United International **University**

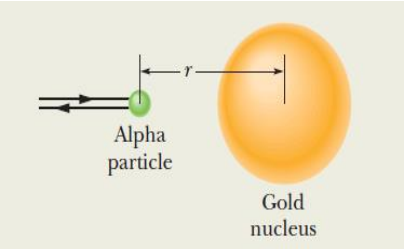
School of Science and Engineering

Assignment-2; Year 2020; Trimester: Fall

Course: PHY 105; Title: Physics, Section: A

Electric Potential

1. Fair weather atmospheric electricity 100 N/C is acting downward 100 km high in the ionosphere. What is the ionosphere voltage required?
2. An alpha particle (two protons, two neutrons) moves into a stationary gold atom (79 protons, 118 neutrons), passing through the electron region that surrounds the gold nucleus like a shell and headed directly toward the nucleus (Fig. below). The alpha particle slows until it momentarily stops when its center is at radial distance r =9.23 fm from the nuclear center. Then it moves back along its incoming path. **What was the kinetic energy *Ki* of the alpha particle when it was initially far away**? Assume that the only force acting between the alpha particle and the gold nucleus is the (electrostatic) Coulomb force and treat each as a single charged particle.



3. In Fig-1, 12 electrons (of charge -e) are equally spaced and fixed around a circle of radius R. Imagine the radius is 13 pm. Relative to V= 0 at infinity, (a) what are the electric potential and electric field at the center C of the circle (imagine an uniform electric field) due to these electrons? (b) The electrons are moved along the circle until they are non-uniformly spaced over a 120 degree arc (Fig-2). At C, find the electric potential and describe the electric field.

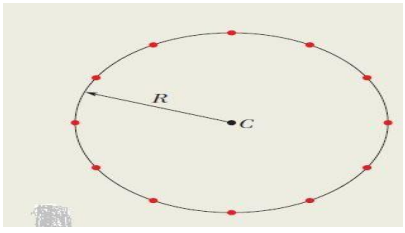


Fig-1

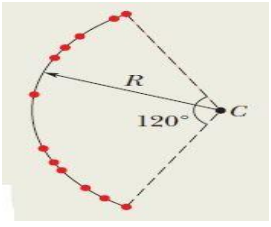
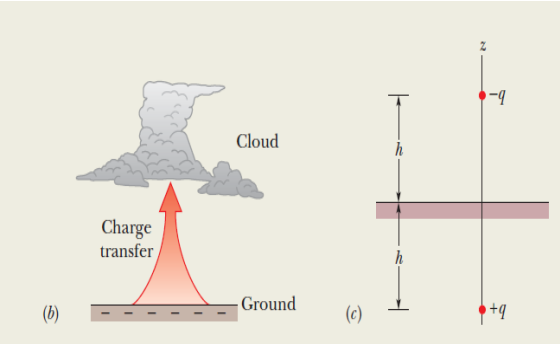


Fig-2

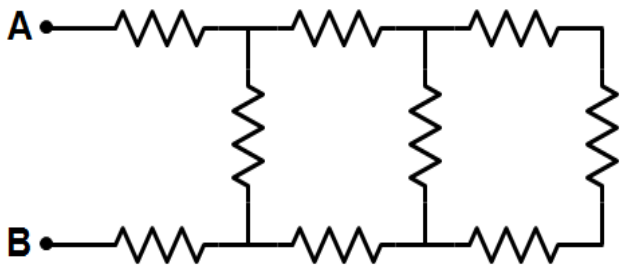
4. Sprites are huge flashes that occur far above a large thunderstorm. Lightning transfers a huge amount of negative charge $-q$ from the ground to the base of the clouds (Fig-b). Just after such a transfer, the ground has a complicated distribution of positive charge. The electric field due to the charges in the clouds and the ground by assuming a vertical electric dipole that has charge $-q$ at cloud height h and charge $+q$ at below-ground depth h (Fig-c). If q=200C and h=60 km, (i) What is the magnitude of the diploe's electric field at altitude z_1=30 km somewhat above the clouds? (ii) What is the magnitude of the diploe's electric field at altitude z_2=60 km somewhat above the stratosphere?



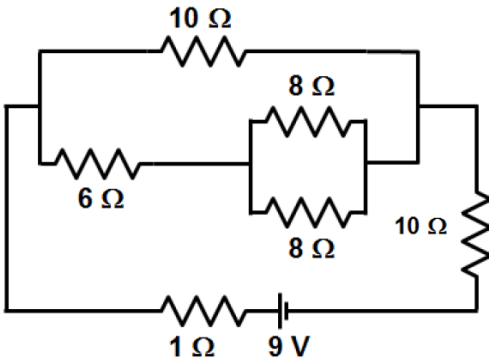
5. Hydrogen sulfide (H_2S) is a molecule that has a permanent dipole moment with dipole charge $q=|\pm 18e|$. The dipole distance of H_2S molecule is 1.12 pm. What is the dipole moment?
6. A Sodium (mass *23g*, charge +11*e*) atom and an alpha particle (mass 4g, charge +2*e*) approach one another with the same initial speed $v=10^6$ m/s from an initially large distance. How close will these two particles get to one another before turning around? **[**Given, $k=8.99\times10^9$ Nm^2C^{-2} and $q_e= 1.6\times10^{-19}$ Coulomb**]**

Current, Resistance, & EMF:

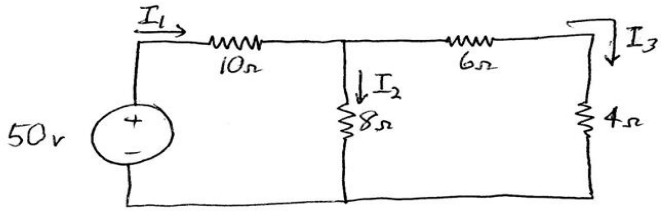
7. A 65.0-Ω resistor is connected to the terminals of a battery whose emf is 12.0 V and whose internal resistance is 0.5 Ω. Calculate (a) the current in the circuit, (b) the terminal voltage of the battery, Vab, and (c) the power dissipated in the resistor R and in the battery's internal resistance r.
8. A copper wire 3.2 mm in diameter carries a 5.0 A current. The conduction electron density in copper is 8.49×10^{28} electrons/m^3. Determine (a) the current density in the wire, and (b) the drift velocity of the free electrons. (c) Estimate the rms speed of electrons assuming they behave like an ideal gas at 20°C. Assume that one electron per Cu atom is free to move (the others remain bound to the atom).
9. Calculate the equivalent resistance of the resistor "ladder" shown. All resistors have same resistance R.



10. For the circuit below, calculate the current drawn from the battery and the current in the 6Ω resistor.



11. Find the voltage and current using KVL and KCL.



12. Determine the (i) nominal value, tolerance, and maximum-minimum resistance value of following resistor, and (ii) color code of a resistor with nominal value of 1.5KΩ and a tolerance of ±5%.