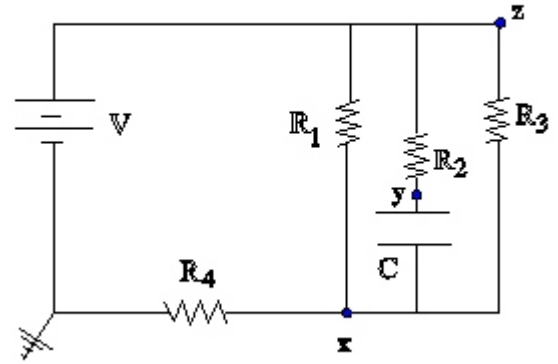


Each problem is worth 10 points.

1. (10 points) Three equal positive charges, q , are held fixed at the corners of a square of side length D . One charge is at each corner so three of the four corners have a fixed charge there. **Find the magnitude of the electric field due to the three charges at the fourth unoccupied corner of the square.**

2. For the circuit shown to the right, let $V = 10$ volts and all resistances are $R = 20$ ohms. Assume the capacitor is fully charged. 2 points a piece. Write down the answer and briefly justify.

2a. Find the electric potential at point y.



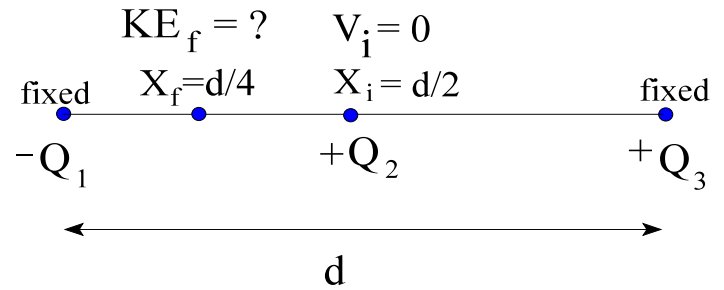
2b. Find the current through R_4 .

2c. Find the electric potential at point x.

2d. Find the current through R_1 .

2e. Find the voltage across the capacitor, C .

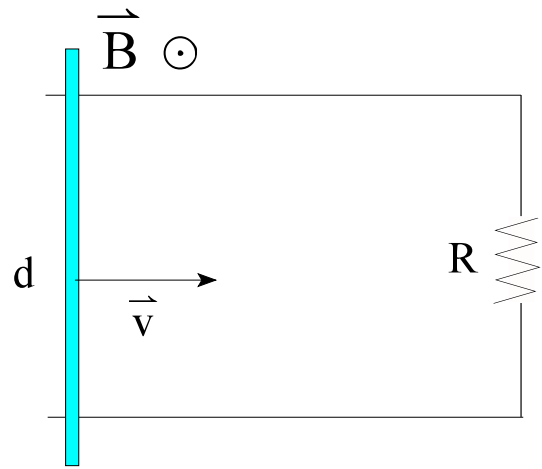
3. Given two fixed charges, $-Q_1$ and $+Q_3$, a distance d apart. Another charge, $+Q_2$, is held at rest in between the other two and then released. That charge speeds up heading towards Q_1 . **What is the kinetic energy of Q_2 when it is $d/4$ from Q_1 ?** Your answer will be in terms of the three charges and d . For full credit, simplify your final answer and let the magnitude of each charge be equal.



4. Name and then briefly describe in words three properties of charge.

5. Three positive charges, Q_1 , Q_2 , and Q_3 are connected by two strings of equal length L . One string is between charges 1 and 2. The other string is between 2 and 3. All three charges connected with the two strings form a straight line. Find the tension force in each string. There is no gravity in this problem.

6. The conducting bar of *connected* length d and mass m is moving with an initial velocity given as v_0 to the right as shown in the diagram. Recall that the motional emf induced in the rod is given by: $\mathcal{E} = Bdv$. Find the distance the rod travels before coming to rest. There is no friction or gravity in this problem.



7. Given the two straight line currents both into the page and separated by a distance a as shown in the diagram. **Find the magnetic force per unit length (magnitude and direction) on a third current, I_3 , pointing out of the paper** at the point indicated.

Let $I_1 = I_2 = I_3$ at the end of your problem for simplicity and recall:

$$B = \frac{\mu_o I}{2\pi r}$$

Your answer should be in terms of I , a and μ_o only.

See that the interior angles of the triangle are 45 degrees

and recall that $\cos 45 = \sin 45 = \frac{\sqrt{2}}{2}$

