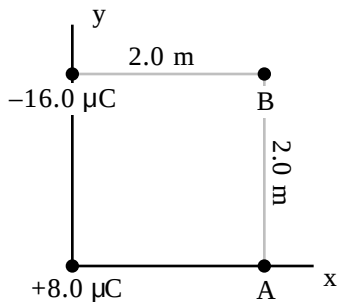
Name _____

Please work the problems on separate sheets of paper and staple this sheet to the front. Read each problem carefully. Show your work and/or give explanations for *all* answers. Make sure that your answers are given with a reasonable number of sig figs and that you have included appropriate units. Check your answers for physical *reasonableness* whenever possible. I do give partial credit, but *only* if I can follow your work, so be as clear as possible about what you are doing.

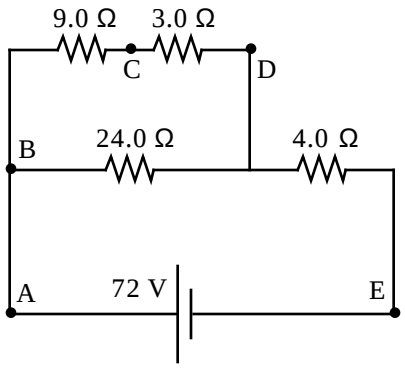
1. [35 pts] Two charges are located at adjacent corners of a square as shown at right.



   a) [5] How much *work* would you need to do to separate the two charges "to infinity"?
   b) [10] What is the *electric field* (magnitude and direction) at corner A?
   c) [5] What *force* (magnitude and direction) would be exerted on a –2.0 μC charge placed at corner A?
   d) [5] Which is at *higher potential*—A or B? (Don't forget to explain!)
   e) [5] What *is* the *potential difference* $V_B - V_A$?
   f) [5] What *charge*, placed at A, would make the total electrostatic energy of the three charges be zero?

2. [30 pts] A capacitor is constructed by taking two flat sheets of metal the *size* of notebook paper (28 cm x 21 cm) and separating them by the *thickness* of a sheet of notebook paper (.10 mm).
   a) [10] What is the *capacitance* of this capacitor?
   b) [5] If a second capacitor was made with the same dimensions but *with* a sheet of notebook paper ($\kappa = 3.3$) between the plates, what would *its* capacitance be?
   c) [10] If the two capacitors were connected in parallel and charged with a 9.0 V battery, how much *total charge* would they store?
   d) [5] The two capacitors in the circuit of part c store energy. For how long a *time* would that amount of energy be able to light a (*very* dim) 1.0 mW light bulb?

3. [35 pts, 5 pts each] Consider the circuit shown at right.



   a) Find the *equivalent resistance* of the resistor network.
   b) Find the *potential difference* between points C and E.
   c) *Which* resistor has the most current flowing in it?
   d) Find the *voltage drop* across the 24 Ω resistor.
   e) How much *power* is the battery delivering?
   f) What would happen to the current through the 4.0 Ω resistor if we reversed the polarity of the battery?
   g) Suppose we insert an 8.0 Ω resistor between points B and D. What is the new *current* through the 4.0 Ω resistor?