(12) • $\boxed{\text{Firm sells } Q_A}$

• Demand function $\Rightarrow Q_A = 3000 - 3P_A$

• Step 1: Inverse demand function:

$$3P_A = 3000 - Q_A$$

$$\boxed{P_A = 1000 - \frac{1}{3} Q_A}$$

• Firm buys $\boxed{Q_B = Q_A}$

• Supply of market B: $Q_B = 6P_B - 4800$

• Step 2: Inverse demand function

$$\frac{Q_B + 4800}{6} = P_B \Rightarrow \boxed{P_B = \left(\frac{1}{6}\right) Q_B + 800}$$

• Transport cost from market A to market B: $\boxed{100\,Q}$

a) Profit of the firm: three elements.

Enters positively (1) the revenues he gets from selling in market A: $P_A \cdot Q_A$

Enters negatively (2) The cost he faces when buying in market B: $P_B \cdot Q_B$

Enters negatively (3) The transportation costs: $100 \cdot Q$

$$\Pi_i = P_A \cdot Q_A - P_B \cdot Q_B - 100 \cdot Q$$

Step 3: In eq, $Q_A = Q_B = Q$

Step 4: Substitute P_A and P_B in Π_i:

$$\Pi_i = \left(1000 - \left(\frac{1}{3}\right) Q_A\right) \cdot Q_A - \left(\frac{1}{6} Q_B + 800\right) Q_B - 100\,Q$$

$$\Rightarrow \Pi_i = \boxed{1000\,Q} - \frac{1}{3} Q^2 - \frac{1}{6} Q^2 + \boxed{-800\,Q - 100\,Q}$$

$$\Rightarrow \boxed{\Pi_i = 100\,Q - \frac{1}{2} Q^2}$$

b) Maximise profit (Q is one variable)

$$\max_Q \Pi_i = 100\,Q - \frac{1}{2} Q^2$$

$$\rightarrow \frac{\partial \Pi_i}{\partial Q} = 0 \Rightarrow 100 - Q = 0 \Rightarrow \boxed{Q = 100}$$

$$\frac{\partial^2 \Pi_i}{\partial Q^2} = \boxed{-1 < 0} \rightarrow \text{maximum}$$

c) Now, firm profits face a new cost: the per unit tax: $t \cdot Q$.

$\Pi_i = 100\,Q - \frac{1}{2} Q^2 - t\,Q$; $\Pi_i'(Q) = 0 \Rightarrow 100 - Q - t = 0 \Rightarrow \boxed{Q^* = 100 - t}$

d) tax revenue: $t \cdot Q^* = t \cdot (100 - t) = 100t - t^2 \Rightarrow \boxed{TR'(t) = 0} \Rightarrow 100 - 2t = 0$ $\boxed{TR''(t) = -2 < 0}$ $\boxed{50 = t}$