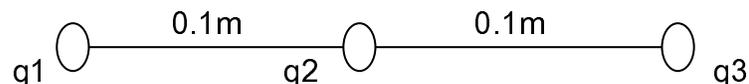


Prof. Adrian Feiguin

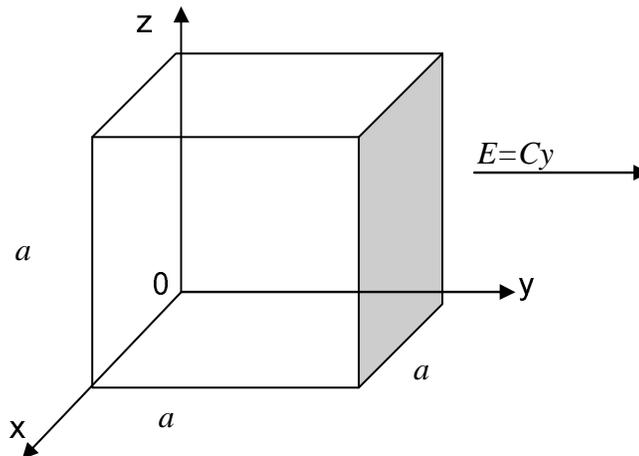
(your name)

Problems: (1 pt. each. You can choose 6 out of 7, or lowest score will be dropped if you complete all of them). USE SI UNITS TO EXPRESS YOUR RESULTS

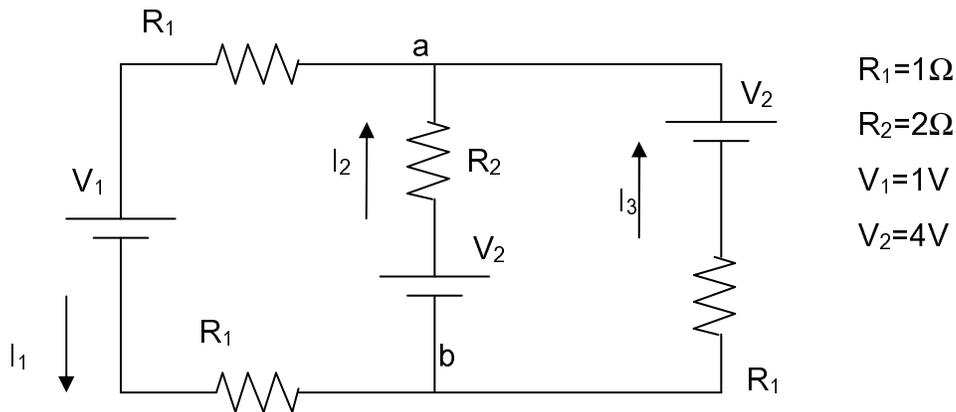
- 1) Three point charges q_1, q_2, q_3 , with $q_2 = -q_1$, and $q_1 = 2 \times 10^{-7} \text{C}$, are arranged equally spaced along a horizontal line, as shown in the figure. Calculate the sign and magnitude of q_3 , such that the resulting force on q_1 is zero.



- 2) Two positive point charges of magnitude $q_1 = 2 \times 10^{-7} \text{C}$ and $q_2 = 3 \times 10^{-7} \text{C}$ are separated by a distance of 0.1m. Calculate the electric field and the electric potential at:
- The midpoint between the charges.
 - A point located at 0.1 m from both charges.
- 3) Consider a close surface shaped as a cube of size a , as shown in the figure. There is an electric field going through the cube along the y -direction that varies linearly as $E = C \cdot y$, where C is some constant. Find the flux through the surface of the cube, and the total charge inside as a function of a and C .



- 4) An insulating, infinitely long cylinder of radius R is uniformly charged with a density ρ . Calculate the expression for the electric field at a distance $r < R$ from the axis of the cylinder.
- 5) A solid sphere of radius $a = 0.2\text{m}$ has a surface charge distribution of σ . The potential difference between the surface of the sphere and a point p at a distance $r = 0.5\text{m}$ from the center of the sphere is $\Delta V = V_{\text{surface}} - V_p = 12.57\text{V}$. Determine the value of σ .
- 6) A parallel plate capacitor has a capacitance of 10^{-6}F . The density of charge on the plates is $\sigma = 10\text{C/m}^2$. The area of the plates is 10^{-6}m^2 .
 - a) What is the potential difference between the plates?
 - b) If the charge remains constant, what will be the potential difference between the plates if the distance between them doubles?
 - c) What amount of work is necessary to double the separation between the plates? Hint: Use conservation of energy
- 7) In the circuit of the figure: Find I_1, I_2 , and I_3 , and voltage difference V_{ab}



BONUS QUESTIONS (optional – 0.2 points each)

- 1) If more electric field lines are leaving a Gaussian surface than entering, what can you say about the charge enclosed by that surface?
- 2) A negative charge moves in the direction parallel to an electric field.
 - a) Does the potential energy of the charge increase or decrease?
 - b) Does it move to a region of higher or lower potential?
- 3) Two identical light bulbs are connected to a battery. Will they be brighter if they are connected in series or in parallel?
- 4) Show that for two resistors connected in parallel, it is always the lowest resistance that dissipates the most power.
- 5) What are the ideal internal resistances of a voltmeter and an ammeter? Do real meters ever attain these values?