ECE 2300
Recitation Class 3

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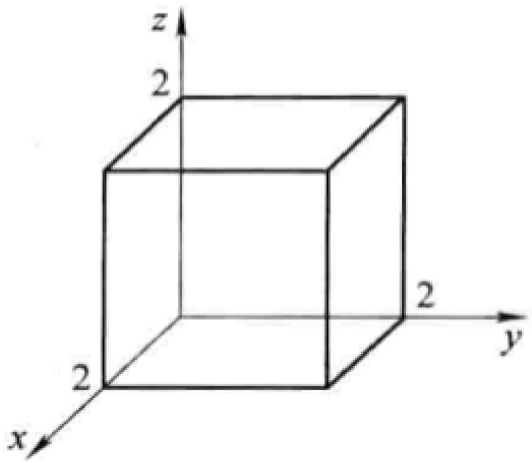
Pre-class

- Quiz Graded.
  - No quiz this week, Quiz 2 next week.
- Homework 2 due tomorrow.
  - Not graded, but recommend you to do it.

3.1 Quiz 1 Answers

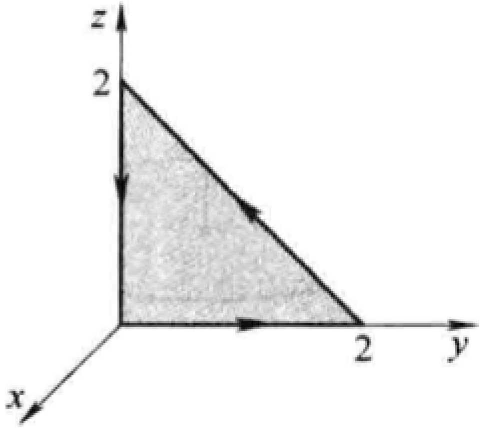
Question 1

(a) Use the cube of side length 2 in the following picture and function $\boldsymbol{v} = (xy)\hat{\boldsymbol{x}} + (2yz)\hat{\boldsymbol{y}} + (3xz)\hat{\boldsymbol{z}}$ to verify the divergence theorem.



3.1 Quiz 1 Answers

(b) Use the triangle in the following picture and function $\boldsymbol{v} = (xy)\hat{\boldsymbol{x}} + (2yz)\hat{\boldsymbol{y}} + (3xz)\hat{\boldsymbol{z}}$ to verify Stokes' theorem.



3.1 Quiz 1 Answers

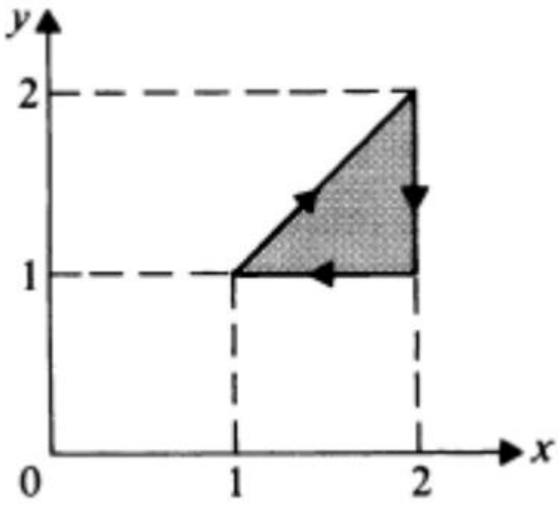
Question 2

Assume the vector function $\mathbf{A} = \mathbf{a}_x 3x^2y^3 - \mathbf{a}_y x^3y^2$.

(a) Find $\oint \mathbf{A} \cdot d\ell$ around the triangular contour shown in the following figure.

(b) Evaluate $\int (\nabla \times \mathbf{A}) \cdot d\mathbf{s}$ over the triangular area.

(c) Can $\mathbf{A}$ be expressed as the gradient of a scalar? Explain.



3.2 Recap - Electro Statistic Fundamentals

- Coulomb’ s Law:

3.2 Recap – Maxwell’s Description

- Gauss’s Law:
  - Equation:
  - When to use?
  - How to use?
    - Step1:
    - Step2:
    - Step3:

Recap Ex.

A total charge Q is put on a thin spherical shell of radius b. Determine the electric field intensity at an arbitrary point inside the shell

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3.2 Recap – Maxwell's Description

- Some Important Results:

different models	E(magnitude)
infinitely long, line charge	$E = \frac{\rho_\ell}{2\pi r \epsilon_0}$
infinite planar charge	$E = \frac{\rho_s}{2\epsilon_0}$
uniform spherical surface charge with radius R	$\begin{cases} E = 0 (r < R) \\ E = \frac{Q}{4\pi r^2 \epsilon_0} (r > R) \end{cases}$
uniform sphere charge with radius R	$\begin{cases} E = \frac{Qr}{4\pi R^3} (r < R) \\ E = \frac{Q}{4\pi r^2 \epsilon_0} (r > R) \end{cases}$
infinitely long, cylindrical charge with radius R	$\begin{cases} E = \frac{\rho_v r}{2\epsilon_0} (r < R) \\ E = \frac{\rho_v R^2}{2r\epsilon_0} (r > R) \end{cases}$

3.3.1 Electrical Potential

- Definition:

- Expression:
  - Differential form:
  - Integration form:

3.3.2 Electrical Potential For Common Models

- Line:

- Surface:

- Volume:

Ex.1 Electric Potential

Obtain a formula for the electric field intensity and potential on the axis of a circular disk of radius b that carries a uniform surface charge ρ_s.

3.4.1 Conductors

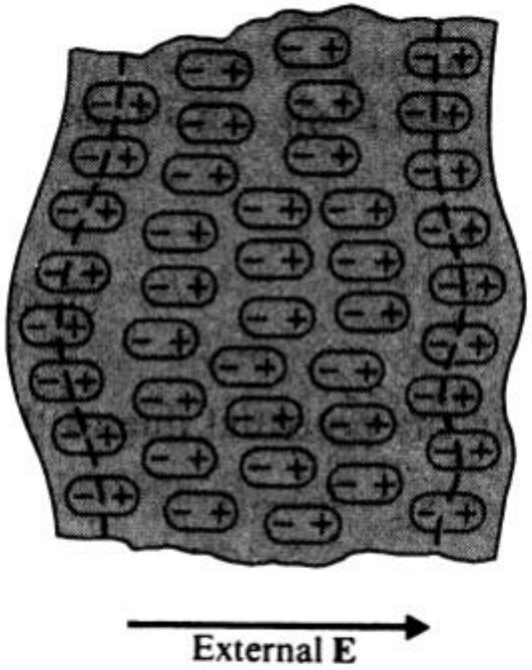
- Definition:

3.4.1 Conductors

- Characteristics:
  - Inside:
  - Surface:
  - Outside:

3.4.2 Dielectrics

- Definition:



3.4.2 Dielectrics

- Polarization vector:
  - Defined with dipole moment:
  - Density of dipole moment in a unit volume:

3.4.2 Dielectrics

- Characteristics:
  – Surface Charge Density

3.4.2 Dielectrics

- Characteristics:
  - Volume Charge Density

Ex.2 Conductors

Example. 3-11 A postive point charge Q is at the center of a spherical conducting shell of an inner radius R_i and an outer radius R_0. Determine $\boldsymbol{E}$ and V as functions of the radial distance R.

Ex.3 Dielectrics

(HW3-2) Determine the electric field intensity at the center of a small spherical cavity cut out of a large block of dielectric in which a polarization $\mathbf{P}$ exists.

Thank You

Credit to Deng Naihao for this slides & information