∂ 11.5 figure it out

Sticky Stuff produces cases of taffy in a monopolistically competitive market. The inverse demand curve for its product is $P = 50 - Q$, where Q is in thousands of cases per year and P is dollars per case.

Sticky Stuff can produce each case of taffy at a constant marginal cost of $10 per case and has no fixed cost. Its total cost curve is therefore $TC = 10Q$.

a. To maximize profit, how many cases of taffy should Sticky Stuff produce each month?

b. What price will Sticky Stuff charge for a case of taffy?

c. How much profit will Sticky Stuff earn each year?

d. In reality, firms in monopolistic competition generally face fixed costs in the short run. Given the information above, what would Sticky Stuff's fixed costs have to be in order for this industry to be in long-run equilibrium? Explain.

e. Redo parts (a) and (b) using calculus by solving for marginal revenue directly from the revenue function and marginal cost from the total cost function that is relevant to the monopolistic competition problem, and confirm that your answers are the same.

Solution:

a. Sticky Stuff maximizes its profit by producing where $MR = MC$. Since the demand curve is linear, we know from Chapter 9 that the MR curve will be linear with twice the slope. Therefore, $MR = 50 - 2Q$. Setting $MR = MC$, we get

$$50 - 2Q = 10$$
$$Q = 20$$

Sticky Stuff should produce 20,000 cases of taffy each year.

b. We can find the price Sticky Stuff will charge by substituting the quantity into the demand curve:

$$P = 50 - Q = 50 - 20 = \$30 \text{ per case}$$

c. Total revenue for Sticky Stuff will be $TR = P \times Q = \$30 \times 20{,}000 = \$600{,}000$. Total cost will be $TC = 10Q = (10 \times 20{,}000) = \$200{,}000$. Therefore, Sticky Stuff will earn an annual profit of $\pi = TR - TC = \$600{,}000 - \$200{,}000 = \$400{,}000$.

d. Long-run equilibrium occurs when firms have no incentive to enter or exit. Therefore, firms must be earning zero economic profit. From (c), we know that Sticky Stuff is earning a profit of $400,000. In order for its profit to be zero, Sticky Stuff must face annual fixed cost equal to $400,000.

e. Sticky Stuff's total revenue function is

$$\begin{aligned} R(Q) &= P(Q) \times Q \\ &= (50 - Q)Q \\ &= 50Q - Q^2 \end{aligned}$$

Marginal revenue is $\frac{dR}{dQ} = 50 - 2Q$. Notice that this is the same marginal revenue as noted in part (a). Marginal cost is $\frac{dTC}{dQ} = 10$. Since the rest of the calculations are the same, $Q = 20$ (20,000 cases) and $P = \$30$ per case as above.

Alternately, we could set up the profit function:

$$\begin{aligned} \pi &= R(Q) - TC \\ &= 50Q - Q^2 - 10Q \\ &= 40Q - Q^2 \end{aligned}$$

and maximize this with respect to quantity by taking the derivative with respect to Q and setting it equal to zero to form Sticky Stuff's first-order condition. Here, $\frac{d\pi}{dQ} = 40 - 2Q = 0$, so $Q = 20$ (20,000 cases) as noted above. (Note that if we had gone with the long-run scenario from part (d) and included fixed costs in the TC function above, the answer would not change. This is because the derivative of fixed costs (a constant) is zero.)