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MAGNETISM AND MATTER

MCQs with One Correct Answer

1. A small bar magnet placed with its axis at 30° with an external field of 0.06 T experiences a torque of 0.018 Nm. The minimum work required to rotate it from its stable to unstable equilibrium position is :

(a) 6.4×10^{-2} J (b) 9.2×10^{-3} J
(c) 7.2×10^{-2} J (d) 11.7×10^{-3} J

2. A paramagnetic material has 10^{28} atoms/m^3. Its magnetic susceptibility at temperature 350 K is 2.8×10^{-4}. Its susceptibility at 300 K is:

(a) 3.267×10^{-4} (b) 3.672×10^{-4}
(c) 3.726×10^{-4} (d) 2.672×10^{-4}

3. A paramagnetic substance in the form of a cube with sides 1 cm has a magnetic dipole moment of 20×10^{-6} J/T when a magnetic intensity of 60×10^3 A/m is applied. Its magnetic susceptibility is:

(a) 3.3×10^{-2} (b) 4.3×10^{-2}
(c) 2.3×10^{-2} (d) 3.3×10^{-4}

4. A bar magnet is demagnetized by inserthing it inside a solenoid of length 0.2 m, 100 turns, and carrying a current of 5.2 A. The coercivity of the bar magnet is:

(a) 285 A/m (b) 2600 A/m
(c) 520 A/m (d) 1200 A/m

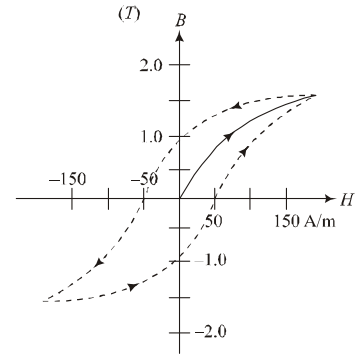
5. A magnetic compass needle oscillates 30 times per minute at a place where the dip is 45°, and 40 times per minute where the dip is 30°. If B_1 and B_2 are respectively the total magnetic field due to the earth and the two places, then the ratio B_1/B_2 is best given by :

(a) 1.8 (b) 0.7
(c) 3.6 (d) 2.2

6. 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

7.



The figure gives experimentally measured B vs. H variation in a ferromagnetic material. The retentivity, co-ercivity and saturation, respectively, of the material are:

(a) 1.5 T, 50 A/m and 1.0 T
(b) 1.5 T, 50 A/m and 1.0 T
(c) 150 A/m, 1.0 T and 1.5 T
(d) 1.0 T, 50 A/m and 1.5 T

8. An iron rod of volume 10^{-3} m^3 and relative permeability 1000 is placed as core in a solenoid with 10 turns/cm. If a current of 0.5 A is passed through the solenoid, then the magnetic moment of the rod will be :

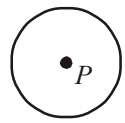
(a) 50×10^2 Am^2 (b) 5×10^2 Am^2
(c) 500×10^2 Am^2 (d) 0.5×10^2 Am^2

9. A paramagnetic sample shows a net magnetisation of 6 A/m when it is placed in an external magnetic field of 0.4 T at a temperature of 4 K. When the sample is placed in an external magnetic field of 0.3 T at a temperature of 24 K, then the magnetisation will be :

(a) 1 A/m (b) 4 A/m

(c) 2.25 A/m (d) 0.75 A/m

10. A perfectly diamagnetic sphere has a small spherical cavity at its centre, which is filled with a paramagnetic substance. The whole system is placed in a uniform magnetic field $\vec{B}$. Then the field inside the paramagnetic substance is :



(a) $\vec{B}$

(b) zero

(c) much large than $|\vec{B}|$ and parallel to $\vec{B}$

(d) much large than $|\vec{B}|$ but opposite to $\vec{B}$

11. A bar magnet having a magnetic moment of 2×10^4 JT^{-1} is free to rotate in a horizontal plane. A horizontal magnetic field B = 6×10^{-4} T exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is

(a) 12 J (b) 6 J

(c) 2 J (d) 0.6 J

12. The angle of dip at a certain place is 30°. If the horizontal component of the earth's magnetic field is H, the intensity of the total magnetic field is

(a) $\frac{H}{2}$ (b) $\frac{2H}{\sqrt{3}}$

(c) $H\sqrt{2}$ (d) $H\sqrt{3}$

13. If the dipole moment of magnet is 0.4 amp – m^2 and the force acting on each pole in a uniform magnetic field of induction 3.2×10^{-5} Weber/m^2 is 5.12×10^{-5} N, the distance between the poles of the magnet is

(a) 25 cm (b) 16 cm

(c) 12.5 cm (d) 12 cm

14. The angle of dip at a place is 37° and the vertical component of the earth's magnetic field is 6×10^{-5}T. The earth's magnetic field at this place is (tan 37° = 3/4)

(a) 7×10^{-5} T (b) 6×10^{-5} T

(c) 5×10^{-5} T (d) 10^{-4} T

15. 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

16. 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

17. The magnetic dipole moment of a coil is 5.4×10^{-6} joule/tesla and it is lined up with an external magnetic field whose strength is 0.80 T. Then the work done in rotating the coil (for θ = 180°) is

(a) 4.32 μJ (b) 2.16 μJ

(c) 8.6 μJ (d) None of these

18. A bar magnet of length 6 cm has a magnetic moment of 4 J T^{-1}. Find the strength of magnetic field at a distance of 200 cm from the centre of the magnet along its equatorial line.

(a) 4×10^{-6} tesla (b) 3.5×10^{-7} tesla

(c) 5×10^{-8} tesla (d) 3×10^{-3} tesla

19. 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 4×10^{-6} *T*. The pole strength of the magnet is

(a) 6.25×10^{-2} Am (b) 5×10^{-5} Am

(c) 2×10^{-4} Am (d) 3×10^{-4} Am

20. A bar magnet of length 0.2 m and pole strength 5 Am is kept in a uniform magnetic induction field of strength 15Wbm^{-2} making an angle of 30° with the field. Find the couple acting on it

(a) 7.5 Nm (b) 4.5 Nm

(c) 5.5 Nm (d) 6.5 Nm

Numeric Value Answer

21. A bar magnet is demagnetized by inserthing it inside a solenoid of length 0.2 m, 100 turns, and carrying a current of 5.2 A. The coercivity (in A/m) of the bar magnet is:

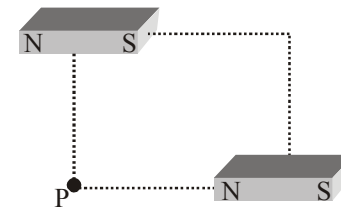
22. At some location on earth the horizontal component of earth's magnetic field is 18×10^{-6} T. At this location, magnetic needle of length 0.12 m and pole strength 1.8 Am is suspended from its mid-point using a thread, it makes 45° angle with horizontal in equilibrium. To keep this needle horizontal, the vertical force (in N) that should be applied at one of its ends is:

23. A paramagnetic substance in the form of a cube with sides 1 cm has a magnetic dipole moment of 20×10^{-6} J/T when a magnetic intensity of 60×10^{3} A/m is applied. Its magnetic susceptibility is:

24. A paramagnetic material has 10^{28} atoms/m^3. Its magnetic susceptibility at temperature 350 K is 2.8×10^{-4}. Its susceptibility at 300 K is:

25. If the dipole moment of magnet is 0.4 amp – m^2 and the force acting on each pole in a uniform magnetic field of induction 3.2×10^{-5} Weber/m^2 is 5.12×10^{-5} N, the distance (in cm) between the poles of the magnet is

26. Two short bar magnets of magnetic moments 1000 Am^2 are placed as shown at the corners of a square of side 10 cm. The net magnetic induction (in Tesla) at P is



27. The magnetic field of earth at the equator is approximately 4×10^{-5} T. The radius of earth is 6.4×10^{6} m. Then the dipole moment (in A-m^2) of the earth will be nearly of the order of

28. Two tangent galvanometers having coils of the same radius are connected in series. A current flowing in them produces deflections of 60º and 45º respectively. The ratio of the number of turns in the coils is

29. 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

30. A certain amount of current when flowing in a properly set tangent galvanometer, produces a deflection of 45°. If the current be reduced by a factor of $\sqrt{3}$, the deflection (in degree) would decrease by

ANSWER KEY																			
1	(c)	**4**	(b)	**7**	(d)	**10**	(b)	**13**	(a)	**16**	(a)	**19**	(a)	**22**	(6.5×10^{-5})	**25**	(25)	**28**	$(\sqrt{3})$
2	(a)	**5**	(Bonus)	**8**	(b)	**11**	(b)	**14**	(d)	**17**	(c)	**20**	(a)	**23**	(3.3×10^{-4})	**26**	(0.1)	**29**	(0.51)
3	(d)	**6**	(b)	**9**	(d)	**12**	(b)	**15**	(d)	**18**	(c)	**21**	(2600)	**24**	(3.266×10^{-4})	**27**	(10^{23})	**30**	(15)