HW#8, Electronic Circuit, Spring semester 2020

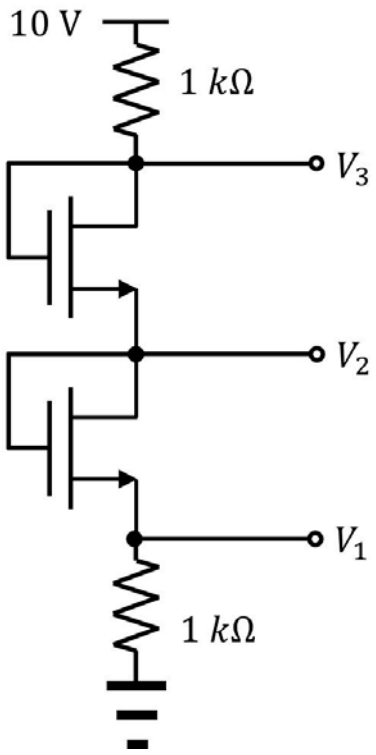
May 19, 2020

Due: 23:55, May 15 (Sunday night)

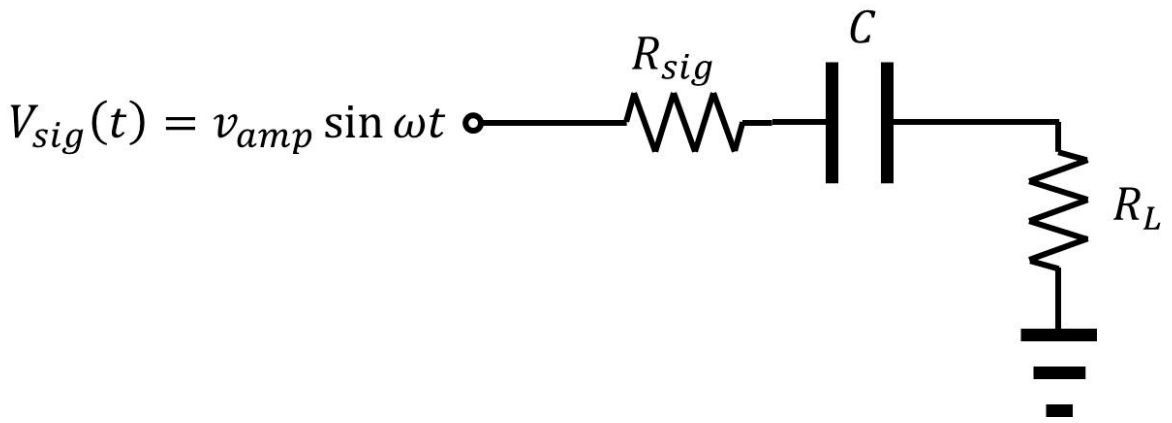
We have 8 problems.

In your answer file, specify both the **SOLUTION PROCEDURE** and the **FINAL SOLUTION**.

1. For the circuit shown below, find the labeled node voltages, V_1, V_2, and V_3. The NMOS transistors have a threshold voltage of 1.0 V. $\mu_n C_{ox} \frac{W}{L} = 2\ \mathrm{mA/V^2}$. Neglect the channel-length modulation.



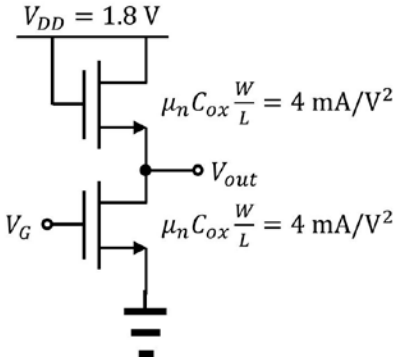
2. Consider a circuit shown below. Express the voltage for the load resistor as a function of time.



3. Complex number representations that denote sinusoidal signals at a fixed frequency are called phasors. In this problem, for a given time-varying function $f(t)$, let us denote its phasor $f(\omega)$. Then, $f(t) = Re[f(\omega)\exp(j\omega t)]$. For example, when $f(t) = \cos \omega t$, its phasor is 1. When $f(t) = \sin \omega t$, its phasor is $-j$. Consider a phasor, $3 + j4$. Write down the time-varying function for the phasor.

4. The impedance (Z) satisfies a relation, $V(\omega) = Z\, I(\omega)$. Using the phasor notation, write down the impedance of the circuit in the Problem#2.

5. Consider the circuit shown below. Two MOSFETs in the circuit have the identical parameters. Even the threshold voltages are assumed to be the same, 0.8 V. When the gate voltage is 1.1 V, what is the output voltage?



6. Assume the low-frequency limit. Write down the impedance seen from the drain terminal. The source and gate are ac-grounded.

7. Assume the low-frequency limit. Write down the impedance seen from the source terminal. The gate and drain are ac-grounded.

8. Assume the low-frequency limit. Write down the impedance seen from the drain terminal. Although the gate is ac-grounded, the drain is connected with a drain resistor , R_D. The other terminal of R_D is ac-grounded.