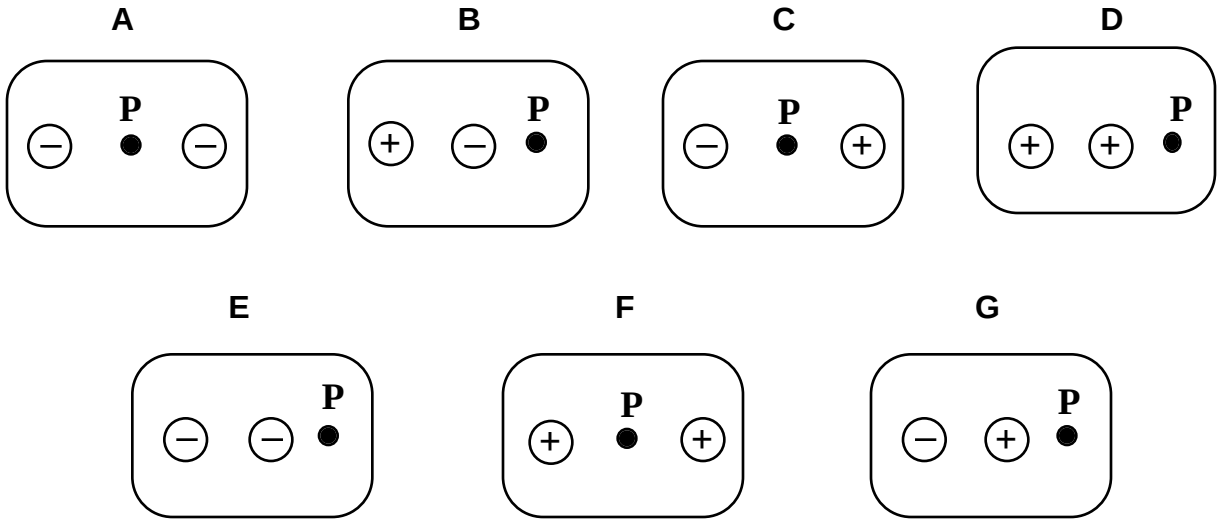
Two Electric Charges—Electric Force [126]

Given below are seven arrangements of two electric charges. In each figure, a point labeled P is also identified. All of the charges are the same size, 20 C, but they can be either positive or negative. The charges and point P all lie on a straight line. The distances between adjacent items, either between two charges or between a charge and point P, are all 5 cm. There are no other charges in this region. For this problem, we are going to place a +5 C charge at point P.

Rank these arrangements from greatest to least on the basis of the strength of the electric force on the +5 C charge when it is placed at point P. That is, put first the arrangement that will exert the strongest force on the +5 C charge at point P, and put last the arrangement that will exert the weakest force on the +5 C charge when it is placed at point P.



Strongest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____ Weakest

Or, all of these arrangements exert the same strength force on the +5 C charge. _____

Or, all of these arrangements will exert zero force on the +5 C charge. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[126] D. Maloney

Three Linear Electric Charges—Electric Force[127]

Given below are arrangements of three fixed electric charges. In each figure, a point labeled P is also identified. All of the charges are the same size charge, *q*, but they can be either positive or negative as indicated. The charges and point P all lie on a straight line. The distances between adjacent items, either between two charges or between a charge and point P, are all the same. There are no other charges in this region. A test charge, +*Q*, is placed at point P.

Rank these arrangements from greatest to least on the basis of the strength (magnitude) of the electric force on the test charge, +*Q*, at P.

A

B 

C 

D 

E 

F 

Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Least

Or, all of these arrangements exert the same magnitude force on the +*Q* test charge. _____

Or, all of these arrangements will exert zero force on the +*Q* test charge. ___

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

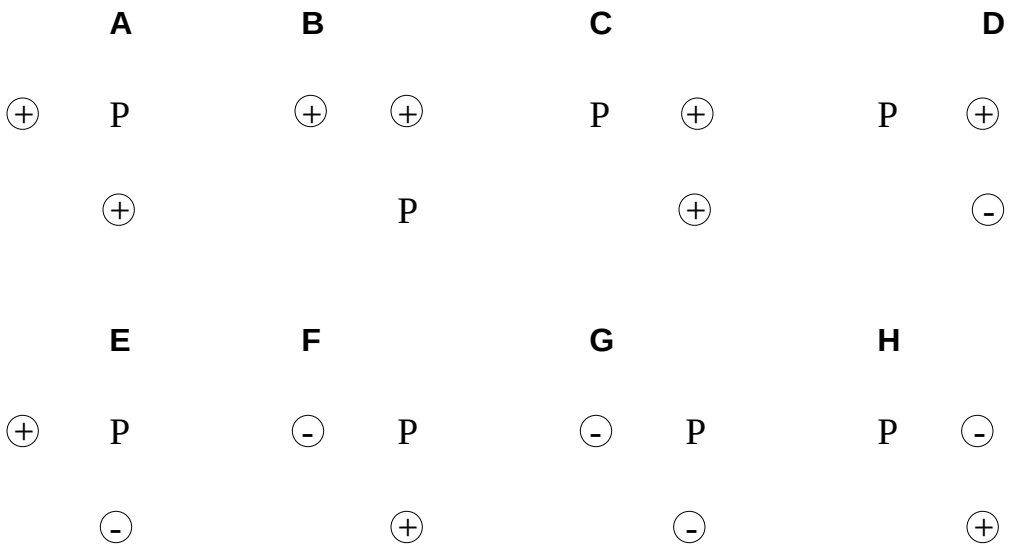
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[127] T. O'Kuma

Two Nonlinear Electric Charges—Electric Force[128]

Given below are arrangements of two fixed electric charges. In each figure, a point labeled P is also identified. All of the charges are the same size, *q*, but they can be either positive or negative as indicated. The distances between adjacent items, either between two charges or between a charge and point P, are all the same. There are no other charges in this region. For this problem, we are going to place a test charge,+*Q* , at point P.

Rank these arrangements from greatest to least on the basis of the strength (magnitude) of the electric force on the test charge, +*Q*, at P.



Greatest 1___ 2____ 3____ 4____ 5____ 6____ 7____ 8____ Least

Or, all of these arrangements exert the same magnitude force on the +*Q* test charge._____

Or, all of these arrangements will exert zero force on the +*Q* test charge. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

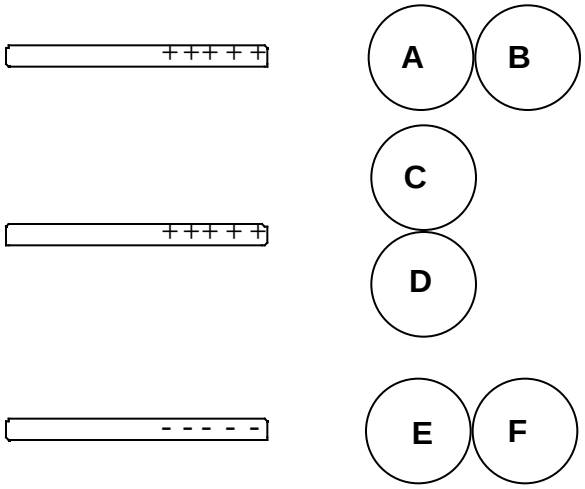
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[128] T. O'Kuma

Induced Charges—Near a Charged Rod [136]

A (positively or negatively) charged rod is brought up to the same distance from each set of metal spheres as shown in separate situations below. The spheres in each pair are initially in contact, but they are then separated while the rod is still in place. Then the rod is removed.

Rank the net charge on each sphere from most positive to most negative after the spheres have been separated and the charged rod removed.



Positive 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Negative

Or, all spheres have the same charge. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

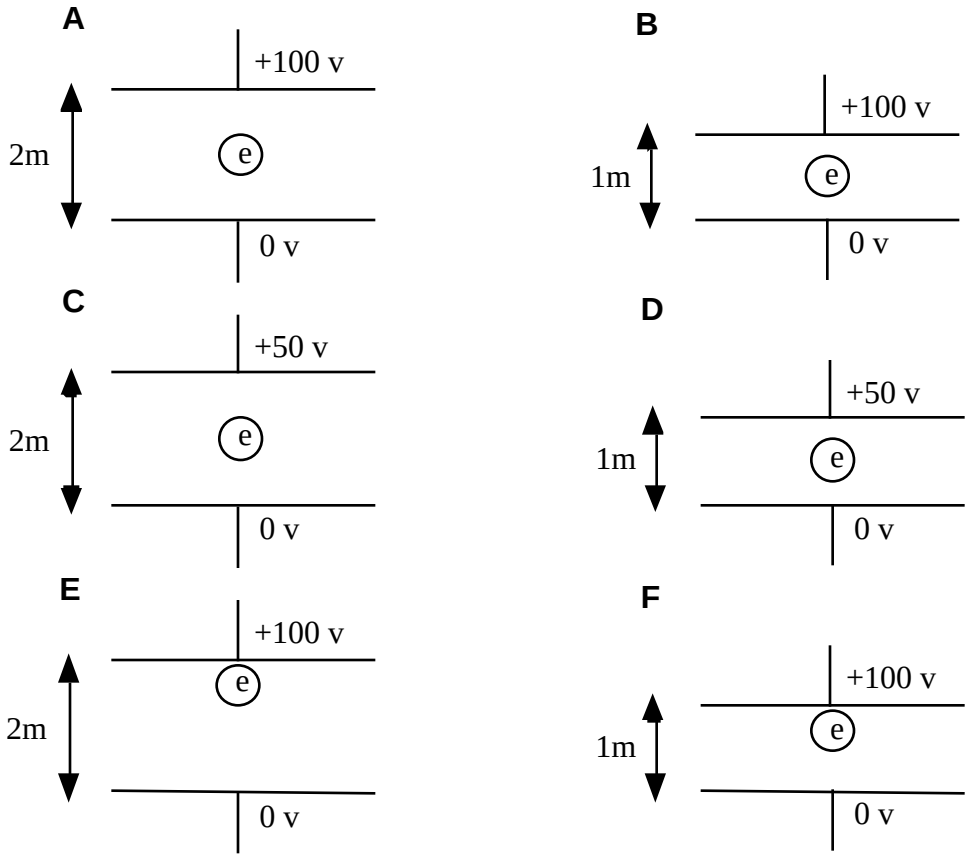
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[136] B. Emerson, C. Hieggelke, D. Maloney, T. O'Kuma

Electron Within a Charged Capacitor—Force on the Electron [144]

Consider an electron between the plates of a charged capacitor. The figures below show situations where the potential across the capacitor, and the separations between the capacitor plates, vary. Specific values are given in each figure.

Rank according to the magnitude of the force felt by the electron.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, all of the forces are the same strength. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

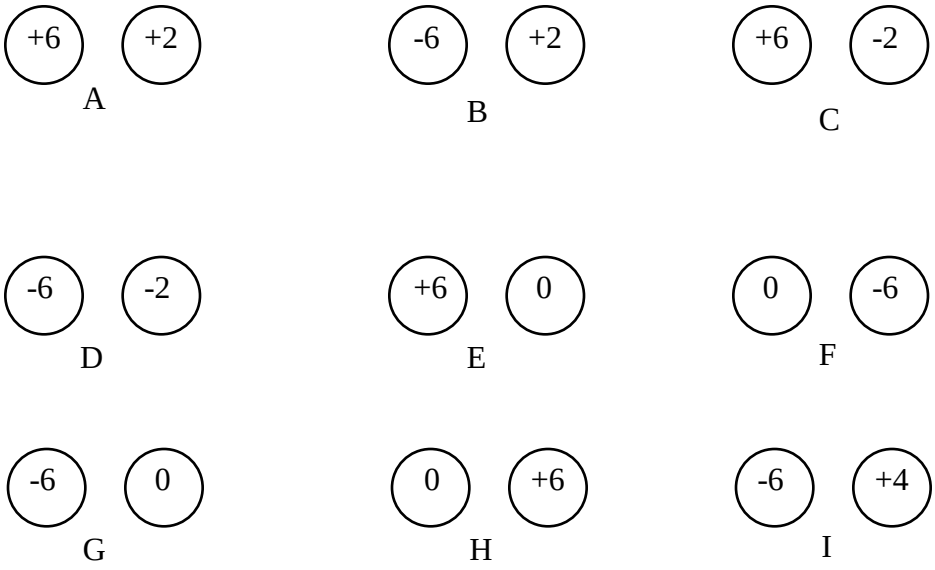
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[144] A. Van Heuvelen, S. Heath, B. Willis, L. Bryant

Transfer of Charge in Conductors—Left Conductor [145]

In each of the following situations two conducting spheres with the same size are shown with an initial given number of units of charge. The two spheres are brought into contact with each other. After several moments the spheres are separated.

Rank the situations as to the quantity of charge on the first (left) sphere from the highest positive charge to the lowest negative charge after they have been separated. (Note that -6 is lower than -2.)



Highest 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ Lowest

Or, the charge on the first (left) sphere after contact will be the same for all cases._____

Or, the first (left) sphere after contact will have no charge for all cases._____

Please carefully explain your reasoning.

How sure were you of your ranking? (Circle one)

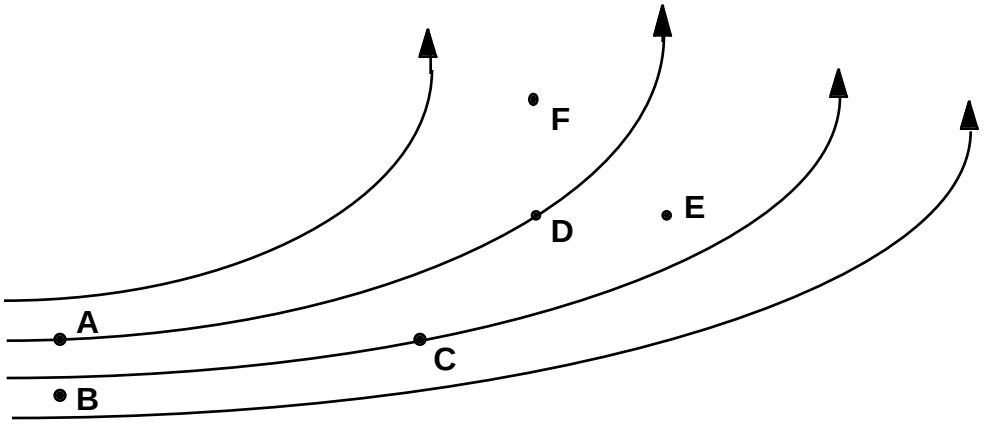
Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[145] J. Gundlach, B. Kaasa, U. Pandey, M. West

Non-Uniform Electric Field—Electric Potential [147]

A non-uniform electric field is being represented below by electric field lines. Six points in this region are identified in this diagram.

Rank the electric potential of the marked points from greatest to least.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, all of these points have the same electric potentials._____

Please carefully explain your reasoning.

How sure were you of your ranking? (Circle one)

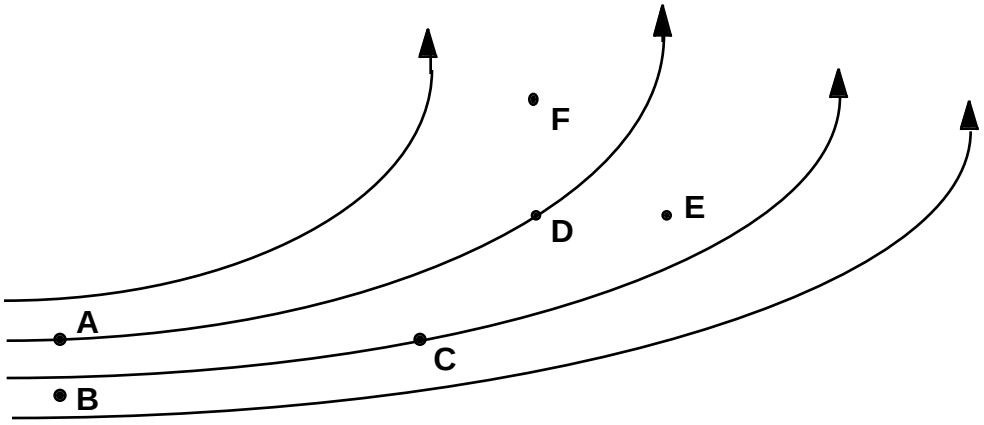
Guessed					Sure				Very Sure
1	2	3	4	5	6	7	8	9	10

[147] R. Johnson, B. Keramati, C. Lam, S. Savrda

Non-Uniform Electric Field—Electric Field Strength [148]

A non-uniform electric field is being represented below by electric field lines. Six points in this region are identified in this diagram.

Rank the strength (magnitude) of the electric field of the marked points from greatest to least.



Highest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Lowest

Or, the magnitude of the electric field is the same at all of these points._____

Please carefully explain your reasoning.

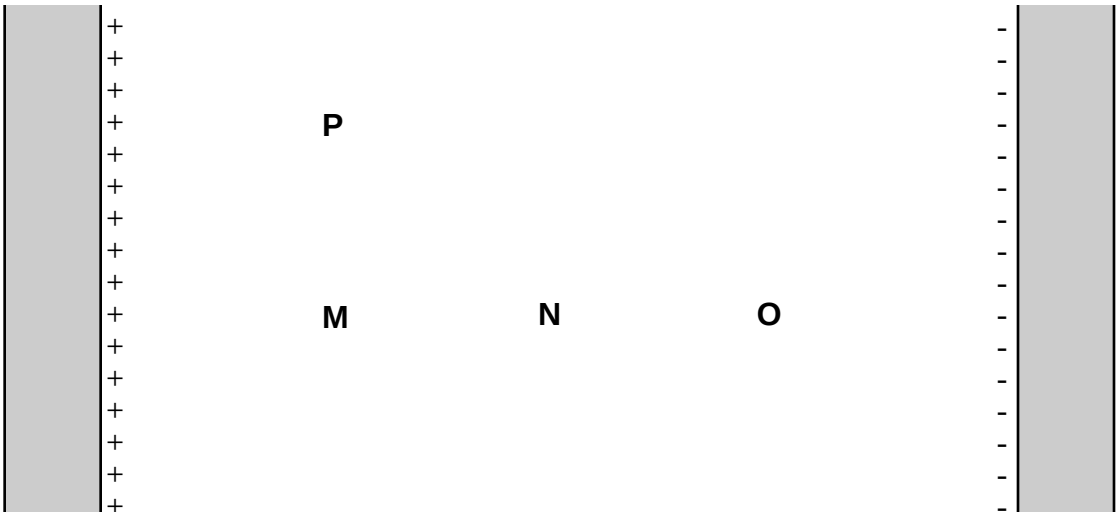
How sure were you of your ranking? (Circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[148] R. Johnson, B. Keramati, C. Lam, S. Savrda

Uniform Electric Field—Potential Difference[149]

Two parallel plates that have been charged create a uniform electric field of 30 N/C between the plates. Rank the electrical potential differences of all the different combinations listed below between the four points **M** at (2,0) m; **N** at (5, 0)m; **O** at (8,0) m; and **P** at (2, 3) m within this region. (Positive values are larger than negative values.)



Potential difference combinations that are to be ranked—

A: M to **N** **B**: **M** to **O** **C: N** to **O** **D**: **P** to **M** **E: P** to **N**
F: P to **O** **G: N** to **M** **H: M** to **P**

Highest 1____ 2____ 3____ 4____ 5____ 6____ 7____ 8____Lowest

Or, all the combinations have the same potential difference._____

Please carefully explain your reasoning.

How sure were you of your ranking? (Circle one of the following.)

Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

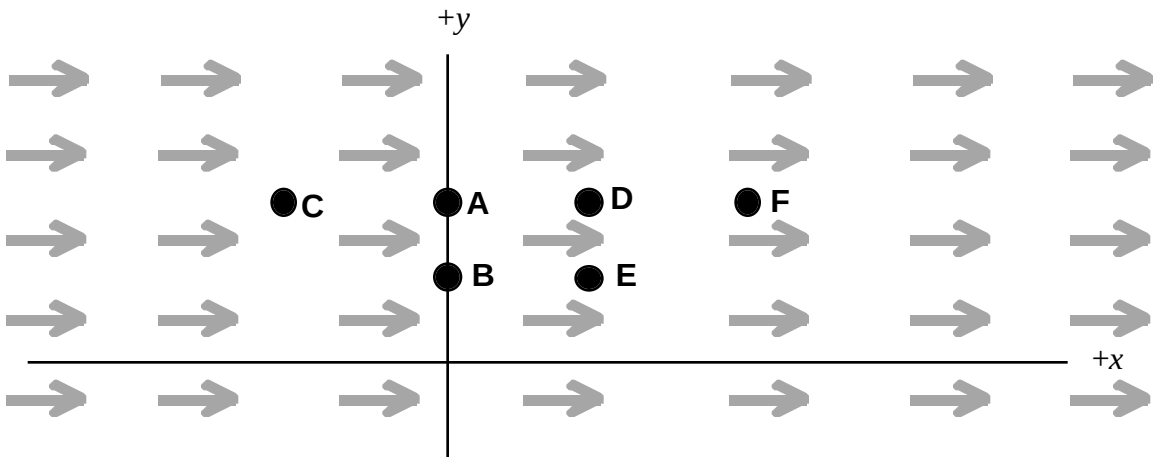
[149] A. Dickison, C. Ezrailson, M. Plumb, D. Ting

Uniform Electric Field—Electric Potential at Different Points II [153]

We have a large region of space that has a uniform electric field in the $+x$ direction ($\Rightarrow$) as indicated by the arrows in the diagram below. At the point (0,0) m, the electric field is 30 **i** N/C and the electric potential is 100 volts.

Rank the electric potential from greatest to least at the following points within this region.

A: (0, 6) m **B**: (0, 3) m **C**: (-3, 6) m **D**: (3, 6) m **E**: (3,3) m **F**: (6, 6) m



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, all the points have the same electric potential. _____
Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

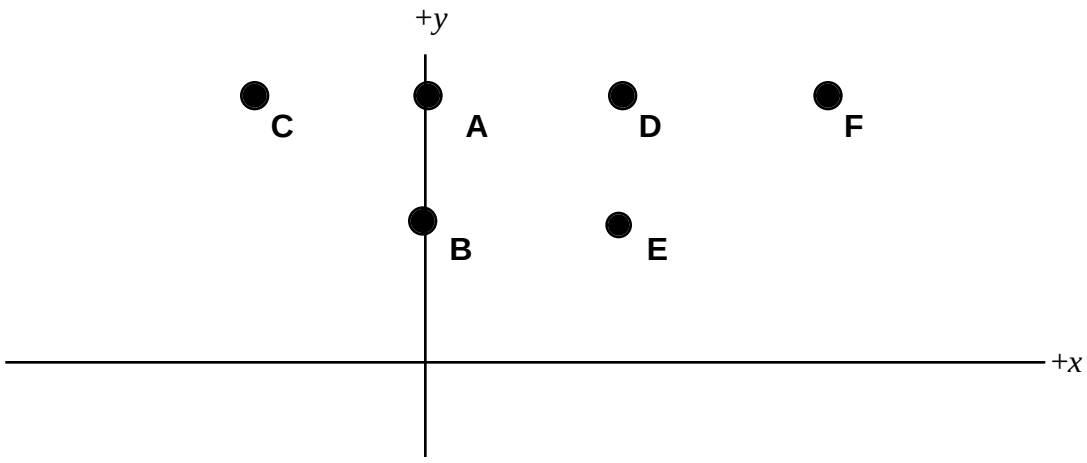
[153] C. Hieggelke

Uniform Electric Field—Potential Energy of a Negative Charge[155]

We have a large region of space that has a uniform electric field in the $+x$ direction ($\Rightarrow$). At the point (0,0) m, the electric field is 30 **i** N/C and the electric potential is 100 volts.

Rank the points specified below on the basis of the electric potential energy of a single negative charge of -5 C that may be placed at these points.

A: (0, 6) m **B**: (0, 3) m **C**: (-3, 6) m **D**: (3, 6) m **E**: (3,3) m **F**: (6, 6) m



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, the –5 C charge would have the same electric potential energy at all of these points. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

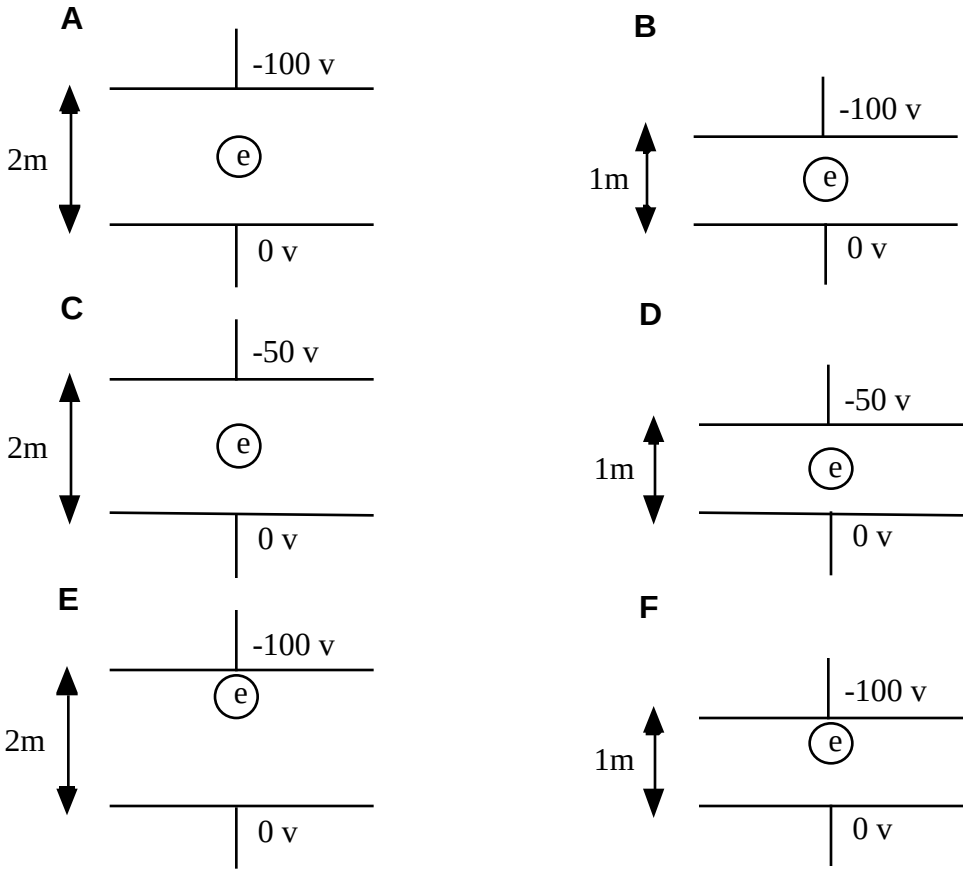
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[155] C. Hieggelke

Electron Within a Charged Capacitor—Electric Potential Energy [158]

Consider an electron between the plates of a charged capacitor. The figures below show situations where the potential across the capacitor, and the separations between the capacitor plates, vary. Specific values are given in each figure.

Rank according to the magnitude of the electric potential energy of the electron.



Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, all of the electric potential energies are the same. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed				Sure				Very Sure	
1	2	3	4	5	6	7	8	9	10

[158] A. Van Heuvelen, S. Heath, B. Willis, L. Bryant, D. Maloney, T. O'Kuma