PHYSICS

BOOKS - MODERN PUBLICATION

CLASSIFICATION OF MAGNETIC MATERIALS

Example

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1. The permeability of material is measured to be $0.126 T A^{-1}$m. Find its relative permeability

and susceptibility.

2. An iron rod of $0.5 cm^2$ area of cross-section is subjected to a magnetising field of 1,200 Am^{-1}. If susceptibility of iron is 599, calculate μ

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4. An iron rod of $0.5cm^2$ area of cross-section is subjected to a magnetising field of 1,200 Am^{-1}. If susceptibility of iron is 599, calculate μ

5. A bar magnet has pole strength 4.5Am, magnetic length 12cm and cross sectional area $0.9cm^2$. Find intensity of magnetisation (I).

6. A bar magnet has pole strength 4.5Am, magnetic length 12cm and cross sectional area $0.9cm^2$. Find magnetising intesity (H) at the centre

7. For a magnetising field of intensity $2 \times 10^3 A/m$, aluminium at 280K acquires intensity of magnetisation of $4.8 \times 10^{-2} Am^{-1}$. Find the susceptibility of aluminium at 280K. If the temperature of the metal is raised to 320K, what will be its susceptibility and intensity of magnetisation?

8. An iron rod of volume $10^{-4} m^3$ and relative permeability 1000 is placed inside a long solenoid wound with 5 turns/cm. If a current of 0.5A is passed through the solenoid, find the magnetic moment of the rod.

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9. An iron smaple having mass 8.4 kg is repeatedly taken over cycles of magnetisation and demagnetisation at a frequency of 50Hz. It is found that energy of 3.2 J is dissipated as

heat in the sample in 30 minutes. If the denstiy of iron is $7200 kgm^{-3}$, calculate the value of energy dissipated per unit volume per cycle in the iron sample.

10. A bar magnet has coercivity $4 \times 10^3 Am^{-1}$ it is desired to demagnetize it by inserting it inside a solenoid 12cm long and has 60 turns the current that should be sent through the solenoid.

11. How does the intensity of magnetization of a paramagnetic material vary with temperature?

12. Write the dimensional formula of magnetic flux.

13. Name the physical quantity which is measured in weber $ampere^{-1}$.

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14. Define the term magnetic flux.

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15. Define Weber unit of Magnetic flux.

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16. SI unit of magnetic flux is :

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17. Which physical quantity has the unit $\dfrac{Wb}{m^2}$

Is it a scalar or a vector quantity?

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18. Name the physical quantity, whose unit is tesla. Hence, define tesla.

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19. Define magnetic susceptibility.

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20. Define permeability. Give its types.

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21. An iron rod of $0.1m^2$ area of cross-section subjected to a magnetising field of 1,000 Am^{-1}. Calculate its magnetic permeability. Given susceptibility of iron is 59.9.

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22. Name the source of magnetic properties of materials.

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23. What is meant by non-magnetic material?

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24. What are diamagnetic substances ? Give three examples

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25. What are diamagnetic substances ? Give three examples

26. The permeability of a magnetic material is 0.9983. Name the type of magnetic material it represents.

27. Write two properties of diamagentic substances.

28. What happens when a diamagnetic substance is placed in a varying magnetic field?

29. Answer the following questions: Why is diamagnetism, in contrast, almost independent of temperature?

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30. The susceptibility of a magnetic material is -4.2×10^{-6}. Name the type of magnetic materials it represents.

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31. The magnetic susceptibilityfor a sample has a small negative value. To which class of magnetic substances, does the specimen belong?

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32. What is paramagnetic substance ? Give one example.

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33. Name any two paramagnetic substances.

34. The susceptibility of a magnetic material is 1.91×10^{-5}. Name the type of magneti material it represents.

35. The value of intensity of magnetisation is small positive for a specimen. Is it diamagnetic

or paramagnetic or ferromagnetic?

36. State two properties of a paramagnetic substances.

37. Answer the following questions: Why does a paramagnetic sample display greater

magnetisation (for the same magnetising field) when cooled?

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38. State and explain Curie's law in magnetism.

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39. What is Curie point?

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40. How does the magnetic induction of a paramagnetic material vary with increasing applied magnetic field?

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41. What are anti-ferromagnetic substances? Give one example.

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42. Write two properties of ferromagnetic substances.

43. Why do magnetic lines prefer to pass through ferromagnetic substances (e.g. Fe) than through oil?

44. Explain magnetic hysteresis.

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45. Define retentitivity.

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46. Define the term retentivity and coercivity.

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47. What type of magnetic material is used in making permanent magnets?

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48. What type of magnetic material is used in making permanent magnets?

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49. Why should the material usesd for making permanent magnets have high coercivity?

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50. Why should the high retentivity and low coercivity material used for making electromagnets?

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51. What type of magnetic material is used in making permanent magnets?

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52. What type of magnetic material is used in making permanent magnets?

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53. Why do we prefer to use the alloy alnico for making permanent magnets?

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54. Name one metal each to make a permanent magnet and a temporary magnet.

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55. Which material is used for making electromagnet and why?

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56. Which material is used for making electromagnet and why?

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57. Why the core of a transformer made of a magnetic material of high permeability?

58. Why soft iron is used in making the core of a transformer ?

59. Why soft iron is used in making the core of a transformer ?

60. Answer the following questions:The hysteresis loop of a soft iron piece has a much smaller area than that of a carbon steel piece. If the material is to go through repeated cycles of magnetisation, which piece will dissipate greater heat energy?

61. State two methods to destroys the magnetism of a magnet.

62. What is magnetic field intensity?

63. Define magnetic susceptibility.

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64. What is relative permeability of a magnetic material? How is it related to the magnetic susceptibility?

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65. What is the basic difference between the atom/molecule of a diamagnetic and a paramagnetic material?

66. Out of two materials 'A' has relatiave permeability slightly greater than unity while 'B' has less than unity. Identify the nature of materials 'A' and 'B'. Will their relative susceptibilities be positive or negative?

67. What do you infer from the large value of the susceptibility of the material? For example susceptibility of iron is more than that of copper. Explain?

68. Out of the following, identify the materials, which can be classified as paramagnetic: Al, Bi, Cu, Na.

69. Out of the following, identify the materials, which can be classified as diamagnetic : Aluminium, bisuth, copper and sodium.

70. Differentiate between diamagnetic and paramagnetic substances.

71. What is the difference between ferromagnetic and paramagnetic substances ?

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72. Differentiate between diamagnetic and paramagnetic substances.

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73. Write two properties of diamagentic substances.

74. The susceptiblity of a magnetic material is -2.6×10^{-5}. Identify the type of magnetic material and state its properties.

75. Draw diagrams to depict the behaviour of magnetic field lines near a bar of copper

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76. Draw diagrams to depict the behaviour of magnetic field lines near a bar of aluminium

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77. Draw diagrams to depict the behaviour of magnetic field lines near a bar of mercury, cooled to a very low temperature (4.2K)

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78. Draw magnetic field lines, when a diamagnetic substance is placed in an external magnetic field

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79. Draw magnetic field lines, when a paramagnetic substance is placed in an external magnetic field.

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80. If a toroid used bismuth for its core, will the field in the core be (slightly) greater or (slightly) less than when the core is empty?

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81. The susceptibility of a magnetic material is 0.085. Identify the magnetic type of the material. A speciman of this material is placed in a uniform magnetic field. Draw the modified field pattern.

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82. Name two elements, one having positive susceptibility and the other having negative susceptibility . What does negative susceptibility signify ?

83. State two properties of a paramagnetic substances.

84. Differentiate between diamagnetic and paramagnetic substances.

85. Out of two materials 'A' has relatiave permeability slightly greater than unity while 'B' has less than unity. Identify the nature of materials 'A' and 'B'. Will their relative susceptibilities be positive or negative?

86. State two properties of a paramagnetic substances.

87. The susceptiblity of a magnetic material is -2.6×10^{-5}. Identify the type of magnetic material and state its properties.

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88. Does the magnetisation of a paramagnetic salt dependon temperature ? Give reason for your answer.

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89. Differentiate between diamagnetic and paramagnetic substances.

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90. Answer the following questions: Would the maximum possible magnetisation of a paramagnetic sample be of the same order of magnitude as the magnetisation of a ferromagnet?

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91. The relative magnetic permeability of a magnetic material is 800. Identify the type of magnetic material and state its properties.

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92. An iron bar is heated to $1000°C$ and then cooled in a magnetic field free space. Will it retain magnetism?

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93. Answer the following questions: Is the permeability of a ferromagnetic material independent of the magnetic field? If not, is it more for lower or higher fields?

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94. Steel si preferred for making permanent magnets, whereas soft iron is prefferred for making electromagnets. Give one reason.

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95. Answer the following questions: What kind of ferromagnetic material is used for coating magnetic tapes in a cassette player, or for building 'memory stores' in a modern computer?

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96. Compare magnetic properties of soft iron and steel.

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97. What are the uses of studying hystersis curve of substance?

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98. Why do we prefer to use the alloy alnico for making permanent magnets?

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99. State two most important properties of the alloy used to design permanent magnets.

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100. Why do we prefer to use the alloy alnico for making permanent magnets?

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101. Why soft iron is used in making the core of a transformer ?

102. Show that $B = \mu_0(H + I)$, where the symbols have their usual meanings.

103. Show that $I = (\mu_r - 1)H$, where the symbols have their usual meanings.

104. An iron rod of length 0.5 m, radius 0.02 m having relative permeability 120 is placed inside a long solenoid carrying a current of 0.8 A. If the solenoid has 250 turns m^{-1}, find the intensity of magnetisation

105. An iron rod of length 0.5 m, radius 0.02 m having relative permeability 120 is placed inside a long solenoid carrying a current of 0.8 A. If the solenoid has 250 turns m^{-1}, find the magnetic dipole moment acquired by the iron rod.

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106. Why are all pieces of iron not magnet even though iron is a ferromagnetic material?

107. Magnetic field lines are always nearly normal to the surface of a ferromagnet at every point.

108. Suppose a man proposes a theory that the earth's magnetic field is due to permanent magnetisation field is due to permanent

magnetisation of molten iron core of earth. Will you acceept this theory? Give reasons for your answer.

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109. Answer the following questions: A certain region of space is to be shielded from magnetic fields. Suggest a method.

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110. A particle suspended from a fixed point, by a light inextensible thread of length L is projected horizontally from its lowest position with velocity $\left(7g\dfrac{L}{2}\right)^{\frac{1}{2}}$. The thread will slack after swinging through an angle θ, such that θ equal

111. Obtain the expression for the energy stored per unit volume in a charged parallel

plate capacitor.

112. A transformer is working on 220V.50 Hz a.c. supply. The iron core of the transformer has a mass of 8.4 kg.. From the plot of B-H loop for the core, it is found that area of hte loop is $480Jm^{-3}$. If the density of iron is 7,500 kgm^{-3}, find the loss of energy in the core of transformer in 1 hour.

113. The area of B - H loop for a ferromagnetic material is $540Jm^{-3}$. If the absolute permeability of free space is $4\pi \times 10^{-7}JA^{-2}m^{-1}$, find the area of the I - H loop of the ferrogmangnetic material.

114. A magnet weighs 75 g and its magnetic moment is $2 \times 10^{-4}Am^2$. If the density of the

material of the magnet is $7.5 \times 10^3 kgm^{-3}$, calculate the intensity of magnetisation.

115. The magnetic induction and magnetising field in a sample of magnetic material are $1.0 Wbm^{-2}$ and $2 \times 10^3 Am^{-1}$ respectively. Find magnetic permeability

116. The magnetic induction and magnetising field in a sample of magnetic material are $1.0 Wbm^{-2}$ and $2 \times 10^3 Am^{-1}$ respectively. Find relative permeability of the material.

117. The magnetic induction and magnetising field in a sample of magnetic material are $1.0 Wbm^{-2}$ and $2 \times 10^3 Am^{-1}$ respectively. Find magnetic susceptibility

118. The magnetic induction and magnetising field in a sample of magnetic material are $1.0 Wbm^{-2}$ and $2 \times 10^3 Am^{-1}$ respectively. Find magnetic permeability

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119. The amgnetising field of $1600 Am^{-1}$ produces a magnetic flux of 2.4×10^{-5} weber in a bar of iron of cross-section $0.2 cm^2$.

Calculate relative permeability, intensity of magnetisation and susceptibility of the bar.

120. The core of toroid having 3,000 turns has inner and outer radii of 11 cm and 12 cm respectively. The magnetic field in the core for a current of 0.70 A is 2.5 T. What is the relative permeability of the core?

121. A Rowland ring has 10^3 turns per uit length. On passing a current of 2 A, magnetic induction is measured to be 1.5 Wbm^{-2}. Calculate relative permeability of the core.

122. A Rowland ring has 10^3 turns per uit length. On passing a current of 2 A, magnetic induction is measured to be 1.5 Wbm^{-2}. Calculate magnetic susceptibility

123. A Rowland ring has 10^3 turns per uit length. On passing a current of 2 A, magnetic induction is measured to be 1.5 Wbm^{-2}. Calculate magnetising field intensity.

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124. A Rowland ring has 10^3 turns per uit length. On passing a current of 2 A, magnetic

induction is measured to be 1.5 Wbm^{-2}.

Calculate magnetisation.

125. The susceptibility of magnesium at 300 K is 1.2×10^{-5}, At what temperature will the susceptibility equal to 1.44×10^{-5}?

126. They hysteresis loss for a speciment of iron weighing 12 kg is equivalent to $300 Jm^{-3} cyc^{-1}$. Find the loss of energy per hour at 50 cycles s^{-1}. Given, density of iron $= 7,500 kgm^{-3}$

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127. Assume that each iron atom has a permanent magnetic moment equal to 2 Bohr magneton . The number density of atoms in

iron is $8.52 \times 10^{28} m^{-3}$. Find the maximum value of intensity of magnetisation.

128. Assume that each iron atom has a permanent magnetic moment equal to 2 Bohr magneton . The number density of atoms in iron is $8.52 \times 10^{28} m^{-3}$. Find the maximum value of magnetic induction in an iron bar.

129. A paramagnetic gas consists of atoms each with a dipole moment of $1.5 \times 10^{-23} jT^{-1}$. The temperature of the gas is $27°C$ and its number density is $2 \times 10^{26} m^{-3}$. What is the maximum magnetisation of the sample possible, when it is placed in an external magnetic field?

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Exercise

1. Explain the terms magnetic intensity. Give their SI units.

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2. Explain the terms intensity of magnetisation. Give their SI units.

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3. Define the term magnetic flux.

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4. Explain the terms magnetic induction. Give their SI units.

5. Define magnetic susceptibility.

6. Explain the terms magnetic permeability. Give their SI units.

7. Show diagrammatically the behavoiur of magnetic field lines in the presence of paramagnetic. How does one explain this distinguishing feature?

8. Show diagrammatically the behavoiur of magnetic field lines in the presence of

diamagnetic substance. How does one explain this distinguishing feature?

9. What is the difference between ferromagnetic, pawramagnetic and diamagnetic substances ? Classify the following materials in respect of the magnetic behaviour: Mercury

10. What is the difference between ferromagnetic, pawramagnetic and diamagnetic substances ? Classify the following materials in respect of the magnetic behaviour: Water

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11. What is the difference between ferromagnetic, pawramagnetic and diamagnetic substances ? Classify the

following materials in respect of the magnetic behaviour: Iron

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12. What is the difference between ferromagnetic, pawramagnetic and diamagnetic substances ? Classify the following materials in respect of the magnetic behaviour: Aluminium.

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13. Differentiate between diamagnetic and paramagnetic substances.

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14. How are magnetic materials classified?

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15. What are dia, para and ferromagnetic substances? Give one example of each.

16. Classify materials on the baiss of their behaviour in a magnetic field. Under which cateogry does iron come? How does the magnetic property of iron change with increase of temperature?

17. Explain the magnetism on the basis of atomic theory.

18. How are materials classified according to their behaviour in a magnetic field? Why does the magnetisation of a paramagnetic salt increase on cooling?

19. Two similar bars made from two different materials P and Q are placed one by one in a

non-uniform magnetic field. It is observed that bar P tends to move from the weak to the strong field region and d. What is the nature of the magnetic materials for making these two bars? Show with the help of a diagram, the behaviour of the field lines due to an external magneic field near each of these two bars.

20. Two similar bars made from two different materials P and Q are placed one by one in a non-uniform magnetic field. It is observed that bar P tends to move from the weak to the strong field region and d. What is the nature of the magnetic materials for making these two bars? Show with the help of a diagram, the behaviour of the field lines due to an external magneic field near each of these two bars.

21. What are ferromagnetic substances? Explain briefly domain theory to explain ferromagnetism?

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22. Draw magnetic field lines, when a diamagnetic substance is placed in an external magnetic field

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23. Give six properties of diamagnetic substance.

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24. Name any two paramagnetic substances.

▶ **Watch Video Solution**

25. Explain the magnetism on the basis of atomic theory.

26. What are dia and paramagnetic substances?

27. Distinguish between diamgnetic and ferromagnetic materials in respect of behaviour of non-uniform magnetic field

28. State and explain Curie's law in magnetism.

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29. Explain magnetic hysteresis.

▶ **Watch Video Solution**

30. Explain magnetic hysteresis.

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31. Explain the phenomenon of self induction?

32. Explain briefly the importance of retentivity and coercivity for permanent magnets.

33. What are permanent magnets? Give one example.

34. What is the difference between an electromagnet and a permanent magnet? How is an electromagnet designed? Stable any two factors on which the strength of an electromagnet depends.

35. Find an expression for the magnetic dipole moment of an atom.

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36. Distinguish between diamgnetic and ferromagnetic materials in respect of intensity of magnetisation.

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37. What are ferromagnetic substances? Explain briefly domain theory to explain ferromagnetism?

▶ **Watch Video Solution**

38. What are dia, para and ferromagnetic substances? Give one example of each.

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39. Define coercivity and remanene. How are soft iron and hard steel distinguished by the values of these magnetic properties?

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