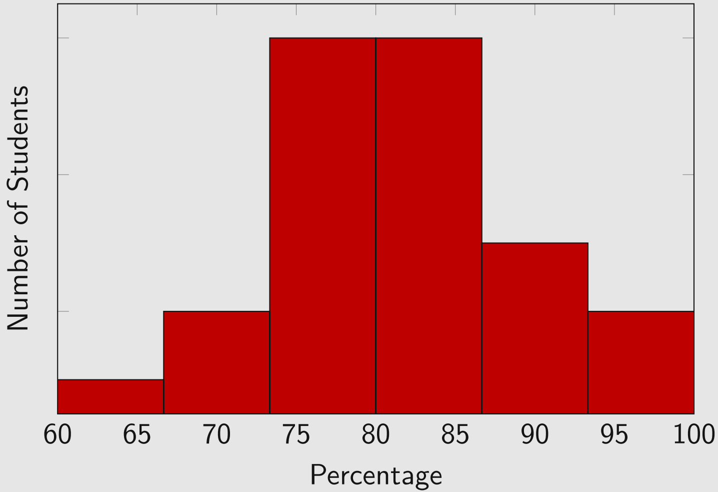
Announcements

- Congrats to Ricky for making the best maze solver last Thursday!
    - And congrats to Cassie for being the bold person to solve a large one by hand!
    - You can still get in on the fun at `http://jrembold.github.io/code_challenge`
- Exam 1 is getting handed back!
    - You can add 1 to your score
- Homework 7 is due tonight!
- Starting Chapter 5 on Wednesday. Read 5.1

Test Results

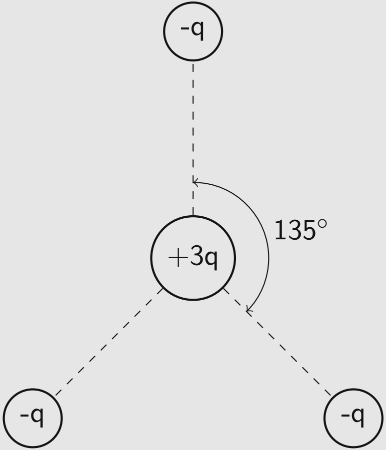


- High: 96%
- Mean: 80%
- Median: 81%

Question 1

55%

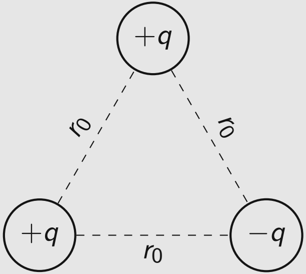
For the below symmetric charge distribution, what r dependence would the *electric field* have far from the charges?



Question 2

72.5%

What is the total energy contained in the below system of charges?



Question 3

53.7%

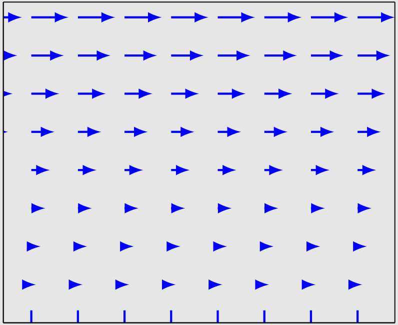
Write down an expression for the volume charge density, $\rho(\vec{\boldsymbol{r}})$, of a system containing all of the following:

- A charge of $+2q$ located at $\vec{\boldsymbol{r}} = (2, 2, 0)$
- A charge of $-q$ located at $\vec{\boldsymbol{r}} = (5, 0, 2)$
- A line charge with density λ_0 which extends infinitely in the $\hat{\boldsymbol{y}}$ direction and passes through the point $\vec{\boldsymbol{r}} = (-1, 0, -3)$.

Question 4

Can the vector field below have a consistent corresponding “potential” defined? Why or why not?

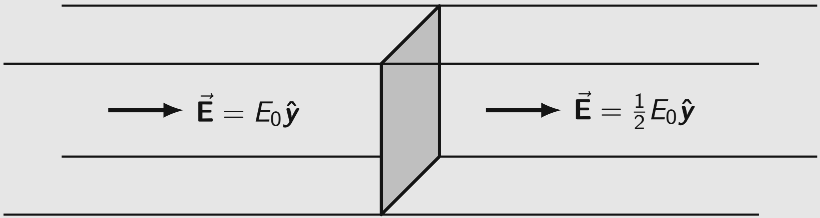
General Vector Field



Question 5

82%

A large rectangular pipe has charge spread along the exterior that drives a uniform electric field through the pipe as shown. In the middle of the pipe lies a sheet (insulated from the sidewalls). To the left of the sheet the electric field has a magnitude of E_0, to the right of the sheet the magnitude of the electric field is $\frac{E_0}{2}$. What is the surface charge density of the sheet in the center (far from the sidewalls)? What overall concept did you employ to find your answer?



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Question 6

68%

An electric field is described by:

$$\vec{\mathbf{E}} = E_0 \left(3y\hat{\boldsymbol{x}} + (3x - 2y\sin(z))\,\hat{\boldsymbol{y}} - y^2\cos(z)\hat{\boldsymbol{z}} \right)$$

What is the potential difference when moving from the point $\vec{\boldsymbol{r}}_1 = 4\hat{\boldsymbol{x}} + 2\hat{\boldsymbol{y}}$ to $\vec{\boldsymbol{r}}_2 = 6\hat{\boldsymbol{x}} + 2\hat{\boldsymbol{y}} + \pi\hat{\boldsymbol{z}}$?

Question 7

88.6%

The general solution for spherical separation of variables is

$$V(r,\theta) = \sum_{\ell=0}^{\infty} \left(A_\ell r^\ell + \frac{B_\ell}{r^{\ell+1}} \right) P_\ell(\cos\theta)$$

Given that the potential on the surface of a sphere is given by:

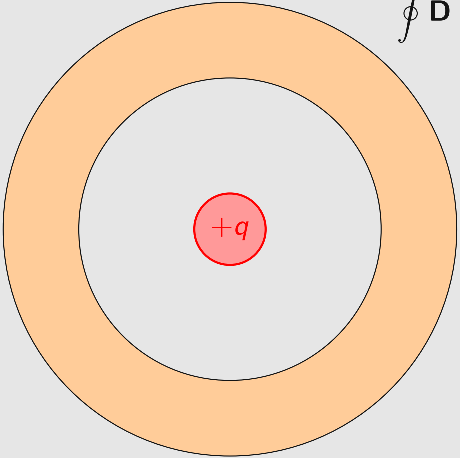
$$V(R,\theta) = V_0 \left(3\cos^2\theta + 4\cos\theta - 1 \right)$$

Write down the final solution of the potential inside the sphere. (*Your answer should only depend on constants and* r *and* θ*, not in terms of Legendre polynomials.*)

Q1

A point charge $+q$ is placed at the center of a neutral, linear homogeneous dielectric teflon spherical shell. Can $\vec{\mathbf{D}}$ be computed from its divergence?

$$\oint \vec{\mathbf{D}} \cdot d\vec{\mathbf{A}} = Q_{free}$$



A. Yes
B. No
C. Depends on information not given

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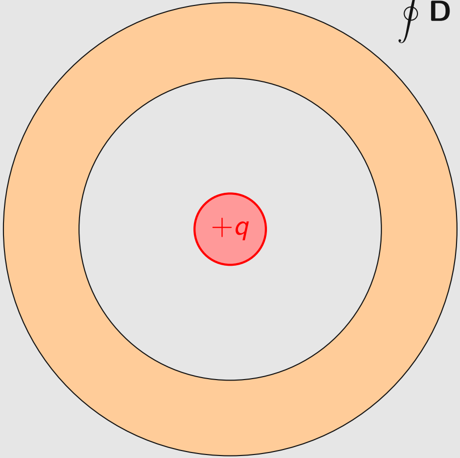
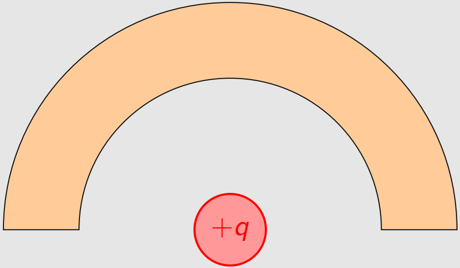


A. Yes
B. No
C. Depends on information not given

Q2

A point charge $+q$ is placed at the center of a neutral, linear, homogeneous, dielectric hemispherical shell. Can $\vec{\mathbf{D}}$ be computed from its divergence?



A. Yes
B. No
C. Depends on information not given

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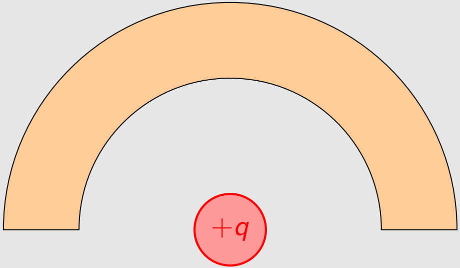

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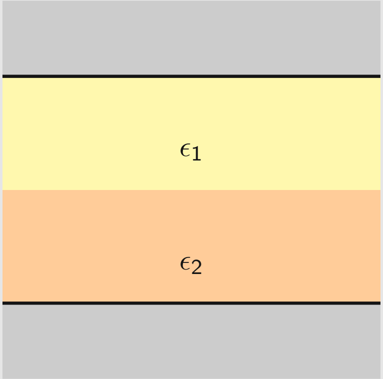
Q3

Suppose you have two large conducting plates which have some potential difference ΔV applied between them. In the region between the plates, you have inserted *two* different dielectrics. When you go to solve Laplace's equation for the region between the plates, how many different boundary conditions do you have?

A. 2
B. 3
C. 4
D. 6



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