ECE 2100 Circuit Analysis
Spring 2016
Final Exam

NAME: _____

INSTRUCTIONS:

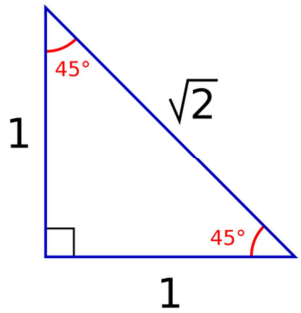
1. **THIS EXAM IS CLOSED BOOK AND CLOSED NOTES**. A "Potentially Useful Facts" sheet is provided.
2. **NO ELECTRONIC DEVICES ARE ALLOWED**.
3. Work each problem in the provided space.
4. Show ALL work required to arrive at a solution for either full or partial credit.
5. READ the entire question before answering.
6. CIRCLE YOUR ANSWERS.
7. Have your student ID on your desktop for inspection by the instructor.
8. SIGN the honesty pledge at the bottom of the page. Exams without a signature will receive no credit.

I have neither given nor received assistance from anyone in regards to completion of this exam. I have followed the instructions as provided on this sheet.

SIGNATURE: _____ DATE: _____

Note: some problems might be adapted from the course text or other sources. Schematics prepared using LTspice IV (linear.com).

Potentially Useful Facts

1. $A\angle\theta = Ae^{j\theta} = A\cos\theta + A\sin\theta\, j$
2. $v = L\frac{di}{dt}$ (follows passive sign convention)
3. $i = C\frac{dv}{dt}$ (follows passive sign convention)
4. $\overrightarrow{\boldsymbol{Z_L}} = j\omega L$
5. $\overrightarrow{\boldsymbol{Z_C}} = \frac{1}{j\omega C}$
6. $\vec{\boldsymbol{S}} = \overrightarrow{\boldsymbol{V_{RMS}}}\left(\overrightarrow{\boldsymbol{I_{RMS}}}\right)^*$ (follows passive sign convention)
7. $V_{\text{RMS}} = \sqrt{\frac{1}{T}\int_0^T v^2(t)dt}$
8. 

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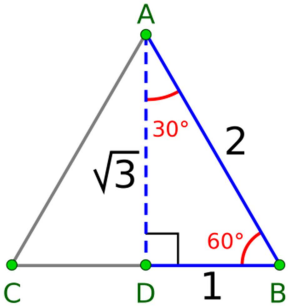
9. 

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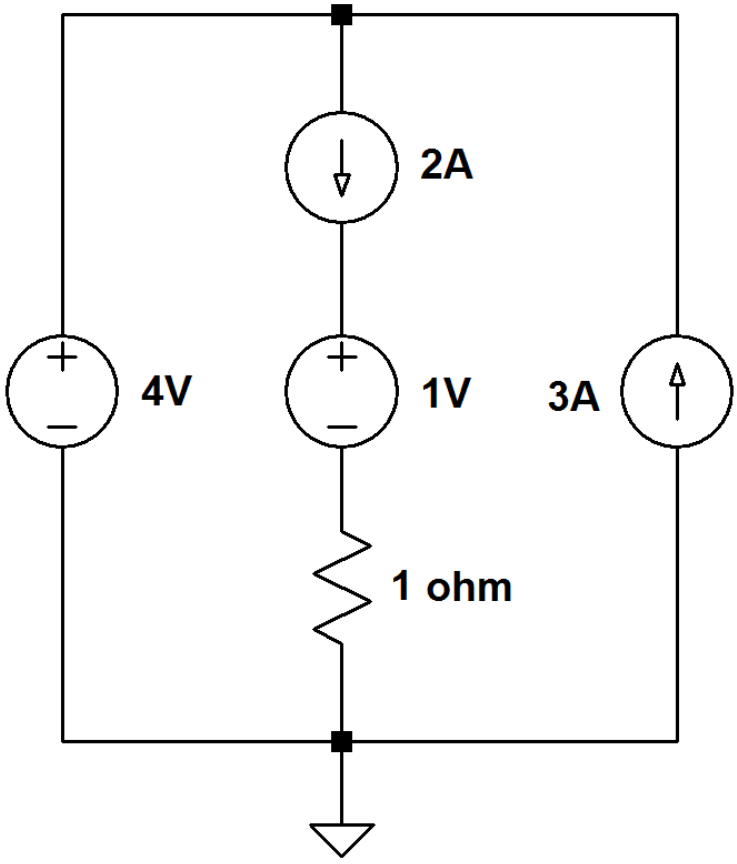
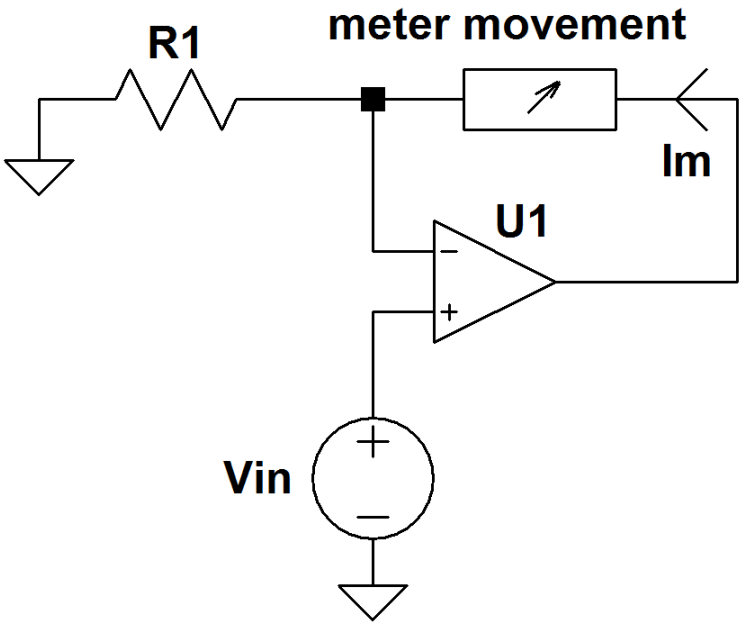
https://commons.wikimedia.org/wiki/File:30-60-90.svg
10. first-order circuit (natural and step) response
$x(t) = x(\infty) + [x(0) - x(\infty)]e^{-t/\tau}$

Maximum exam score is 30 points.

1. (5 points) Find the power of each circuit element.

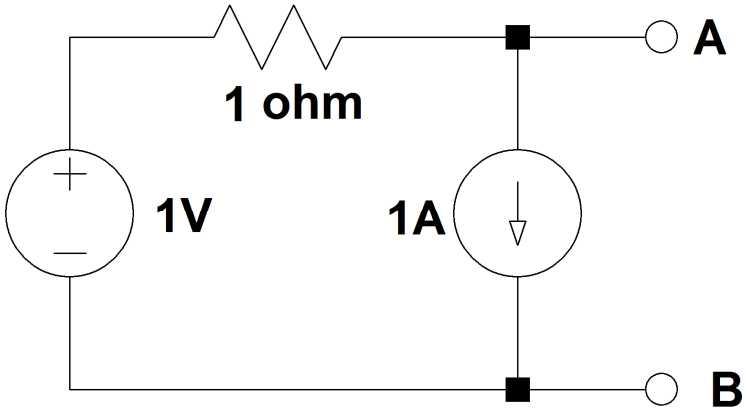


2. (5 points) An ideal op-amp can be used to make a voltmeter to measure an input voltage Vin as shown. The meter movement has a full scale current Im=1mA.
    a. Find the value of R1 so that the voltmeter has a full scale voltage of 10V.
    b. What is the input resistance of the voltmeter 'seen' by Vin?

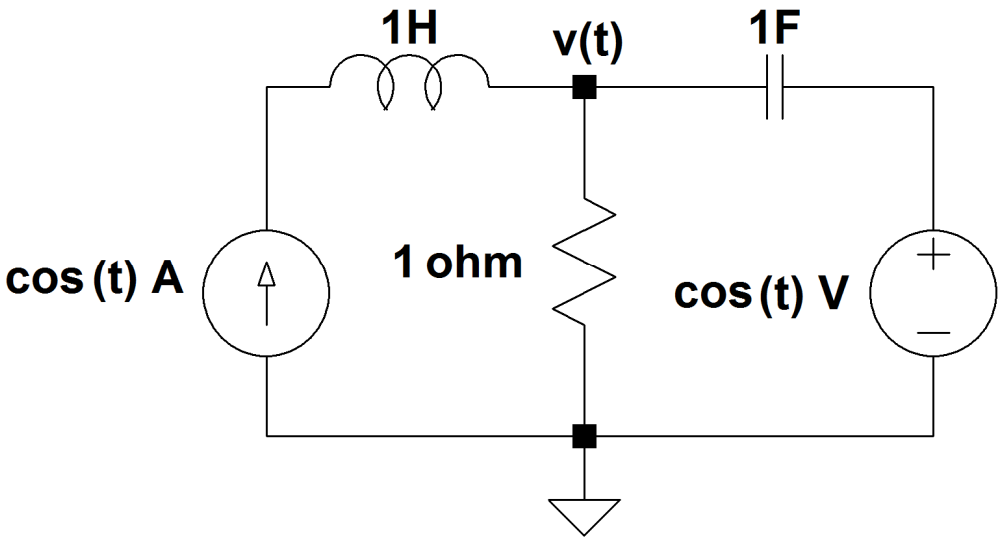


3. (5 points) The complex power of a load is **S** = 10 + 10j VA at frequency 1 rad/s. If the voltage across the load is 10V RMS, find the value of a component to be connected in parallel with the load to provide a unity power factor.

4. (5 points) Thevenize the following circuit “looking into” terminals A-B.



5. (5 points) Find node voltage v(t) in the sinusoidal steady state using nodal analysis.



6. (5 points) The switch has been **CLOSED** for a long time. Find v(t) for all times after the switch is **OPENED** at t=0. It might be useful to draw the circuit conditions right before the switch is opened, right after the switch is opened, and at t=∞.