

## 1 | Voltage

### 1.1 | First, a geography thing.



Figure 1: Screen Shot 2020-09-02 at 8.37.26 PM.png

In a topological map, you could probably guess that the **steepest path downwards/upwards is perpendicular to the lines.**

The constant voltage lines works in a similar way.

### 1.2 | Then, a Energy Thing.

If we have an object in the air

Object

$\{Air\}$

..ground..

What is that object's gravitation potential energy?

... ..

You will realize that I just asked a very dumb question. This is because that **energy must be relative to**

**something.** You must *raise* the object (giving us the  $\Delta h$  part of  $gpe = mg\Delta h$  to gain gravitational potential energy.

### 1.3 | Electric Potential

Electrical Potential  $\{\frac{V}{C}\}$  Voltage is a measure of how much electric potential energy (yes, it is an *energy* (in  $J$ , joules)), would change per Coulomb of energy that is moved through.

Recall the energy example above. When you raise an object of  $1kg$  from a place with elevation ( $\Delta h$ )  $10m$  to  $100m$ , you could represent the change in gravitation potential energy of that operation as  $mg\Delta h_1 - mg\Delta h_0 = m(g\Delta h_1 - g\Delta h_0) = 1kg(9.8\frac{m}{s^2}100m - 9.8\frac{m}{s^2}10m)$ . Where,  $g\Delta h_1$  is a unit  $\frac{m^2}{s^2} = \frac{J}{kg}$ . Proving this last relationship is left as an exercise to the reader.

Funny way to write it, I know. But, we could take the equation  $m(g\Delta h_1 - g\Delta h_0)$  and use it as a perfect analogy for using electric potential.

The amount of electric potential energy that would change by moving an object of charge  $1C$  from a place with voltage ( $\Delta V$ )  $10V$  to  $100V$ , is  $Q_2(V_1 - V_0) = 1C(100V - 10V)$ , where Voltage,  $V$ , represent the *energy* potential — analogous to, drumroll please,  $\frac{J}{kg}$ , except this time its  $\frac{J}{C}$ .

[Where  $Q_2$  is the the charge in Coulombs  $C$  of the test charge, and  $V_1$  and  $V_0$  are the electric potential values of the points the charge is being moved to and from] Electric Potential Energy  $Q_2(V_1 - V_0)$  Electric Potential, Volts  $\{V = \frac{J}{C}\}$