Magnetism and Matter

1. Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid-point *O* of the line joining their centres is close to

   (Horizontal component of earth's magnetic induction is 3.6×10^{-5} Wb/m^2) **[JEE (Main)-2013]**

   (1) 3.6×10^{-5} Wb/m^2

   (2) 2.56×10^{-4} Wb/m^2

   (3) 3.50×10^{-4} Wb/m^2

   (4) 5.80×10^{-4} Wb/m^2

2. The coercivity of a small magnet where the ferromagnet gets demagnetized is 3×10^3 A m^{-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 **[JEE (Main)-2014]**

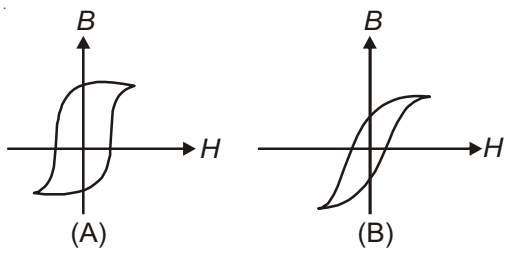
   (1) 30 mA

   (2) 60 mA

   (3) 3 A

   (4) 6 A

3. Hysteresis loops for two magnetic materials *A* and *B* are given below:



   These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use: **[JEE (Main)-2016]**

   (1) *A* for electromagnets and *B* for electric generators

   (2) *A* for transformers and *B* for electric generators

   (3) *B* for electromagnets and transformers

   (4) *A* for electric generators and transformers

4. A magnetic needle of magnetic moment 6.7×10^{-2} Am^2 and moment of inertia 7.5×10^{-6} kg m^2 is performing simple harmonic oscillations in a magnetic field of 0.01 T. Time taken for 10 complete oscillations is **[JEE (Main)-2017]**

   (1) 6.65 s (2) 8.89 s

   (3) 6.98 s (4) 8.76 s

5. A bar magnet is demagnetized by inserting 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 **[JEE (Main)-2019]**

   (1) 520 A/m (2) 2600 A/m

   (3) 1200 A/m (4) 285 A/m

6. A magnet of total magnetic moment $10^{-2}\hat{i}$ Am^2 is placed in a time varying magnetic field, $B\hat{i}(\cos\omega t)$ where *B* = 1 Tesla and ω = 0.125 rad/s. The work done for reversing the direction of the magnetic moment at *t* = 1 second, is **[JEE (Main)-2019]**

   (1) 0.020 J (2) 0.007 J

   (3) 0.014 J (4) 0.01 J

7. 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 that should be applied at one of its ends is **[JEE (Main)-2019]**

   (1) 1.3×10^{-5} N (2) 1.8×10^{-5} N

   (3) 6.5×10^{-5} N (4) 3.6×10^{-5} N

8. A hoop and a solid cylinder of same mass and radius are made of a permanent magnetic material with their magnetic moment parallel to their respective axes. But the magnetic moment of hoop is twice of solid cylinder. They are placed in a uniform magnetic field in such a manner that their magnetic moments make a small angle with the field. If the oscillation periods of hoop and cylinder are T_h and T_c respectively, then **[JEE (Main)-2019]**

(1) $T_h = 0.5T_c$ (2) $T_h = T_c$

(3) $T_h = 2T_c$ (4) $T_h = 1.5T_c$

9. 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 **[JEE (Main)-2019]**

(1) 3.3×10^{-2} (2) 2.3×10^{-2}

(3) 3.3×10^{-4} (4) 4.3×10^{-2}

10. A 10 m long horizontal wire extends from North East to South West. It is falling with a speed of 5.0 ms^{-1}, at right angles to the horizontal component of the earth's magnetic field, of 0.3×10^{-4} Wb/m^2. The value of the induced emf in wire is: **[JEE (Main)-2019]**

(1) 1.1×10^{-3} V (2) 0.3×10^{-3} V

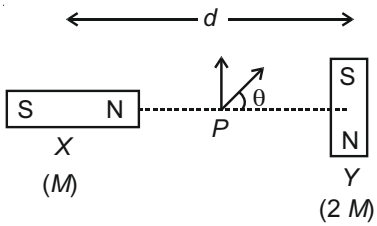
(3) 2.5×10^{-3} V (4) 1.5×10^{-3} V

11. 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 **[JEE (Main)-2019]**

(1) 3.726×10^{-4} (2) 3.672×10^{-4}

(3) 2.672×10^{-4} (4) 3.267×10^{-4}

12. Two magnetic dipoles *X* and *Y* are placed at a separation *d*, with their axes perpendicular to each other. The dipole moment of *Y* is twice that of *X*. A particle of charge *q* is passing through their mid-point *P*, at angle $\theta = 45°$ with the horizontal line, as shown in figure. What would be the magnitude of force on the particle at that instant? (*d* is much larger than the dimensions of the dipole) **[JEE (Main)-2019]**



(1) 0

(2) $\sqrt{2}\left(\frac{\mu_0}{4\pi}\right)\frac{M}{\left(\frac{d}{2}\right)^3} \times qv$

(3) $\left(\frac{\mu_0}{4\pi}\right)\frac{2M}{\left(\frac{d}{2}\right)^3} \times qv$

(4) $\left(\frac{\mu_0}{4\pi}\right)\frac{M}{\left(\frac{d}{2}\right)^3} \times qv$

13. 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 at the two places, then the ratio B_1/B_2 is best given by : **[JEE (Main)-2019]**

(1) 2.2 (2) 0.7

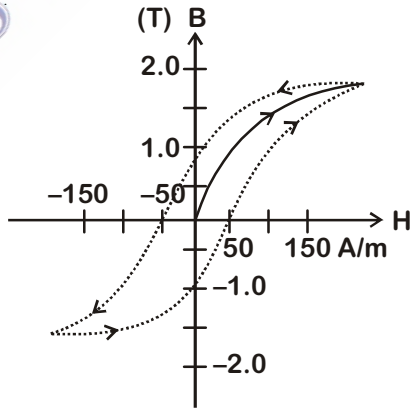
(3) 3.6 (4) 1.8

14. Consider a circular coil of wire carrying constant current *I*, forming a magnetic dipole. The magnetic flux through an infinite plane that contains the circular coil and excluding the circular coil area is given by ϕ_i. The magnetic flux through the area of the circular coil area is given by ϕ_0. Which of the following option is correct? **[JEE (Main)-2020]**

(1) $\phi_i = -\phi_0$ (2) $\phi_i < \phi_0$

(3) $\phi_i = \phi_0$ (4) $\phi_i > \phi_0$

15.



The figure gives experimentally measured *B* vs. *H* variation in a ferromagnetic material. The retentivity, co-ercivity and saturation, respectively, of the material are **[JEE (Main)-2020]**

(1) 1.0 T, 50 A/m and 1.5 T

(2) 1.5 T, 50 A/m and 1.0 T

(3) 1.5 T, 50 A/m and 1.0 T

(4) 150 A/m, 1.0 T and 1.5 T

16. Magnetic materials used for making permanent magnets (P) and magnets in a transformer (T) have different properties of the following, which property best matches for the type of magnet required?

[JEE (Main)-2020]

(1) T : Large retentivity, small coercivity

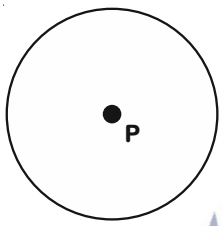
(2) P : Large retentivity, large coercivity

(3) P : Small retentivity, large coercivity

(4) T : Large retentivity, large coercivity

17. 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

[JEE (Main)-2020]



(1) Much large than $|\vec{B}|$ and parallel to $\vec{B}$

(2) $\vec{B}$

(3) Much large than $|\vec{B}|$ but opposite to $\vec{B}$

(4) Zero

18. 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

[JEE (Main)-2020]

(1) 9.2×10^{-3} J (2) 6.4×10^{-2} J

(3) 7.2×10^{-2} J (4) 11.7×10^{-3} J

19. 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 **[JEE (Main)-2020]**

(1) 1 A/m

(2) 0.75 A/m

(3) 4 A/m

(4) 2.25 A/m

20. 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 **[JEE (Main)-2020]**

(1) 5×10^2 Am^2

(2) 0.5×10^2 Am^2

(3) 500×10^2 Am^2

(4) 50×10^2 Am^2

❑ ❑ ❑