Problem Set 4
Due: 9/29/09, Tuesday

Chapter 24: Electric Potential
Exercises & Problems: 7, 13, 17, 35, 43, 55, 58, 111

Chapter 24 Even Answers
reversed, 1.0 × 10^7 m/s;

Question A
When dealing with practical devices, we often take ground (the Earth) to be 0 V. (a) If instead we said that ground was −10 V, how would this affect V and E at other points? (b) Does the fact that the Earth carries a net charge affect the choice of V at its surface?

Question B
Explain the origin of the glow sometimes observed around the cables of a high-voltage power line.

Question C
It is easy to produce a potential difference of several thousand volts between your body and the floor by scuffing your shoes across a nylon carpet. When you touch a metal doorknob, you get a mild shock. Yet contact with a power line of comparable voltage would probably be fatal. Why is there a difference?

Question D
Advice to mountaineers caught in lightning and thunderstorms is to (a) get rapidly off of peaks and ridges and (b) put both feet together and crouch in the open, only the feet touching the ground. What is the basis for this good advice?

Problem 24.7
An infinite nonconducting sheet has a surface charge density σ = +5.80 pC/m². (a) How much work is done by the electric field due to the sheet if a particle of charge q = +1.60 × 10⁻¹⁹ C is moved from the sheet to a point P at distance d = 3.56 cm from the sheet? (b) If the electric potential V is defined to be zero on the sheet, what is V at P?

Problem 24.13
What are (a) the charge and (b) the charge density on the surface of a conducting sphere of radius 0.15 m whose potential is 200 V (with V = 0 at infinity)?
Problem 24.17
In Fig. 24.33, particles of the charges $q_1 = +5e$ and $q_2 = -15e$ are fixed in place with a separation of $d = 24.0$ cm. With $V = 0$ at infinity, what are the finite (a) positive and (b) negative values of $x$ at which the net electric potential on the $x$ axis is zero?

Problem 24.35
The electric potential at points in an $xy$ plane is given by $V = (2.0x^2 - 3.0y^2)$ V/m$^2$. In unit-vector notation, what is the electric field at the point $(3.0 \text{ m}, 2.0 \text{ m})$?

Problem 24.43
A particle of charge $+7.5 \mu\text{C}$ is released from rest at the point $x = 60\text{ cm}$ on an $x$ axis. The particle begins to move due to the presence of a charge $Q$ that remains fixed at the origin. What is the kinetic energy of the particle at the instant it has moved $40\text{ cm}$ if (a) $Q = +20 \mu\text{C}$ and (b) $Q = -20 \mu\text{C}$?

Problem 24.55
In Fig. 24.52, a charged particle (either an electron or a proton) is moving rightward between two parallel charged plates separated by distance $d = 2.00\text{ mm}$. The plate potentials are $V_1 = -70.0\text{ V}$ and $V_2 = -50.0\text{ V}$. The particle is slowing from an initial speed of $90.0 \text{ km/s}$ at the left plate. (a) Is the particle an electron or a proton? (b) What is its speed just as it reaches plate 2?

Problem 24.58
A positron (charge $+e$, mass equal to the electron mass) is moving at $1.0 \times 10^7 \text{ m/s}$ in the positive direction of an $x$ axis when, at $x = 0$, it encounters an electric field directed along the $x$ axis. The electric potential $V$ associated with the field is given in Fig. 24.54. The scale of the vertical axis is set by $V_S = 500\text{ V}$. (a) Does the positron emerge from the field at $x = 0$ (which means its motion is reversed) or at $x = 0.50\text{ m}$ (which means its motion is not reversed)? (b) What is its speed when it emerges?

Problem 24.111
Point charges of equal magnitudes ($25 \text{ nC}$) and opposite signs are placed on diagonally opposite corners of a $60\text{ cm} \times 80\text{ cm}$ rectangle. Point $A$ is the unoccupied corner nearest the positive charge, and point $B$ is the other unoccupied corner. Determine the potential difference $V_B - V_A$. 