Show max instantaneous power for
$p = P + P\cos 2\omega t - Q\sin 2\omega t$
is $P + \sqrt{P^2 + Q^2}$

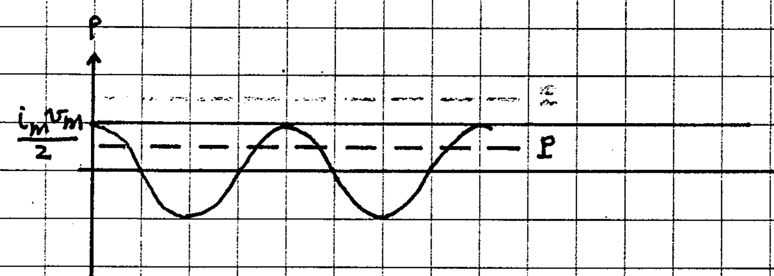
sol'n: We could use $\frac{\partial p}{\partial t} = 0$ at max instantaneous power,

but it is easier to use an earlier form we had for p:

$$p = P + \frac{i_m v_m}{2}\cos(2\omega t + \theta_v - \theta_i)$$

Note that $P \equiv \frac{i_m v_m}{2}\cos(\theta_v - \theta_i)$ is constant.

$\therefore$ p = const + sinusoid at freq $2\omega t$



The max for p will be when sinusoid is at its max. Since the max of cos is +1, the max of $\frac{i_m v_m}{2}\cos(2\omega t + \theta_v - \theta_i) = \frac{i_m v_m}{2}$.

(Note that $\theta_v - \theta_i$ doesn't affect max.)

$$\therefore \max p = P + \frac{i_m v_m}{2}$$

Now we show $\sqrt{P^2 + Q^2} = \frac{i_m v_m}{2}$.

$$\sqrt{P^2 + Q^2} = \sqrt{\left(\frac{i_m v_m}{2}\right)^2\left[\cos^2(\theta_v - \theta_i) + \sin^2(\theta_v - \theta_i)\right]}$$

$$= \frac{i_m v_m}{2} \checkmark \text{ (since } \cos^2 + \sin^2 = 1)$$

Note: P and Q are the <u>rectangular</u> coord version of $\frac{i_m v_m}{2} \angle \theta_v - \theta_i$ which is the <u>polar</u> version of <u>reactive power</u>.