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Module: Electricity and Magnetism

Final Exam

Exercise 1: (13 pts)

Answer with True or False (and correct the statement if it is false):

1) Electrostatics studies moving point charges.
2) The unit of the electric field is V·m.
3) The unit of the Coulomb force is $N \cdot C^{-1}$.
4) Electrostatic interaction can be repulsive.
5) Electrostatic interaction can be attractive.
6) The force **F** acting on a particle of charge **q** placed at a point **A** in an electrostatic field is related to the field **E** by the relation: $\vec{E} = q\vec{F}$
7) In an electric dipole, the direction of the electric field goes from the positive charge (+) to the negative charge (−).
8) The displacement vector in cylindrical coordinates is: $\overrightarrow{dl} = dr\overrightarrow{u_r} + d\theta\overrightarrow{u_\theta} + dz\vec{k}$

Choose or circle the correct answer:

9) The force between two like charges q_1 and q_2 **is:**

a) Repulsive if: $q_1 \times q_2 > 0$ b) Zero if the distance between q_1 and q_2 is zero c) Attractive if $q_1 \times q_2 < 0$

10) What is an equipotential surface?

a) A surface where the electric field is zero everywhere. b) A surface where the electric potential is constant.
c) A surface where charges can move freely. d) A surface where the electric potential increases linearly.

11) Which of the following is the correct expression for the scalar Laplacian :

a) $\nabla f = \frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z}$ b) $\nabla \cdot f = \frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z}$ c) $\Delta f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$ d) $\nabla \times f = 0$

12) Green-Ostrogradsky Theorem:

a) $\oiint \vec{A}.\overrightarrow{dS} = \oiint \overrightarrow{rot}\vec{A}.d\vec{S}$ b) $\oiint \vec{A}.\overrightarrow{dS} = \iiint \overrightarrow{grad}\vec{A}.dV$ c) $\oiint \vec{A}.\overrightarrow{dS} = \iiint div\vec{A}.dV$

13) The electric dipole moment is defined as:

a) $\vec{p} = q \cdot \vec{d}$ b) $\vec{p} = \varepsilon_0 \cdot \vec{E}$ c) $\vec{p} = q \cdot \vec{r}^2$ d) $\vec{p} = \frac{q}{d}$

Exercise 2: (3 pts) Calculate the following quantities:

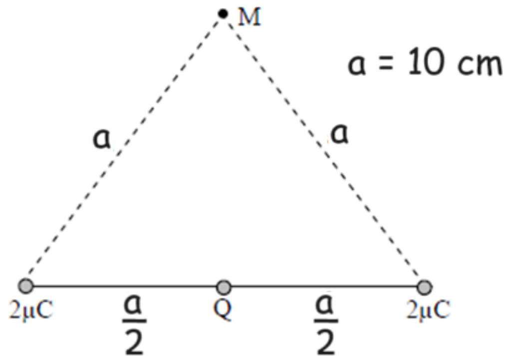
$f(x,y,z) = 3xyz^3 - 2y$ $\vec{A} = r.z\overrightarrow{u_r} + r.cos\theta\overrightarrow{u_\theta} + r.z^2\overrightarrow{u_z}$ $\vec{B} = r\overrightarrow{u_r} + r.cos\theta.sin\varphi\overrightarrow{u_\theta} + r.cos\varphi\overrightarrow{u_\varphi}$

$grad f = ...$ $div\vec{A} = ...$

$\overrightarrow{rot}\vec{B} = ...$

Exercise 3: (4 pts) Three point charges are aligned as shown in the figure.

1. Calculi the result Force at the charge Q ?
2. Calculate the value of charge Q so that the resulting electric field at point M is zero.
3. Calculate the electric potential at point M.



K= 8,987 × 10^9 N m^2 C^{-2}

Dr. Saidi Abdelkader **Good Luck**