Physics 9C-A **Midterm Exam #2** **Winter of 2020**

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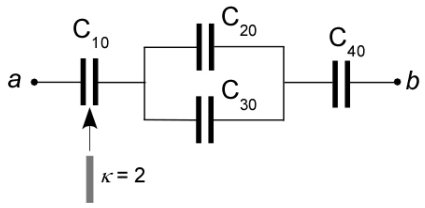
1. Four *air-gapped* capacitors, C_{10} = 10 μF, C_{20} = 5 μF, C_{30} = 15 μF, and C_{40} = 20 μF are connected as shown in the following figure. A battery maintains a potential difference V_{ab} = + 60 V between *a* and *b*. Initially the dielectric slab with $\kappa = 2$ is not inserted in C_{10}.



(a) (**5 points**) Find the equivalent capacitance between *a* and *b*.;

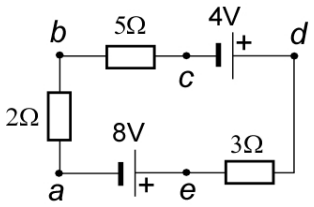
(b) (**10 points**) Find the potential difference across C_{10} and C_{20};

(c) (**10 points**) Find energies stored on C_{20} and C_{30};

(d) (**10 points**) Maintaining the potential difference V_{ab} = + 60 V, insert the dielectric slab with $\kappa = 2$ to *fill* the air-gap in C_{10} and make it C_1. Find the potential drop across C_1 now.

(e) (**Extra 10 points**) For Part (d), before the dielectric slab is inserted, the capacitor network between *a* and *b* is first disconnected from the battery. Now the dielectric slab is inserted in C_{10}. Find the potential drops across C_1 and C_{40}.

2. In the following circuit,

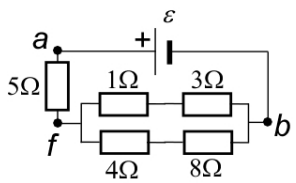


(a) (**10 points**) Find the direction and magnitude of the current in the circuit;

(b) (**5 points**) Find the energy dissipated in the 5Ω resistor;

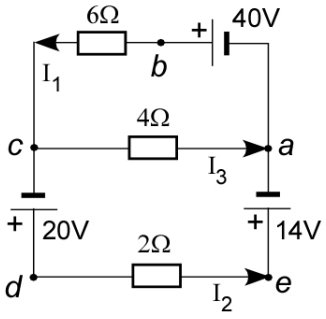
(c) (**5 points**) Find the potential difference $V_{ad} = V_a - V_d$.

3. In the following circuit, ε = +16V,



(a) (**10 points**) Find the network resistance R_{ab};
(b) (**5 points**) Find the potential drop across the 5Ω resistor;
(c) (**10 points**) Find the current and power dissipated in the 8Ω resistor;
(d) (**Extra 5 points**) Explicitly show that the sum of the power dissipated in all five resistors equals to the power dissipated in the network resistor R_{ab}.

4. In the following circuit,



(a) (**15 points**) Find the currents through all three resistors;
(b) (**5 points**) Find the potential difference $V_{bd} = V_b - V_d$.