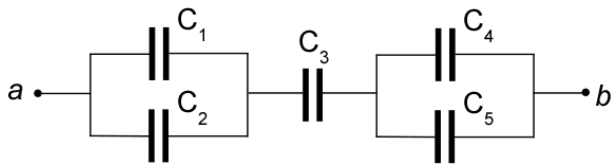
Physics 9C-C **Midterm Exam #2** **Winter of 2021**

---

1. Five capacitors, C_1 = 10 μF, C_2 = 5 μF, C_3 = 15 μF, C_4 = 12 μF, C_5 = 18 μF, are connected as in the figure below. An *emf* device maintains a potential difference V_{ab} = + 10 V between *a* and *b*.



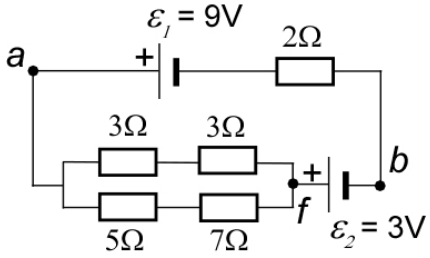
(a) (**10 points**) Find the equivalent capacitance between *a* and *b*;

(b) (**10 points**) Find the potential difference across C_4 and C_5;

(c) (**10 points**) Find energy stored on C_1;

(d) (**5 points**) Find the charge stored on C_2.

2. In the following circuit,

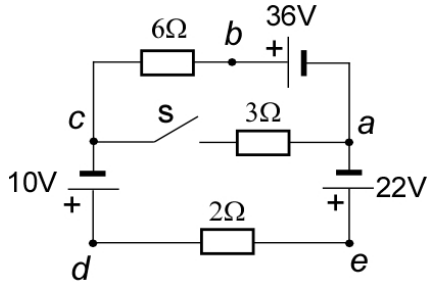


(a) (**10 points**) Find the equivalent resistance between *a* and *f*, R_{af};

(b) (**15 points**) Find the potential drop between *a* and *f*, V_{af};

(c) (**10 points**) Find the current and power dissipated in 7Ω resistor.

3. In the following circuit,



(a) (**10 points**) Find currents through all three resistors when *S* is open;

(b) (**20 points**) Find currents through all three resistors when *S* is closed;

(c) (**10 points**) With *S* being closed, find the potential difference $V_{bd} = V_b - V_d$.
(Hint: *if you do not have the answer from Part (b), show how you will find it in terms of unknown currents through three resistors and known emf values*).

4. (**Optional for extra points**) Two plates of a parallel-plate capacitor have an overlapping area S and are separated by a small distance δ. Plate A has a charge Q and Plate B has a charge - Q. The capacitor is not connected to any emf source.

   (a) (**5 points**) Find the force exerted on Plate A by the charge on Plate B;

   (b) (**5 points**) Hold Plate B still, move Plate A slowly away from Plate B by a distance $d >> \delta$ with an external force. Find the work done by the external force, assuming that $d^2 << S$;

   (c) (**5 points**) Show explicitly that the work done by the external force in Part (b) equals the energy stored in the parallel-plate capacitor now with capacitance $C \approx \varepsilon_0 S/d$, namely, $U = Q^2/2C$.