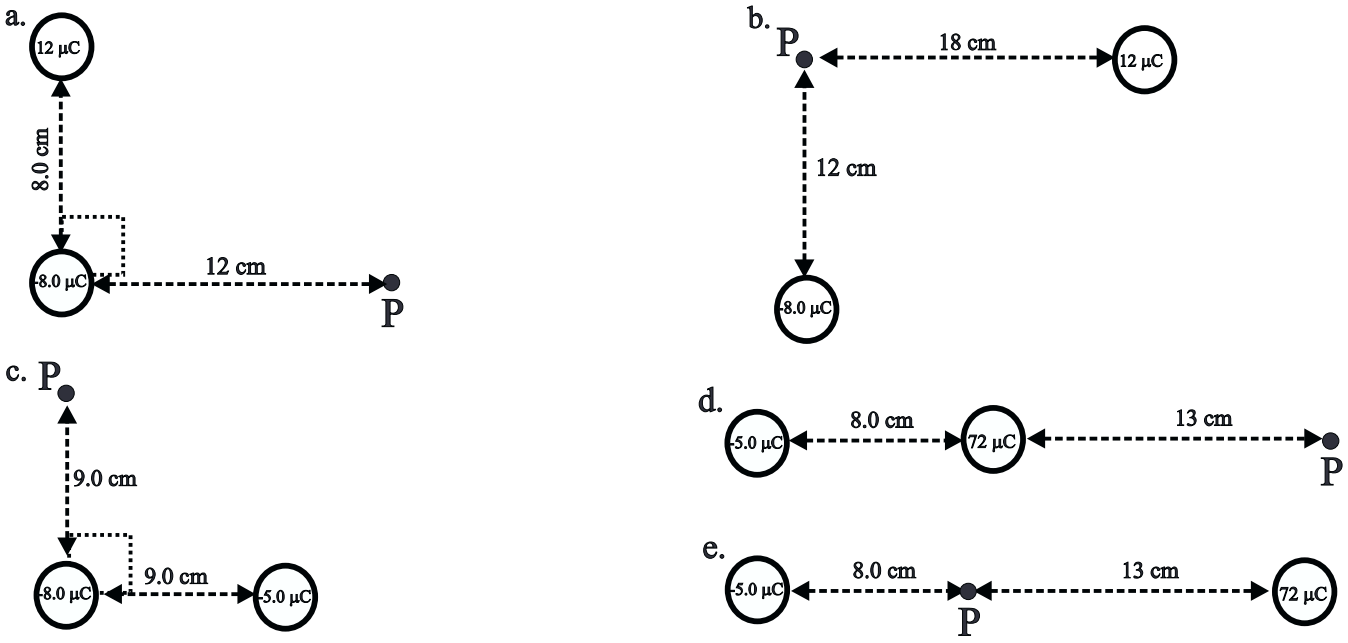
PHYSICS HOMEWORK #145 ELECTROSTATIC POTENTIAL
ELECTROSTATIC POTENTIAL ENERGY

6. What will be the electrostatic potential of a point **P** which is both 12.0 cm from a 25.0 μC charge and 6.0 cm from a 50 μC charge?

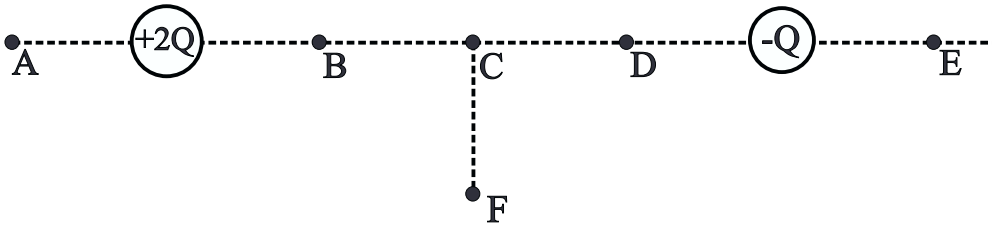
7. Determine the **electrostatic potential** at point **P** in each of the following diagrams.



8. Suppose that in each diagram above a 7.00 μC charge is to be moved from **infinity** to point **X**. In each case above, determine how much **work** would be required to place the 7.00 μC charge at point **X**.

9. What will be the **electrostatic potential energy** of each set of charges above? [including the 7.0 μC charge!]

10. Each of the following questions refers to the diagram below.



a. At which point in the above diagram will the **electric field strength** be the **greatest**?
b. At which point in the above diagram will the **electrostatic potential** be the **greatest**?
c. At which point in the above diagram will the **electric field strength** be the **weakest**?
d. At which point in the above diagram will the **electrostatic potential** be the **least**?

ANSWERS TO THE OPPOSITE SIDE: 1a. 37.5 μF b. 2700 μC 2. 16 μF 3. 1260 μC 4. 30,000 μC
5. 0.015 μF 6. 0.22 μF 7. 20.3 μF 8. 238 m^2 9. 400 μF 10. 155 μF 11. 500 μF 12. 0.030 J
13. 14.4 J 14. 144 Volts 15. 161 μF

PHYSICS HOMEWORK #146 ELECTROSTATIC POTENTIAL
CAPACITORS & CAPACITANCE

$$C = \frac{q}{V} = \frac{\varepsilon \cdot A}{d} \qquad \varepsilon = \varepsilon_o \cdot K \qquad \varepsilon_o = 8.85 \cdot 10^{-12} \cdot \frac{Farad}{m}$$

1. A given capacitor is rated to store 450 μC of charge whenever a potential difference of 12.0 Volts is applied.
   a. What is the capacitance of this capacitor?
   b. How much charge will this capacitor store when a potential difference of 72.0 Volts is applied?

2. What is the capacitance of capacitor which can store 720 μC of charge whenever a potential difference of 45.0 Volts is applied?

3. How much charge can be stored in a capacitor rated at 210 μF, if a potential difference of 6.00 Volts is applied?

4. How much charge can be stored in a 2000 μF capacitor when a potential difference of 15.0 Volts is applied?

5. A parallel plate capacitor is made of two parallel plates, each of which has an area of 2.0 m^2, and which are separated by 1.20 mm of air. What is the capacitance of this capacitor?

6. What will be the capacitance of a parallel plate capacitor which is made from two parallel plates, each with an area of 3.5 m^2, which are separated by 0.85 mm of mica ?

DIELECTRIC MATERIAL	DIELECTRIC CONSTANT K
AIR	1.0
PARAFFIN	2.2
POLYETHYLENE	2.3
POLYSTYRENE	2.5
HARD RUBBER	2.8
MICA	6.0
GLASS	8.0

7. What will be the capacitance of a parallel plate capacitor consisting of two two parallel plates, each of which has an area of 13.3 m^2, which are separated by 0.0145 mm of polystyrene?

8. A parallel plate capacitor is to be made from two conducting plates separated by 0.022 m of polyethylene. This capacitor is to have a total capacitance of 220 μF. What should the area of each plate of this capacitor be?

9. What will be the total capacitance if a 250 μF capacitor is connected in parallel with a 150 μF capacitor?

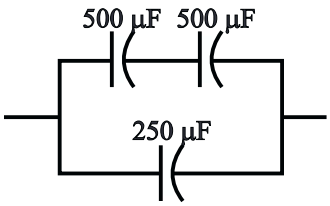
10. What will be the total capacitance if a 240 μF capacitor is connected in series with a 440 μF capacitor?

Series
$$\frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C_t}$$

Parallel
$$C_1 + C_2 = C_t$$

Energy
$$U = \tfrac{1}{2} \cdot C \cdot V^2$$

11. What will be the total capacitance if two 500 μF capacitors are connected is series with each other but which are connected in parallel with a 250 μF capacitor? See diagram at the right!



12. How much energy will be stored in a 420 μF capacitor to which a potential difference of V = 12.0 Volts has been applied?

13. How much energy would be stored in a 2000 μF capacitor attached to a 120 Volt power supply?

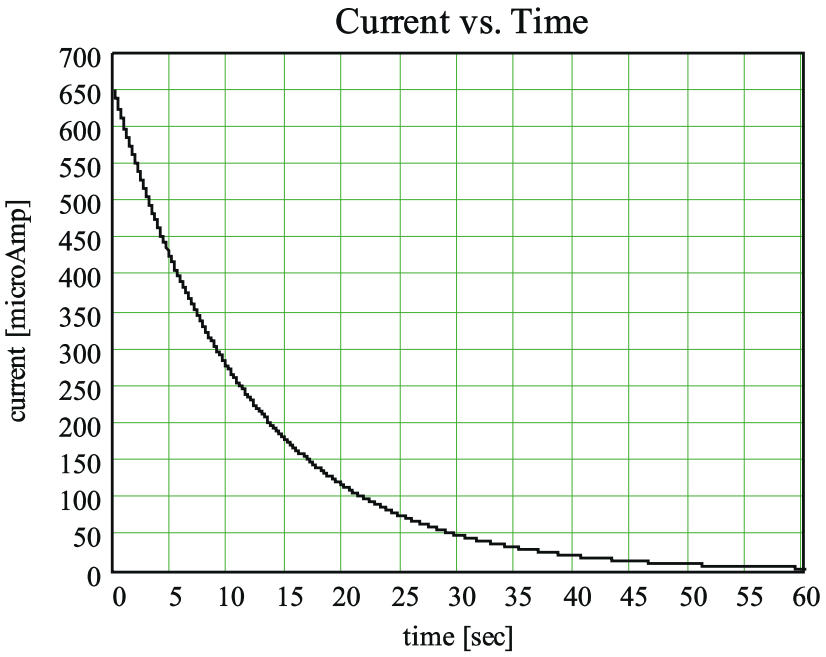
14. A capacitor is rated at 1200 μF. What potential difference should be applied to this capacitor so that the energy stored in this capacitor is 12.4 Joules?

15. What will be the total capacitance if a 350 μF, a 520 μF and a 700 μF capacitor are all connected in series?

Answers to opposite side: 6. 9,400,000 Volts 7a. 1.5 x 10^5 Volts b. 0.0 Volts c. -1.15 x 10^6 Volts d. 4.77 x 10^6 Volts 7e. 4.42 x 10^6 Volts 8a. 1.05 J b. 0.0 J c. -8.08 J d. 33.4 J e. 30.9 J 9a. -9.75 J b. -3.99 J c. -4.08 J 9d. -7.10 J e. 15.5 J 10a. B b. A c. E d. E

PHYSICS HOMEWORK #147 ELECTROSTATIC POTENTIAL
DISCHARGING CAPACITORS

16. A capacitor with a capacitance C is attached to a power supply which has a potential V and is then fully charged. This capacitor is then attached to a simple series circuit consisting of a galvanometer and a 13,000 Ω resistor. The graph to the right represents the current flowing out of this capacitor as a function of time through the galvanometer.
    a. What was the initial current flowing out of the capacitor?
    b. What was the initial voltage across the capacitor?
    c. What is the time constant for this circuit?
    d. Write an equation describing the current flowing out of this circuit as a function of time?
    e. Using the equation derived in d above predict the current flowing out of this capacitor after t = 30 seconds and compare to the value on the graph.
    f. What was the total charge contained in this capacitor?
    g. What is the capacitance of this capacitor?
    h. How much charge will be stored in this capacitor after t = 20 seconds?
    i. What will be the current flowing out of this capacitor after t = 85 seconds?



17. A capacitor, which has a capacitance of 470 μF, is attached to a 6.00 Volt battery and is fully charged. This capacitor is then removed from the battery and is attached in series to a 1500 Ω resistor.
    a. What is the time constant for this circuit?
    b. What will be the total charge stored in this capacitor?
    c. What will be the initial current flowing through this circuit?
    d. What will be the current flowing through this circuit after 1.5 seconds?
    e. How long will it take for the current flowing in this circuit to fall to 1% of its initial value?

18. A 220 μF capacitor is charged up by a 12.0 Volt battery.
    a. What will be the charge stored on this capacitor after being charged up?
    This capacitor is then attached to a second capacitor, which is initially uncharged and has a capacitance of 470 μF.
    b. What will be the total charge stored on both of these capacitors after being attached together?
    c. What will be the charge stored on each of these capacitors after being attached together?
    d. What will be the potential difference across each of the these capacitors after being attached together?

ANSWERS TO THE OPPOSITE SIDE:
19a.. 5000 μC, 19,800 μC b. 24,800 μC c. 7750 μC, 17,050 μC d. 7.75 Volts e. 14,800 μC f. 4625 μC, 19f. 10,175 μC g. 4.625 Volts 20a. 3300 μC, 24,750 μC b. 28,050 μC c. 7010 μC, 21,040 μC 20d. 12.75 Volts e. 21,450 μC f. 5360 μC, 16,100 μC g. 9.75 Volts 21a. 2.30 μF b. 27.6 μC c. 166 μJ 21d. 13.8 μF e. 166 μC f. 994 μJ g. 828 μJ 22. 48.0 C