

Finding Potentials From Fields

1) Consider the vector field in rectangular coordinates:

$$\vec{E} = \frac{q}{4\pi\epsilon_0} [(2xy^3z + z)\hat{x} + (3x^2y^2z)\hat{y} + (x^2y^3 + x)\hat{z}]$$

a) Have each member of your group take one of the components of this electric field and use it to find as much information as possible about the potential from which the field might come.

b) Compare the answers of your group members. Does this field come from a potential? If it does, what is the potential? Is there any freedom in your answer?

c) Could this vector field be the electric field of a static collection of charges? If it could be, can you say what static collection of charges would produce this field?

2) Consider the vector field in rectangular coordinates:

$$\vec{E} = \frac{q}{4\pi\epsilon_0}(-y\hat{x} + x\hat{y})$$

a) Have each member of your group take one of the components of this electric field and use it to find as much information as possible about the potential from which the field might come.

b) Compare the answers of your group members. Does this field come from a potential? If it does, what is the potential? Is there any freedom in your answer?

c) Could this vector field be the electric field of a static collection of charges? If it could be, can you say what static collection of charges would produce this field?

3) Consider the vector field in cylindrical coordinates:

$$\vec{E} = \frac{q}{4\pi\epsilon_0} \left(\frac{r\hat{r}}{(r^2 + z^2)^{3/2}} + \frac{z\hat{z}}{(r^2 + z^2)^{3/2}} \right)$$

a) Have each member of your group take one of the components of this electric field and use it to find as much information as possible about the potential from which the field might come.

b) Compare the answers of your group members. Does this field come from a potential? If it does, what is the potential? Is there any freedom in your answer?

c) Could this vector field be the electric field of a static collection of charges? If it could be, can you say what static collection of charges would give this field?

4) Consider the vector field in cylindrical coordinates:

$$\vec{E} = \frac{q}{4\pi\epsilon_0} (r\hat{\phi})$$

a) Have each member of your group take one of the components of this electric field and use it to find as much information as possible about the potential from which the field might come.

b) Compare the answers of your group members. Does this field come from a potential? If it does, what is the potential? Is there any freedom in your answer?

c) Could this vector field be the electric field of a static collection of charges? If it could be, can you say what static collection of charges would give this field?

5) Sketch the vector fields for each of the problems. Compare the vector field from problem 2 with the vector field from problem 4. What do they have in common?