MAGNETISM AND MATTER

FACT/DEFINITION TYPE QUESTIONS

1. The magnetism of magnet is due to
(a) pressure of big magnet inside the earth
(b) earth
(c) cosmic rays
(d) the spin motion of electron

2. The primary origin (s) of magnetism lies in
(a) atomic currents
(b) polar nature of molecules
(c) extrinsic spin of electron
(d) None of these

3. For bar magnet effective length (Le) related with geometrical length (L_g) as
(a) $Le = \frac{6}{5} L_g$ (b) $Le = \frac{5}{6} L_g$
(c) $Le = L_g$ (d) $Le = 2 L_g$

4. A bar magnet of magnetic moment M, is placed in magnetic field of induction B. The torque exerted on it is
(a) $\vec{M}.\vec{B}$ (b) $-\vec{M}.\vec{B}$
(c) $\vec{M} \times \vec{B}$ (d) $-\vec{B} \times \vec{M}$

5. A bar magnet is cut into two equal halves by a plane parallel to the magnetic axis. Of the following physical quantities the one which remains unchanged is
(a) pole strength
(b) magnetic moment
(c) intensity of magnetisation
(d) None of these

6. Current I is flowing in a coil of area A and number of turns is N, then magnetic moment of the coil in M equal to
(a) NIA (b) NI/A
(c) $NI/\sqrt{A}$ (d) $N^2 AI$

7. Magnetic dipole moment is a vector quantity directed from
(a) south pole to north pole
(b) north pole to south pole
(c) east to west
(d) west to east

8. When a current in a circular loop is equivalently replaced by a magnetic dipole
(a) the pole strength m of each pole is fixed
(b) the distance d between the poles is fixed
(c) the product md is fixed
(d) None of these

9. Magnetic lines of force due to a bar magnet do not intersect because
(a) a point always has a single net magnetic field
(b) the lines have similar charges and so repel each other
(c) the lines always diverge from a single force
(d) the lines need magnetic lenses to be made to interest

10. The magnetic lines of force inside a bar magnet
(a) are from N-pole to S-pole of magnet
(b) do not exist
(c) depend upon the area of cross section of bar magnet
(d) are from S-pole of magnet

11. A circular loop carrying a current is replaced by an equivalent magnetic dipole. A point on the axis of the loop is in
(a) end-on position (b) broadside-on position
(c) both (d) None of these

12. The ratio of magnetic fields due to a smaller bar magnet in the end on position to broad side on position is
(a) 1/4 (b) 1/2
(c) 1 (d) 2

13. Let r be the distance of a point on the axis of a bar magnet from its centre. The magentic field at such a point is proportional to
(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$
(c) $\frac{1}{r^3}$ (d) None of these

14. Magnetic field intensity is defined as
(a) Magnetic moment per unit volume
(b) Magnetic induction force acting on a unit magnetic pole
(c) Number of lines of force crossing per unit area
(d) Number of lines of force crossing per unit volume

15. On cutting a solenoid in half, the field lines remain ...A..., emerging from one face of the solenoid and entering into the other face.
Here, A refers to
(a) irregular (b) discontinuous
(c) continuous (d) alternate

16. The magnetic moment of a bar magnet is thus ...*A*... to the magnetic moment of an equivalent solenoid that produces the same magnetic field.
Here, *A* refers to
(a) unequal (b) different
(c) equal (d) same

17. The lines of force due to earth's horizontal magnetic field are
(a) parallel and straight (b) concentric circles
(c) elliptical (d) curved lines

18. The earth's magnetic field always has a vertical component except at the
(a) magnetic equator (b) magnetic poles
(c) geographic north pole (d) latitude 45°

19. At magnetic poles, the angle of dip is
(a) 45° (b) 30°
(c) zero (d) 90°

20. The strength of the earth's magnetic field is
(a) constant everywhere
(b) zero everywhere
(c) having very high value
(d) vary from place to place on the earths surface

21. At the magnetic north pole of the earth, the value of the horizontal component of earth's magnetic field and angle of dip are respectively
(a) zero, maximum (b) maximum, minimum
(c) maximum, maximum (d) minimum, minimum

22. The magnetic compass is not useful for navigation near the magnetic poles, since
(a) $R = 0$ (b) $V = 0$
(c) $H = 0$ (d) $\theta = 0°$

23. A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It will
(a) stay in north-south direction only
(b) stay in east-west direction only
(c) become rigid showing no movement
(d) stay in any position

24. A dip circle is taken to geomagnetic equator. The needle is allowed to move in a vertical plane perpendicular to the mangetic meridian. the needle will stay in
(a) horizontal direction only
(b) vertical direction only
(c) any direction except vertical and horizontal
(d) any direction it is released

25. Which of the following is responsible for the earth's magnetic field?
(a) Convective currents in earth's core.
(b) Diversive current in earth's core.
(c) Rotational motion of earth.
(d) Translational motion of earth.

26. One can define ...*A*... of a place as the vertical plane which passes through the imaginary line joining the magnetic North and the South–poles.
Here, A refers to
(a) geographic meridian (b) magnetic meridian
(c) magnetic declination (d) magnetic inclination

27. The ratio of intensity of magnetisation and magnetising field is called
(a) permeability (b) magnetic intensity
(c) magnetic intensity (d) magnetic susceptibility

28. Susceptibility is positive and large for a
(a) paramagnetic substance
(b) ferromagnetic substance
(c) diamagnetic substance
(d) non magnetic substance

29. The relation between B, H and I in S.I. units is
(a) $B = \mu_0(H + I)$ (b) $B = H + 4\pi I$
(c) $H = \mu_0(B + I)$ (d) None of these

30. If μ_0 is absolute permeability of vacuum and μ_r is relative magnetic permeability of another medium, then permeability μ of the medium is
(a) $\mu_0 \mu_r$ (b) μ_0/μ_r
(c) μ_r/μ_0 (d) $1/\mu_0 \mu_r$

31. Which of the following is not correct about relative magnetic permeability (μ_r)?
(a) It is a dimensionless pure ratio.
(b) For vacuum medium its value is one.
(c) For ferromagnetic materials $\mu_r >> 1$
(d) For paramagnetic materials $\mu_r > 1$.

32. Hysterisis is the phenomenon of lagging of
(a) I behind B (b) B behind I
(c) I and B behind H (d) H behind I

33. Metals getting magnetised by orientation of atomic magnetic moments in external magnetic field are called
(a) diamagnetic (b) paramagnetic
(c) ferromagnetic (d) antimagnetic

34. The magnetic susceptibility for diamagnetic materials is
(a) small and negative (b) small and positive
(c) large and positive (d) large and negative

35. Which magnetic materials have negative susceptibility?
(a) diamagnetic materials
(b) paramagnetic materials
(c) ferromagnetic materials
(d) All the above

36. If a diamagnetic substance is brought near north or south pole of a bar magnet, it is
(a) attracted by poles
(b) repelled by poles
(c) replaced by north pole and attracted by south pole
(d) attracted by north pole and repelled by south pole

37. Among which of the following the magnetic susceptibility does not depend on the temperature?
(a) Dia-magnetism (b) Para-magnetism
(c) Ferro-magnetism (d) Ferrite

38. The narrowest hysterisis loop is for
(a) cobalt steel (b) alnico
(c) perm alloy (d) stainless steel

39. The hysterisis curve is studied generally for
(a) ferromagnetic materials (b) paramagnetic materials
(c) diamagnetic materials (d) all of the above

40. Of dia, para and ferromagnetism, the universal property of all substances is
(a) diamagnetism (b) paramagnetism
(c) ferromagnetism (d) all of the above

41. Curie temperature is the temperature above which
(a) a ferromagnetic material becomes paramagenetic
(b) a paramagnetic material becomes diamagnetic
(c) a ferromagnetic material becomes diamagnetic
(d) a paramagnetic meterial becomes ferromagnetic

42. A material is placed in a magnetic field and it is thrown out of it. Then the material is
(a) paramagnetic (b) diamagnetic
(c) ferromagnetic (d) non-magnetic

43. A diamagnetic material in a magnetic field moves
(a) perpendicular to field
(b) from stronger to weaker parts of field
(c) from weaker to stronger parts of the field
(d) None of these

44. A temporary magnet is made of
(a) cast iron (b) steel
(c) soft iron (d) stainless steel

45. The hysteresis cycle for the material of permanent magnet is
(a) short and wide (b) tall and narrow
(c) tall and wide (d) short and narrow

46. Materials suitable for permanent magnet, must have which of the following properties?
(a) High retentivity, low coercivity and high permeability.
(b) Low retentivity, low coercivity and low permeability.
(c) Low retentivity, high coercivity and low permeability.
(d) High retentivity, high coercivity and high permeability.

47. Which of the following is the most suitable material for making permanent magnet ?
(a) Steel (b) Soft iron
(c) Copper (d) Nickel

48. The materials suitable for making electromagnets should have
(a) high retentivity and low coercivity
(b) low retentivity and low coercivity
(c) high retentivity and high coercivity
(d) low retentivity and high coercivity

49. Core of elctromagnets are made of ferromagnetic materials which have
(a) low permeability and low retentivity
(b) high permeability and high retentivity
(c) high permeability and high retentivity.
(d) low permeability and high retentivity.

50. Permanent magnets are the substances having the property of
(a) ferromagnetism at room temperature for a long period of time.
(b) paramagnetism at room temperature for a long period of time.
(c) anti ferromagnetism at room temperature for a long period of time.
(d) diamagnetism at room temperature for a long period of time.

51. Identify the mismatched pair
(a) Hard magnet - Alnico
(b) Soft magnet - Soft iron
(c) Bar magnet - Equivalent solenoid
(d) Permanent magnet - Loud speaker

52. When the temperature of a magnetic material decreases, the magnetization
(a) decreases in a diamagnetic material
(b) decreases in a paramagnetic material
(c) decreases in a ferromagnetic material
(d) remains the same in a diamagnetic material

53. Identify the correctly matched pair
(a) Diamagnetic - Gadolinium
(b) Soft ferromagnetic - Alnico
(c) Hard ferromagnetic - Copper
(d) Paramagnetic - Sodium

54. A magnetic needle is kept in a non-uniform magnetic field. It experiences
(a) neither a force nor a torque
(b) a torque but not a force
(c) a force but not a torque
(d) a force and a torque

55. If μ_0 is absolute permeability of vacuum and μ_r is relative magnetic permeability of another medium, then permeability μ of the medium is
(a) $\mu_0 \mu_r$ (b) μ_0/μ_r
(c) μ_r/μ_0 (d) $1/\mu_0 \mu_r$

56. Susceptibility is positive and large for a
(a) paramagnetic substance
(b) ferromagnetic substance
(c) diamagnetic substance
(d) non magnetic substance

57. Relative permittivity and permeability of a material are ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material ?
(a) $\varepsilon_r = 1.5, \mu_r = 0.5$ (b) $\varepsilon_r = 0.5, \mu_r = 0.5$
(c) $\varepsilon_r = 1.5, \mu_r = 1.5$ (d) $\varepsilon_r = 0.5, \mu_r = 1.5$

58. Magnetic permeability is maximum for
(a) diamagnetic substance
(b) paramagnetic substance
(c) ferromagnetic substance
(d) All of the above

59. When a piece of a ferromagnetic substance is put in a uniform magnetic field, the flux density inside it is four times the flux density away from the piece. The magnetic permeability of the material is
(a) 1 (b) 2
(c) 3 (d) 4

60. Demagnetisation of magnets can be done by
(a) rough handling
(b) heating
(c) magnetising in the opposite direction
(d) All of the above

61. A diamagnetic material in a magnetic field moves
(a) perpendicular to the field
(b) from stronger to the weaker parts of the field
(c) from weaker to the stronger parts of the field
(d) None of these

62. A ferromagnetic material is heated above its curie temperature. Which one is a correct statement?
(a) Ferromagnetic domains are perfectly arranged
(b) Ferromagnetic domains become random
(c) Ferromagnetic domains are not influenced
(d) Ferromagnetic material changes into diamagnetic material

63. A substance which retains magnetic moment for a long time is
(a) Diamagnetic (b) Paramagnetic
(c) Ferromagnetic (d) Non magnetic

64. Ferromagnetism arises due to
(a) vacant inner shells of an atom
(b) filled inner sub shells of an atom
(c) partially filled inner sub shells
(d) large number of electrons in valence orbit

65. Domain is a region where in all atoms have their magnetic momentum
(a) parallel
(b) antiparallel
(c) randomly oriented
(d) perpendicular to one another

66. Domains are formed in
(a) non magnetic substance
(b) paramagnetic substance
(c) ferromagnetic substance
(d) para and ferromagnet substance

67. The magnetic susceptibility is given by
(a) $\chi = \frac{1}{H}$ (b) $\chi = \frac{B}{H}$
(c) $\chi = \frac{M_{net}}{V}$ (d) $\chi = \frac{M_z}{H}$

68. Iron is ferromagnetic
(a) above 770°C (b) below 770°C
(c) at all temperature (d) above 1100°C

69. According to Curie's law,
(a) $\chi \propto (T - T_c)$ (b) $\chi \propto \frac{1}{T - T_c}$
(c) $\chi \propto \frac{1}{T}$ (d) $\chi \propto T$

70. Susceptibility of ferromagnetic substance is
(a) > 1 (b) < 1
(c) 0 (d) 1

71. Magnetic field intensity due to a dipole varies as x^n, where n is
(a) 2 (b) -2
(c) 3 (d) -3

72. A susceptibility of a certain magnetic material is 400. What is the class of the magnetic material?
(a) Diamagnetic (b) Paramagnetic
(c) Ferromagnetic (d) Ferroelectric

73. Which of the following is paramagnetic?
(a) Gold (b) Water
(c) Nickel (d) Aluminium

74. On applying an external magnetic field, to a ferromagnetic substance domains
(a) align in the direction of magnetic field
(b) align in the opposite direction of magnetic field
(c) remain undeflected
(d) None of these

75. The magnetic moment of atoms of diamagnetic substances is
(a) equal to zero (b) less than zero
(c) greater than 1 (d) none of these

76. If the susceptibility of dia, para and ferromagnetic materials are χ_d, χ_p, χ_f respectively, then
(a) $\chi_d < \chi_p < \chi_f$ (b) $\chi_d < \chi_f < \chi_p$
(c) $\chi_f < \chi_d < \chi_p$ (d) $\chi_f < \chi_p < \chi_d$

77. The magnetic susceptibility of a paramagnetic substances at –73°C is 0.0060, then its value at –173°C will be
(a) 0.0030 (b) 0.0120
(c) 0.0180 (d) 0.0045

78. Needles N_1, N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet when brought close to them will
(a) attract N_1 and N_2 strongly but repel N_3
(b) attract N_1 strongly, N_2 weakly and repel N_3 weakly
(c) attract N_1 strongly, but repel N_2 and N_3 weakly
(d) attract all three of them

79. If a paramagnetic liquid is placed in a watch glass, resting on the pole pieces, the liquid accumulates where the field is
(a) zero (b) weak
(c) strong (d) None of these

STATEMENT TYPE QUESTIONS

80. Which of the following statements is / are correct about magnetism ?
I. The Earth behaves as a magnet with the magnetic field pointing approximately from the geographic South to the North.
II. When a bar magnet is freely suspended, it points in the North–South direction. The tip which points to the geographic North is called the North –pole and the tip which points to georaphic South is called the South–pole of magnet.
III. There is a repulsive force when North–poles (or South–poles) of two magnets are brought close together. Conversely, there is an attractive force

between the North–pole of one magnet and the South–pole of other.

IV. We can isolate the North or South–pole of a magnet.

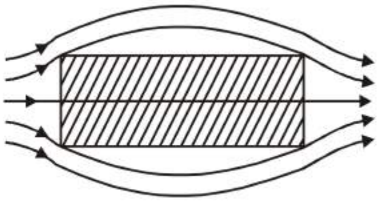
(a) I and II
(b) I, II and IV
(c) III and IV
(d) I, II and III

81. Consider the given statements with respect to the figure showing a bar of diamagnetic material placed in an external magnetic field.

I. The field lines are repelled or expelled and the field inside the material is reduced.

II. When placed in a non–uniform magnetic field, the bar will tend to move from high to low field.

III. Reduction in the field inside the material slight, being one part in 10^5



Which of the above statements are correct?

(a) I and II
(b) I and III
(c) II and III
(d) I, II and III

82. A ferromagnetic material is heated above its curie temperature. Which of the following are incorrect ?

I. Ferromagnetic domains are perfectly arranged

II. Ferromagnetic domains are not influenced

III. Ferromagnetic material changes into diamagnetic material

(a) I and II (b) I, II and III
(c) II and III (d) I and III

83. Consider the following statements and identify incorrect statement(s).

I Diamagnetism is temperature independent.

II Paramagnetism is explained by domain theory.

III Above curie temperature a ferromagnetic material becomes paramagnetic.

IV Magnetic susceptibility is small and negative for diamagnetic substance.

(a) I only (b) II only
(c) I, II and III (d) II and IV

84. Consider the following statements and select the correct statement(s).

I Diamagnetic materials do not have permanent magnetic moment

II Diamagnetism is explained in terms of electromagnetic induction

III Diamagnetic materials have a small positive susceptibility

(a) I only (b) II only
(c) I and II (d) I, II and III

85. Consider the following statements and choose the incorrect statement(s)

I A paramagnetic material tends to move from a strong magnetic field to weak magnetic field

II A magnetic material is in the paramagnetic phase below its Curie temperature.

III The resultant magnetic moment in an atom of a diamagnetic substance is zero

(a) I only (b) II only
(c) I and II (d) I, II and III

MATCHING TYPE QUESTIONS

86. Match the columns I and II.

Column I	Column II
(A) Axial field for a short dipole	(1) $-M.B$
(B) Equatorial field for a short dipole	(2) $M \times B$
(C) External field torque	(3) $\mu_0 2M/4\pi r^3$
(D) External field energy	(4) $-\mu_0 M/4\pi r^3$

(a) (A) → (3) ; (B) → (4) ; (C) → (2) ; (D) → (1)
(b) (A) → (3) ; (B) → (4) ; (C) → (3) ; (D) → (1)
(c) (A) → (4) ; (B) → (3) ; (C) → (2) ; (D) → (1)
(d) (A) → (2) ; (B) → (1) ; (C) → (4) ; (D) → (3)

87.

Column I	Column II
(A) Horizontal component	(1) $B_E \sin\theta$
(B) Vertical component	(2) $\frac{B_V}{B_H}$
(C) tan θ	(3) $B_E \cos\theta$
(D) Tangent law	(4) $B = B_H \tan\theta$

(a) A → (3); B → (2); C → (1); D → (4)
(b) A → (3); B → (1); C → (2); D → (4)
(c) A → (2); B → (3); C → (1); D → (4)
(d) A → (1); B → (3); C → (2); D → (4)

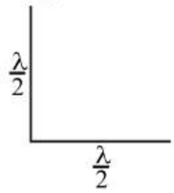
88.

Column I	Column II
(A) Negative susceptibility	(1) Ferromagnetic
(B) Positive and small susceptibility	(2) Diamagnetic
(C) Positive and large susceptibility	(3) Paramagnetic
(D) Loadstone	(4) Magnetite

(a) A → (3); B → (2); C → (4); D → (1)
(b) A → (1); B → (2); C → (3); D → (4)
(c) A → (2); B → (3); C → (1); D → (4)
(d) A → (2); B → (1); C → (4); D → (3)

DIAGRAM TYPE QUESTIONS

89. A steel wire of length ℓ has a magnetic moment M. It is bent in L-shape (Figure). The new magnetic moment is

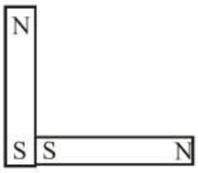


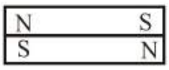
(a) M
(b) $\frac{M}{\sqrt{2}}$
(c) $\frac{M}{2}$
(d) 2M

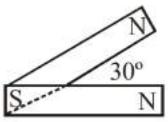
90. Imagine rolling a sheet of paper into a cylinder and placing a bar magnet near its end as shown in figure. What can you say about the sign of $\vec{B}.d\vec{A}$ for every area $d\vec{A}$ on the surface?

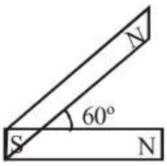
(a) Positive
(b) Negative
(c) No sign
(d) Can be positive or negative

91. Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnet ic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment ?

A. 

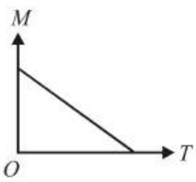
B. 

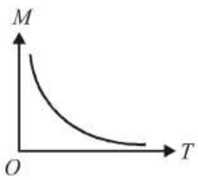
C. 

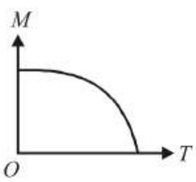
D. 

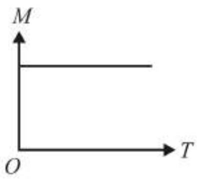
(a) A
(b) B
(c) C
(d) D

92. A curve between magnetic moment and temperature of magnet is

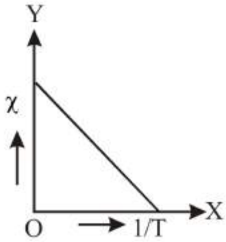
(a) 

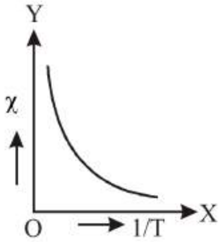
(b) 

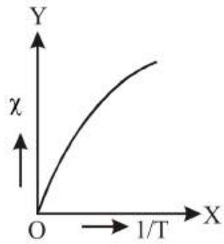
(c) 

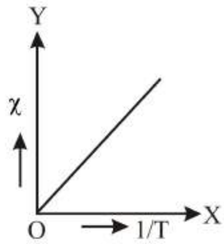
(d) 

93. The graph between χ and 1/T for paramagnetic material will be represented by

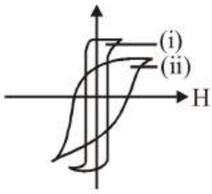
(a) 

(b) 

(c) 

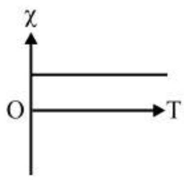
(d) 

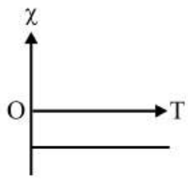
94. The B – H curve (i) and (ii) shown in fig associated with

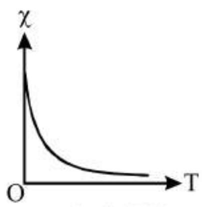


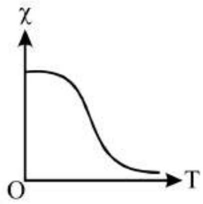
(a) (i) diamagnetic and (ii) paramagnetic substance
(b) (i) paramagnetic and (ii) ferromagnetic substance
(c) (i) soft iron and (ii) steel
(d) (i) steel and (ii) soft iron

95. The variation of magnetic susceptibility (x) with temperature for a diamagnetic substance is best represented by

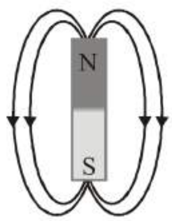
(a) 

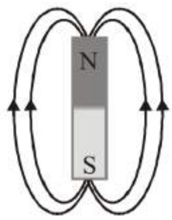
(b) 

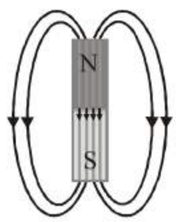
(c) 

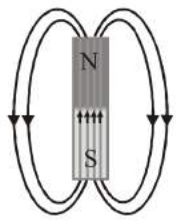
(d) 

96. The magnetic field lines due to a bar magnet are correctly shown in

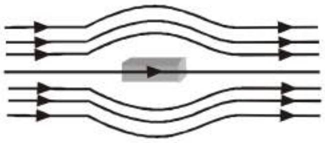
(a) 

(b) 

(c) 

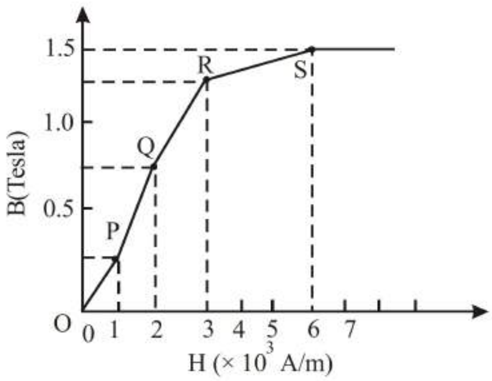
(d) 

97. The given figure represents a material which is



(a) paramagnetic (b) diamagnetic
(c) ferromagnetic (d) none of these

98. The basic magnetization curve for a ferromagnetic material is shown in figure. Then, the value of relative permeability is highest for the point



(a) P (b) Q
(c) R (d) S

ASSERTION- REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

99. **Assertion :** The poles of magnet can not be separated by breaking into two pieces.
Reason : The magnetic moment will be reduced to half when a magnet is broken into two equal pieces.

100. **Assertion :** We cannot think of magnetic field configuration with three poles.
Reason : A bar magnet does not exert a torque on itself due to its own field.

101. **Assertion :** The earth's magnetic field is due to iron present in its core.
Reason : At a high temperature magnet losses its magnetism.

102. **Assertion :** To protect any instrument from external magnetic field, it is put inside an iron body.
Reason : Iron has high permeability.

103. **Assertion :** The sensitivity of a moving coil galvanometer is increased by placing a suitable magnetic material as a core inside the coil.
Reason : Soft iron has high magnetic permeability and cannot be easily magnetized or demagnetized.

104. **Assertion :** Magnetism is relativistic.
Reason : When we move along with the charge so that there is no motion relative to us, we find no magnetic field associated with the charge.

105. **Assertion :** The ferromagnetic substance do not obey Curie's law.
Reason : At Curie point a ferromagnetic substance start behaving as a paramagnetic substance.

106. **Assertion :** A paramagnetic sample display greater magnetisation (for the same magnetic field) when cooled.
Reason : The magnetisation does not depend on temperature.

107. **Assertion :** Electromagnets are made of soft iron.
Reason : Coercivity of soft iron is small.

CRITICAL THINKING TYPE QUESTIONS

108. A bar magnet has a length 8 cm. The magnetic field at a point at a distance 3 cm from the centre in the broad side-on position is found to be $4\times10^{-6}\,T$. The pole strength of the magnet is.
(a) 6×10^{-5} Am (b) 5×10^{-5} Am
(c) 2×10^{-4} Am (d) 3×10^{-4} Am

109. Two bar magnets of the same mass, same length and breadth but having magnetic moments M and 2M are joined together pole for pole and suspended by a string. The time period of assembly in a magnetic field of strength H is 3 seconds. If now the polarity of one of the magnets is reversed and combination is again made to oscillate in the same field, the time of oscillation is
(a) $\sqrt{3}$ sec (b) $3\sqrt{3}$ sec
(c) 3 sec (d) 6 sec

110. A compass needle made of pure iron (with density 7900 kg/m^3) has a length L of 3.0 cm, a width of 1.00 mm, and a thickness of 0.50 mm. The magnitude of the magnetic dipole moment of an iron atom is $M_{Fe}=2.1\times10^{-23}\,J/T$. If the magnetisation of the needle is equivalent to the alignment of 10% of the atoms in the needle, what is the magnitude of the needle's magnetic dipole moment $\vec{M}$?
(a) 2.7×10^{-1} J/T (b) 2.7×10^{-2} J/T
(c) 2.7×10^{-3} J/T (d) 2.7×10^{-4} J/T

111. The work done in turning a magnet of magnetic moment M by an angle of 90° from the meridian, is n times the corresponding work done to turn it through an angle of 60°. The value of n is given by
(a) 2 (b) 1
(c) 0.5 (d) 0.25

112. A short bar magnet of magnetic moment $0.4 J T^{-1}$ is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is

(a) -0.64 J (b) zero
(c) -0.082 J (d) 0.064 J

113. The magnetic moment of a magnet is 0.1 amp × m^2. It is suspended in a magnetic field of intensity 3×10^{-4} weber/m^2. The couple acting upon it when deflected by 30° from the magnetic field is

(a) 1×10^{-5} N m (b) 1.5×10^{-5} N m
(c) 2×10^{-5} N m (d) 2.5×10^{-5} N m

114. Time periods of vibation of two bar magnets in sum and difference positions are 4 sec and 6 sec respectively. The ratio of their magnetic moments M_1 / M_2 is

(a) 6:4 (b) 30:16
(c) 2.6:1 (d) 1.5:1

115. A magnet of magnetic moment 20 C.G.S. units is freely suspended in a uniform magnetic field of intensity 0.3 C.G.S. units. The amount of work done in deflecting it by an angle of 30° in C.G.S. units is

(a) 6 (b) $3\sqrt{3}$
(c) $3(2-\sqrt{3})$ (d) 3

116. A magnet of length 0.1 m and pole strength 10^{-4} $A.m.$ is kept in a magnetic field of 30 Wb / m^2 at an angle 30°. The couple acting on it is .... × 10^{-4} Nm.

(a) 7.5 (b) 3.0
(c) 1.5 (d) 6.0

117. A short bar magnet is placed in the magnetic meridian of the earth with north pole pointing north. Neutral points are found at a distance of 30 cm from the magnet on the East – West line, drawn through the middle point of the magnet. The magnetic moment of the magnet in Am^2 is close to: (Given $\frac{\mu_0}{4\pi} = 10^{-7}$ in SI units and B_H =Horizontal component of earth's magnetic field = 3.6×10^{-5} tesla)

(a) 14.6 (b) 19.4
(c) 9.7 (d) 4.9

118. A bar magnet of moment of inertia 9×10^{-5} kg m^2 placed in a vibration magnetometer and oscillating in a uniform magnetic field $16\pi^2 \times 10^{-5}$T makes 20 oscillations in 15 s. The magnetic moment of the bar magnet is

(a) 3 Am^2 (b) 2 Am^2
(c) 5 Am^2 (d) 4 Am^2

119. If a magnetic dipole of moment M situated in the direction of a magnetic field B is rotated by 180°, then the amount of work done is

(a) MB (b) 2MB
(c) $\frac{MB}{\sqrt{2}}$ (d) $\sqrt{MB}$

120. Two short magnets with their axes horizontal and perpendicular to the magnetic maridian are placed with their centres 40 cm east and 50 cm west of magnetic needle. If the needle remains undeflected, the ratio of their magnetic moments $M_1 : M_2$ is

(a) 4 : 5 (b) 16 : 25
(c) 64 : 125 (d) $2 : \sqrt{5}$

121. A bar magnet 8 cms long is placed in the magnetic merdian with the N-pole pointing towards geographical north. Two netural points separated by a distance of 6 cms are obtained on the equatorial axis of the magnet. If horizontal component of earth's field = 3.2×10^{-5} T, then pole strength of magnet is

(a) 5 ab-amp × c (b) 10 ab-amp × cm
(c) 2.5 ab-amp × cm (d) 20 ab-amp × cm

122. At a certain place, the angle of dip is 30° and the horizontal component of earth's magnetic field is 0.50 oerested. The earth's total magnetic field (in oerested) is

(a) $\sqrt{3}$ (b) 1
(c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{2}$

123. Two magnets are held together in a vibration magnetometer and are allowed to oscillate in the earth's magnetic field with like poles together. 12 oscillations per minute are made but for unlike poles together only 4 oscillations per minute are executed. The ratio of their magnetic moments is

(a) 3:1 (b) 1:3
(c) 3:5 (d) 5:4

124. The horizontal component of the earth's magnetic field is 3.6×10^{-5} tesla where the dip angle is 60°. The magnitude of the earth's magnetic field is

(a) 2.8×10^{-4} tesla (b) 2.1×10^{-4} tesla
(c) 7.2×10^{-5} tesla (d) 3.6×10^{-5} tesla

125. A torque of 10^{-5} Nm is required to hold a magnet at 90° with the horizontal component H of the earth's magnetic field. The torque to hold it at 30° will be

(a) 5×10^{-6} Nm (b) data is insufficient
(c) $\frac{1}{3} \times 10^{-5}$ Nm (d) $5\sqrt{3} \times 10^{-6}$ Nm

126. A short magnet oscillates in an oscillation magnetometer with a time period of 0.10s where the earth's horizontal magnetic field is 24 μT. A downward current of 18 A is established in a vertical wire placed 20 cm east of the magnet. Find the new time period.

(a) 0.076 s (b) 0.5 s
(c) 0.1 s (d) 0.2 s

127. The susceptibility of annealed iron at saturation is 5500. Find the permeability of annealed iron at saturation.
(a) 6.9×10^{-3} (b) 5.1×10^{-2}
(c) 5×10^{2} (d) 3.2×10^{-5}

128. The moment of a magnet (15 cm × 2 cm × 1 cm) is 1.2 A-m^2. What is its intensity of magnetisation?
(a) 4×10^4 A m^{-1} (b) 2×10^4 A m^{-1}
(c) 10^4 A m^{-1} (d) None of these

129. A magnetising field of 2×10^3 A m^{-1} produces a magnetic flux density of 8π T in an iron rod. The relative permeability of the rod will be
(a) 10^2 (b) 1
(c) 10^4 (d) 10^3

130. A permanent magnet in the shape of a thin cylinder of length 10 cm has magnetisation (M) = 10^6 A m^{-1}. Its magnetization current I_M is
(a) 10^5 A (b) 10^6 A
(c) 10^7 A (d) 10^8 A

131. If relative permeability of iron is 2000. Its absolute permeability in S.I. units is
(a) $8\pi \times 10^{-4}$ (b) $8\pi \times 10^{-3}$
(c) $800/\pi$ (d) $8\pi \times 10^9/\pi$

132. The relative permeability of a medium is 0.075. What is its magnetic susceptibility?
(a) 0.925 (b) −0.925
(c) 1.075 (d) −1.075

133. At a temperatur of 30°C, the susceptibility of a ferromagnetic material is found to be χ. Its susceptibility at 333°C is
(a) χ (b) 0.5χ
(c) 2χ (d) 11.1χ

134. Assume that each iron atom has a permanent magnetic moment equal to 2 Bohr magnetons (1 Bohr magneton = 9.27×10^{-24} A-m^2). The density of atoms in iron is 8.52×10^{28} $atoms/m^3$. Find the maximum magnetisation I in a long cylinder of iron.
(a) 1.5×10^2 A|m (b) 1.58×10^6 A|m
(c) 1.2×10^5 A|m (d) 1.3×10^6 A|m

135. The coercivity of a small magnet where the ferromagnet gets demagnetized is 3×10^3 Am^{-1}. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is:
(a) 30 mA (b) 60 mA
(c) 3 A (d) 6 A

136. A bar magnet has coercivity 4×10^3 Am^{-1}. It is desired to demagnetise it by inserting it inside a solenoid 12 cm long and having 60 turns. The current that should be sent through the solenoid is
(a) 2 A (b) 4 A
(c) 6 A (d) 8 A

137. A magnetising field of 2×10^3 amp/m produces a magnetic flux density of 8π tesla in an iron rod. The relative permeability of the rod will be
(a) 10^2 (b) 10^0
(c) 10^3 (d) 10^4

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (d) 2. (a) 3. (b) 4. (c) 5. (c)
6. (a) 7. (a) 8. (c) 9. (a) 10. (d)
11. (a) 12. (d) 13. (d)

14. (b) Number of lines of force passing through per unit area normally is intensity of magnetic field, hence option (c) is incorrect. The correct option is (b).

15. (c) The field lines remain continuous, emerging from one face of the solenoid and entering into the other face.

16. (c) The magnetic moment of a bar magnet is thus equal to the magnetic moment of an equivalent solenoid that produces the same magnetic field.

17. (b) 18. (a) 19. (d)

20. (d) The streangth of the earths magnetic field is not constant. It varies from one place to other place on the surface of earth. Its value being of the order of 10^{-5} T.

21. (a) 22. (c) 23. (d) 24. (d)

25. (a) The earth,s core is hot and molten. Hence, convective current in earth's core is responsibli for it's magnetic field.

26. (b) Magnetic meridian of a place is defined as the vertical plane which passes through the imaginary line joining the magnetic North and South-poles. This pane would intersect the surface of the Earth in a longitude like circle.

27. (d) 28. (b) 29. (a)

30. (a)

31. (d) Relative magnetic permeability

$$\mu_r = \frac{\text{magnetic permeability of material } (\mu)}{\text{permeability of free space } (\mu_0)}$$

It is a dimensionless pure ratio and for paramagnetic materials $\mu_r > 1$.

32. (c) 33. (b) 34. (a) 35. (a) 36. (b)
37. (a) 38. (c) 39. (a) 41. (a) 41. (a)
42. (b) 43. (b) 44. (a) 45. (c)

46. (d) Materials suitable for permanent magnets should have high retentivity, high coercivity and high permeability.

47. (a)

48. (b) Electro magnet should be amenable to magnetisation and demagnetization

$\therefore$ retentivity should be low and coercivity should be low.

49. (c) Core of electromagnets are made of soft iron that is a ferromagnetic material with high permeability and low retentivity.

50. (a) Permanent magnets are those substances that retain their ferromagnetic property for a long period of time at room temperature.

51. (d) Permanent magnet – Loud speaker

52. (d) When the temperature of a magnetic material decreases, the magnetization remains the same in a diamagnetic material.

53. (d)

54. (d) A magnetic needle kept in non uniform magnetic field experience a force and torque due to unequal forces acting on poles.

55. (a) $\mu = \mu_r \mu_0$, as $\mu_r = \mu / \mu_0$.

56. (b) For ferromagnetic substances, χ_m is large and positive.

57. (a) $\mu_r < 1$ and $\varepsilon_r > 1$.

58. (c)

59. (d) The magnetic permeability of the material

$$\mu = \frac{B}{H} = \frac{4H}{H} = 4$$

60. (d)

61. (b) A diamagnetic material in a magnetic field moves from stronger to the weaker parts of the field.

62. (b) Beyond curie temperature, ferormagnetic material turns into paramagnetic material, as if ferromagnetic domains become random.

63. (c) 64. (c) 65. (a) 66. (c) 67. (d)
68. (b) 69. (c) 70. (a)

71. (d) Magnetic field intensity $= \frac{\mu_0}{4\pi}\frac{M}{x^3}$

$\propto Mx^{-3}$

$\therefore$ n = – 3

72. (c) 73. (d)

74. (a) By the property of ferromagnetic substance.

75. (a)

76. (a) $\chi_d < \chi_p < \chi_f$

For diamagnetic substance χ_d is small negative (10^{-5})

For paramagnetic substances χ_p is small and positive (10^{-3} to 10^{-5})

For ferromagnetic substanes χ_f is very large (10^3 to 10^5)

77. (b) As magnetic susceptibility $\chi_m \propto \frac{1}{T}$, therefore

$$\frac{\chi_2}{\chi_1}=\frac{T_1}{T_2} \Rightarrow \frac{\chi_2}{0.0060}=\frac{273-73}{273-173}=\frac{200}{100}=2$$

$\chi_2 = 2\times0.0060 = 0.0120$

78. (b) Ferromagnetic substance has magnetic domains whereas paramagnetic substances have magnetic dipoles which get attracted to a magnetic field. Diamagnetic substances do not have magnetic dipole but in the presence of external magnetic field due to their orbital motion of electrons these substances are repelled.

79. (c)

STATEMENT TYPE QUESTIONS

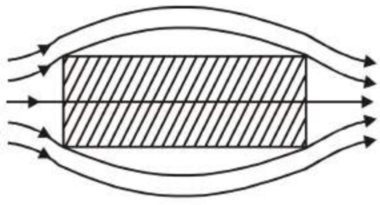
80. (d) (i) The Earth behaves as a magnet with the magnetic field pointing appoximately from the geographic South to the North.

(ii) When a bar magnet is freely suspended, it points in the North-South direction. The tip which points to the geographic North is called the North pole and the tip which points to the geographic South is called the South-pole of the magnet.

(iii) There is a repulsive force when North poles (or South-poles) of two magnets are brought close together. Conversely there is an attractive force between the North-pole of one magnet and the South-pole of the other.

(iv) We cannot isolate the North or South-pole of a magnet. If a bar magnet is broken into two halves, we get two similar bar magnets with somewhat weaker properties. Unlike electric charges, isolated magnetic North and South poles known as magnetic monopoles do not exist.

81. (d) Figure shows a bar of diamagnetic material placed in an external magnetic field.



The field lines are repelled or expelled and the field inside the material is reduced, this reduction is slight, being one part in 10^5. When placed in a non-uniform magnetic field, the bar will tend to move from high to low field.

82. (b)

83. (b) Domain theory is for ferromagnetic substance.

84. (c) Susceptibility of diamagnetic substance is negative and it does not change with temperature.

85. (c) Diamagnetic substances are those substances in which resultant magnetic moment in an atom is zero.
A paramagnetic material tends to move from a weak magnetic field to strong magnetic field.
A magnetic material is in the paramagnetic phase above its Curie temperature.
Typical domain size of a ferromagnetic material in 1 mm.

MATCHING TYPE QUESTIONS

86. (a) (A) → 3; (B) → 4; (C) → 2; (D) → 1

87. (b) 88. (c)

DIAGRAM TYPE QUESTIONS

89. (b) Magnetic moment, $M = m\ell$

$\frac{M}{\ell} = m$, where m is the polestrength.

Therefore distance between poles

$$= \sqrt{(\ell/2)^2+(\ell/2)^2} = \frac{\ell}{\sqrt{2}}$$

So, $M' = \frac{m\ell}{\sqrt{2}} = \frac{M}{\sqrt{2}}$

90. (b) The field is entering into the surface so flux is negative.

91. (c) Net magnetic dipole moment $= 2\,M\cos\frac{\theta}{2}$

As value of $\cos\frac{\theta}{2}$ is maximum in case (c) hence net magnetic dipole moment is maximum for option (c).

92. (c) Magnetism of a magnet falls with rise of temperatue and becomes practically zero above curie temperature.

93. (d) 94. (c) 95. (b) 96. (d) 97. (b)

98. (b) $B = \mu_0\mu_r H \Rightarrow \mu_r \propto \frac{B}{H}$ = slope of B-H curve

According to the given graph, slope of the graph is highest at point Q.

ASSERTION- REASON TYPE QUESTIONS

99. (b) When a magnet is cut into pieces, each piece becomes new magnet. $M' = \frac{m\ell}{2} = \frac{M}{2}$.

100. (b)

101. (d) Magnetic field of earth is due to moving charged particles in the atmosphere. With increase in temperature, the magnetic moment of magnet decreases.

102. (a) Because of high permeability of the iron, the entire magnetic field will pass through iron, and so rest space becomes free from magnetic field.

103. (c) Sensitivity of galvanometer,

$$s = \frac{\theta}{i} \simeq \frac{\tan\theta}{i}$$

$$= \frac{\mu_0 N}{2RB_H}.$$

If a magnetic material is placed inside coil of galvanometer, then

$$s' = \frac{\mu_r \mu_0 N}{2RB_H}.$$

104. (b) A magnetic field is produced by the motion of electric charge. Since motion is relative, the magnetic field is also relative.

105. (c) The susceptibility of ferromagnetic substance decreases with the rise of temperature in a complicated manner. After Curies point in the susceptibility of ferromagnetic substance varies inversely with its absolute tempearture. Ferromagnetic substance obey's Curie's law only above its Curie point.

106. (d) A paramagnetic sample display greater magnetisation when cooled, this is because at lower temperature, the tendency to disrupt the alignment of dipoles (due to magnetising field) decreases on account of reduced random thermal motion.

107. (b) Electromagnets are magnets, which can be turnd on and off by switching the current on and off.

As the material in electromagnets is subjected to cyclic changes (magnification and demangetisation), the hysteresis loss of the material must be small. The material should attain high value of I and B with low value of magnetising field intensity H. As soft iron has small coercivity, so it is a best choice for this purpose.

CRITICAL THINKING TYPE QUESTIONS

108. (a) Magnetic field due to a bar magnet in the broad-side on position is given by

$$B = \frac{\mu_0}{4\pi}\frac{M}{\left[r^2 + \frac{\ell^2}{4}\right]^{3/2}} \quad ; M = m\ell.$$

After substituting the values and simplifying we get

$$B = 6\times10^{-5} \text{ A-m}$$

109. (b) $\frac{T_2^2}{T_1^2} = \frac{2M+M}{2M-M} = 3 \qquad \therefore T_2 = T_1\sqrt{3} = 3\sqrt{3}\,s.$

110. (c) The volume of the needle,

$$V = (3\times10^{-2})\times(1\times10^{-3})\times(0.5\times10^{-3})$$
$$= 1.5\times10^{-8}\ m^3$$

The mass of the needle = ρV

$$= 7900\times1.5\times10^{-8}$$
$$= 1.183\times10^{-4}\text{ kg}$$

The number of atoms in the needle

$$= \left[\frac{1.185\times10^{-4}}{56\times10^{-3}}\right]\times6.02\times10^{23}$$
$$= 1.27\times10^{21}$$

The needle's dipole moment

$$M = \frac{1}{10}(1.27\times10^{21})\times(2.1\times10^{-23})$$
$$= 2.7\times10^{-3}\text{ J/T}$$

111. (a) Magnetic moment = M; Initial angle through which magnet is turned $(\theta_1) = 90^\circ$ and final angle which magnet is turned $(\theta_2) = 60^\circ$. Work done in turning the magnet through

$90^\circ (W_1) = MB(\cos 0^\circ - \cos 90^\circ) = MB(1-0) = MB.$

Similarly, $W_2 = MB(\cos 0^\circ - \cos 60^\circ)$

$$= MB\left(1-\frac{1}{2}\right) = \frac{MB}{2}.$$

$\therefore W_1 = 2W_2$ or n = 2.

112. (a) For stable equilibrium

$U = -MB = -(0.4)(0.16) = -0.064$ J

113. (b) $\tau = MB\sin\theta = 0.1\times3\times10^{-4}\sin 30^\circ$

or $\tau = 1.5\times10^{-5}$ N–m.

114. (c) $\frac{M_1}{M_2} = \frac{T_2^2 + T_1^2}{T_2^2 - T_1^2} = \frac{6^2+4^2}{6^2-4^2} = \frac{52}{20} = (2.6):1$

115. (c) Work done $W = MB_H(1-\cos\theta)$

$$= 20\times0.3(1-\cos 30^\circ) = 6\left(1-\frac{\sqrt{3}}{2}\right) = 3(2-\sqrt{3})$$

116. (c) $\tau = MB\sin\theta = m\times(2\ell)\times B\sin\theta$

$= 10^{-4}\times0.1\times30\sin 30^\circ = 1.5\times10^{-4}\ Nm$

117. (c) Here, r = 30cm = 0.3cm

we know $\frac{\mu_0 M}{4\pi r^3} = B_H = 3.6\times10^{-5}$

$$\Rightarrow M = \frac{3.6\times10^{-5}}{10^{-7}}(0.3)^3$$

Hence, M = 9.7 Am^2

118. (d) Given, $I = 9\times10^{-5}$ kg m^2, $B = 16\pi^2\times10^{-5}$ T

$$T = \frac{15}{20} = \frac{3}{4}s$$

In a vibration magnetometer

Time period, $T = 2\pi\sqrt{\frac{I}{MB}}$ or $M = \frac{4\pi^2 I}{BT^2}$

$$M = \frac{4\pi^2 \times 9 \times 10^{-5}}{16\pi^2 \times 10^{-5} \times \left(\frac{3}{4}\right)^2} = 4\ \text{A m}^2$$

119. (b) Work done in rotating the magnetic dipole from position $\theta_1 = 0°$ to $\theta_2 = 180°$

$\because W = MB(\cos\theta_1 - \cos\theta_2)$

$\therefore W = MB(\cos 0° - \cos 180°) = 2MB$

120. (c) For null deflection $\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3 = \left(\frac{40}{50}\right)^3 = \frac{64}{125}$

121. (a) Here, $2\ell = 8\,\text{cm},\ \ell = 4\,\text{cm},\ d = \frac{6}{2} = 3\,\text{cm}.$

At neutral point,

$$H = B = \frac{\mu_0}{4\pi}\frac{M}{(d^2 + \ell^2)^{3/2}}$$

$$= 10^{-7}\frac{M}{(5 \times 10^{-2})^3} = \frac{M}{1250}$$

$\therefore\ M = 1250\,H = 1250 \times 3.2 \times 10^{-5}\ \text{Am}^2$

$$m = \frac{M}{2\ell} = \frac{1250 \times 3.2 \times 10^{-5}}{8 \times 10^{-2}}\ \text{A m.}$$

$$= 0.5\ \text{Am} = 0.5 \times \frac{1}{10}\text{ab amp} \times 100\ \text{cm}$$

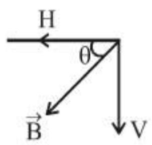
$= 5$ ab-amp cm.

122. (c) $B = \frac{H}{\cos\theta} = \frac{0.50}{\cos 30°} = \frac{0.50 \times 2}{\sqrt{3}} = 1/\sqrt{3}$

123. (d) Here, $T_1 = \frac{60}{12} = 5\,\text{s},\ T_2 = \frac{60}{4} = 15\,\text{s}$

$$\frac{M_1}{M_2} = \frac{T_2^2 + T_1^2}{T_2^2 - T_1^2} = \frac{15^2 + 5^2}{15^2 - 5^2} = \frac{250}{200} = \frac{5}{4}$$

124. (c)



Horizontal component of earth's field, $H = B\cos\theta$, since, $\theta = 60°$

$$3.6 \times 10^{-5} = B \times \frac{1}{2} \Rightarrow B = 7.2 \times 10^{-5}\ \text{Tesla}$$

125. (a) The torque acting on the magnet of magnetic moment M, when held at angle θ to magnetic field B,

$\tau = MB\sin\theta$

$\tau = MB = 10^{-5}\,\text{Nm}.$

$\tau = MB\sin 30° = 0.5 \times 10^{-5}\,\text{Nm}.$

$= 5 \times 10^{-6}$ Nm

126. (a) We know that $T_1 = 2\pi\sqrt{\frac{T}{MB_{H_1}}}$ ...(i)

Where $B_{H_1} = 24 \times 10^{-6}\,\text{T}$

The magnetic field produced by, wire

$$B = \frac{\mu_0}{2\pi}\cdot\frac{i}{r}$$

$$= (2 \times 10^{-7}) \times \frac{(18)}{0.20}$$

$$= 1.8 \times 10^{-6}\ \text{T}$$

Now $B_{H_2} = B_{H_1} + B = 42 \times 10^{-6}\,\text{T}$

$T_2 = 2\pi\sqrt{\frac{I}{MBH_2}}$ ...(ii)

Using equations (i) and (ii), and substituting the values, we get

$T_2 = 0.076\,\text{s}$

127. (a) We know that $\mu_r = 1 + x$

$= 1 + 5500 = 5501$

$\therefore\ \mu = \mu_r\mu_0 = (5501) \times (4\pi \times 10^{-7})$

$= 6.9 \times 10^{-3}$

128. (a) Intensity of magnetisation

$$I_m = \frac{M}{V} = \frac{1.2}{(15 \times 2 \times 1)10^{-6}} = 4 \times 10^4\ \text{A m}^{-1}$$

129. (c) Here, $H = 2 \times 10^3\ \text{A}\ m^{-1}$, $B = 8\pi$ T, $\mu_0 = 4\pi \times 10^7$

Since $\mu_r = \frac{\mu}{\mu_0} = \frac{\mu H}{\mu_0 H} = \frac{B}{\mu_0 H}$

$$= \frac{8\pi}{4\pi \times 10^{-7} \times 2 \times 10^3} = 10^4$$

130. (a) As $BI = \mu_0 MI_M = \mu_0(I + I_M)$

Here, $I = 0$

Then $\mu_0 MI = \mu_0(I_M)$

$\Rightarrow\ I_M = MI = 10^6 \times 0.1^3\ 10^{-5}$ A

131. (a) $\mu = \mu_0 \mu_r = (4\pi \times 10^{-7}) \times 2000 = 8\pi \times 10^{-4}$ S.I. units

132. (b) From $\mu_r = 1 + \chi_m$;

Magnetic suscaptibility, $\chi_m = \mu_r - 1$

$\chi_m = 0.075 - 1 = -0.925.$

133. (b) According to Curie's law, $\chi_m = \frac{\mu_0 C}{T}$

where C is Curie constant, T = temperature

$\therefore \chi_m \alpha \frac{1}{T}$

$\frac{\chi_{m_1}}{\chi_{m_2}} = \frac{T_2}{T_1} = \frac{273+333}{273+30} = \frac{606}{303} = 2$

$\therefore \chi_{m_2} = \chi_{m_1}/2 = 0.5\chi_{m_1} = 0.5\chi. (\because \chi_{m_1} = \chi)$

134. (b) The total magnetic moment per unit volume. i.e., magnetisation

$I = \frac{(8.52 \times 10^{28}) \times (2 \times 9.27 \times 10^{-24})}{1}$

$= 1.58 \times 10^6$ A/m

135. (c) Magnetic field in solenoid $B = \mu_0 n\, i$

$\Rightarrow \frac{B}{\mu_0} = ni$

(Where n = number of turns per unit length)

$\Rightarrow \frac{B}{\mu_0} = \frac{Ni}{L}$

$\Rightarrow 3 \times 10^3 = \frac{100i}{10 \times 10^{-2}}$

$\Rightarrow i = 3A$

136. (d) The bar magnet has coercivity 4×10^3 Am^{-1} i.e., it requires a magnetic intensity $H = 4 \times 10^3$ Am^{-1} to get demagnetised. Let i be the current carried by solenoid having n number of turns per metre length, then by definition H = ni. Here, $H = 4 \times 10^3$ Am^{-1}

$n = \frac{N}{l} = \frac{60}{0.12} = 500$ turn metre^{-1}

$\Rightarrow i = \frac{H}{n} = \frac{4 \times 10^3}{500} = 8A$

137. (d) $\mu_r = \frac{\mu}{\mu_0} = \frac{B}{\mu_0 H}$

$= \frac{8\pi}{(4\pi \times 10^{-7})(2 \times 10^3)}$

$\mu_r = 10^4$