Physics 313 assignment 3  9/3/09

1. a) \( z = \sqrt{R^2 + X_c^2} \)  
\( X_c = \frac{1}{\omega C} = \frac{1}{2\pi \times (0.2 \times 10^{-6})} = 5.3 \, k \)  
so \( z = \sqrt{10^2 + 5.3^2} = 11.3 \, k \)

b) \( I_p = \frac{V_0}{z} = 0.18 \, mA \)

c) \( V_R = I R = 1.8 \, V \)  
\( V_c = I X_c = 0.9 \, V \)

d) \( V_c \) projects \( V_{in} \) according to the phasor diagram

e) \( V_c \) logs \( V_{in} \) according to the phasor diagram

f) \( \phi_c = \tan^{-1} \left( \frac{1.8}{0.9} \right) = 63^\circ \) (\( V_c \) logs \( V_{in} \) by 63°)

g) for resonance in an RLC series circuit, \( X_L = X_C \)  
\( \Rightarrow \omega L = \omega C \)  
\( L = \frac{1}{\omega^2 C} = \frac{1}{(2\pi \times (0.2 \times 10^{-6}))^2 (0.2 \times 10^{-6})} = 5.6 \, H \)

h) at resonance, \( z = R \), so \( I_p = \frac{V_0}{R} = 0.20 \, mA \) \( \to \) larger
\( V_0 \) across \( L + C \) cancel (opposite phase, same magnitude)  
so all \( V_{in} \) drop across \( R \) \( \to \) largest \( I \)

i) DMM reads \( V_{rms} = \frac{V_p}{\sqrt{2}} = 1.4 \, V \)