CIRCUITS II
"How To Have fun on the weekends"

① Write the expressions for the following waveforms:

Ⓐ 2 volt peak sinewave at 2 KHZ

Ⓑ 10 volt RMS sinewave at 1KHZ

Ⓒ 10 volt peak-peak sinewave at 1KHZ, lagging by 90°.

Ⓓ 5 volt peak sinewave at 100HZ riding on a +2V DC offset.

② Plot waveform 1-A as seen on a 'scope with the following settings (assume ground is centered and the trigger level and slope are set to start the trace as the waveform passes through 0, going positive).

Ⓐ vertical: 1V/DIV, Horizontal: 100 μSec/DIV, Coupling: AC

Ⓑ vertical: .2V/DIV, Horizontal: 200 μSec/DIV, coupling: DC

③ Plot waveform 1-D as seen on a 'scope with the following settings (assume ground is centered, Trigger slope is negative, trigger level is approx +1V).

Ⓐ vertical: 2V/DIV, Horizontal: 2mSec/DIV, coupling: DC

Ⓑ vertical: 2V/DIV, Horizontal: 2mSec/DIV, coupling: AC

④ Find X_L if $f = 1KHZ$, $L = 1mH$

⑤ Find X_C if $f = 100HZ$, $C = .1\mu F$

⑥ Find Z for a series combo of $R = 1k\Omega$, $L = 10mH$, if $f = 20KHZ$

CIRCUITS II

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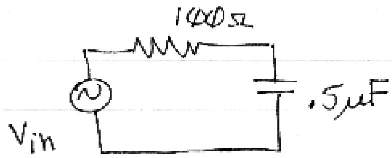
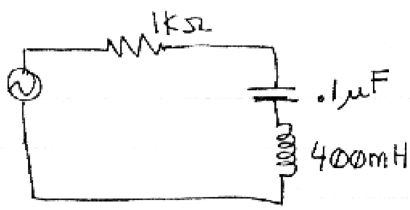
(7) Draw the 3 voltage waveforms for the circuit below. (v_{in}, v_R, v_c). Also, determine Total power dissipated.



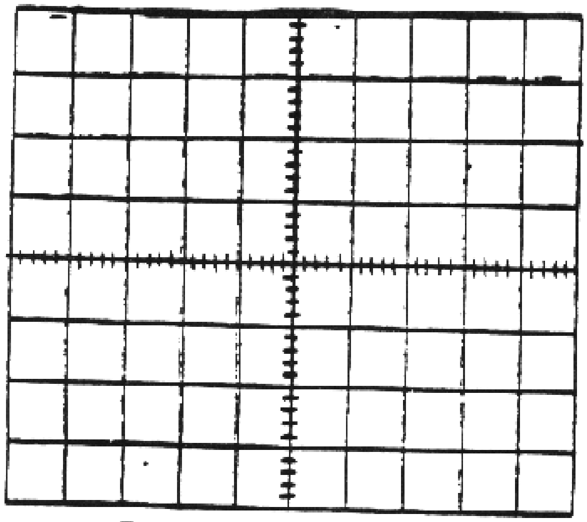
↑ 5V peak at 1KHZ

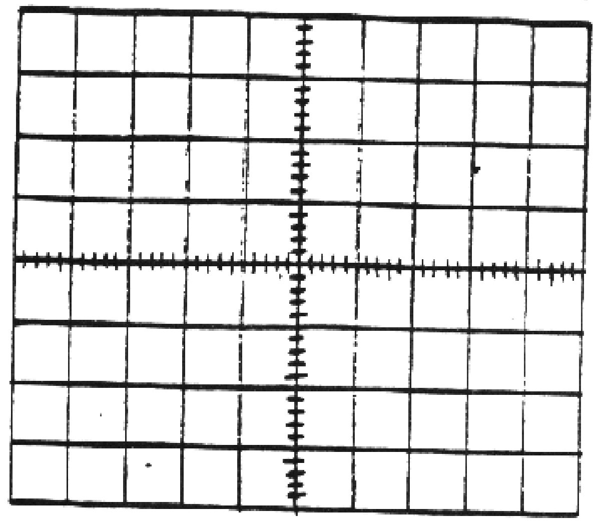
(8) Draw the 4 voltage waveforms for the circuit below. (v_{in}, v_R, v_L, v_c)

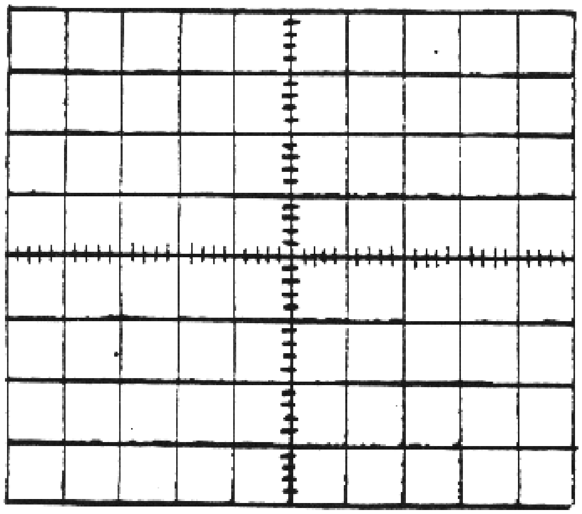


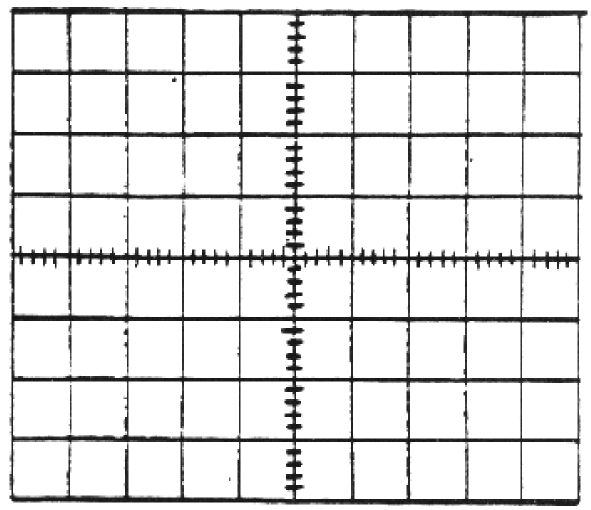
V_{in} = 1 volt at 500HZ

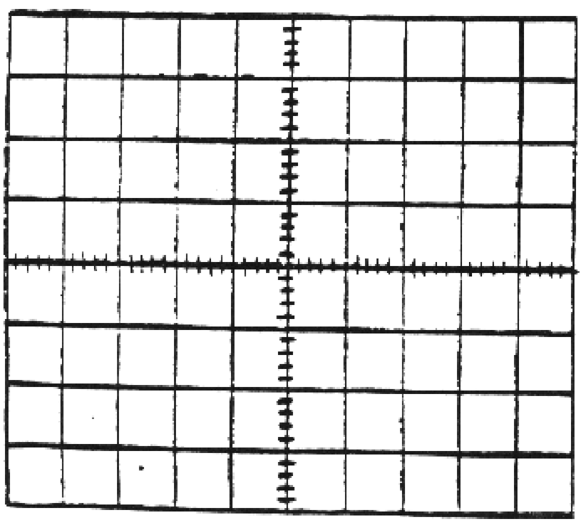
(9) find the frequency for the circuit of problem 8 such that $X_L = X_C$, and determine Z of the circuit at that point.

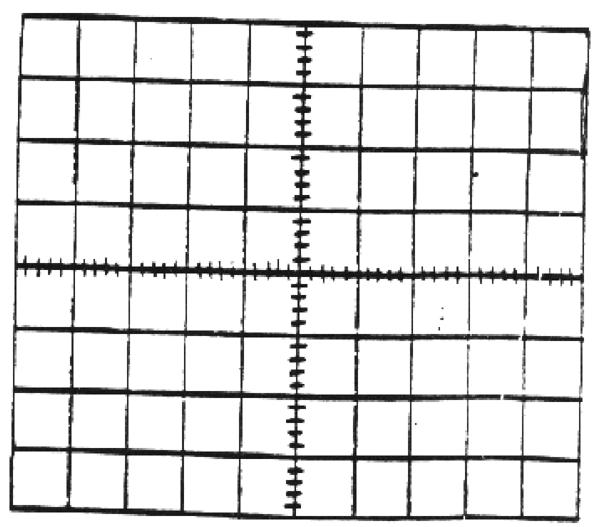












CIRCUITS II

so much weekend fun (answers)

① Ⓐ $v(t) = 2\sin 2\pi 2000t$

Ⓑ $10V\ RMS = 14.14\ v\ peak$, $v(t) = 14.14 \sin 2\pi 1000t$

Ⓒ $10 V_{p\text{-}p} = 5 v_p$, $v(t) = 5\sin(2\pi 1000t - 90°)$

Ⓓ $v(t) = 5\sin 2\pi 100t + 2$ (note lack of parenthesis for sin)

or $v(t) = 2 + 5\sin 2\pi 100t$ (less confusing)

② + ③ - see graphs

④ $X_L = 2\pi f L = 2\pi\, 1KHZ \cdot 1mH = 6.28\Omega$

⑤ $X_C = \dfrac{1}{2\pi f C} = \dfrac{1}{2\pi\, 100HZ \cdot .1\mu F} = 15.9K\Omega$

⑥ $X_L = 2\pi\, 20KHZ \cdot 10mH = 1256\Omega$

$Z = 1k + j1256\ \Omega = 1605\angle 51.5°\ \Omega$

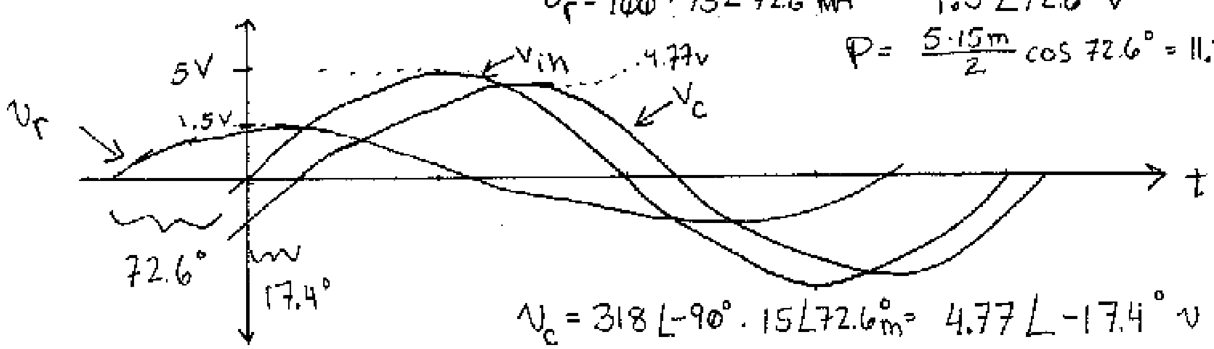
⑦ $X_C = \dfrac{1}{2\pi\, 1KHZ \cdot .5\mu F} = 318\Omega$

$Z = 100 - j318\ \Omega = 333.3\angle -72.6°\ \Omega$

$i = \dfrac{5\angle 0°\ v}{333.3\angle -72.6°\ \Omega} = 15\angle 72.6°\ mA$

$V_r = 100 \cdot 15\angle 72.6° mA = 1.5\angle 72.6° V$

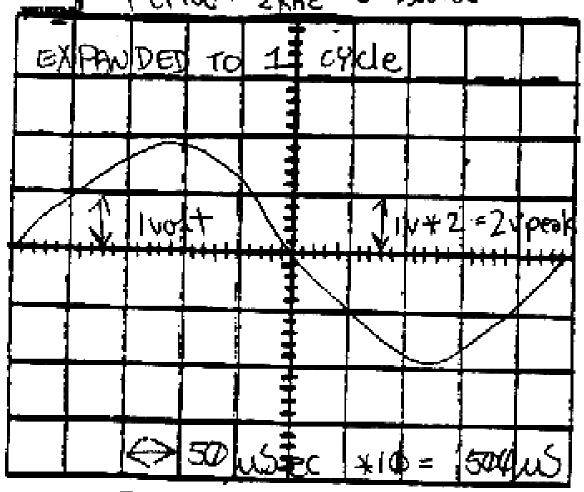
$P = \dfrac{5 \cdot 15m}{2} \cos 72.6° = 11.2mW$



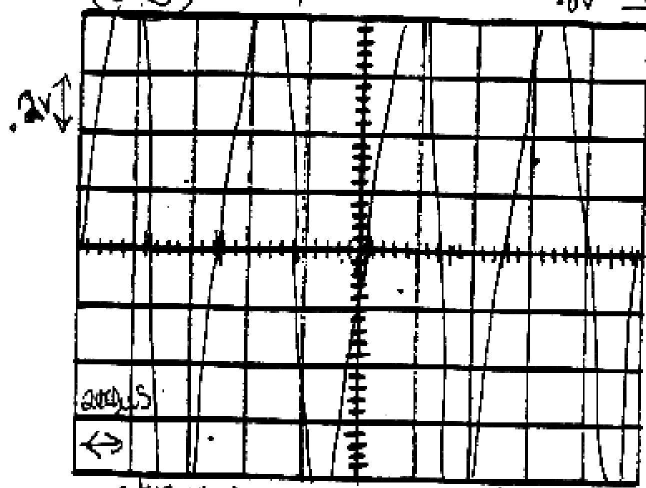
$V_c = 318\angle -90° \cdot 15\angle 72.6° m = 4.77\angle -17.4°\ v$

fun so much weekend fun - circuits II

(2A) Period = $\frac{1}{2KHz}$ = 500µSec



(2B) At .2V/DIV we can only see .8v

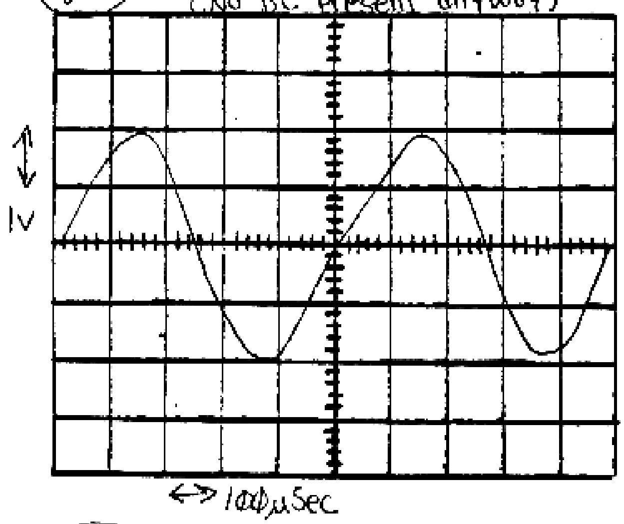


The top and bottom are chopped off.

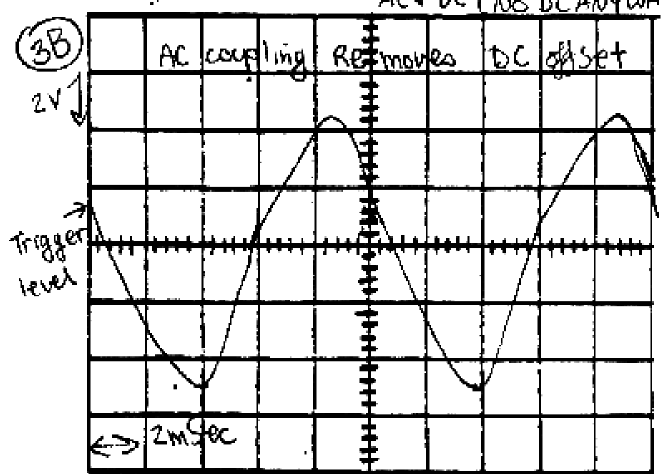
at 200uS, we can see 4 cycles

DC coupling lets us see both AC + DC (No DC ANYWAY)

(2A) AC coupling Removes DC (No DC present anyway)

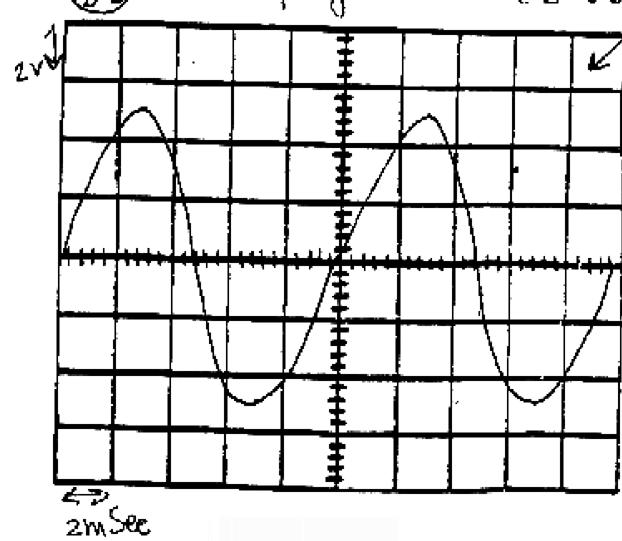


(3B)

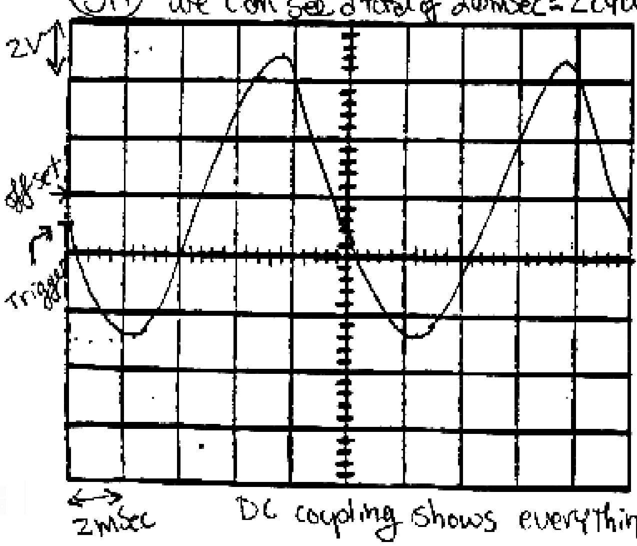


— USING SAME TRIGGER AS (2A + 2B)

(3B) AC coupling removes the 2VDC



(3A) we can see a total of 20mSec = 2 cycles



DC coupling shows everything

CIRCUITS II

so much fun on the weekends fun (answers, cont.)

(8) $X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi 500 \cdot .1\mu F} = 3185\Omega$

$X_L = 2\pi f L = 2\pi 500 \cdot 400mH = 1256\Omega$

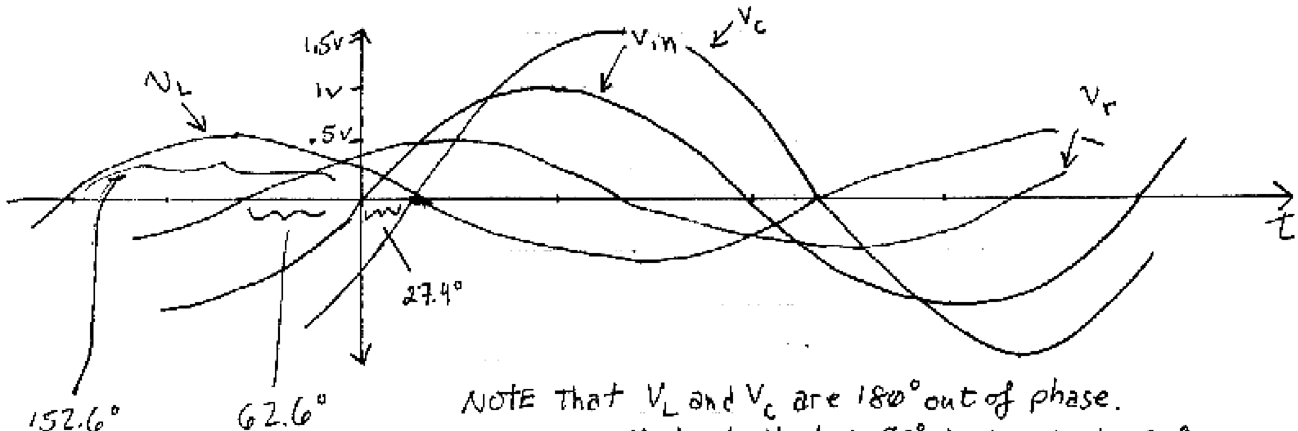
$Z = 1K + j1256 - j3185\,\Omega = 1K - j1929\,\Omega = 2173\angle{-62.6^\circ}\,\Omega$

$i = \frac{1\angle 0^\circ\, v}{2173\angle{-62.6^\circ}\,\Omega} = .46mA\angle 62.6^\circ$ (current leads voltage - circuit is basically capacitive).

$v_r = 1K \cdot .46mA\angle 62.6^\circ = .46v\angle 62.6^\circ$

$v_c = 3185\angle{-90^\circ} \cdot .46mA\angle 62.6^\circ = 1.47\angle{-27.4^\circ}\,v$

$v_L = 1256\angle 90^\circ \cdot .46mA\angle 62.6^\circ = .578\angle 152.6^\circ V$



NOTE That V_L and V_c are 180° out of phase. V_L leads V_r by 90°, V_c lags V_r by 90°

(9) since $X_L = 2\pi f L$ and $X_C = \frac{1}{2\pi f C}$, if $X_C = X_L$ then

$2\pi f L = \frac{1}{2\pi f C}$, $f^2 = \frac{1}{2\pi C\, 2\pi L}$

$f = \frac{1}{2\pi\sqrt{LC}}$ $\quad f = \frac{1}{2\pi\sqrt{.1\mu F \cdot 400mH}} = 796Hz$

$X_L = 2\pi 796 \cdot 400mH = 2k\Omega$ $\quad X_C = \frac{1}{2\pi 796 \cdot .1\mu F} = 2K\Omega$

$Z = 1K\Omega + j2K - j2K = \underline{1K\Omega}$