Electronics classwork 3, 20th January 2005

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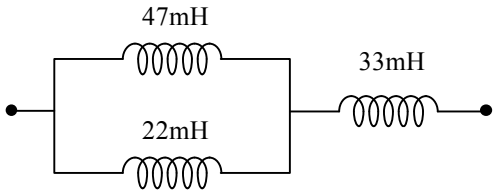
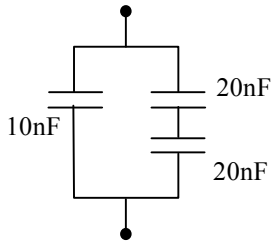
1. Find the single component equivalent of the following networks of capacitors and inductors.

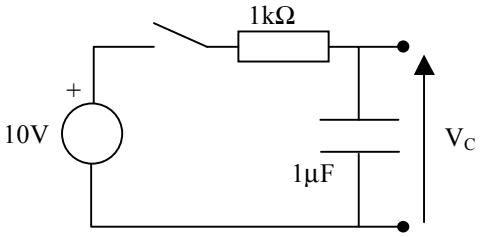


(a)



(b)

2. In the following circuit the 1μF capacitor is initially uncharged and then at time t=0 the switch is closed to connect it across the 10V voltage source via the 1kΩ resistor.



Write down a differential equation governing the voltage on the capacitor. Solve this differential equation to show that the voltage across the capacitor for times t>0 can be written as

$$V_C=V_o(1-\exp[-t/\tau])$$

And find V_o and τ.

Write down expressions for the voltage across the resistor and the current through it.

3. Write down the real current and voltage equivalents of the following complex phasor current and voltage:

(a) $\tilde{I}=I_o \exp[j0]$ operating at an angular frequency of ω

(b) $\tilde{V}=240\sqrt{2} \exp[j\pi/2]$ operating at a frequency 50Hz

Express the following current and voltage in complex phasor form

(c) $V=5.0 \cos(1000\, t + \pi/4)$

(d) $I=7.0 \sin(62.8\times10^6\, t - \pi/6)$

In each case can you identify the amplitude, the frequency, the angular frequency and the phase of the relevant signals.

4. For each of the voltages in Q3 what is the complex impedance of a 1nF capacitor and what current would flow if this voltage were connected across the 1nF capacitor.

5. For each of the currents in Q3 what is the complex impedance of a 1μH inductor and what voltage would result if the current were passed through the 1μH inductor.