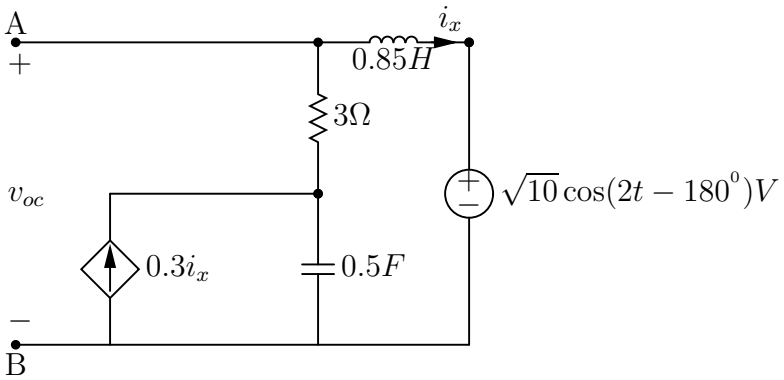
332:221 Principles of Electrical Engineering I – Fall 2004

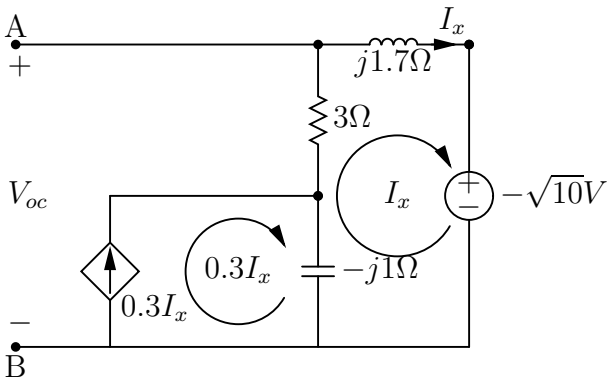
Quiz 6

Student's name in capital letters:

The circuit shown is in steady state. Using mesh current analysis, determine the open circuit voltage $v_{oc}(t)$ between the terminals A and B with node A positive compared to the node B. None of the methods other than mesh current analysis are acceptable. Both concepts and complex algebra are important. Be aware of all mesh current directions, source voltage signs, voltage drop signs, etc. If your mesh equation is wrong, you will not get much points.

The phasor domain circuit is given on the right along with the chosen mesh current directions. Note that the phasor of $\sqrt{10}\cos(2t - 180^0)$ is $\sqrt{10}\angle -180^0$ which simplifies to $-\sqrt{10}$.





One of the mesh equations can be written as

$$-3I_x - j1.7I_x - (-\sqrt{10}) - (-j1(0.7I_x)) = 0.$$

The above equation simplifies to

$$3I_x + j1.7I_x - j0.7I_x = \sqrt{10}.$$

The above equation tells us that

$$I_x = \frac{\sqrt{10}}{3+j} = \frac{\sqrt{10}}{\sqrt{10}\angle 18.43^0} = 1\angle -18.43^0$$

We can now compute V_{oc} as

$$V_{oc} = -\sqrt{10} + j1.7I_x = -\sqrt{10} + j1.7\angle -18.43^0 = -\sqrt{10} + 1.7\angle 71.57^0 = 3.08\angle 148.43^0$$

This implies that

$$v_{oc}(t) = 3.08\cos(2t + 148.43^0)\,V.$$