PHY1MN104:Electricity and Magnetism
Section-A-Mark-3

1. Explain how temperature variations affect the resistivity of a metallic conductor and its impact on resistance.
2. Illustrate the relationship between current, voltage, and resistance using Ohm's law, and apply it to a practical circuit problem.
3. Compare the resistivity of conductors, semiconductors, and insulators, and explain how their current-carrying capabilities differ.
4. Describe how different materials' resistivities affect their suitability for use as electrical conductors in various applications.
5. Explain why current is a scalar quantity, while current density is a vector.
6. Explain how the resistivity of a material affects its resistance and the current flow through it.
7. Discuss the effect of temperature on the resistivity of superconductors.
8. Find the color code of following resistors a).200 k ohm b).1.2 Mohm c).750 ohm
9. Discuss the relationship between resistance and resistivity using ohm's law.
10. Define ohmic and non-ohmic resistors and draw the corresponding graph to show the variation.
11. Explain why the resistivity of graphite decreases with increasing temperature.
12. Make a comment on how potential energy changes when emf is applied for a charge maintained at higher potential and other at a lower potential.
13. Explain the concept of electromotive force (EMF) and describe how it differs from potential difference in a circuit.
14. Analyze a simple circuit and determine the current flowing through a resistor when the EMF is provided.
15. Discuss on power input to a pure resistance.
16. Calculate the power dissipated in a resistor when a known current flows through it.

17. Determine the relationship between power, voltage, and resistance in a purely resistive circuit.
18. Explain the process of electron movement in metallic conductors and how it relates to electrical conductivity.
19. calculate the mean free time between collisions in copper at room temperature. For copper n= 8.5*10^28 m^-3 and resistivity is 1.72*10^-8 ohm m
20. Make a comment on the terms short circuit and open circuit.
21. Discuss why does an electric bulb nearly always burn out just as you turn on the light,almost never while the light is shining?
22. Discuss the factors that affect the electrical conductivity of metals
23. Solve for the total resistance of a circuit that has resistors in series and parallel combinations.
24. a).show that when two resistors are connected in parallel,the equivalent resistance of the combination is always smaller than that of the smaller resistor.b).Generalize your result from part a for N resistors.
25. Discuss briefly about the use of ground-fault interuupter .
26. Describe how circuit breakers operates when a circuit is overheated.
27. Apply Kirchhoff's current law to analyze the current distribution at a junction in a circuit.
28. Use Kirchhoff’s voltage law to determine the voltage drop across multiple resistors in a closed loop.
29. Illustrate the sign conventions used for loop rule.
30. Apply Kirchhoff's Junction Rule to analyze a circuit and demonstrate how the conservation of current is maintained at a junction.
31. Illustrate the electric field on the surface containing a positive and negative charge.
32. Make a Comment on what happens to electric flux when zero charge inside the box.
33. Discuss the limitations of the fluid-flow analogy when applied to electric fields.

34. Define electric flux.How is it mathematically expressed for a flat surface in a uniform electric field.
35. Explain the significance of the angle in the formula for electric flux.What happens to the flux when angle is 90 degree.
36. Express the SI unit of electric flux?Describe what this unit indicates in the context of electric fields.
37. Explain,if the area vector is reversed , how does it effect the electric flux.
38. Estimate the relationship between electric field strength and electric flux?
39. Discuss in the case of a closed surface ,why is the outward direction of the area vector significant for calculating electric flux.
40. Describe how does electric flux turns out when the electric field is non-uniform?
41. Define Gauss's law and explain its significance in electrostatics.
42. Describe the relationship between electric flux and the enclosed charge in a closedsurface
43. Illustrate the concept of electric field lines around a positive point charge
44. Compute for A thin -walled, hollow sphere of radius 0.250m has an unknown amount of charge distributed uniformly around its surface.At a distance of 0.300 m from the centre of the sphere,the electric field points directly towards the center of the sphere and has a magnitude of 1.8*10^2 N/C.How much charge is on the sphere.
45. Explain why the electric field inside a conductor is zero in electrostatic equilibrium.
46. identify what happens to the electric field at the surface of a conductor in electrostatic equilibrium.
47. Describe the setup of Farday's icepail experiment .What are the key components involved.
48. identify the significance of Faraday's experiment in relation to Coloumb's law.
49. Explain briefly the setup of Faraday Cage .
50. Explain the relationship between the electric field E at a point just outside a conductor and the surface charge at that point.

51. Discuss what happens when a baseball falls from higher point to lower point under the influence of earth's gravity.
52. Determine the expression for electric potential energy in a uniform electricfield.
53. Explain the terms Ionization and corona discharge.
54. Explain the term electric potential and compute the potential due to a single point charge.
55. Electric charge Q is uniformly distributed along a line or thin rod of length 2a.Compute the potential at a point P along the perpendicular bisector of the rod at a distance x from its center
56. Determine the electric field at the surface of a conductor.
57. Discuss a real example which works on the principle of Faraday's Cage.
58. Discuss the working of Vande graff electrostatic generator on the principle of ice pail experiment.
59. Discuss the Farday's experiment and it's outcomes to prove laws in electrostatics.
60. Discuss how an isolated charge placed in the cavity of a charged conductor effects.
61. Explain briefly about the importance of symmetry in electrostatics.
62. Describe how the right-hand thumb rule helps in determining the direction of the magnetic field around a current-carrying conductor.
63. Clarify Why can’t magnetic field lines intersect, and what would it mean if they did?
64. Discuss the relationship between the radius of the circular path of a charged particle in a magnetic field and the particle’s velocity and charge.
65. Tabulate the difference between electric charges and magnetic poles
66. Explain why magnetic field lines do not represent lines of force
67. Discuss the term magnetic field lines with its properties.
68. Illustrate the concept of magnetic field lines with an example.

69. Clarify how does the presence of a magnetic field affect the orientation of a compass needle, and what factors could influence this alignment?

70. Cite one scenario you might observe the attraction of an unmagnetized iron object to a permanent magnet, such as in everyday life?

71. Classify why does the north pole of a compass needle point toward the geographic north pole?

72. Draw schematic digram of earth’s magnetic field.Label geographic north, geographic south and direction of magnetic field.

73. Categorize key differences between the forces exerted by electric fields and magnetic fields on charges?

74. If a charge is moving through a magnetic field at an angle, Predict how can you determine the magnitude of the magnetic force acting on it?

75. Predict what would happen to the magnetic force on a charge if its velocity is increased while keeping the magnetic field strength constant?

76. Discuss how does the angle ϕ between the velocity v and the magnetic field B affect the magnetic force experienced by a charge?

77. Discuss the significance of the right-hand rule to determine the direction of the magnetic force on a positive charge?

78. Identify the differece between the direction of the magnetic force F for positive and negative charges moving in a magnetic field?

79. If you have a magnetic field with closely spaced lines, what can you infer about the force experienced by a charged particle moving in that field?

80. If a positive charge moves in a magnetic field and a negative charge of equal magnitude moves in the same field with the same velocity, how would the forces on both charges.categorize?

81. Discuss the limitations of using magnetic field lines to predict the force on a charged particle compared to electric field lines.

82. Define Gauss's law for magnetism.

83. Explain why the total magnetic flux through a closed surface is always zero.

84. Describe the relationship between the angle θ and the magnetic flux through a surface.

85. Evaluate the importance of the angle between the current and the magnetic field in determining the force on a conductor.

86. Tabulate the analogy between magnetic and electric interactions.

87. A proton and an electron are placed 1 nm apart. Find the force between them.

88. Explain the process of charging by induction.

89. If a neutral atom loses two electrons, Predict its resulting charge?

90. Two charges of +4μC and +6μC are placed 8 cm apart. Identify whether they will repel or attract each other and calculate the force.

91. State and explain the law of conservation of electric charge.

92. Explain the concept of charge quantization with an example.

93. Find the force between two charges of +3μC and -2μC placed 5 cm apart in a vacuum.

94. Define electric charge and explain its basic properties.

95. Discuss the change in electrostatic force if the magnitude of one of the charges is tripled while keeping the distance constant?

96. Two charges of +2C and −3C are placed 1 meter apart. Find out the direction of the force between them?

97. Discuss different factors that are affect the magnitude of the electrostatic force between two charges according to Coulomb's Law?

98. Explain the relationship between electric force and electric field. How is the force on a test charge related to the electric field?

99. Find the electric field at a point on the axial line of an electric dipole. How does the electric field behave at points far from the dipole?

100. Compare the electric field produced by a point charge and that produced by an infinite sheet of charge. How does the distance affect the two fields differently?

101. Discuss the orientation of an electric dipole in an external electric field affect the torque on the dipole?

102. Discuss the behavior of electric field lines between two parallel plates of opposite charge.

103. Explain the significance of the direction of electric field lines in understanding the nature of electric fields.

104. Discuss how electric field lines help in understanding the behavior of charged particles in a non-uniform electric field.

105. Describe the difference between electric field lines for point charges and for an electric dipole.

106. Draw the electric field lines for a system with two equal but opposite charges (a dipole).

107. Discuss the concept of equipotential lines and how they relate to electric field lines.

108. Explain the conditions under which a dipole in a uniform electric field experiences no torque.

109. Define electric dipole moment and explain its significance in electrostatics.

110. Discuss the factors that affect the torque experienced by an electric dipole in an external electric field.

111. Draw and label a diagram showing the forces acting on an electric dipole placed in a uniform electric field and the resulting torque

112. Define the torque on an electric dipole in a uniform electric field.

Section-B-Mark-6

1. Explain how the concept of electric flux relates to the net charge enclosed within a closed surface.Provide an example to illustrate your explanation.

2. Discuss the scenarios by comparing the electric flux when the box is empty versus when it contains equal positive and negative charges.

3. Summarize the implications of Gauss's Law based on the relationship between enclosed charge and electric flux.How does this principle aid in understanding electric fields.

4. Using the fluid-flow analogy,explain how the volume flow rate through a surface can be calculated.What assumptions must be made for this analogy to hold true.

5. Determine the expression for electric flux through a flat surface when the surface is oriented at an angle to the electric field.
6. Illustrate the concept of electric flux with a diagram. Label the electric field,area vector, and the angle between them.Explain the significance of each labeled component.
7. Given a uniform electric field E = 5N/C and a flat surface area of 2m^2 at an angle of 30 degree to the field,calculate the elctric flux through the surface.
8. A cube of side L is placed in a region of uniform electric field E.Compute the electric flux through each face of the cube and the total flux through the cube when a).it is oriented with two of its faces perpendicular to the field E.b). when the cube is rotated by an angle
9. A positive point charge q=3.0 uc is surrounded by a sphere with radius 0.20 m centered on the charge.Determine the electric flux through the sphere due this charge.
10. Considering the electric field of a point charge located at the center of a spherical surface and determine the expression for electric flux through that surface.
11. Make a comment on Comparing the electric flux through two spherical surfaces of different radii surrounding same point charge and explain your reasoning.
12. Demonstrate how the projection technique can be applied to find the electric flux through a nonspherical surface surrounding a point charge.
13. Describe the role of the Gaussian surface in Gauss's Law and give the expression for general form of Gauss's Law.
14. Determine the expression of electric flux considering a spherical gaussian surface around a positive point charge and a negative point charge.
15. using Gauss's law, compute the expression for electric field of a conducting sphere.
16. Two large plane parallel conducting plates are given charges of equal magnitudes and opposite sign. Find the electric field in the region between the plates.
17. positive electric charge Q is distributed uniformly throughout the volume of an insulating sphere with radius R.Find the magnitude of the electric field at a point

P a distance r from the center of the sphere.

18. Discuss the effect of placing a charge q inside a cavity of an uncharged condcutor.What is the distribution of charges that occur in response.

19. Illustrate the concept of finding electric field within a charged conductor a).solid conductor with charge q b).same conductor with an internal cavity c). An insolated charge q placed inside the cavity.

20. Discuss the implications of Faraday's experiment for our understanding of electrostatic shielding.How does this principle protect sensitive instruments?

21. Determine the relationship between the surface charge density and the electric field at the surface of a conductor using Gauss's law.

22. An 18 guage copper wire has a nominal diameter of 1.02 mm. This wire carries a constant current of 1.67A to 200-watt lamp.The density of free electrons is 8.5*10^28 electrons per cubic meter.Find the magnitudes of A).the current density B).the drift velocity.

23. Compare the behavior of resistors in series and parallel circuits in terms of current and voltage distribution.

24. Explain the variation of resistivity with Temperature for different materials like metals, semiconductors and superconductors .

25. Suppose there are n moving charged particles per unit volume of a conductor , determine the expression for current density.

26. A cylindrical rod has resistance R.If we triple its length and diameter,determine its resistance , in terms of R.

27. Illustrate the case when a positive charge q flows around the circuit, the potential rise as it passes through the ideal source is numerically equal to the potential drop as it passes through the remainder in the circuit.

28. Make a comment on the energy and power in electric circuits.

29. Explain the characteristics of the material used to make a fuse.

30. Sove for the following , measurements were made on a Thyrite Resistor :

I(A)	:	0.50	1.00	2.00	4.00
Vab(V)	:	2.55	3.11	3.77	4.58

a).Graph Vab as a function of I. b).Does Thyrite obey Ohm's law?How can you tell? C).Graph the resistance R=Vab/I as a function of I.

31. calculate the equivalent resistance of a network has emf 18v (the source of emf has negligible internsal resistance) , resistors of 12 ohm and 6 ohm is connected parallel to a resistor of 4 ohm connected in series.Find the current in each resistor.

32. Infer that for Long distance, electric-power,transmission lines always operate at very high voltage , sometimes as much as 750 kv.what are the advantages of such high voltages.what are the disadvantages.

33. current causes the temperature of a real resistror to increase.why? What effect does this heating have on resistance?Explain.

34. Solve for An 1600 W toaster, a 1.4 k-W electric frying pan ,and a 100 W lamp are plugged into the same 20A , 120 V circuit.a).what current is drawn by each device,and what is the resistance of each device ?b).Will this combination blow the fuse?

35. The hollow cylinder has length L and inner and outer radii a and b. It is made of a material with resistivity ρ. A potential difference is set up between the inner and outer surfaces of the cylinder (each of which is an equipotential surfaces) so that current flows radially through cylinder. What is the resistance to this radial current flow?

36. Define current , resistance and resistivity.Explain their interrelations.

37. Discuss the behaviour opf electric potential around a charged conducting sphere.

38. An electric potential consists of two point charges q1=+12nC and q2=-12 nC place 10 cm apart.Compute the potential at a,b, and c by adding potential due to either charge.

39. Compute the electric potential due electric field a).Positive charge b).negative charge

40. Discussing with the term Electric Potential show how it satisfies work-energy theorem.

41. Applying the method of finding electric potential derive the potential due to several charges .

42. By integrating the electric field ,calculate the potential at a distance r from a point charge q.

43. Discuss with the experiment which is used to test Gauss's law .

44. Explain Gauss's law and find a).Field inside a spherical surface b).,Field inside a non-spherical surface.

45. Discussing electric flux find the flux due a uniform electric field.

46. Discuss the importance of equipotential surface in finding the electric potential.

47. Illustrate electric field lines of a). a point charge b). a dipole c).Two equal positive charges

48. Compare the properties of field lines of electric field and magnetic field.

49. Discuss about magnetic field lines, and how do they represent the magnetic field in a region?

50. Explain the concept of a magnetic monopole and What does Gauss's law for magnetism say about the existence of magnetic monopoles?

51. Describe the motion of a charged particle in a uniform magnetic field and explain the factors that influence its trajectory.

52. Explain how the magnetic force acts on a current-carrying straight conductor placed in a magnetic field, using the right-hand rule to describe the direction of the force.

53. A beam of protons ($q = 1.6 \times 10^{-19}$ C) moves at 3.0× 105 m/s through a uniform 2.0-T magnetic field directed along the positive z-axis. The velocity of each proton lies in the xz-plane and is directed at 30° to the +z-axis. Find the force on a proton.

54. A magnetron in a microwave oven emits electromagnetic waves with frequency f = 2450 MHz. Infer what magnetic field strength is required for electrons to move in circular paths with this frequency?

55. Illustrate an experiment to demonstrate the magnetic field around a bar magnet and how it interacts with different materials, including iron and other metals.

56. Illustrate an experiment to demonstrate how a magnetic field is created by a moving charge or current

57. Discuss the four key characteristics of the magnetic force on a moving charge?

58. If a charged particle moves with a velocity of 5 m/s at an angle of 30° to a magnetic field of 0.1T, find the magnitude of the magnetic force on a charge of 2mC?

59. Illustrate a diagram to illustrate the right-hand rule for determining the direction of the magnetic force on a moving charge.

60. Find the magnetic flux through a flat surface of area A=2 m² when a uniform magnetic field of B=0.5T makes an angle of 30° with the normal to the surface.

61. A proton moves with a speed of 2×10^5m/s perpendicular to a magnetic field of 0.5T. Find the radius of the circular path.

62. A straight wire carries a current of 5.0A in a magnetic field of 0.8T directed perpendicular to the wire. Find the force on a 0.2 m segment of the wire.

63. Two-point charges, q1=+3 μC and q2=−5 μC are placed 10 cm apart in a vacuum. find:(a) The magnitude and direction of the force between the charges. (b) If the distance between the charges is doubled, what will be the new force?

64. A small conducting sphere has a charge of 4×10^{-9} C.Infer how many excess protons are present on the sphere?

65. Two point charges q1=+4 μC and q2=−6 μC are placed 0.2 meters apart. Find the magnitude and direction of the electrostatic force between them.

66. If the distance between two charges q1=5 C and q2=10 C is reduced by half, infer how does the electrostatic force between them change?

67. A dipole consists of charges +2 μC and −2 μC separated by a distance of 0.1 m. Find the electric field due to the dipole at a point 0.2 m away from the center of the dipole along its axial line.

68. A point charge of $q=6\times10^{-6}$ C is placed 0.3 m away from a uniformly charged infinite sheet with a charge density of $\sigma=4\times10^{-6}$ C/m^2. Find the force experienced by the point charge due to the electric field of the infinite sheet.

69. Two opposite charges of +1 μC and −1 μC are placed at two ends of a 0.2 m long dipole. Find the torque on the dipole if it is placed in a uniform electric field of 5×10^4 N/C at an angle of 30° to the field.

70. Two-point charges, +5 μC and −5 μC are placed 2 cm apart. Find the electric field strength at a point 1 cm away from the midpoint along the axis of the dipole.

71. A point charge of +2 μC is placed near an infinite charged sheet with a surface charge density of $\sigma=5\times10^{-6}$ C/m^2. Find the force experienced by the point

charge due to the electric field of the charged sheet.

72. Find the electric potential energy of a system of two-point charges, +3 μC and +6 μC, placed 10 cm apart.

73. A uniformly charged infinite sheet creates an electric field of $E=3\times10^5$ N/C at a point just outside the sheet. Find the surface charge density of the sheet.

74. An electric dipole consists of two charges, +2 μC and -2 μC, separated by a distance of 0.1 m. Find the dipole moment of the dipole.

75. An electric dipole with a dipole moment of 3×10^{-6} C m is placed in a uniform electric field of 500 N/C. Find the torque experienced by the dipole when it is oriented at an angle of 30° with the electric field.

76. If the torque on an electric dipole in a uniform electric field is measured to be 0.001 N m and the dipole moment is 4×10^{-6} C m, find the angle at which the dipole is oriented with respect to the electric field.

77. An electric dipole is placed in an electric field of strength 200 N/C. If the dipole moment is 5×10^{-6} C m, find the force acting on each charge of the dipole.

Section-C-Mark-10

1. Discuss the theory of metallic conduction.

2. Deduce the expression of equivalent resistance when 3 resistors are connected in series and parallel

3. Describe the functioning of a household power distribution system, and illustrate how electrical power is distributed from the main supply to various circuits in the home."

4. Define electric flux and explain its significance in the context of Gauss's Law.How is it related to the charge enclosed by surface.

5. Explain the relationship between electric field lines and electric flux.How can this relationship help visualize the concept of electric flux through a surface.

6. Compare and contrast electric flux in different orientations of a flat -surface .

7. Evaluate the role of electric flux in determining electric fields due to point charges.

8. Calculate electric flux a). Fluid flow analogy b).In a Uniform electric field c).In a Non-Uniform electric field .

9. Evaluate the implications of Gauss's Law for calculating electric fields in various geometrics , including spherical and non-spherical surfaces.
10. Using Gauss's Law , determine the electric field due to an infinite line charge and infinite plane sheet of charge and discuss the assumptions made in this derivation.
11. Discuss any two applications of Gauss's Law.
12. Summarize the applications of the principles demonstrated in Faraday's experiment in modern technology.How do these applications reflect the concepts of electrostatics.
13. Discuss the concept of emf and show how current is related to the source emf.
14. Explain the terms drift velocity, conventional current and current density and derive the expression for current density .
15. Explain current and resistance , state ohm's law and show how the conductivity of different materials varies
16. Apply Kirchoff's laws to analyze a complex circuit and determine the current in different branches
17. Discuss the behaviour of electric potential around a). a charged conducting sphere.b). A ring of charge
18. Compute Electric potential due to a).two point charges b).Several point charges .c). Discuss the behaviour of both
19. Discuss the imporatnce of Gauss's law and find a).Electric field between two parallel plates b).Electric field due to a conducting sphere
20. Explain the term " Electric Potential " and find a).Potential of a charged spherical conductor . b).Potential of Two Oppositively charged parallel plates.
21. Calculate the Potential a). At a distance r from a very long line of charge with a linear charge density . b).At a point P on the ring axis at a distance x from the center of the ring.
22. Calculate the electric field due a a).infinite sheet of charge b).oppositively charged parallel conducting plates.
23. Discuss the effects of EMF and derive the expression of emf associated with a circuit containg a charge q.

24. Discuss the concept of flux, derive its mathematical expression, explain and verify Gauss's law for magnetism.
25. Explain the motion of charged particle in a magnetic field. Provide relevant mathematical expression and examples.
26. Explain magnetic force on a current carrying conductor. Provide relevant mathematical expression.
27. Discuss the Relationship between Electric Charge and Electric Field.
28. Discuss the significance of Coulomb’s law in understanding electrostatic interactions. Explain the mathematical formulation of the law and its applications in real-world scenarios.
29. Discuss the electric field due to an infinite uniformly charged sheet using Gauss's law and derive at an expression.
30. Discuss the properties of electric field lines and how they represent the behavior of electric fields. Include in your discussion the patterns of electric field lines for different charge configurations (point charge, dipole, and infinite charged sheet) and the implications for the strength and direction of the electric field.
31. Discuss how an electric dipole experiences torque when placed in a uniform electric field. Derive the formula for torque and explain the factors affecting its magnitude.