Given that $MC > 0$, $MR$ must also be positive at equilibrium. Since $MR = P$ the first-order condition may be written as $MC = P$.

(b) The second-order condition for a maximum requires that the second derivative of the function be negative (implying that after its highest point the curve turns downwards). The second derivative of the total-profit function is

$$\frac{\partial^2 \Pi}{\partial X^2} = \frac{\partial^2 R}{\partial X^2} - \frac{\partial^2 C}{\partial X^2}$$

This must be negative if the function has been maximised, that is

$$\frac{\partial^2 R}{\partial X^2} - \frac{\partial^2 C}{\partial X^2} < 0$$

which yields the condition

$$\frac{\partial^2 R}{\partial X^2} < \frac{\partial^2 C}{\partial X^2}$$

But $\partial^2 R/\partial X^2$ is the slope of the $MR$ curve and $\partial^2 C/\partial X^2$ is the slope of the $MC$ curve. Hence the second-order condition may verbally be written as follows

$$\text{(slope of } MR) < \text{(slope of } MC)$$

Thus the $MC$ must have a steeper slope than the $MR$ curve or the $MC$ must cut the $MR$ curve from below. In pure competition the slope of the $MR$ curve is zero, hence the second-order condition is simplified as follows

$$0 < \frac{\partial^2 C}{\partial X^2}$$

which reads: the $MC$ curve must have a positive slope, or the $MC$ must be rising.

## B. THE SUPPLY CURVE OF THE FIRM AND THE INDUSTRY

The supply curve of the firm may be derived by the points of intersection of its $MC$ curve with successive demand curves. Assume that the market price increases gradually. This causes an upward shift of the demand curve of the firm. Given the positive slope of the $MC$ curve, each higher demand curve cuts the (given) $MC$ curve to a point which lies to the right of the previous intersection. This implies that the quantity supplied by the firm increases as price rises. The firm, given its cost structure, will not supply any quantity (will close down) if the price falls below $P_w$, because at a lower price the firm does not cover its variable costs (figure 5.8). If we plot the successive points of intersection of $MC$ and the demand curves on a separate graph we observe that the supply curve of the individual firm is identical to its $MC$ curve to the right of the closing-down point $w$. Below $P_w$ the quantity supplied by the firm is zero. As price rises above $P_w$ the quantity supplied increases. The supply curve of the firm is shown in figure 5.9.

The industry-supply curve is the horizontal summation of the supply curves of the individual firms. It is assumed that the factor prices and the technology are given and that the number of firms is very large. Under these conditions the total quantity supplied in the market at each price is the sum of the quantities supplied by all firms at that price. In figure 5.10 we show the industry supply as a straight line with a positive slope. It should, however, be noted that the particular shape of the market-supply curve depends on the technology and on factor prices, as well as the size distribution of the firms in the industry. All firms are not usually of the same size. The particular size of each firm in perfect competition depends on the entrepreneurial efficiency of the businessman, which is traditionally considered as a random attribute.