Exam 2 – white version

Physics 2760

FS 2008

Last Name_____

First Name_____

ID # _____

Solutions

This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or information other than what is in the official, non-annotated formula sheet.

Signature_____

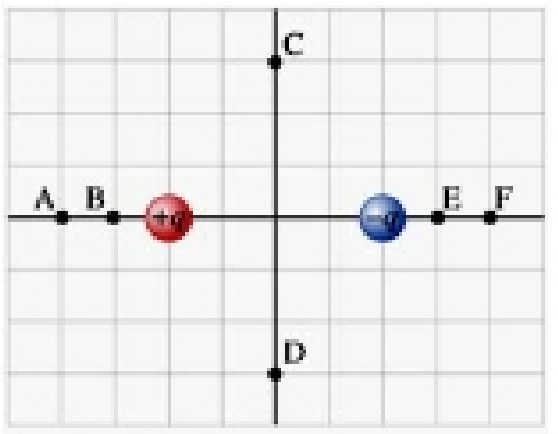
For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

Relax, read carefully, think – and then read everything again.

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

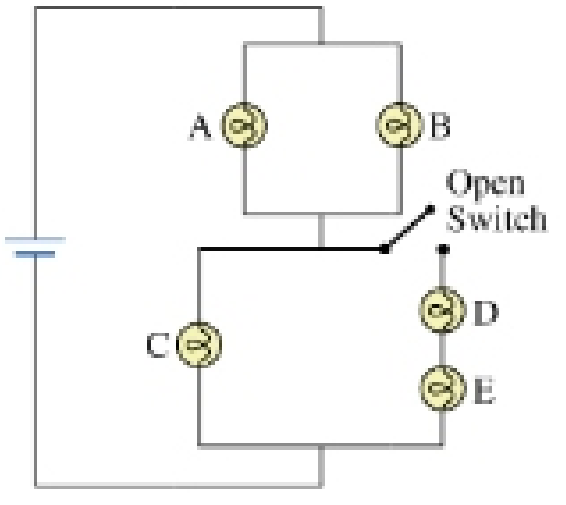
1. (5 points) In the figure below there are two point charges, +q and -q. There are also six positions, labeled A through F, at various distances from the two point charges. Rank the locations A to F on the basis of the electric potential at each point. Rank positive electric potentials as larger than negative electric potentials.



Rank the locations from largest to smallest potential. To rank items as equivalent, write the letters on the same line.

Largest B A C/D F E Smallest

2. (5 points) Consider the circuit below. All light bulbs have the same resistance. When the switch is closed:



a) C is the brightest. A and B have the same brightness and are less bright than C. E and D have the same brightness and are brighter than A and B but less bright than C.
b) C is the brightest. A and B have the same brightness and are brighter than C. E and D have the same brightness and are brighter than A and B.
c) C is the brightest. A and B have the same brightness and are less bright than C. E and D have the same brightness and are less bright than A and B.
d) A and B have the same brightness and are the brightest. E and D have the same brightness and are less bright than A and B. C is less bright than A but brighter than E and D.
e) A and B have the same brightness and are the brightest. C is less bright than A. E and D have the same brightness and are less bright than C.

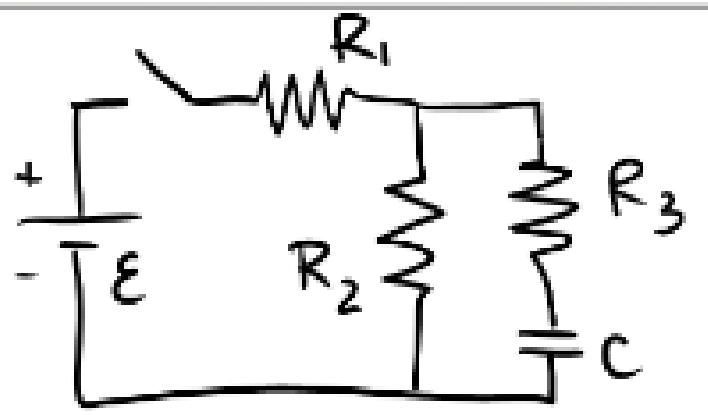
3. (5 points) Consider now that the switch is open. What happens to the brightness of bulb A?
a) It gets dimmer.
b) It gets brighter
c) Nothing happens.

4. For an electron moving in a direction opposite to the electric field
a) its potential energy decreases and its electric potential decreases.
b) both its potential energy and it electric potential remain constant.
c) its potential energy decreases and its electric potential increases.
d) its potential energy increases and its electric potential decreases.
e) its potential energy increases and its electric potential increases.

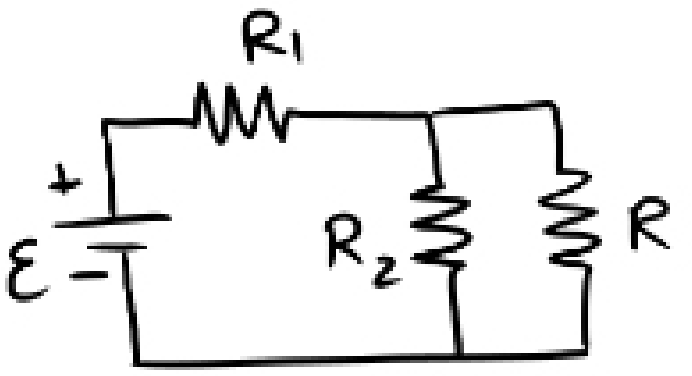
5. (5 points) An equipotential surface must be
a) randomly oriented with respect to the electric field.
b) perpendicular to the electric field at any point.
c) parallel to the electric field at any point.
d) equal to the electric field at any point.

6. (30 points) The capacitor in the figure below is initially uncharged. Consider that switch S is closed at t = 0 s.

$\varepsilon = 19$ V
$R_1 = 3\ \Omega$
$R_2 = 4\ \Omega$
$R_3 = 1\ \Omega$
$C = 2.5\ \mu$F



a) In the space provided below, draw the equivalent circuit for t = 0 s. (3 points)



b) Calculate the equivalent resistance of this circuit (at t = 0 s). (3 points)

$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{4} + \frac{1}{1} = \frac{5}{4} \Rightarrow R_{23} = \frac{4}{5}\ \Omega = 0.8\ \Omega$$

$$R_{eq} = R_1 + R_{23} = 3 + 0.8 \Rightarrow \boxed{R_{eq} = 3.8\ \Omega}$$

c) Immediately after the switch is closed, what is the current through the resistor R_1? (4 points)

$$I_1 = \frac{\varepsilon}{R_{eq}} = \frac{19}{3.8} \Rightarrow \boxed{I_1 = 5\ A}$$

d) Immediately after the switch is closed, what is the voltage across resistor R_1? (3 points)

$$V_1 = I_1 R_1 \Rightarrow V_1 = (5)(3) \Rightarrow \boxed{V_1 = 15\ V}$$

e) Immediately after the switch is closed, what is the current through the resistor R_2? (3 points)

$$I_2 = \frac{V_2}{R_2} = \frac{\varepsilon - V_1}{R_2} \Rightarrow I_2 = \frac{19 - 15}{4} \Rightarrow \boxed{I_2 = 1\ A}$$

e) Immediately after the switch is closed, what is the current through the resistor R_3? (3 points)

$$I_3 = I_1 - I_2 \Rightarrow \boxed{I_3 = 4\ A}$$