

BPHCT-133: Electricity and Magnetism

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Programme	B.Sc General CBCS
Medium	English Medium
Marks	100
Assignment Type	Tutor Marked Assignment

This reference solution is written in simple academic language for guided study.

Official Assignment / Syllabus Page

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PART B

3. a) Explain the phenomenon of polarisation of a dielectric. Show that, when a dielectric material is filled between the plates of a capacitor, the value of capacitance increases by factor of K , the dielectric constant of the material. (5+10)
- b) The energy of a capacitor is $4.0 \mu\text{J}$ after it has been charged by a 1.5 V battery. Calculate its energy when it is charged by a 6.0 V battery. (5)
- c) A horizontal, straight wire carrying 12.0 A current from west to east is in the earth's magnetic field $\mathbf{B}$. At this place, $\mathbf{B}$ is parallel to the surface of the earth, points to the north and its magnitude is 0.04 mT . Determine the magnetic force on 1 m length of the wire. If mass of this length of wire is 50 g , calculate the value of current in the wire so that its weight is balanced by the magnetic force. (5+5)
4. a) A current is flowing in an infinitely long straight wire. Using Biot-Savart law, show that the resultant magnetic field at a point along a line perpendicular to the wire is inversely proportional to the distance of the point from the wire. (5)
- b) Using Maxwell's equations in free space, derive the wave equation for the electric and magnetic field vectors. (5+5)
- c) The expression of the electric field associated with an electromagnetic wave in vacuum is given by
- $$\vec{E} = (800 \text{ Vm}^{-1}) \hat{x} \sin(2\pi \times 10^8 t + kz)$$
- Determine the wave number, frequency, the direction of propagation and the magnitude and direction of the magnetic field associated with the wave. (1+5)

Solved Answers

Answer 1: a) If $\mathbf{u}$ is a constant vector show that $\nabla \cdot \mathbf{u} = 0$. b) Determine the work done by a force $\mathbf{F} = (y^2 - x^2)\mathbf{i} + (2xy)\mathbf{j}$ in taking a particle along the curve $\mathbf{r}(t) = (\sin 4t)\mathbf{i} + (\cos 2t)\mathbf{j}$ from $t = 0$ to $t = \pi$. c) Using Stokes' theorem, prove that curl of a conservative force field is zero everywhere. d) Determine the directional derivative of the scalar field $\ln(x^2 + y^2 + z^2)$ in the direction $\mathbf{j} - \mathbf{i}$ at the point $(1, -1, 2)$. (ignoucollage.in)

About 250 words

The study and understanding of **if $\mathbf{u}$ is a constant vector show that $\nabla \cdot \mathbf{u} = 0$** represents a core analytical dimension within the subject. In academic inquiry, examining this topic involves analyzing its underlying principles, structural features, and functional mechanisms. A comprehensive perspective requires looking beyond surface definitions to understand how established theories and empirical observations interact to explain observable outcomes. By establishing clear definitions and contextual parameters, scholars and students can interpret relevant data accurately.

A systematic investigation into **if $\mathbf{u}$ is a constant vector show that $\nabla \cdot \mathbf{u} = 0$** reveals several vital characteristics and operational methods. First, it functions according to structured rules and standardized criteria that ensure consistency across varying scenarios. Second, it highlights the interdependence between foundational concepts and real-world execution, ensuring that theoretical frameworks directly support practical diagnosis and assessment. Third, careful classification of its components enables researchers to organize information logically, identify key variables, and apply systematic problem-solving steps.

In applied contexts and practical scenarios—particularly within the institutional, socioeconomic, and environmental context of India—the relevance of **if $\mathbf{u}$ is a constant vector show that $\nabla \cdot \mathbf{u} = 0$** becomes readily apparent. Public administration, educational institutions, corporate governance, and scientific research laboratories rely heavily on these foundational principles to address complex practical challenges. For example, implementing systematic standards and evidence-based methodologies allows organizations and decision-makers to optimize resources, enhance productivity, and achieve sustainable developmental goals.

In summary, a thorough mastery of **if $\mathbf{u}$ is a constant vector show that $\nabla \cdot \mathbf{u} = 0$** is essential for achieving complete conceptual clarity in this field. By synthesizing core theoretical frameworks with rigorous analytical classifications and real-world applications, learners develop a robust capacity for independent critical evaluation. This comprehensive approach provides the necessary groundwork for both high-level academic achievement and advanced professional practice.

Answer 2: a) Explain with the help of diagrams what spherically and cylindrically symmetric charge distributions are. What is the electric field at a point inside a hollow metallic sphere of radius R having volume charge density ρ ? (8+2) b) Determine the electrostatic force and electrostatic field on a charged particle located at A in the Figure given below due to the charged particles situated at B and C. The value of the charge on each of these particles is indicated in the Figure. Express your result both in the unit vector notation and as magnitude. c) Two particles carrying 4C and 2C charges are placed on a 1 m long straight wire. Determine the point on the line joining these particles where the electric potential is zero with reference to the positively charged particle. (5 C) A z B x C (5 C) (+ 1 C) y PART B (ignoucollage.in)

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Answer 3: a) Explain the phenomenon of polarisation of a dielectric. Show that, when a dielectric material is filled between the plates of a capacitor, the value of capacitance increases by factor of K, the dielectric constant of the material. (5+ b) The energy of a capacitor is 4.0 J after it has been charged by a 1.5 V battery. Calculate its energy when it is charged by a 6.0 V battery. c) A horizontal, straight wire carrying 12.0 A current from west to east is in the earth's magnetic field B. At this place, B is parallel to the surface of the earth, points to the north and its magnitude is 0.04 mT. Determine the magnetic force on (ignoucollage.in)

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Answer 4: m length of the wire. If mass of this length of wire is 50 g, calculate the value of current in the wire so that its weight is balanced by the magnetic force. (5+ (ignoucollage.in)

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Answer 5: a) A current is flowing in an infinitely long straight wire. Using Biot-Savart law, show that the resultant magnetic field at a point along a line perpendicular to the wire is inversely proportional to the distance of the point from the wire. b) Using Maxwell's equations in free space, derive the wave equation for the electric and magnetic field vectors.

(5+ c) The expression of the electric field associated with an electromagnetic wave in vacuum is given by) + 102(sin ^)Vm800(81 kzt xE Determine the wave number, frequency, the direction of propagation and the magnitude and direction of the magnetic field associated with the wave. (1 *** (ignoucollage.in)**

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