Outline

- Electric Fields
- Electric Potential

Office hours next week:
Wed 5-6.30 office hours AV Williams Rm 3341
Thu 3-4pm Course Center

Foothold ideas:
Electric potential energy and potential

- The potential energy between two charges is
- The potential energy of many charges is
- The potential energy added by adding a test charge *q* is

$$U_{12}^{elec} = \frac{k_C Q_1 Q_2}{r_{12}}$$

$$U_{12\ldots N}^{elec} = \sum_{i<j=1}^{N} \frac{k_C Q_i Q_j}{r_{ij}}$$

$$\Delta U_q^{elec} = \sum_{i=1}^{N} \frac{k_C q Q_i}{r_{iq}} = qV$$

Potentials

Forces and Fields

$$\vec{F}_q = \sum_{i=1}^{N} \frac{k_C q Q_i}{r_{iq}^2} \hat{r}_{iq}$$

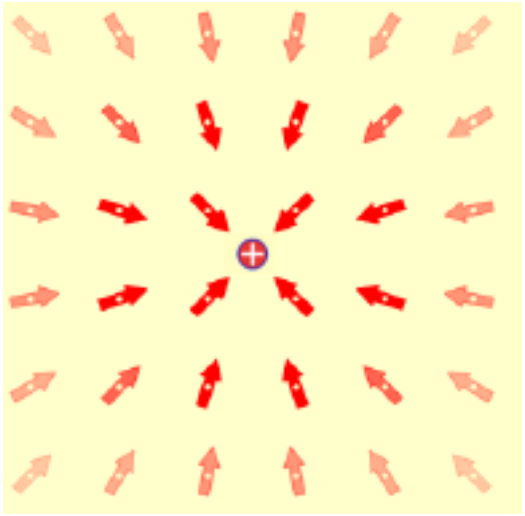
$$\vec{E} = \frac{\vec{F}_q}{q}$$

Potential Energy and Potential

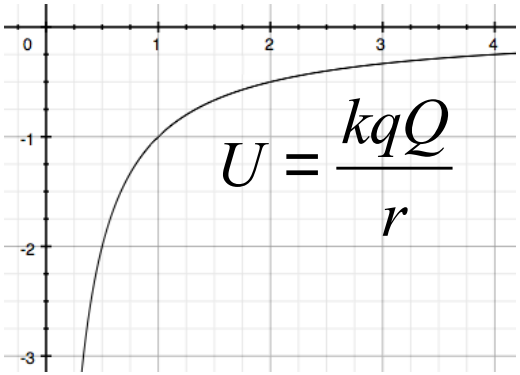
$$\Delta U_q^{elec} = \sum_{i=1}^{N} \frac{k_C q Q_i}{r_{iq}}$$

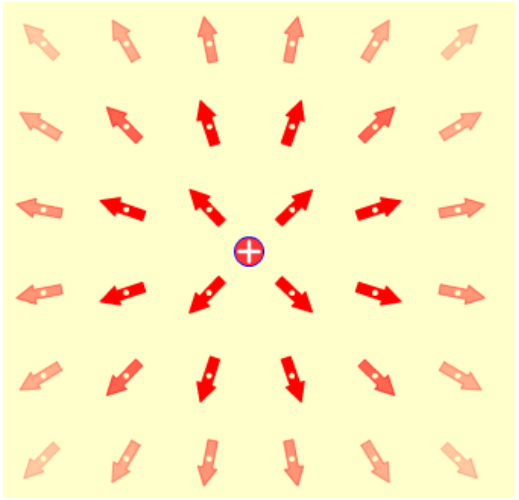
$$V = \frac{\Delta U_q^{elec}}{q}$$

Negative test charge

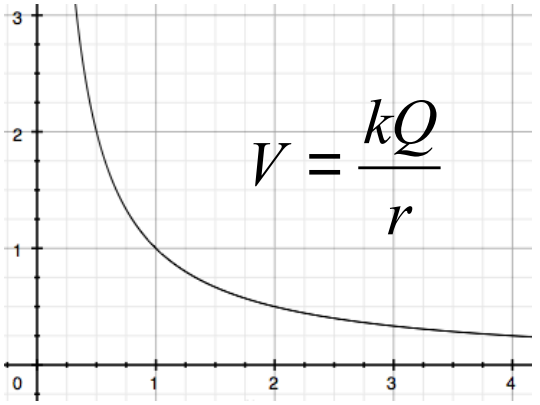


Potential energy
of a negative test charge
near a positive source.





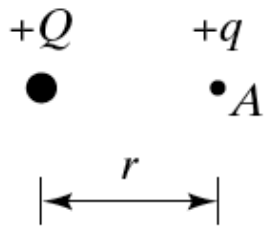
Electric Potential
of a negative test charge
near a positive source.

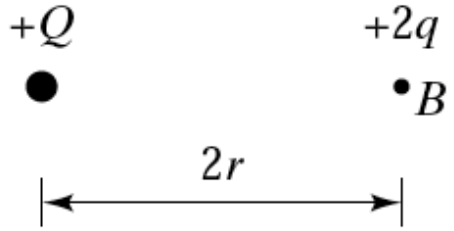


Two test charges are brought separately into the vicinity of a charge +*Q*. First, test charge +*q* is brought to point A a distance *r* from +*Q*.
Next, +*q* is removed and a test charge +2*q* is brought to point B a distance 2*r* from +*Q*.

Compared with the electrostatic potential of the charge at A, that of the charge at B is

1. greater
2. smaller
3. the same
4. you can't tell from the information given





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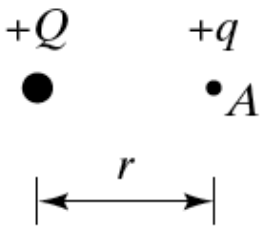
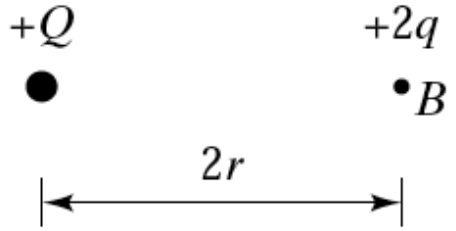
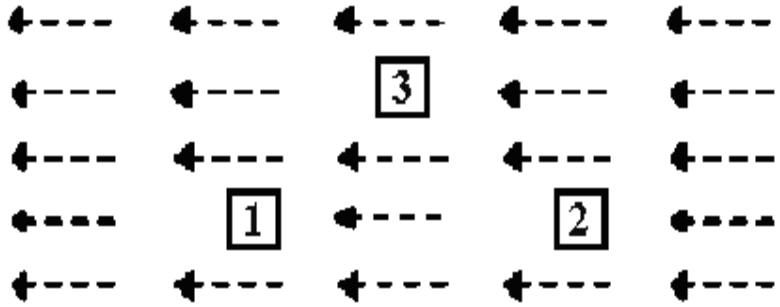




A positive charge might be placed at one of three spots in a region. It feels the same force (pointing to the left) in each of the spots.

How does the electric potential, V_{elec}, on the charge at positions 1, 2, and 3 compare?

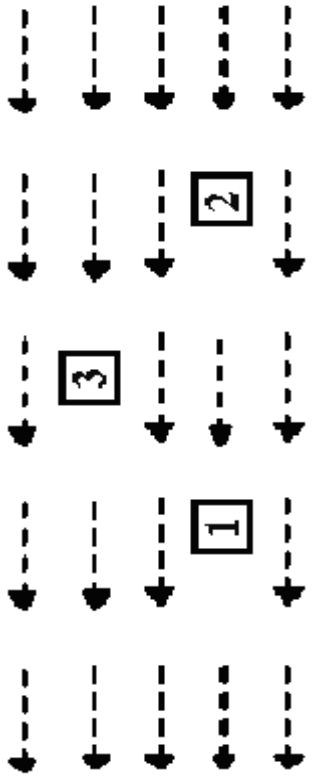
1. *V* is greatest at 1
2. *V* is greatest at 2
3. *V* is greatest at 3
4. *V* is 0 at all 3 spots
5. *V* is = at all 3 spots but not = 0.
6. Not enough information



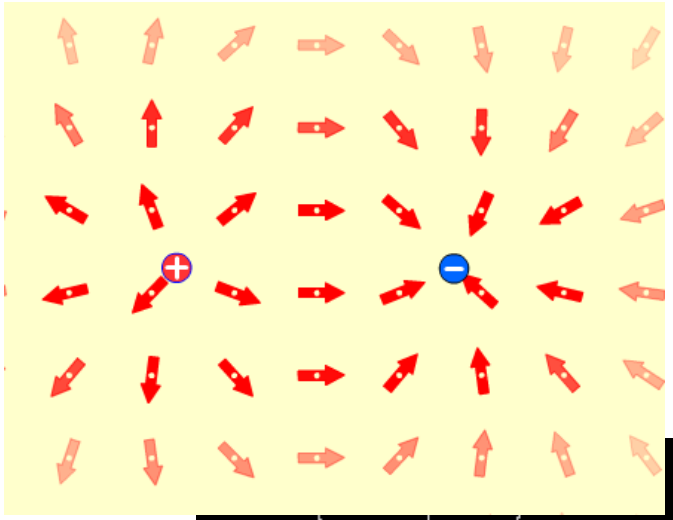
A massive object might be placed at one of three spots in a region where there is a uniform gravitational field.

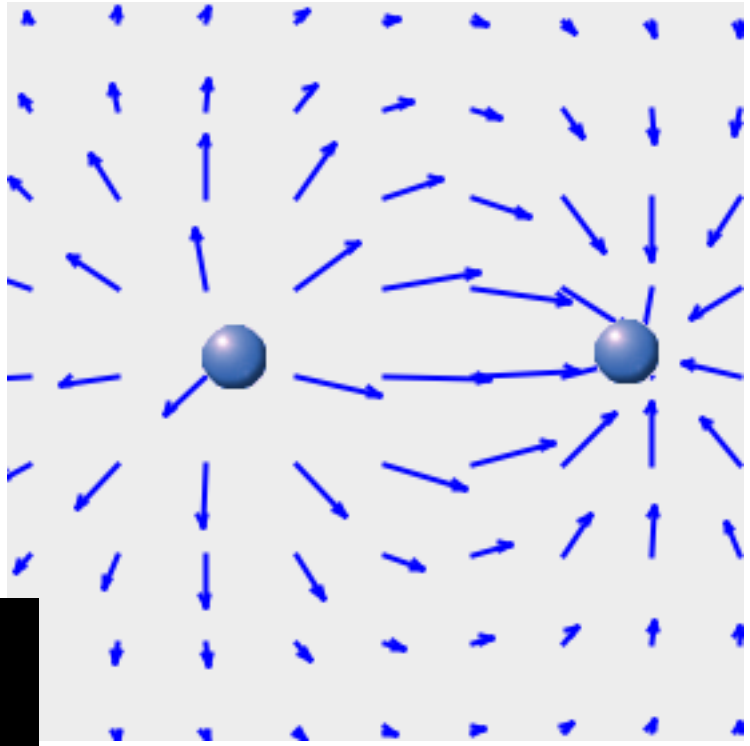
How do the gravitational potentials, $V = gh$, on the masses at positions 1, 2, and 3 compare?

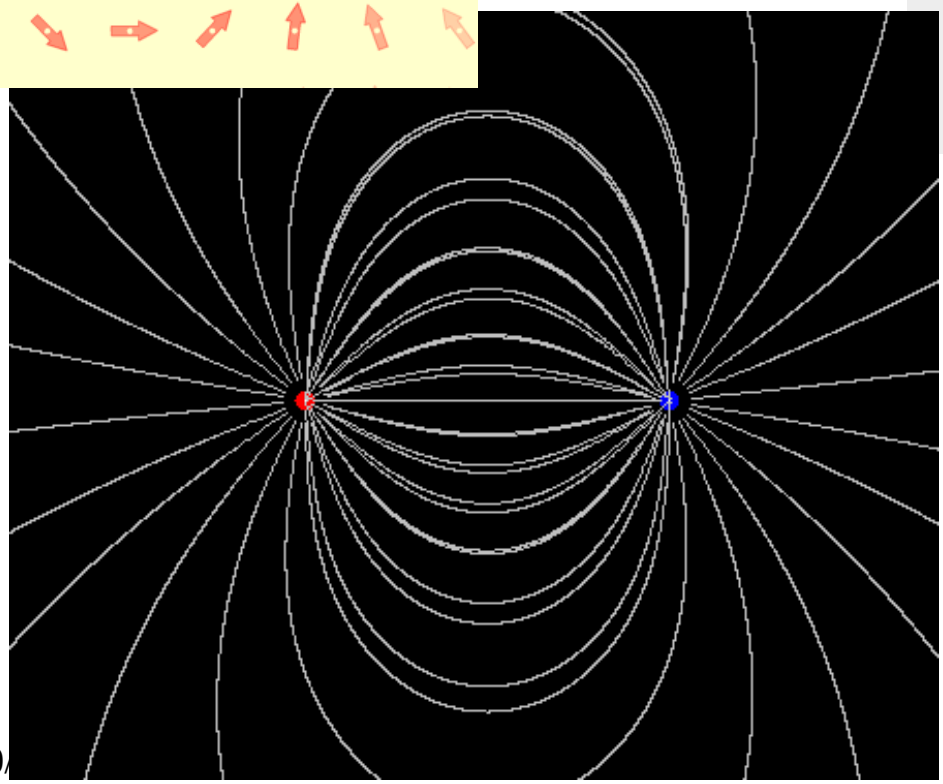
1. V is greatest at 1
2. V is greatest at 2
3. V is greatest at 3
4. V is 0 at all 3 spots
5. V is = at all 3 spots but not = 0.

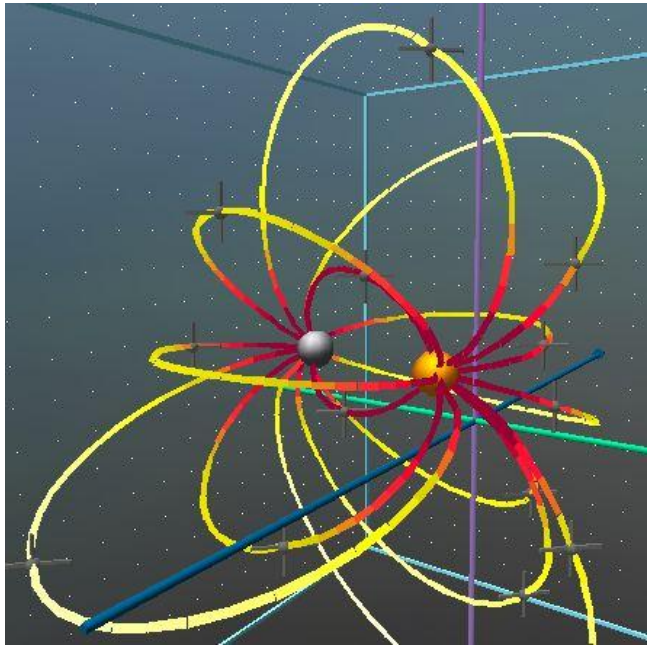


E field





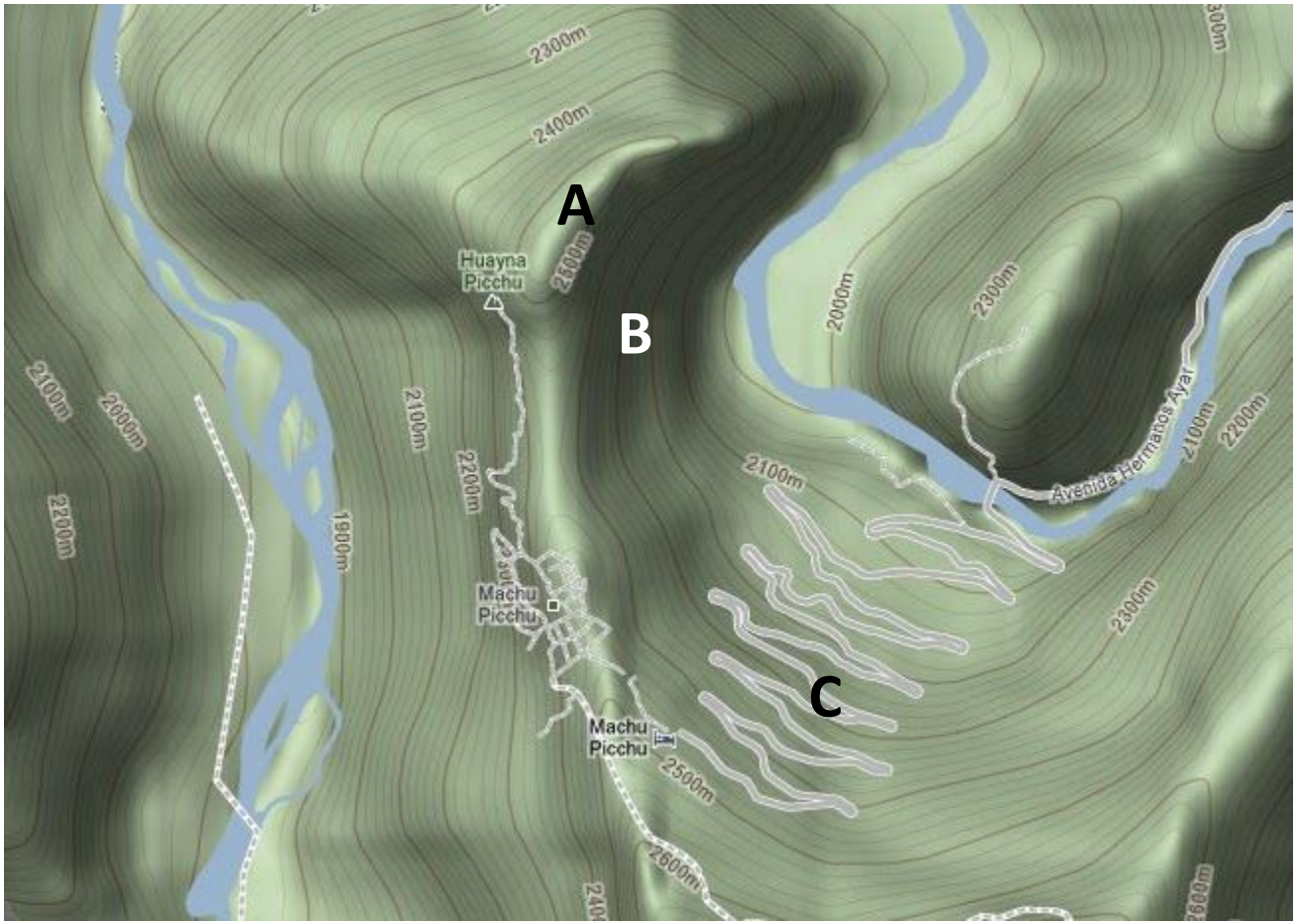




Topography map = gravitational PE graph (2D)

At which point is the force downhill strongest?

1. A
2. B
3. C
4. None



Topography map = gravitational PE graph (2D)

At which point is the force downhill pointing to the east? (North is up)

1. A
2. B
3. C
4. None