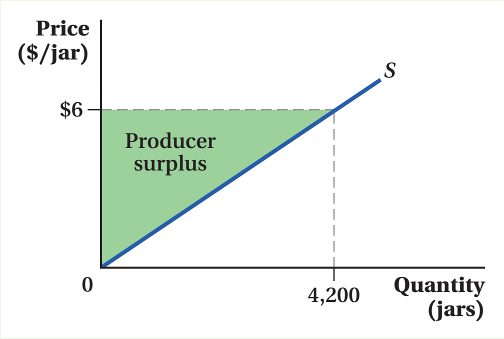
$$Q^D = 6{,}000 - 300P = 6{,}000 - 300(6) = 4{,}200 \text{ jars}$$

$$Q^S = 700P = 700(6) = 4{,}200 \text{ jars}$$

c. At a price of \$6, each high-cost producer will produce $Q_{hc} = 4P = 4(6) = 24$, while each low-cost producer will produce $Q_{lc} = 6P = 6(6) = 36$ jars.

d. The easiest way to calculate industry producer surplus is to graph the industry supply curve. Producer surplus is the area below the market price but above the short-run industry supply curve. In the figure to the right, this is the triangle with a base of 4,200 (the equilibrium quantity at a price of \$6) and a height of \$6:

$$PS = \frac{1}{2} \times \text{base} \times \text{height} = (0.5)(4{,}200)(\$6) = \$12{,}600$$



e. Since supply is $Q^S = 700P$, inverse supply is $P = Q^S/700$. Producer surplus is

$$PS = \int_0^{4,200}\left(6 - \frac{Q}{700}\right) dQ$$
$$= \int_0^{4,200} 6\ dQ - \int_0^{4,200} \frac{Q}{700}\ dQ$$
$$= [6Q]_0^{4,200} - \left[\frac{Q^2}{1,400}\right]_0^{4,200}$$
$$= [6(4,200) - 6(0)] - \left[\frac{(4,200)^2}{1,400} - \frac{(0)^2}{1,400}\right]$$
$$= (25,200 - 0) - (12,600 - 0) = 12,600$$

This is the same producer surplus found in part (d).

f. The short-run industry supply curve can be written generically as $Q^S = N_{hc}(4P) + N_{lc}(6P)$.

g. If $N_{hc} = 25$, we know that $Q^S = 25(4P) + N_{lc}(6P) = 100P + nN_{lc}(6P)$. The equilibrium condition now is

$$Q^D = Q^S$$
$$6,000 - 300P = 100P + N_{lc}(6P)$$

The original equilibrium price was \$6, as found in part (b). At this price,

$$6,000 - 300(6) = 100(6) + N_{lc}(6)(6)$$
$$4,200 = 600 + 36N_{lc}$$
$$N_{lc} = 100$$