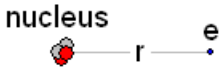
Physics II

Electric Potential

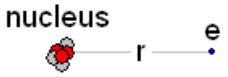
$V = \frac{Work_{test}}{q_{test}}$ Definition of electric potential.

$V = k\frac{Q}{d}$ Electric potential for a point charge.

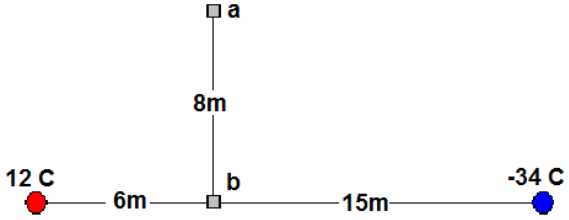
Problem 1.- Calculate the electric potential energy of an electron in a He^{+} ion. Consider the distance between the nucleus and the electron to be $r = 0.264\times10^{-10}$ m and
Charge of the nucleus 3.2×10^{-19} C
Charge of the electron -1.6×10^{-19} C



Problem 1a.- Calculate the electric potential energy of an electron in a Li^{++} ion. Consider the distance between the nucleus and the electron to be $r = 0.176\times10^{-10}$ m and:
The charge of the nucleus is 4.8×10^{-19} C
The charge of the electron is -1.6×10^{-19} C

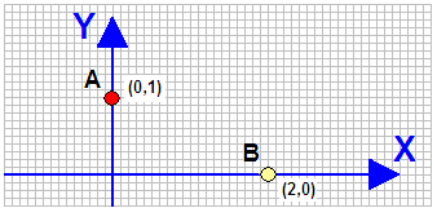


Problem 2.- How much work is required to move a test charge q = 1μC from point a to point b?



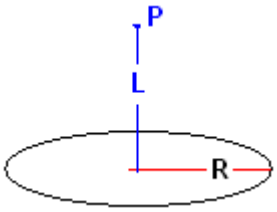
Problem 3.- An 18μC charge is placed 1.2 m from an identical 18μC charge. Calculate the electric field and the electric potential at the point midway between them.

Problem 4.- Determine the electric potential at the origin due to the charges located at A and B. Consider the coordinates given in meters and charge $q_A = -2\mu C$ and $q_B = -1\mu C$.

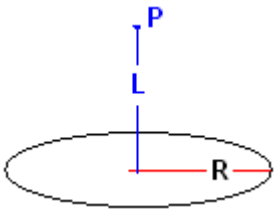


Problem 5.- An alpha particle, which is a helium nucleus with $mass = 6.64\times10^{-27}\,kg$, is emitted in a radioactive decay with kinetic energy $KE = 7.8\times10^{6}\,eV$. Calculate its speed.

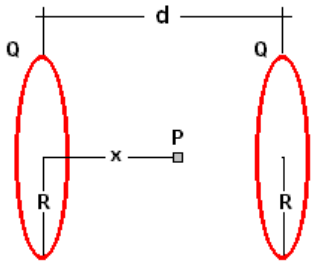
Problem 6.- Calculate the electric potential due to a uniform ring of radius R=1.2m that has a total charge of 32μC at a point *P* on the symmetry axis and a distance L=1.6m from the center of the ring.



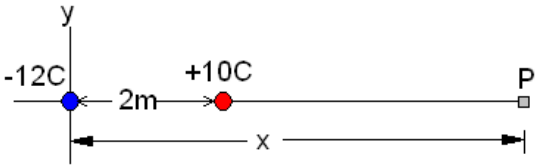
Problem 6a.- Calculate the electric potential due to a disk of radius R=1.2m that has a total charge of 32μC, uniformly distributed on its surface, at a point P on the symmetry axis at a distance L=1.6m from the center of the disk.



Problem 6b.- Each of the rings shown in the figure has uniform charge Q and radius R. Determine the electric potential at P, which is located on the axis of the rings a distance x from the center of the left ring.



Problem 7.- Find the point *P* on the x-axis on the right side of the positive charge where the electric potential is zero:

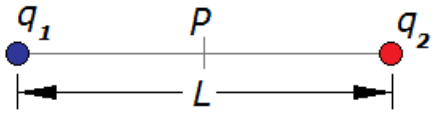


Problem 8.- Calculate the potential energy of an alpha particle separated a distance 2.5×10^{-10} m from an aluminum nucleus. The charge of an alpha particle is 3.2×10^{-19} C and the one of an aluminum nucleus is 20.8×10^{-19} C.

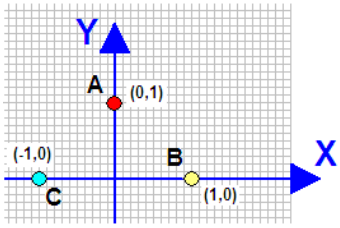
Problem 8a.- How much energy is necessary to put an alpha particle and a sodium nucleus 0.529×10^{-10} m apart?
The charge of an alpha particle is 3.2×10^{-19} C
The charge of a sodium nucleus is 17.6×10^{-19} C

Problem 9.- A sphere of radius R_1 has charge Q and another sphere of radius R_2 is initially uncharged. Then, they are connected through a wire, so charge flows from the first sphere to the second until the potentials are equilibrated. Calculate the charge on each sphere after reaching equilibrium.

Problem 10.- Determine the value of the electric potential at a point *P* midway between a charge q_1=-16μC and another q_2=+11.2μC that are at a distance *L*=10cm apart.



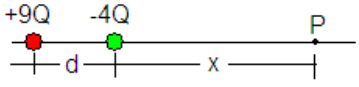
Problem 11.- Determine the electric potential at the origin of coordinates due to the charges located at position A, B and C. Consider the coordinates given in meters and charge of q_A=-2μC, q_B=-1μC and q_C=1μC.



Problem 12.- A free 81μC charge is placed 1.8 mm from an identical, but fixed in space, 81μC charge. The free charge accelerates due to electric repulsion. Calculate the speed of the free charge when it is very far away if its initial velocity was zero and its mass is 2.5g

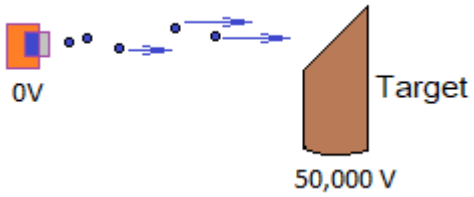
Problem 13.- Given the two charges shown in the figure:

a) At what position *x* is the electric field zero?
b) At what position *x* is the electric potential zero?
c) Find the position between the two charges where the electric potential is zero.



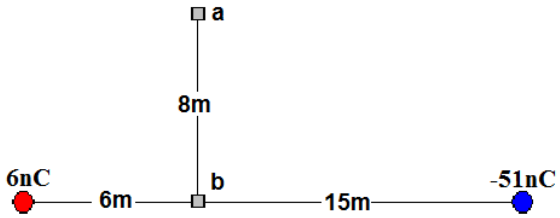
Problem 14.- If a positively charged particle enters a region of uniform electric field which is perpendicular to the particle's initial velocity, will the kinetic energy of the particle increase, decrease or stay the same? Why?

Problem 15.- In an X ray machine for dentists, electrons are accelerated from a potential at zero to a maximum of 50kV. These electrons hit a target (made of copper, for example) and generate X rays. Calculate the speed of the electrons just before hitting the target.
The charge of an electron is -1.6×10^{-19} C
The mass of an electron is 9.1×10^{-31} kg

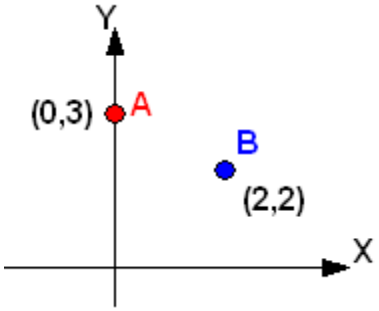


Problem 15a.- In analytical chemistry there are instruments known as HPLC that use a mass spectrometer where electrons (mass 9.1×10^{-31}kg, charge 1.6×10^{-19}C) are accelerated to 70V to ionize molecules. Calculate the speed of these electrons.

Problem 16.- In the figure we see two charges of +6nC and -51nC fixed in the indicated positions. Considering infinite is the reference for the electric potential (V=0), calculate:
a) Voltage at "a"
b) Voltage at "b"
c) The external work needed to move a charge of -3nC from "a" to "b"



Problem 17.- In this charge distribution, find the electric potential at the origin of coordinates.



Problem 18.- Determine the electric potential at the origin of coordinates due to the charges located at A, B and C. Consider the coordinates given in meters and charges Q_A=4μC, Q_B=4μC and Q_C=5μC.