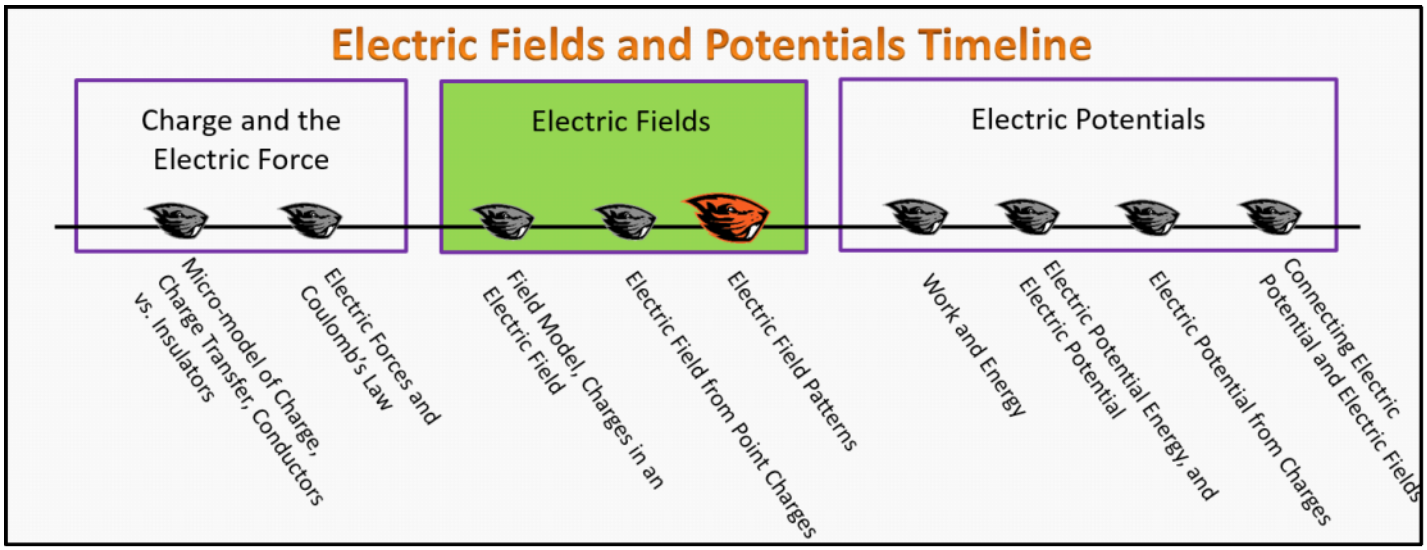
EP.L2.2 - Template

Thursday, March 29, 2018 8:34 PM

Electric Potentials
Foundation Stage (EP.L2.2)

Lecture 2
Electric Potential Field Patterns



Textbook Chapters (* Calculus version)

- **BoxSand** :: KC videos (Electric Fields)
- **Knight** (College Physics : A strategic approach 3rd) :: 20.5 ; 20.6 ; 20.7
- ***Knight** (Physics for Scientists and Engineers 4th) :: 23.2 ; 23.7 ; 24.6
- **Giancoli** (Physics Principles with Applications 7th) :: 16-8 ; 16-9

Warm up

EP.L2.2-1:

Description: Open ended question about how strength of electric field varies with distance.

Learning Objectives: [?] - Can you identify the objectives from the previous lecture, and this lecture, that this question is relevant to?

Problem Statement: Do you agree with the following statement: The strength of the electric field drops off as $1/r^2$ from any charge distribution where **r** is the distance from the charge to the location in space you are measuring the field. Discuss with your neighbors your thoughts on this.

Selected Learning Objectives

1. Coming soon to a lecture template near you.

Key Terms

- Unit vector
- Charge distribution
- Continuous charge distribution

Key Equations

Key Concepts

- Coming soon to a lecture template near you.

Questions

Act I: Rules and Regulations

EP.L2.2-2:

Description: Equipotential line rules. (1 minute + 1 minute + 4 minutes)

Learning Objectives: [?]

Problem Statement: Equipotential lines. (Assume statics)

(a) Where can Equipotential field lines start? (Assume statics)

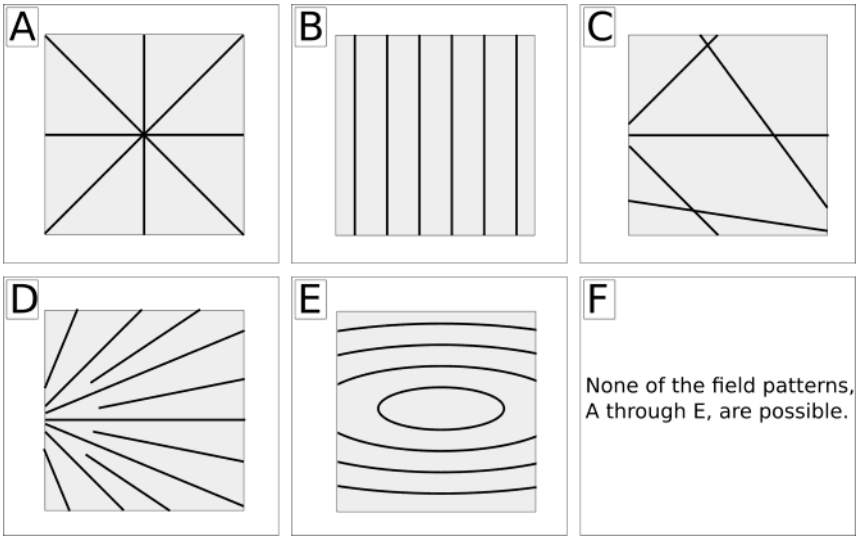
(1) Anywhere
(2) Negative Charges
(3) Positive Charges
(4) Infinity
(5) Have no starting point, they are loops.

(b) Where can Equipotential field lines end? (Assume statics)

(1) Anywhere
(2) Negative Charges
(3) Positive Charges
(4) Infinity
(5) Have no starting point, they are loops.

(c) Consider the five equipotential patterns shown below. Assuming there are no charges in the regions shown, which of the patterns represent(s) a possible electric potential field.

(1) A
(2) B
(3) C
(4) D
(5) E
(6) F



EP.L2.2-4:

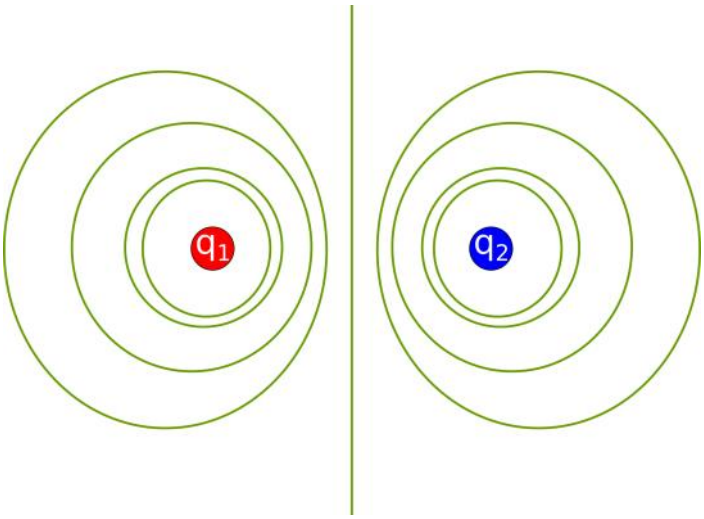
Description: Compare relative amount of charge given equipotential pattern. (2 minutes + 2 minutes)

Learning Objectives: [?]

Problem Statement: Consider the charge distributions and their electric potential field shown below.

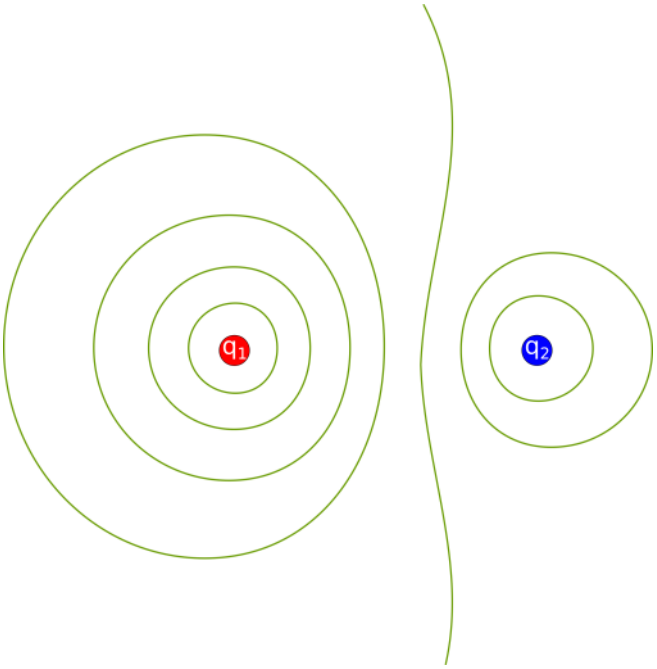
(a) The charge $\mathbf{q_1}$ on the left is $\mathbf{q_1} = \mathbf{q}$. What is the sign and magnitude of the charge $\mathbf{q_2}$ on the right?

(1) **q**
(2) -**q**
(3) 2**q**
(4) -2**q**
(5) **q**/2
(6) -**q**/2



(b) The charge $\mathbf{q_1}$ on the left is $\mathbf{q_1} = \mathbf{q}$. What is the sign and magnitude of the charge $\mathbf{q_2}$ on the right?

(1) **q**
(2) -**q**
(3) 2**q**
(4) -2**q**
(5) **q**/2
(6) -**q**/2



Act II: Symmetries

EP.L2.2-5:

Description: Match charge distribution given equipotential pattern. (4 minutes + 1 minute)

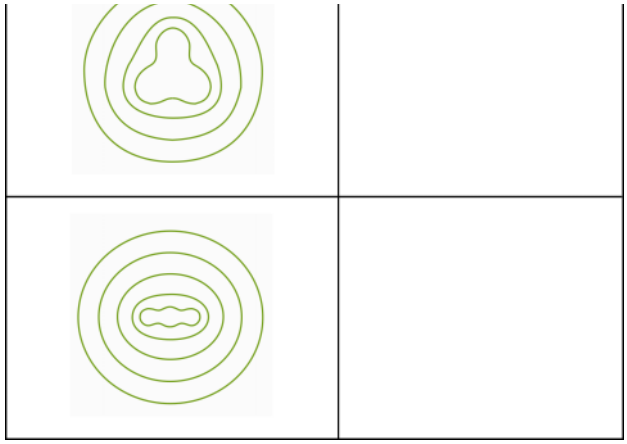
Learning Objectives: [?]

Problem Statement: Shown below are three charge distributions and their corresponding electric potential field patterns.

(a) Match each distribution of charge to the potential field pattern it produces.

Charge Distributions		
A	B	C
q q q	-q -q -q	-q q q

Electric Potential Patterns	Charge Distributions
	
	



EP.L2.2-6:

Description: Determine direction of electric field at center of shell with uniform charge distribution. (2 minutes)

Learning Objectives: [?]

Problem Statement: A positively charged hollow spherical shell of radius **R** has charge uniformly distributed across its 3-D surface. What can be said about the electric potential at the center?

(1) Points left.
(2) Points right.
(3) Points up.
(4) Points Down.
(5) Is < 0 , 0 , 0 > V.
(6) Is positive.
(7) Is negative.

EP.L2.2-7:

Description: Match strength of electric field dependence on distance given charge distribution and electric field patterns. (3 minutes)

Learning Objectives: [?]

Problem Statement: Below is multiple views of the equipotential line representation of a point charge, infinite line of uniform charge, and an infinite sheet of uniform charge. Match these electric potentials with their dependence on the distance **r** from the charge.

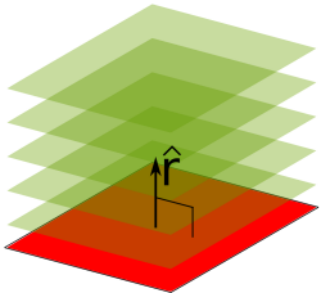
(1) **V** proportional to **r**

(2) **V** proportional to 1/**r**

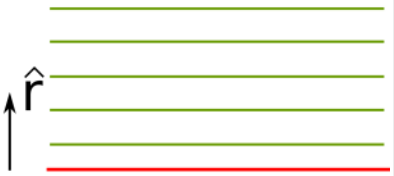
(3) **V** proportional to ln(1/**r**)

Point Charge

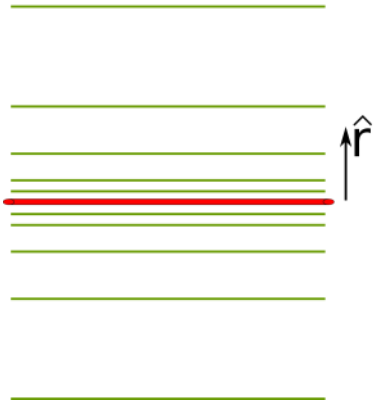
Infinite Sheet of Charge (Perspective)



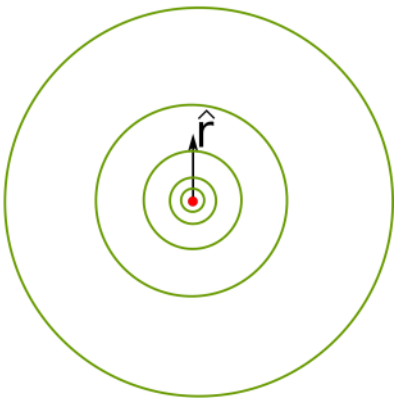
Infinite Sheet of Charge (Side)



Infinite Line of Charge (Side)



Infinite Line of Charge (Down the Line)



Act III: Energy Analysis

EP.L2.2-09:

Description: Energy analysis with electric potential, unknown charge distribution. (5 minutes)

Learning Objectives: [?]

Problem Statement: A 3.00 kg sphere charged up to -2.00 C moves from a region where the electric potential is 4.00 V to a location where it is 14.0 V. If the sphere was moving at an initial speed of 10 m/s, what is the final speed? Ignore gravitational effects.

EP.L2.2-10:

Description: Energy analysis with electric potential, point charge and uniform e-field. (8 minutes)

Learning Objectives: [?]

Problem Statement: A 3.00 kg sphere charged up to -2.00 C is dropped from rest 8.00 meters above the surface of the Earth. An apparatus is set up to produce a uniform electric field of 5.00 N/C, directed vertically upwards, in the region of space that the sphere falls through. What is the speed of the sphere the moment before it hits the ground?

EP.L2.2-11:

Description: Energy analysis with electric potential, two point charges . (6 minutes)

Learning Objectives: [?]

Problem Statement: A 3.00 kg sphere charged up to -2.00 mC is initially at rest and 25.2 m away from a negatively charged sphere of -7.00 mC that is fixed in space and cannot move. What is the speed of the 3.00 kg sphere when it is really far away from the fixed sphere? Ignore gravitational effects.

Conceptual questions for discussion

1. Coming soon to a lecture template near you.

Hints

EF.2.L2-1: No hints.

EF.2.L2-2: No hints.

EF.2.L2-3: No hints.

EF.2.L2-4: No hints.

EF.2.L2-5: No hints.

EF.2.L2-6: No hints.