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Q3

$C(q) = F + 2q^2$

$Q^d = 2400 - 5P$

(a) $F = 800$, $P^* = (?)$

$Q^* = (?)$, $N^* = (?)$,

$C(q) = 800 + 2q^2$

now, it is long-run equilibrium scenario and industry has no. of identical firms.

$\therefore P^* = AC_4$ and

$AC_4 = MC$

where, $mc = 4q$

and $AC = \frac{800}{q} + 2q$

$\therefore 4q = \frac{800}{q} + 2q$

$\therefore 2q^2 = 800 \Rightarrow \boxed{q^* = 20}$

and, $AC_4 = \frac{800}{20} + 2(20)$

$\therefore AC_4 = 80$

$\therefore \boxed{P^* = AC_4 = 80}$

$\therefore Q^d = 2400 - 5P^* = Q^*$

$\therefore Q^* = 2400 - 5(80)$

$\boxed{Q^* = 2000}$

$\therefore$ No. of firms in the market,

$\boxed{N^* = \frac{Q^*}{q^*} = \frac{2000}{20} = 100}$

(b) now, we need to find, $\boxed{P^*, N^*, \pi}$ in terms of F.

$\therefore$ repeating same process,

$AC_4 = MC \Rightarrow P^*$.

where, $AC = \frac{F}{q} + 2q$

$MC = 4q$

$\therefore \frac{F}{q} + 2q = 4q \quad \therefore \frac{F}{q} = 2q$

$\therefore F = 2q^2, \quad \therefore \boxed{q^* = \sqrt{\frac{F}{2}}}$

$\therefore P^* = AC_4 = \frac{F}{q^*} + 2q^* = \frac{F}{\sqrt{F/2}} + 2\sqrt{\frac{F}{2}}$

$\therefore \boxed{P^* = 2\sqrt{2}\sqrt{F}}$ ——— (1)

and, $Q^* = 2400 - 5P^*$

$= 2400 - 5(2\sqrt{2})\sqrt{F}$

$\boxed{Q^* = 2400 - 10\sqrt{2}\sqrt{F}}$

$\therefore N^* = \frac{Q^*}{q^*} = \frac{2400 - 10\sqrt{2}\sqrt{F}}{\sqrt{F/\sqrt{2}}}$

$\therefore \boxed{N^* = \frac{2400\sqrt{2}}{\sqrt{F}} - 20}$ ——— (2)

→ Now, profit for each firm :->

$\pi = P^*q^* - AC\,q^*$

now, we know that,

$AC = AC_4 = P^*$ for this long run, competitive firms.

$\therefore \pi^* = P^*q^* - P^*q^*$

$\therefore \boxed{\pi^* = 0}$ (which does not vary with F). ——— (3)

$\therefore$ eqn (1), (2) & (3) are the required answers.