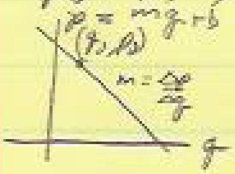
2. $p_0 = \$45$, $q_0 = 55 \Rightarrow (q_0, p_0)$ one point on demand graph



$$m = \frac{\Delta p}{\Delta q} = \frac{\$3}{-4} = -\frac{3}{4}$$

$$p - p_0 = m(q - q_0)$$

$$p - 45 = -\frac{3}{4}(q - 55) \rightarrow p = -\frac{3}{4}q + \frac{3}{4}\cdot 55 + 45$$

$$\boxed{\text{Demand Relation: } p = -\frac{3}{4}q + 86.25}$$

$c = \$35$ cost per unit

$$\boxed{\text{Cost Function } C(q) = \$35 \cdot q}$$

Revenue Function:

$$R(q,p) = p \cdot q = \left(-\frac{3}{4}q + 86.25\right)\cdot q = -\frac{3}{4}q^2 + 86.25q$$

$$\boxed{\text{Revenue: } R(q) = -\frac{3}{4}q^2 + 86.25q}$$

Profit: $P(q) = R(q) - C(q)$

$$= \left(-\frac{3}{4}q^2 + 86.25q\right) - (35q)$$

$$\boxed{\text{Profit Function } P(q) = -\frac{3}{4}q^2 + 51.25q}$$

find q_{max}

$$P'(q) = -\frac{3}{2}q + 51.25 = 0 \rightarrow q_{max} = \frac{2}{3}\cdot(51.25) = 34.2 \text{ or } \begin{matrix} \nearrow 34 \\ \searrow 35 \end{matrix}$$

Test to determine if 34 or 35 gives larger profit.

$$P(34) = -\frac{3}{4}(34)^2 + 51.25(34) = \$875.50 \leftarrow \text{larger} \Rightarrow \boxed{q_{max} = 34}$$

$$P(35) = -\frac{3}{4}(35)^2 + 51.25(35) = \$870.00$$

$$\boxed{q_{max} = 34}$$

$$p_{max} = -3/4(34) + 86.25 = \boxed{\$60.75 = p_{max}}$$

note: To maximize profit under given conditions you must have 34 items available to sell and must charge $60.75 for each