PHYS.2B s 1,3 Midterm1 Sol. Fall 15

1. Two charges, +Q and –Q, are located 2 meters apart and there is a point P along the line that is equidistant from the two charges as indicated. Which vector best represents the direction of the electric field E at that point?
   1. Vector Ea
   2. Vector Eb
   3. Vector Ec
   4. The electric field at that point is zero

-Q○ Ea

E(-Q)

P E(due to +Q)

+Q ○

The resultant vector is Ea

For charges +Q and +Q:

+Q○

E

P Eb

E

+Q ○

The resultant is vector Eb

1. In the diagram below, the current in the 3.0Ω resistor is 4.0 A. The potential difference between points A and B is:

2.0Ω 3.0Ω

A ○ ○B

* 1. 0.75V
  2. 0.8V
  3. 1.25V
  4. 12V
  5. **20V**

The current is the same for the resistors in series.

VAB=I\*Req=I\*(3.0+2.0)Ω=20V

1. In the circuit below, the charge on the capacitor C2 is Q2=16μC. What is the charge Q1 on the capacitor C1?

C1 C2

12V

**Q1=Q2=12μC** (series connection of capacitors)

1. The equipotential surfaces associated with an isolated point charge are:
   1. Radially outward from the charge
   2. **Concentric spheres centered at the charge**
   3. Vertical planes
   4. Horizontal planes
   5. Concentric cylinders with the charge on the axis
2. An electric toaster requires 1300W at 110V. What is the resistance of the heating coil?
   1. 7.5Ω
   2. **9.3Ω**

c. 10.0Ω

d. 11.0Ω

P=V2/R

R= V2/P=(110V)2/1300W=9.3Ohm

Part 2

1. Charges q1=+8 μC, q2=-8 μC, and q3=+2μC are placed at the vertices of an equilateral triangle with the side a=0.5m. as shown. Find the total force exerted on the charge q3. Draw the vectors of the forces F13, F23, and the resultant force.

F13y F13 F23x

F13x Fnet

q3 ○ Fnet

F23x F13x

F23y

F23

q1○ 0.5m ○q2

F13=F23= kq1q3/r2=9.0\*109 Nm2/C2\*(8\*10-6C\*2\*10-12C)/(0.5m)2=0.58N

F13x=F23x= F13\*cos60o=0.87N

F13y=-F13\*sin60o

F23y=+F13\*sin60o

F13y+ F23y=0

Fnet=058N (along positive x-axis)

If all charges are positive, the net vector of the force is in positive y-direction:

Fnet

F23 F13

q3 ○

=

q1 ○ ○q2

2. In the circuit below:

a. What is the equivalent capacitance of the combination shown (Vab=80V) ?

b. What is the voltage drop across capacitor C1?

a C1=20μF C2=12μF C3=24 μF b

○ ○

C4=12 μF

a. C2 and C3 are connected in series: C23=(1/C2+1/C3)-1=8.0 μF

C23 and C4 are in parallel: C234=(8+12) μF=20 μF

C1and C234 are in series: Ceq=(1/20+1/20)-1 μF=**10 μF**

b. Q on C1 equals Q on C234 and is the same as on Ceq: Q=Ceq\*V=10 μF\*80V=800 μC

V across C1=Q/C1=800 μC/20 μF=**40V**

**3**. How long is a wire made from 200cm3 of copper if the resistance is 8.5Ohms? The resistivity of copper is 1.7\*10-5Ω\*m

R=ρ\*L/A

1cm3=(10-2m)3=10-6m3

V(volume)=A\*L=200cm3\*10-6m3/cm3=2\*10-4m3

R= ρ\*L/(V/L)= ρ\*L2 /V

L=√R\*V/ρ=√8.5Ohms\*2\*10-4m3/1.7\*10-5Ω\*m=10m

The electric potential at a certain point in space is -20V. What is the electric potential energy of a -6.0 μC charge placed at this point?

* 1. 12μJ
  2. -12μJ
  3. 36μJ
  4. -36μJ
  5. **120μJ**
  6. -120μJ

U=q\*V=-6.0 μC\*-20V=120μJ