

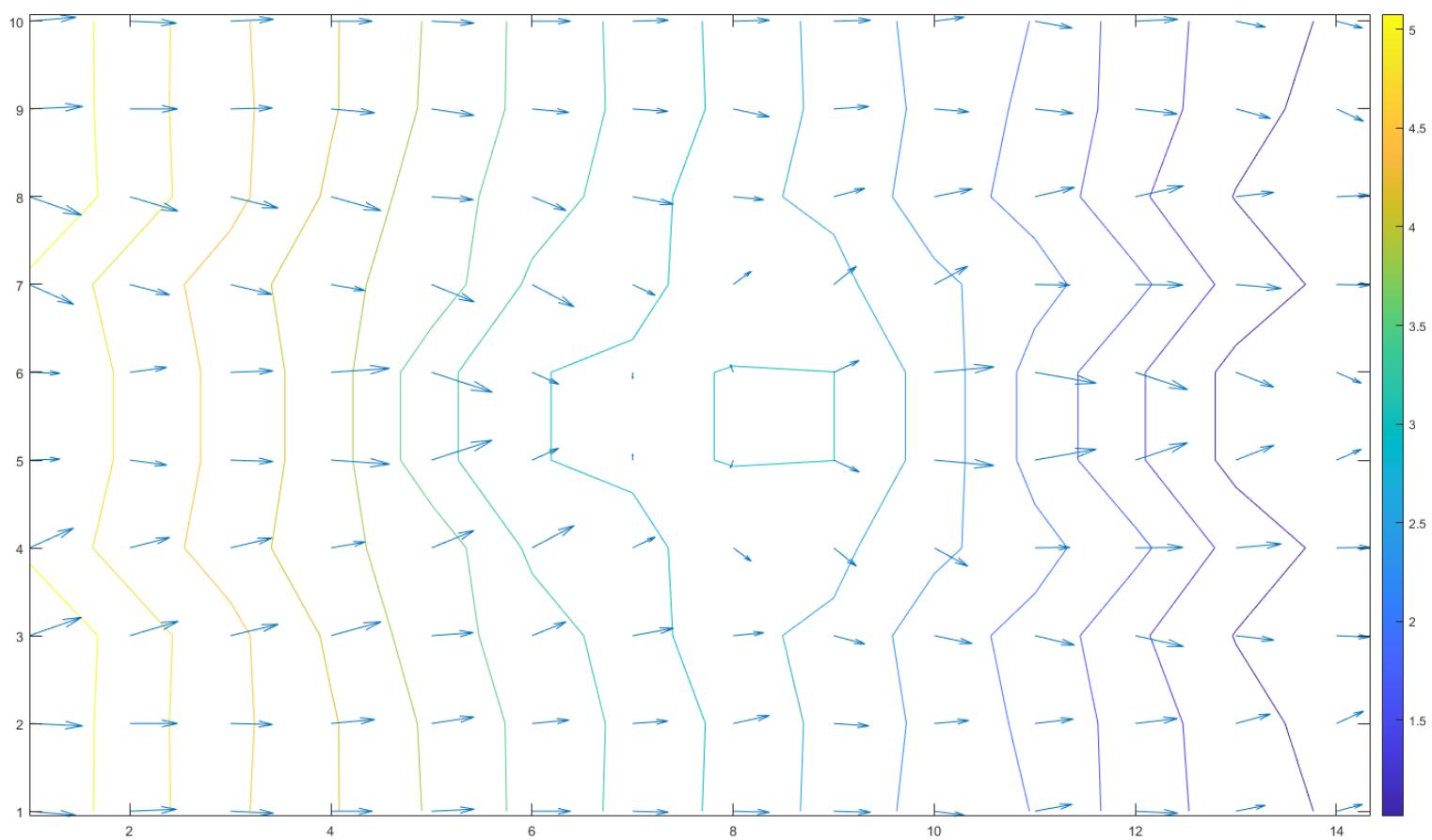
Stephen Falkenroth

Phys 212 3/7/21

- 1.) The contour lines in the sandbox represent the elevation level.
- 2.) The slope is highest when the contour lines are bunched up. Say you have a contour line every 10 m of elevation, when the lines are bunched up you are increasing elevation over a small area and therefore you have "steepness"
- 3.) We think of contour lines as level lines on a surface the gradient at any particular point on that surface will point in the direction of steepest ascent so water will flow in the direction opposite to the gradient. Since the gradient is perpendicular to the tangent we will see waves perpendicularly to the contour lines
- 4.) Electric field lines will be perpendicular to the equipotential lines

5.
Faraday Cage
5.32 volts
lightning rod reading
5.52 volts

b.) Faraday loop route.

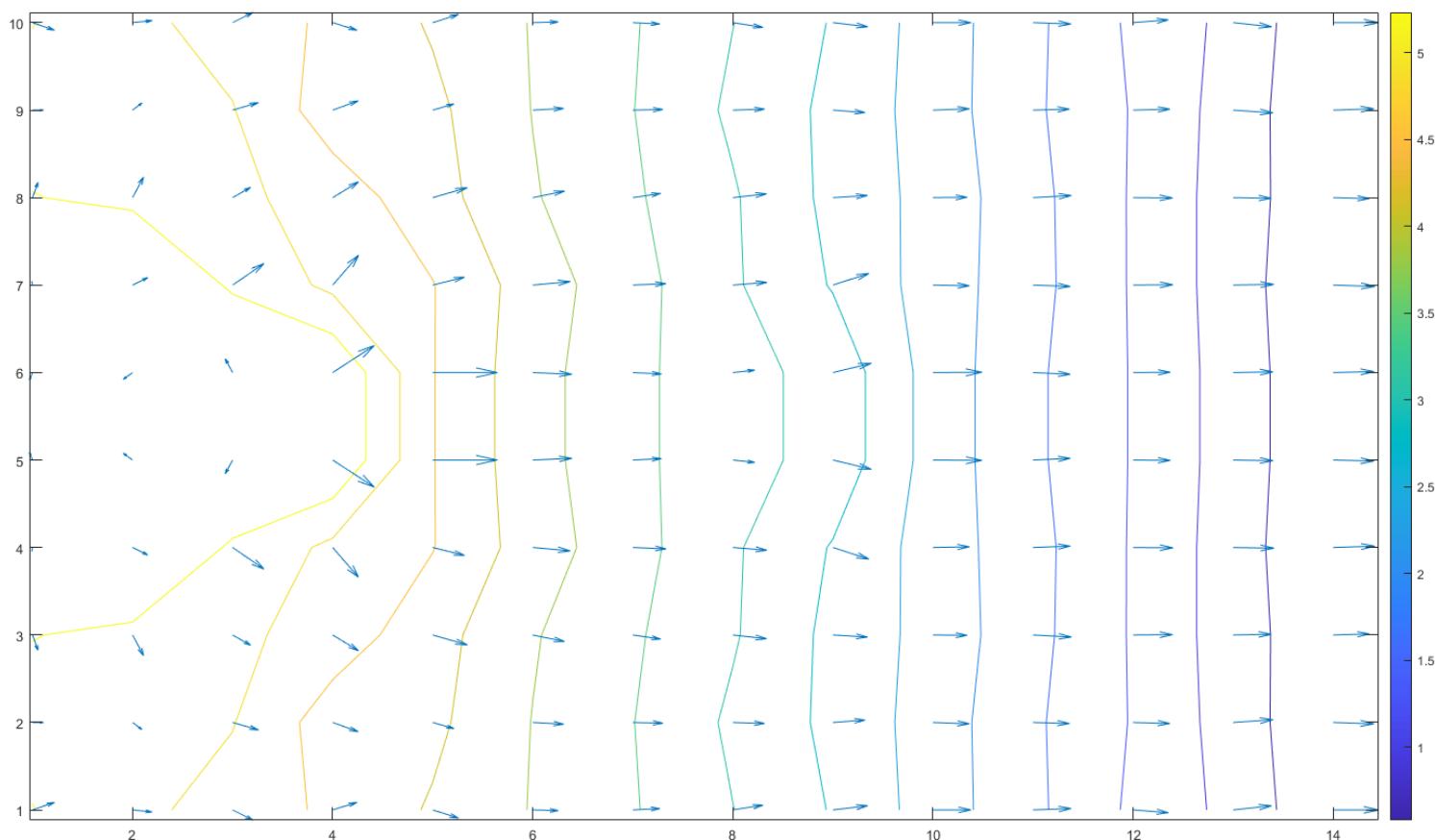


Data Readings.

5.3400	4.9300	4.5200	4.1700	3.7900	3.4200	3.1100	2.7900	2.4700	2.1400	1.9400	1.4800	1.1900	0.9600
5.3800	4.9100	4.5400	4.1700	3.7700	3.4200	3.1200	2.8000	2.4800	2.1800	1.8700	1.5000	1.1300	0.8900
5.3900	4.9300	4.5400	4.0900	3.6600	3.3500	3.0600	2.6300	2.5200	2.0800	1.8500	1.3800	1.0000	0.7100
5.0100	4.6200	4.3100	3.8900	3.7100	3.1400	2.9700	2.7400	2.6500	2.3400	2.0600	1.7200	1.2200	0.9200
4.9900	4.7200	4.3400	3.9700	3.3100	2.9000	2.8400	2.9000	2.8900	2.4500	1.8400	1.3700	0.9200	0.7000
4.9900	4.7200	4.3400	3.9700	3.3100	2.9000	2.8400	2.9000	2.8900	2.4500	1.8400	1.3700	0.9200	0.7000
5.0100	4.6200	4.3100	3.8900	3.7100	3.1400	2.9700	2.7400	2.6500	2.3400	2.0600	1.7200	1.2200	0.9200
5.3900	4.9300	4.5400	4.0900	3.6600	3.3500	3.0600	2.6300	2.5200	2.0800	1.8500	1.3800	1.0000	0.7100
5.3800	4.9100	4.5400	4.1700	3.7700	3.4200	3.1200	2.8000	2.4800	2.1800	1.8700	1.5000	1.1300	0.8900
5.3400	4.9300	4.5200	4.1700	3.7900	3.4200	3.1100	2.7900	2.4700	2.1400	1.9400	1.4800	1.1900	0.9600

7.) The electric Potential does not change much inside the circle. When $E_p = 0$, F is zero as well.

8) Lightning Rod Roots.



Other Readings:

5.2400	4.9600	4.7400	4.4400	4.1200	3.7800	3.4700	3.0900	2.7000	2.2000	1.7300	1.2300	0.8300	0.2500
5.1300	4.9900	4.8900	4.3300	4.2400	3.7900	3.4500	3.0200	2.6400	2.2000	1.7100	1.2700	0.7700	0.2500
5.2400	5.1700	4.9600	4.7100	4.3000	3.8300	3.4900	3.1200	2.6300	2.2400	1.7600	1.2600	0.7500	0.2900
5.5800	5.5900	5.1900	4.7900	4.5300	3.9800	3.5700	3.1300	2.7000	2.2100	1.7700	1.2600	0.7500	0.2200
5.3500	5.3900	5.5900	5.5800	4.5300	3.9300	3.5300	3.2000	2.9700	2.2200	1.7200	1.2700	0.7700	0.2500
5.3500	5.3900	5.5900	5.5800	4.5300	3.9300	3.5300	3.2000	2.9700	2.2200	1.7200	1.2700	0.7700	0.2500
5.5800	5.5900	5.1900	4.7900	4.5300	3.9800	3.5700	3.1300	2.7000	2.2100	1.7700	1.2600	0.7500	0.2200
5.2400	5.1700	4.9600	4.7100	4.3000	3.8300	3.4900	3.1200	2.6300	2.2400	1.7600	1.2600	0.7500	0.2900
5.1300	4.9900	4.8900	4.3300	4.2400	3.7900	3.4500	3.0200	2.6400	2.2000	1.7100	1.2700	0.7700	0.2500
5.2400	4.9600	4.7400	4.4400	4.1200	3.7800	3.4700	3.0900	2.7000	2.2000	1.7300	1.2300	0.8300	0.2500

Note: I actually measured up and had the + terminal connected to the "lightning rod" and the - terminal connected to the sky.

Conclusion:

- 10.) An ideal 6 volt battery supplies 6 Joules of E_{PE} for 1 couomb of charge. So It would take 12 Joules to move 2 Coulombs.

$$\Delta V = V_i - V_f = 6.0 = \frac{W}{2C} \Rightarrow V = 12$$

11)

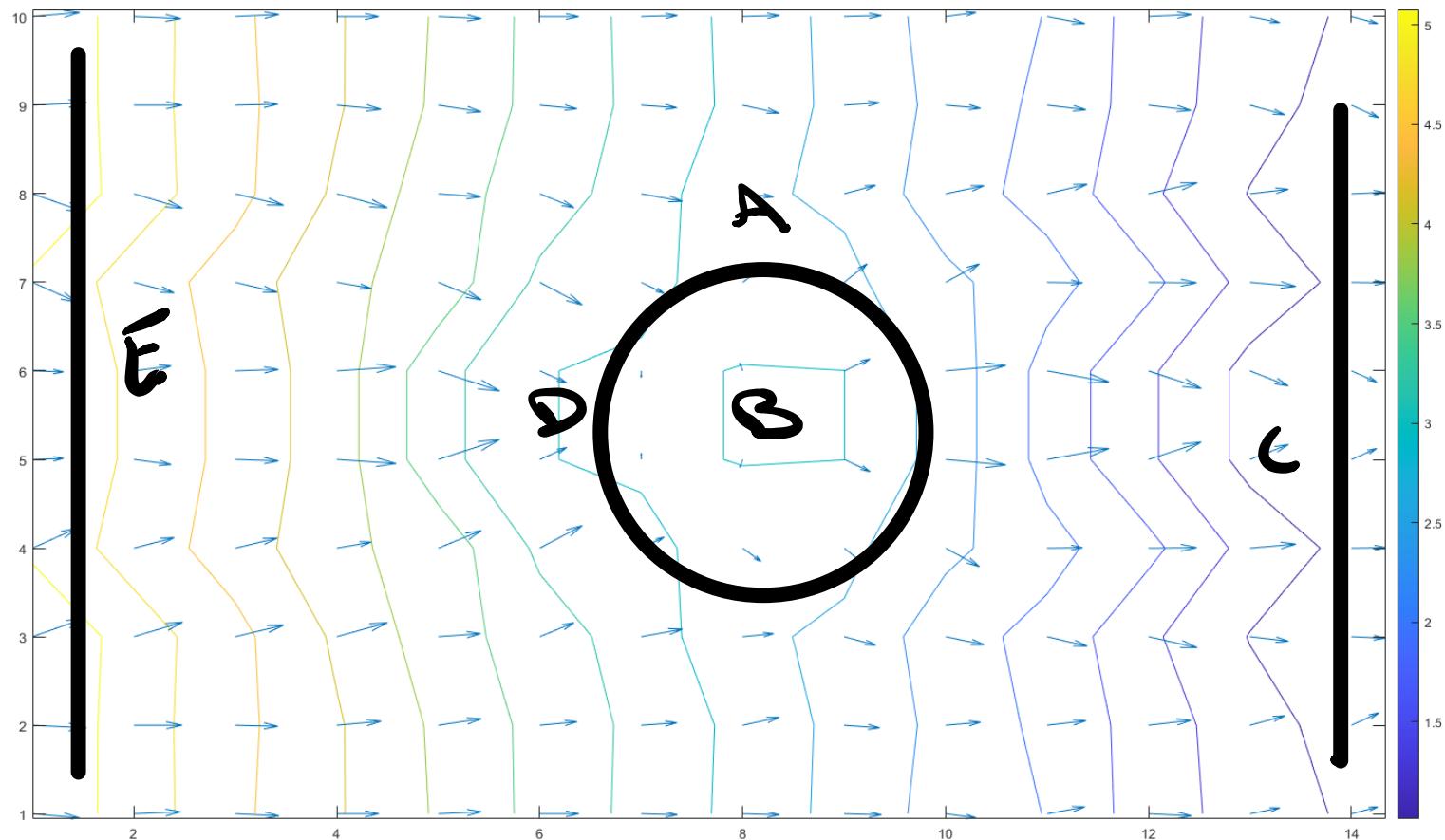
$$\frac{1 \text{ electron}}{1.62 \times 10^{-19} \text{ C}} \cdot 2C = 1.234 \times 10^{19} \text{ electrons.}$$

12)

$$\frac{9.11 \times 10^{-31} \text{ kg}}{1 \text{ electron}} \cdot 1.234 \times 10^{19} \text{ electrons} = 1.1246 \times 10^{-11} \text{ kg}$$

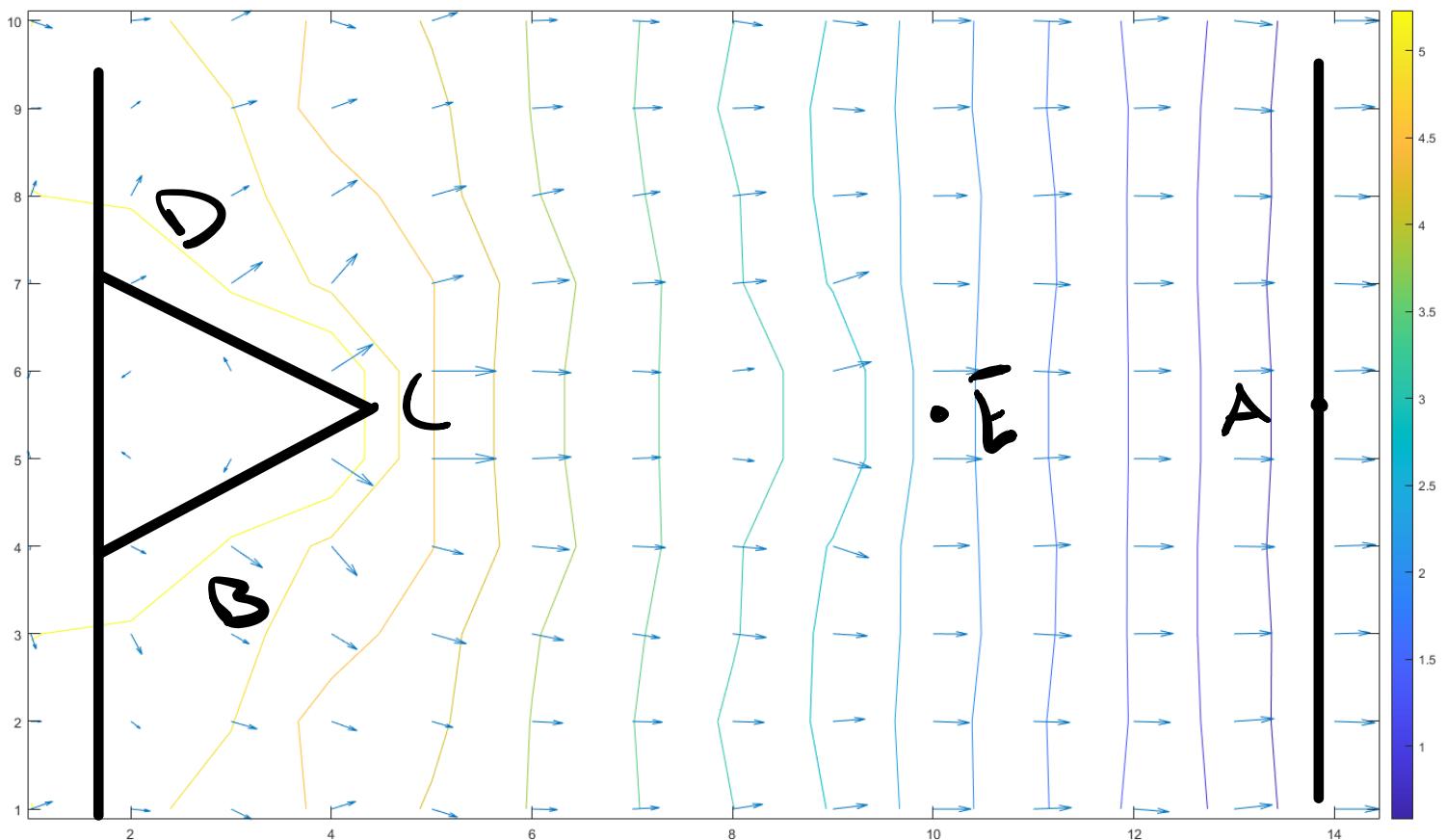
13.) Note, my work for the lightning rod is messed up since + and - are swapped.

I will answer using my works.



Electric Potential: E, D, A, B, L

Field Strength: D, E, A, L, B



Electric Potential : $C \rightarrow B \rightarrow E \rightarrow A$

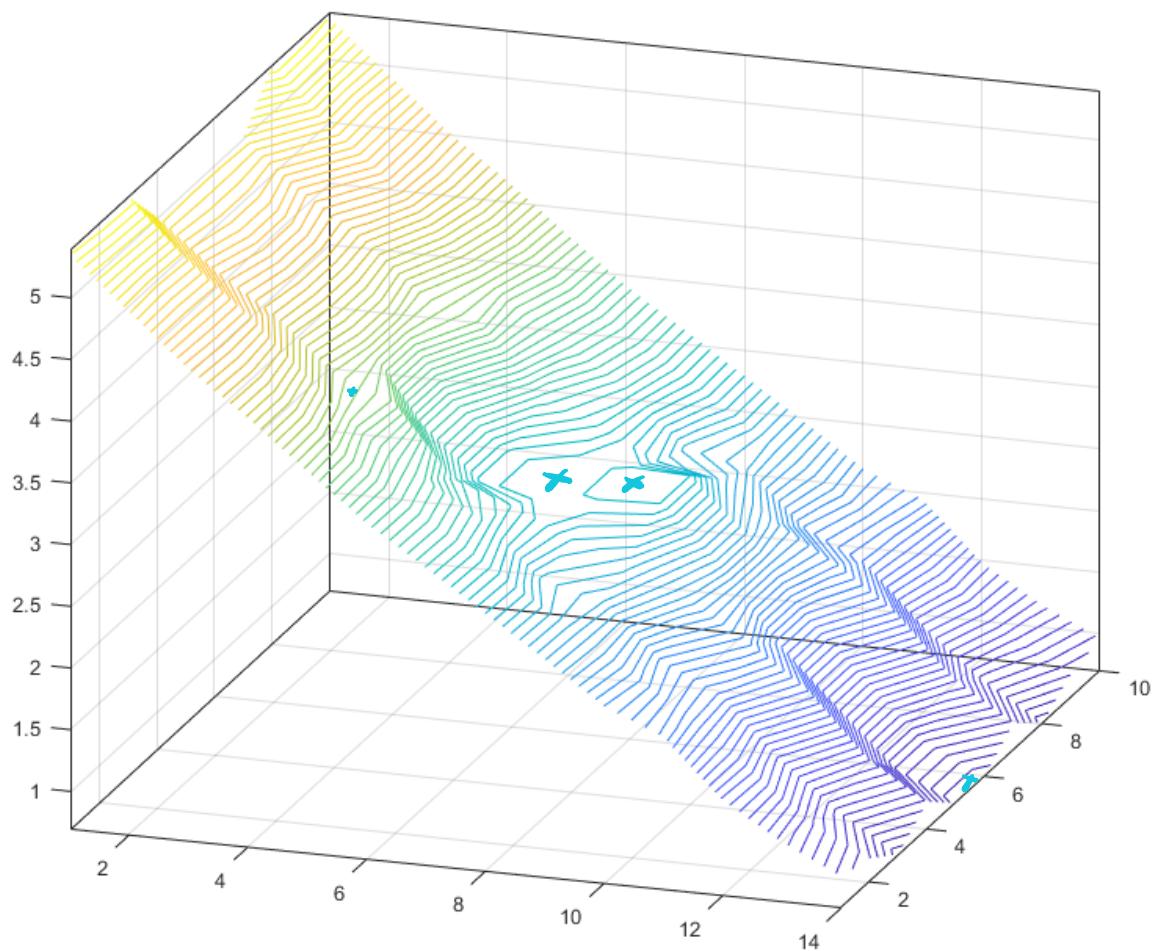
Field Strength : $C, E, A \rightarrow B$.

Qn.) Lightning will strike the lightning rod because it is the most optimal path in terms of gradient descent. It is the path where the field strength is greatest.

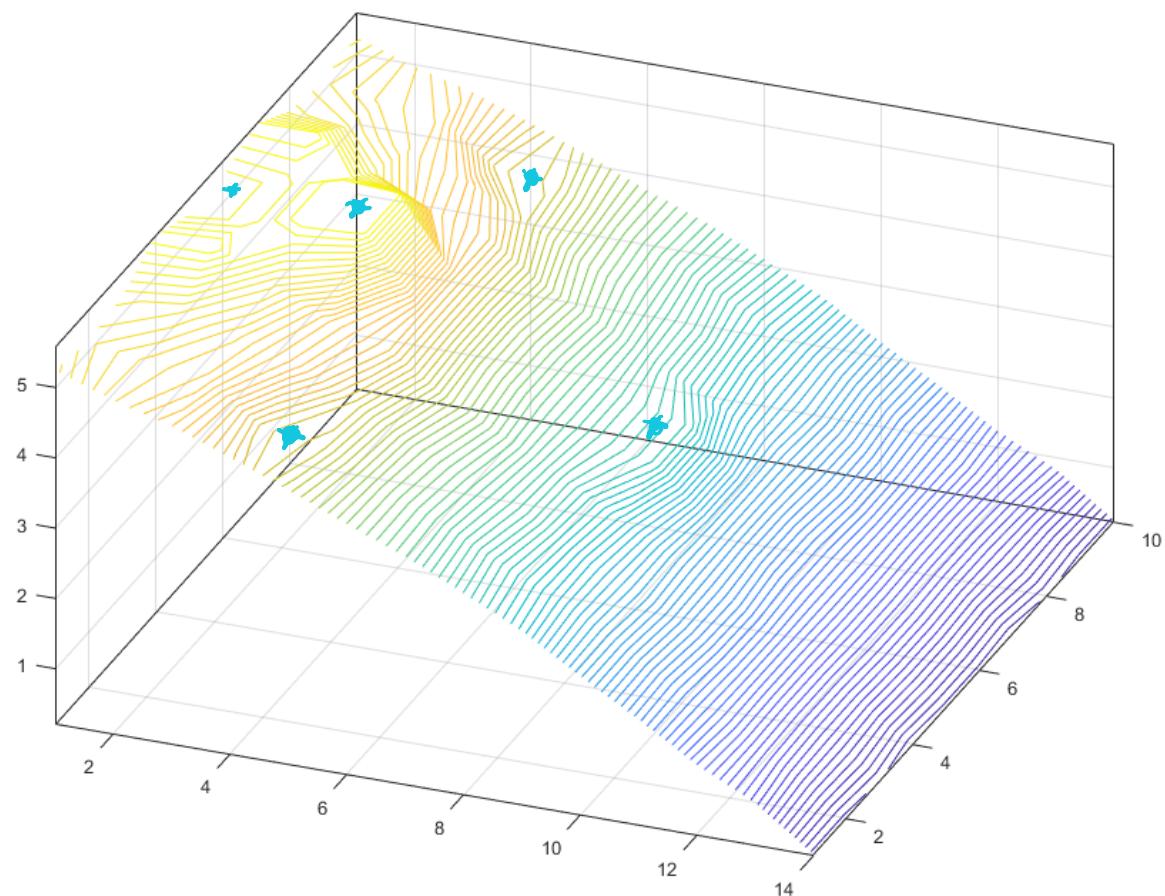
(My data doesn't show that
because I set it up wrong ;)

15.)

Farm during
cruise



Rolling up along lightning Rod



16) It requires the most work to move charge in the sections that are the most + sloping. In our case they look relatively flat and are marked with a \times

17) Equipotential lines are the level curves on a surface and the electric force is the negative gradient on those curves.

$$\text{Equipotential line} = f(x, y)$$

$$\text{Electric force} = -\nabla f$$