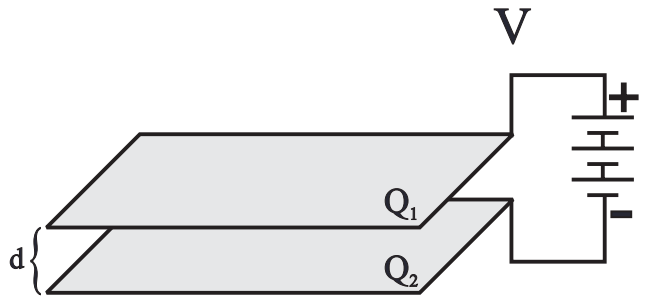


[Unless stated otherwise assume that absolute potential is zero at infinity!]

$$\Delta V = \int_b^a E \cdot dl$$

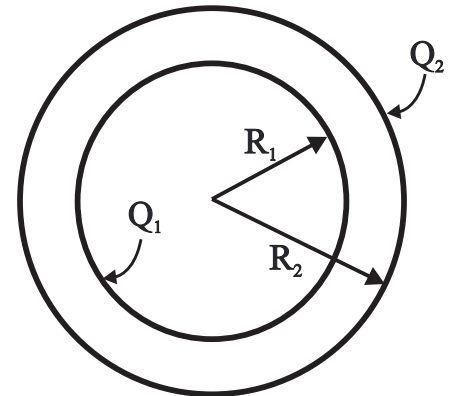
1. Consider two horizontal, parallel plates, each with an area of 3.00 m^2 , separated by a distance of $d = 3.50 \text{ cm}$. These two plates are connected to a battery and, as a result, the upper plate gains a charge of $Q_1 = 12.0 \text{ } \mu\text{C}$ and the lower plate gains a charge of $Q_2 = -12.0 \text{ } \mu\text{C}$.

- What will be the strength of the electric field in the area between these two plates?
- What will be the strength of the electric field in the area outside of these two plates?
- What will be the potential difference between these two plates?
- How much work would be done on an electron in moving it from the positive plate to the negative plate?
- Suppose that this electron is then released and is allowed to accelerate back to the positive plate, what will be the velocity of the electron just as it reaches the positive plate?



2. Consider two concentric, conducting spherical shells with radii of $R_1 = 4.00 \text{ cm}$ and $R_2 = 6.00 \text{ cm}$ as shown in the diagram to the right. The inner shell contains a charge of $Q_1 = -6.00 \text{ } \mu\text{C}$ and the outer shell contains a charge of $Q_2 = +12.0 \text{ } \mu\text{C}$.

- What will be the electrostatic potential of the the outer shell?
- What will be the potential difference between the inner shell and the outer shell?
- What will be the electrostatic potential of the inner shell?
- What will be the electrostatic potential at the center of these two shells?
- How much work must be done to transfer a single electron from the inner shell to the outer shell?
- How much work would be required to bring a proton from infinity to the outer shell?



Suppose that the radius of the outer shell increases until R_2 becomes 9.00 cm .

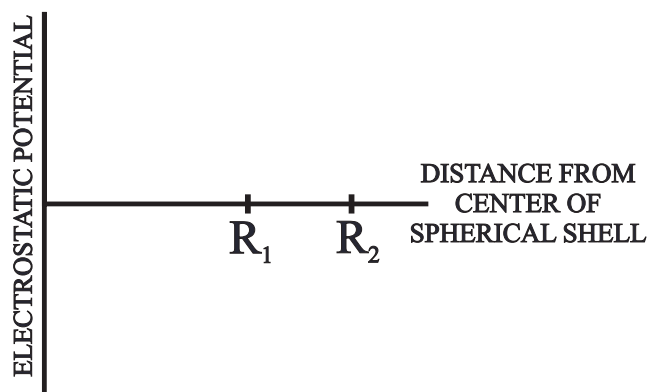
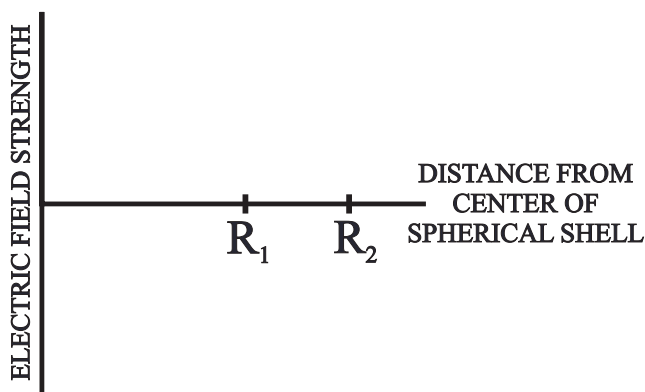
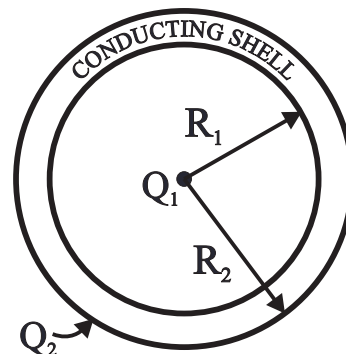
- What will be the potentials of the outer and inner shells?
- What will be the new potential difference between these two shells?

3. Consider two concentric, conducting cylindrical shells which have radii of $R_1 = 4.00 \text{ cm}$ and $R_2 = 6.00 \text{ cm}$ and are $L = 35.0 \text{ m}$ long [same diagram as above]. The inner shell contains a charge of $Q_1 = -12.0 \text{ } \mu\text{C}$ and the outer shell contains a charge of $Q_2 = +12.0 \text{ } \mu\text{C}$.

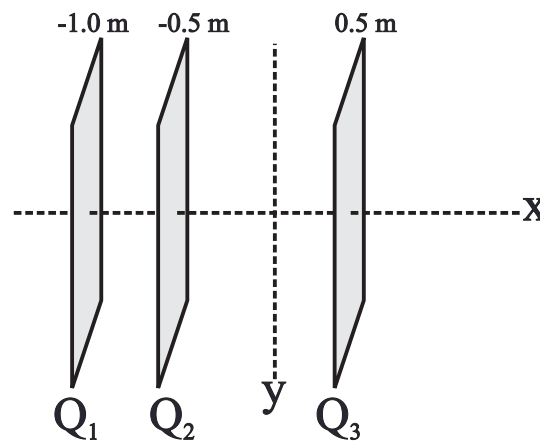
- What will be the electrostatic potential of the the outer shell?
- What will be the potential difference between the outer shell and the inner shell?
- What will be the electrostatic potential of the inner shell?
- What will be the electrostatic potential at the center of these two shells?
- How much work must be done to transfer a single electron from the outer shell to the inner shell?
- How much work would be required to bring a proton from infinity to the outer shell?

Answers to opposite side: 4a. $1.20 \times 10^6 \text{ Volts}$ b. zero c. $1.20 \times 10^6 \text{ Volts}$ d. $-3.43 \times 10^6 \text{ Volts}$ 4e. infinity
4h. 0.027 m 5a. [L to R] $-5.65 \times 10^4 \text{ N/C}$, $1.70 \times 10^5 \text{ N/C}$, $-5.65 \times 10^4 \text{ N/C}$, $5.65 \times 10^4 \text{ N/C}$ 5b. [L to R] $5.65 \times 10^4 \text{ Volts}$,
 $5b. -2.83 \times 10^4 \text{ Volts}$, $2.83 \times 10^4 \text{ Volts}$ c. $8.48 \times 10^4 \text{ Volts}$ d. $2.83 \times 10^4 \text{ Volts}$ e. $4.52 \times 10^{-15} \text{ J}$

4. Consider a conducting spherical conducting shell, which has an inner radius of $R_1 = 7.00$ cm, an outer radius of $R_2 = 9.00$ cm and contains a charge of $Q_2 = +18.0 \mu\text{C}$. This shell, in turn, encloses a point charge of $Q_1 = -6.00 \mu\text{C}$ located at its center as shown in the diagram at the right.
- What will be the electrostatic potential of the outside of the conducting shell?
 - What will be the potential difference between the inside of the conducting shell and the outside of the conducting shell?
 - What will be the electrostatic potential on the inside of the conducting shell?
 - What will be the electrostatic potential at a point 1.0 cm from the central charge?
 - What will be the electrostatic potential at the location of Q_1 ?
 - On the graph below sketch the electric field strength as a function of distance from Q_1 .
 - On the graph below sketch the electrostatic potential as a function of distance from Q_1 .
 - Where, other than infinity, will the absolute potential be zero?

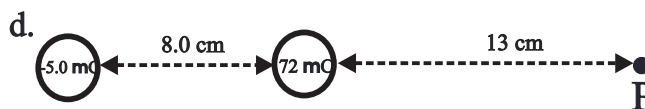
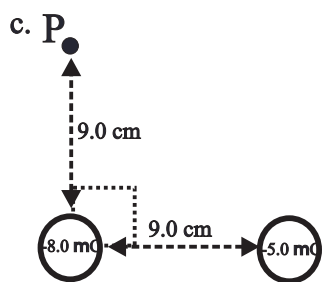
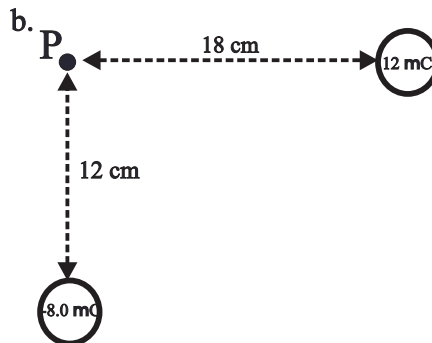
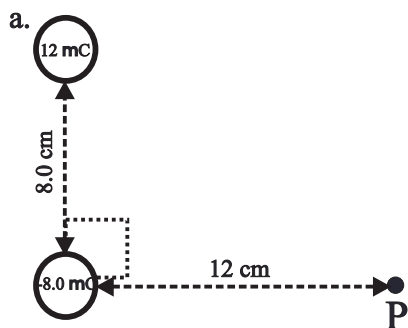


5. Consider three, vertical, parallel, conducting plates as shown to the right. Each plate has an area of 3.00 m^2 . The first plate contains a charge of $Q_1 = +6.00 \mu\text{C}$ and is located at $x = -1.00$ m. The second plate contains a charge of $Q_2 = -6.00 \mu\text{C}$ and is located at $x = -0.50$ m. The third plate contains a charge of $Q_3 = +3.00 \mu\text{C}$ and is located at $x = 0.500$ m. Assume that the absolute electrostatic potential is zero at the origin.
- Determine the electric field everywhere.
 - What will be the electrostatic potential of each plate?
 - What will be the potential difference between plate #1 and plate #2?
 - What will be the potential difference between plate #1 and plate #3?
 - How much work would be required to move a proton from plate #1 to plate #3?

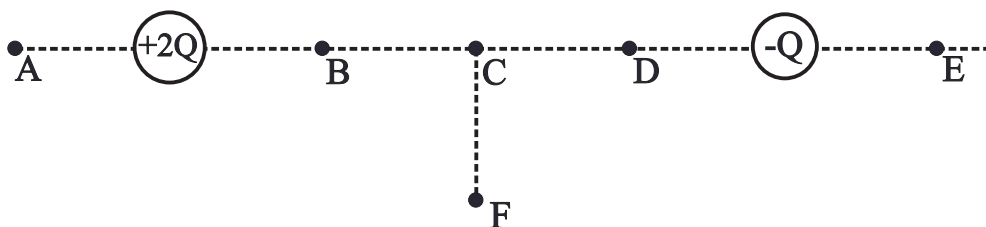


Answers to opposite side #105: 1a. $4.50 \times 10^5 \text{ N/C}$ b. zero c. 15,800 Volts d. $2.50 \times 10^{-15} \text{ J}$ e. $7.50 \times 10^7 \text{ m/s}$
 2a. 900,000 Volts b. -450,000 Volts 2c. 450,000 Volts d. 450,000 Volts e. $-7.2 \times 10^{-14} \text{ J}$ f. $1.44 \times 10^{-13} \text{ J}$
 2g. 600,000 Volts h. 750,000 Volts 3a. zero b. -2500 Volts c. -2500 Volts d. -2500 Volts e. $4.0 \times 10^{-16} \text{ J}$

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									