DAY 1 -- Homework

1. We refer to the mass that is central to Newton's Laws of Motion as "Inertial Mass".

   We call the quantity that determines gravitational force in a gravitational field "Gravitational Mass"; we call the quantity that determines electrical force in a electric field "Electrical Charge".

   Would it be valid to refer to gravitational mass as "gravitational charge"? Would it be valid to refer to electrical charge as "electrical mass"?

2. Discuss the following statement: "An object at high voltage is like the edge of a tall cliff. Unless there's something there to fall off on you, it's not particularly dangerous."

3. When you get a "static shock" from a doorknob, the electric potential present usually is in the range of thousands, if not tens of thousands, of volts. Use the analogy of the cliff to explain why you are not seriously hurt when hit by electrical charge at these voltages in this case.

4. Calculate the gravitational potential, relative to the ground, at the top of a 30 m tall tower. Calculate the potential energy of a 10 kg mass located there. Repeat for a 20 kg mass.

5. What is the difference in potential between the 5^{th} and 10^{th} floors of a building? Assume each floor represents approximately 12 ft.

6. (a) Show that the equation $F_{elec} = q\,E$ indicates that E has units of N/C.
   (b) Show that the equation $U_{elec} = E\,y$ indicates that E has units of V/m.
   (c) Reduce both N/C and V/m down to fundamental units and show that they are the same.

7. (a) Calculate the gravitational PE of 10,000,000,000 protons at a height of 10 meters above the ground in a downward gravitational field of 9.8 N/kg.
   (b) Calculate the electrical PE of 10,000,000,000 protons at a height of 10 meters above the ground in a downward electric field of 9.8 N/C.
   (c) Calculate the gravitational PE of 10,000,000,000 hydrogen atoms at a height of 10 meters above the ground in a downward gravitational field of 9.8 N/kg.
   (d) Calculate the electrical PE of 10,000,000,000 hydrogen atoms at a height of 10 meters above the ground in an electric field of 9.8 N/C.
   (e) Discuss the results of these three calculations.