Wednesday Mar 1, 2017

Last time:

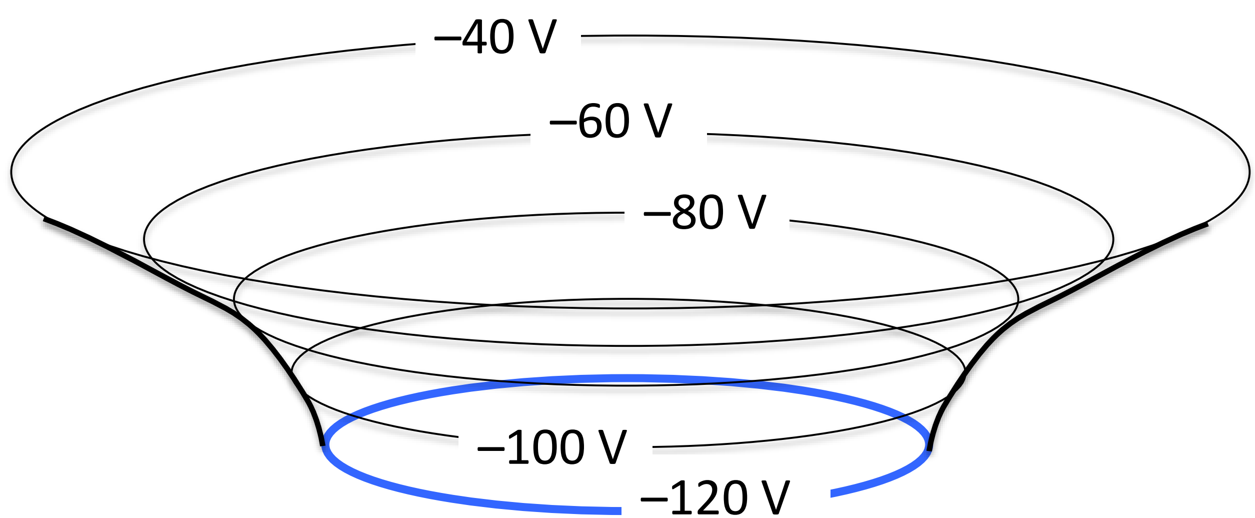
- Equipotential surfaces: visualizing electric potential
- Electrostatic work
- Conductors and electric potential
- Interpreting equipotential surfaces

Today:

- Interpreting equipotential surfaces
- ΔV applications
- Potential of a dipole and line of charge

Equipotential surfaces for charged shell

Equipotential surfaces give you information about **where a charged particle is allowed to go, based on its energy**. If you release a marble in a bowl at some height *h*, it will never be able to reach a higher height. Similarly, if you release a positive charge from some potential, it can never reach a higher potential unless supplied with extra energy.



TopHat Question

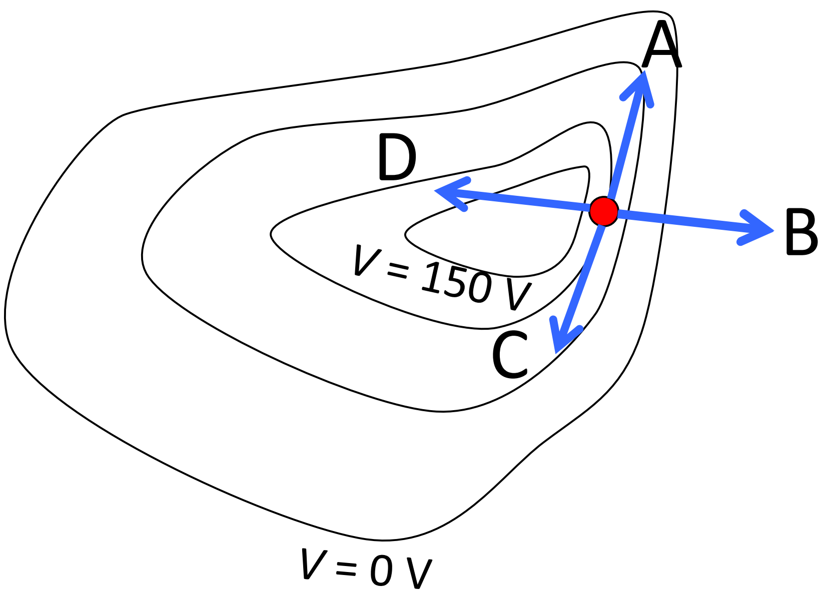
Equipotential surfaces are shown below. If a positively charged particle were released from rest at the point indicated, in which direction would the particle begin to move?

A.

B.

C.

D.



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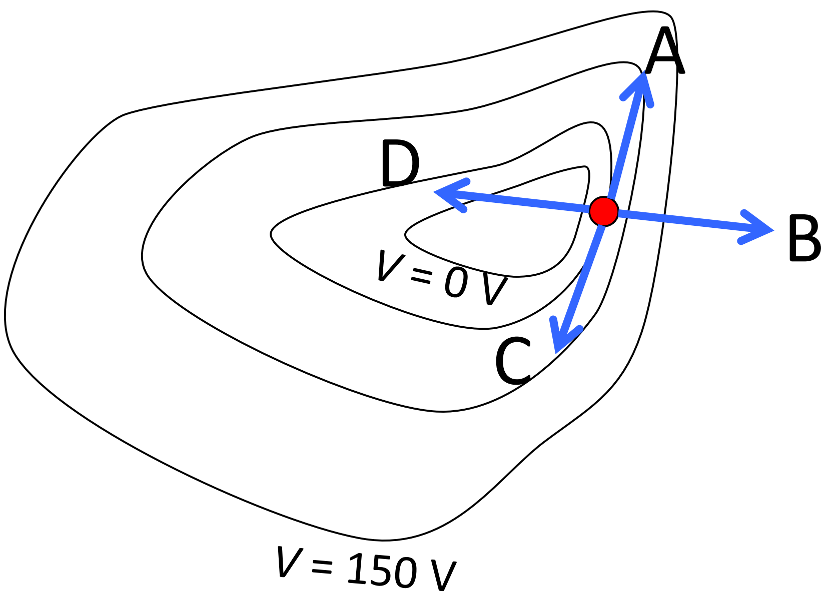
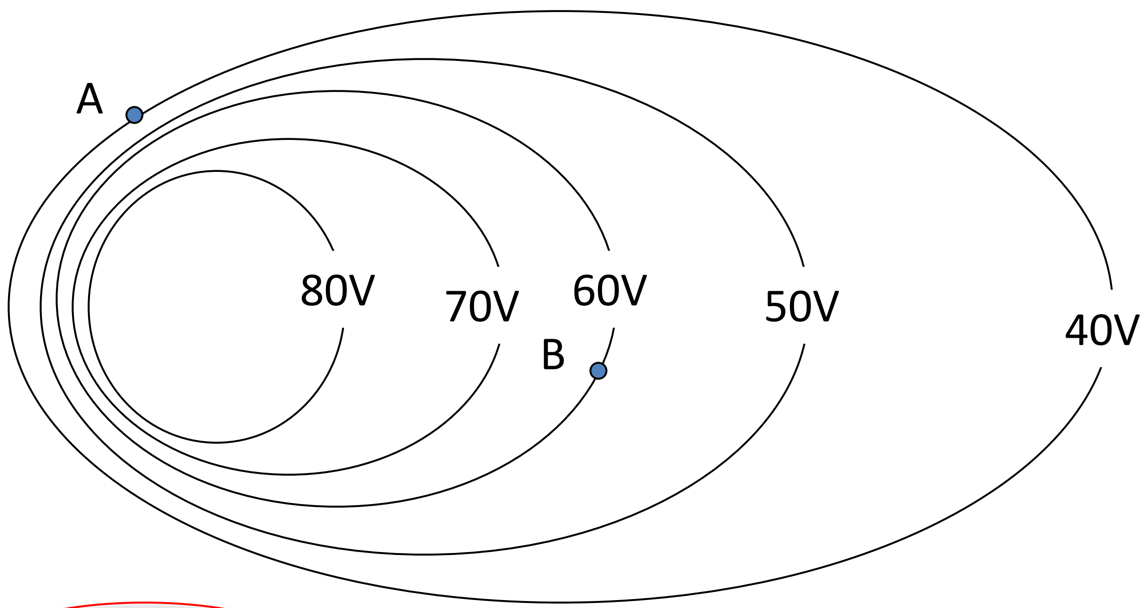


TopHat Question

How much energy (in Joules) would 2C of charge gain if it was pushed from point A to point B?



A. 40 J

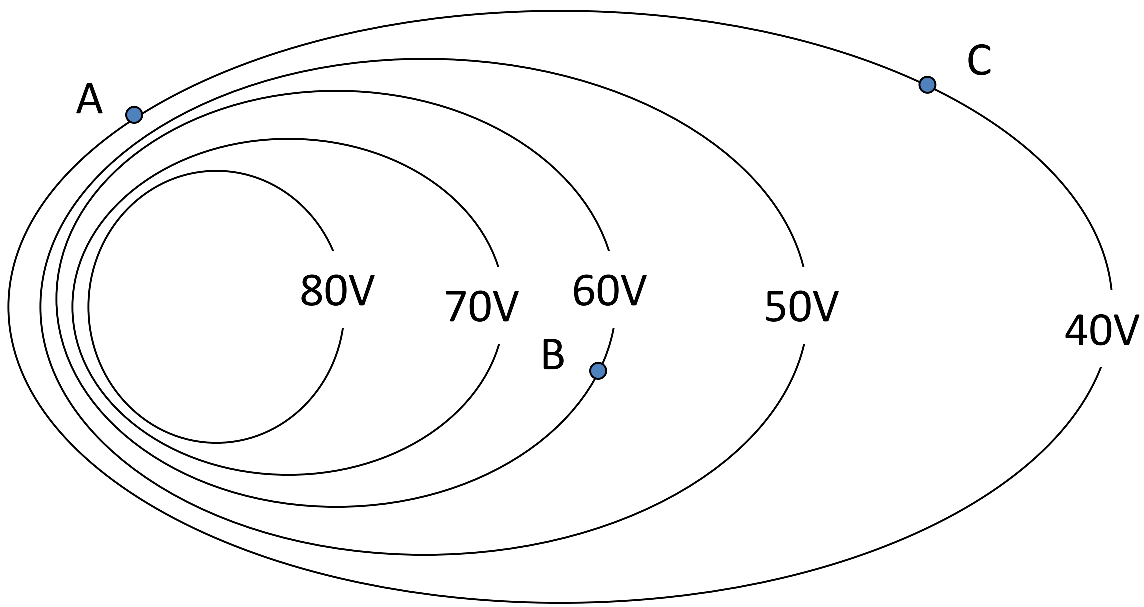
B. 60 J

C. 80 J

D. 120 J

TopHat Question

How much energy (in Joules) would 2C of charge gain if it was pushed from point A to point B, then to point C?



A. 80 J

B. 60 J

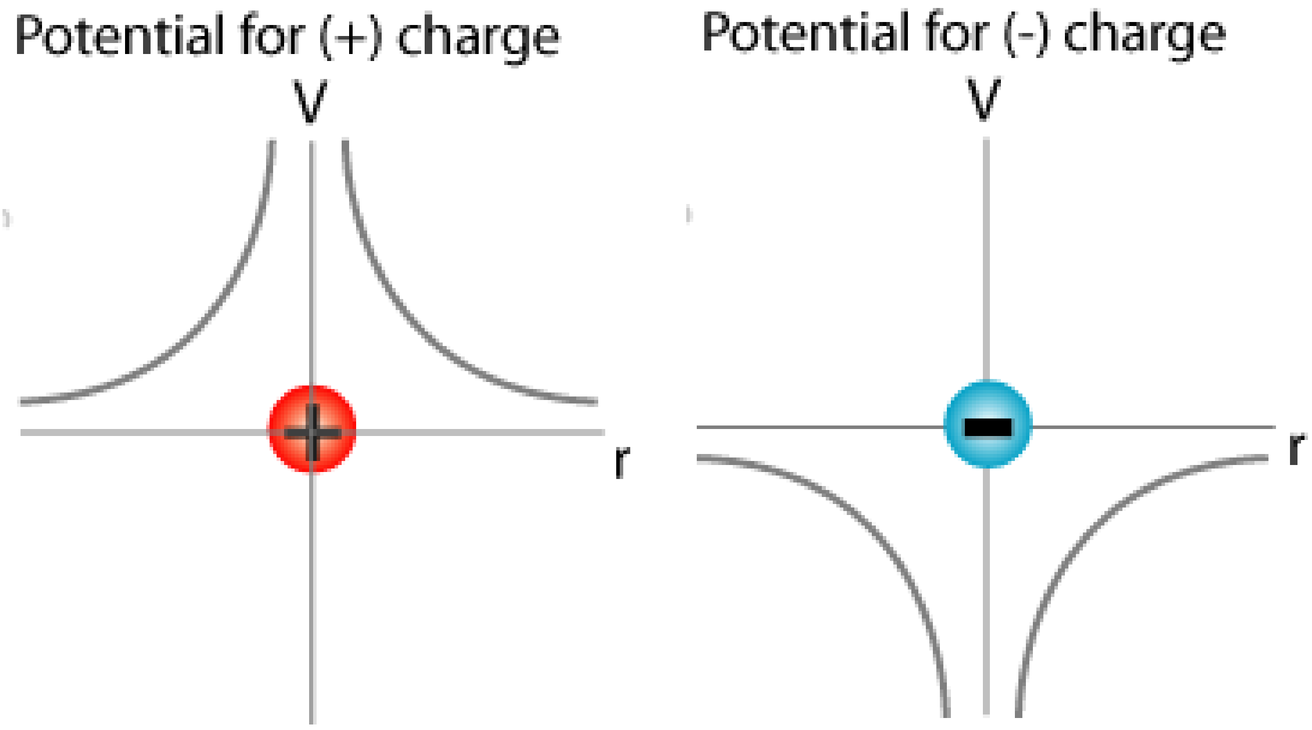
C. 40 J

D. 0 J

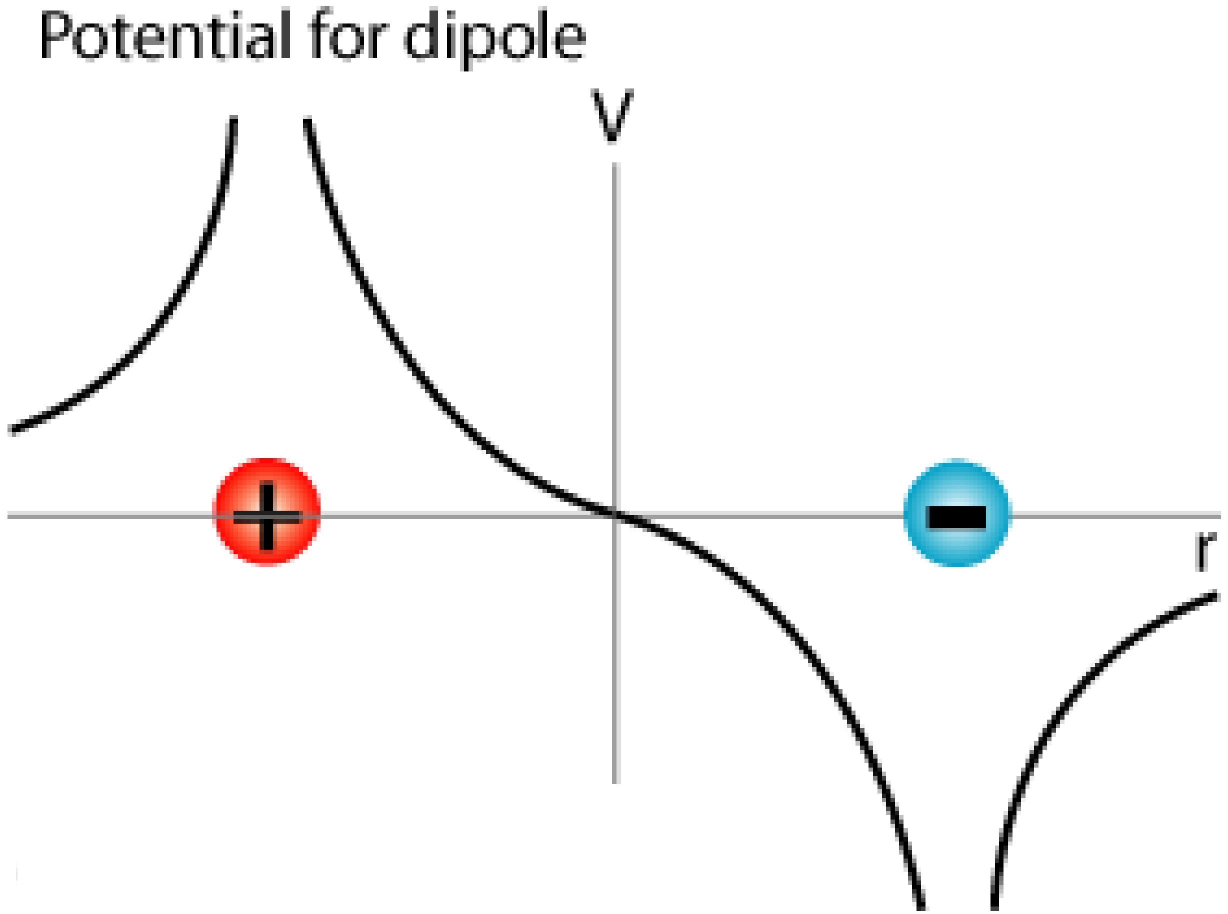
Potential of the dipole - general

- Document camera

Potential

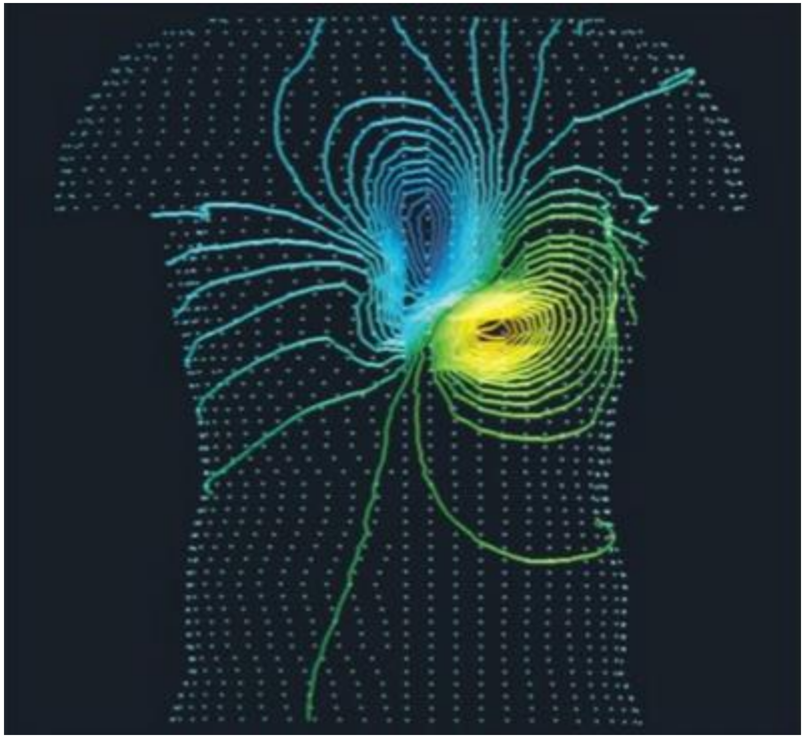


Potential



EKG (ECG) Electrocardiogram

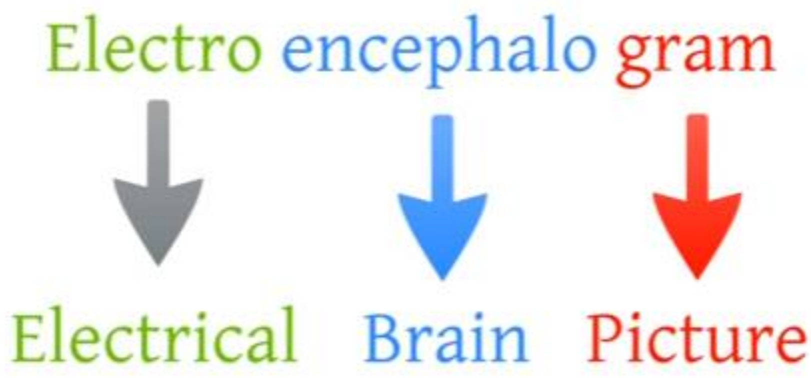
- The equipotential lines near the heart are slightly distorted lines for an electric dipole
- Electric activity of the heart can be monitored by measuring the potential differences



https://www.youtube.com/watch?v=SNrTbeL2h84

EEG electroencephalogram

- Way of measuring the electrical potentials that the brain produces



https://www.youtube.com/watch?v=86zIa3pGM50

Wednesday Mar 1, 2017 class 2

Last time:

- Interpreting equipotential surfaces
- ΔV applications
- Potential of a dipole

Today:

- Potential of line of charge
- Additional examples

Vector quantities

$$\vec{F}_{qq'} = \frac{1}{4\pi\varepsilon_0}\frac{qq'}{r^2}\hat{r}$$

$$\vec{E} = \frac{\vec{F}_{qq'}}{q'} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$$

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

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\int\frac{dq}{r^2}\hat{r}$$

Scalar quantities

$$U_{q'+q} = \frac{1}{4\pi\varepsilon_0}\frac{qq'}{r}$$

$$V = \frac{U_{q'+q}}{q'} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

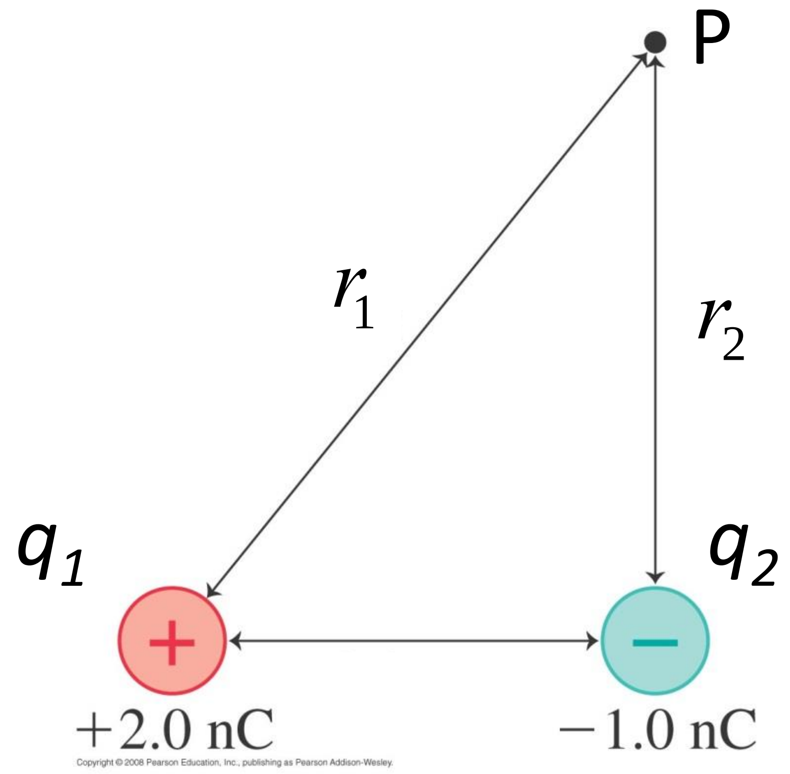
$$U = qV$$

$$V(r) = \frac{1}{4\pi\varepsilon_0}\int\frac{dq}{r}$$

$$U_b - U_a = -q_0\int_a^b \vec{E}\cdot\overrightarrow{dl}$$

$$V_b - V_a = -\int_a^b \vec{E}\cdot\overrightarrow{dl} = \int_b^a \vec{E}\cdot\overrightarrow{dl}$$

Finding V at point P.



Potential is a scalar

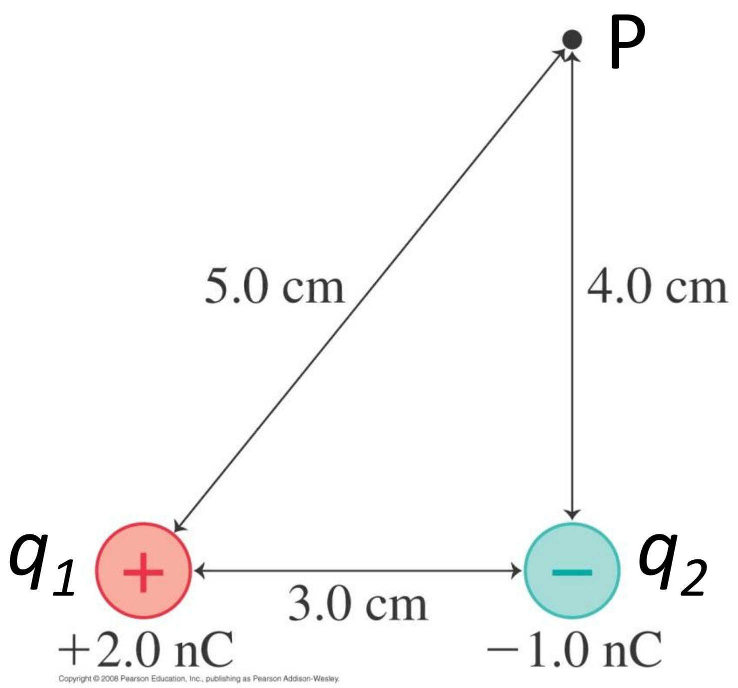
There are no components

Just add the potentials

V at P = (V_1 at P due to q_1) + (V_2 at P due to q_2).

TopHat Question

What is the electric potential at point P for the arrangement of two charges shown to the right?



A. $585\,V$

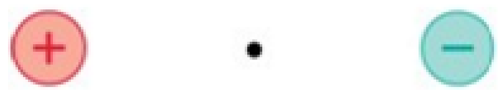
B. $135\,V$

C. $1600\,V$

D. $-140\,V$

TopHat question

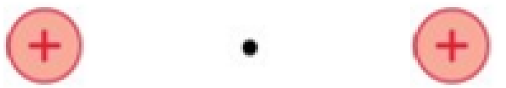
- At midpoint between the two equal, but opposite charges:



A. E=0 and V=0
B. E points to the right 0 and V>0
C. E points to the left and V<0
D. E points to the right 0 and V=0
E. E points to the left and V=0

TopHat question

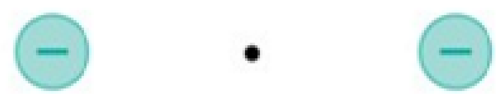
- At midpoint between the two equal positive charges



A. E=0 and V=0
B. E>0 and V>0
C. E=0 and V>0
D. E<0 and V<0
E. E=0 and V<0

TopHat question

- At midpoint between the two equal negative charges



A. $E=0$ and $V=0$
B. $E>0$ and $V>0$
C. $E=0$ and $V>0$
D. $E<0$ and $V<0$
E. $E=0$ and $V<0$

Potential of the line of charge