MAGNETISM
PREVIOUS EAMCET BITS
(ENGINEERING)

1. Two bar magnets A, B are placed one over the other and are allowed to vibrate in a vibration magnetometer. They make 20 oscillations per minutes when the similar poles of A and B are on the same sides, while they make 15 oscillations per minute when their opposite poles lie in the same side. If M_A and M_B are the magnetic moments of A and B and if $M_A > M_B$, the ratio of M_A and M_B is **[EAMCET 2009 E]**

1) 4 : 3 2) 25 : 7 3) 7 : 5 4) 25 : 16

Ans : 2

Sol: Frequency of a vibration magnetometer is

$$n = \frac{1}{2\pi}\sqrt{\frac{MB_H}{I}} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{M_A + M_B}{M_A - M_B}}$$

$$\Rightarrow \frac{20}{15} = \sqrt{\frac{M_A + M_B}{M_A - M_B}}$$

On simplifying we get $\frac{M_A}{M_B} = \frac{25}{7}$

2. A bar magnet of 10 cm long is kept with its north (N)-pole pointing North. A neutral point is formed at a distance of 15 cm from each pole. Given the horizontal component of earth's field is 0.4 Gauss, the pole strength of the magnet is **[EAMCET 2009 E]**

1) 9 amp-m 2) 6.75 amp-m 3) 27 amp-m 4) 13.5 amp-m

Ans: 1

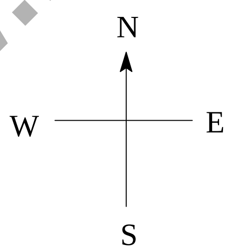
Sol: When N-pole of magnet is pointing towards geographic north null points are obtained on the equatorial line of the bar magnet.

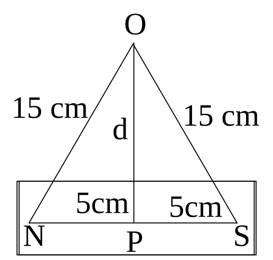
Given $d = \sqrt{(15)^2 - (5)^2} = 10\sqrt{2}$ cm

From tangent law

$$B_H = \frac{\mu_0}{4\pi}\frac{(2\ell)(m)}{(d^2+t^2)^{3/2}}$$

$$\Rightarrow 0.4\times10^{-4} = \frac{10^{-7}\times0.1\times m}{(15\times10^{-2})^3}$$





$\therefore$ m= 13.5 A-m

3. **With a standard rectangular bar magnet the time period of a vibration magnetometer is 4 seconds. The bar magnet is cut parallel to its length into four equal pieces. The time period of vibration magnetometer when one piece is used (in seconds) (bar magnet breadth is small) is** **[EAMCET2008 E]**

1) 16 2) 8 3) 4 4) 2

Ans : 3

Sol: When a bar magnet is cu into 'n' equal parts then moment of inertia (I) becomes $\frac{I}{n}$ and magnetic moment becomes $\frac{M}{n}$. Therefore there is no change in time period.

4. The magnetised wire of women 'M" and length ℓ is bent in the form of semicircle of radius 'r'. Then its magnetic moment is **[EAMCET 2008 E]**

1) $\frac{2M}{\pi}$ 2) 2M 3) $\frac{M}{\pi}$ 4) 0 (zero)

Ans: 1

Sol: If the magnet is bent at an angle θ in the form of arc then $M^1 = \frac{2M\sin\left(\frac{\theta}{2}\right)}{\theta}$

as $\theta = 180°$ $\therefore M' = \frac{2M}{\pi}$

5. A bar magnet of moment of inertia $49\times10^{-2}\,kgm^2$ vibrates in a magnetic field of induction $0.5\times10^{-4}\,T$. The time period of vibration is 8.8s. The magnetic moment of the bar magnet is **[EAMCET 2007 E]**

1) $350A-m^2$ 2) $490A-m^2$ 3) $3300A-m^2$ 4) $5000A-m^2$

Ans: 4

Sol: The time period of a vibration magnetometer is $T = 2\pi\sqrt{\frac{I}{MB_H}}$

$\therefore\ = 2\pi\sqrt{\frac{49\times10^{-2}}{M\times0.5\times10^{-4}}} = 8.8$

Simplifying M = 5000 Am^2

6. A bar magnet of magnetic moment M and moment of inertia I is freely suspended such that the magnetic axial line is the direction of magnetic meridian. If the magnet is displaced acceleration is (Magnetic induction of earth's horizontal field = B_H) **[EAMCET 2007 E]**

1) $\frac{MB_H\theta}{I}$ 2) $\frac{IB_H\theta}{M}$ 3) $\frac{M\theta}{IB_H}$ 4) $\frac{M\theta}{IB_H}$

Ans: 1

Sol: When magnet is displaced by a very small angle θ then restoring couple acting on the magnet is $\tau = -MB_H\sin\theta$

Negative sign indicates that the restoring torque is acting in opposite direction.

As $\tau = I\propto$ and when θ is small $\sin\theta\approx\theta$

$\therefore\ I\propto = -MB_H\theta \Rightarrow \propto = \frac{MB_H\theta}{I}$

7. The effect due to uniform magnetic field on a freely suspended magnetic needle is as follows: **[EAMCET 2006 E]**

1) Both torque and net force are present 2) Torque is present but no net force
3) Both torque and net force are absent 4) Net force is present but no torque

Ans : 2

Sol: When a magnetic needle is placed in a uniform magnetic field equal and opposite forces act on the poles of the needle which give to a torque, but the net force is zero.

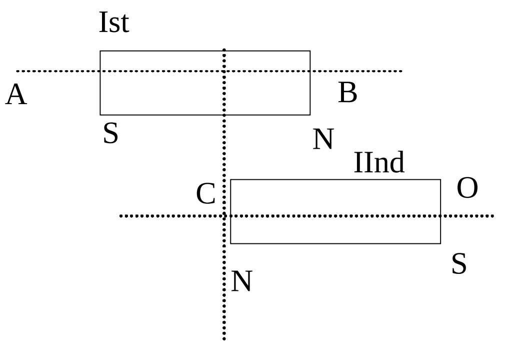
8. Two short magnets AB and CD in the X-Y plane and are parallel to X-axis and the coordinates of their centres respectively are (0, 2) and (2, 0). Line joining the North-South poles of CD is opposite to that of AB and lies along the positive to that of AB and lies along the positive X-axis. The resultant field induction due to AB and CD at a point P(2, 2) is 100×10^{-7} T. When the poles

of the magnet CD are reversed, the resultant field induction is 50×10^{-7} T. The values of magnetic moments of AB and CD (in Am^2) are **[EAMCET 2006 E]**

1) 300 ; 200 2) 600; 400 3) 200; 100 4) 300; 150

Ans: 1

Sol: Consider the following figure



$$B = B_1 + B_2 = \frac{\mu_0}{4\pi}\frac{2M_1}{d^3} + \frac{\mu_0}{4\pi}\frac{2M_2}{d^3} = \frac{\mu_0}{4\pi}\frac{1}{d^3}\left[2M_1 + M_2\right] = 100\times10^{-7} \text{.....(1)}$$

When the poles of the magnet CD are reversed then

$$= \frac{\mu_0}{4\pi d^3}\left[2M_1 - M_2\right] = 50\times10^{-7} \text{........(2)}$$

Dividing (1) and (2)

$$\frac{2M_1 + M_2}{2M_1 - M_2} = \frac{100}{50} \Rightarrow 2M_1 = 3M_2 \text{..........(3)}$$

Substituting (3) in (1) and (2) we get

$M_1 = 300$ Am^2 and $M_2 = 200$ Am^2

9. With a standard rectangular bar magnet of length (ℓ), breadth (b; b<<1) and magnetic moment M, the time period of the magnet in a vibration magnetometer is 4s. If the magnet is cut normal to its length into four equal pieces, the time period (in seconds) with one of the pieces is **[EAMCET 2005 E]**

1) 16 2) 2 3) 1 4) 1/4

Ans: 3

Sol: The time period of vibration magnetometer is $T = 2\pi\sqrt{\frac{I}{MB_H}}$

When the magnet is made into n equal parts normal to its length, then

(1) mass of each part = $\frac{\text{mass}}{m}$

(2) length of each part = $\frac{2\ell}{n}$

(3) Moment of inertia = $\frac{I}{n^3}$

(4) Magnetic moment = $\frac{M}{n}$

$\therefore\ T_1 = 2\pi\sqrt{\dfrac{I/n^3}{M/n.B_H}} = \dfrac{T}{n} = \dfrac{4}{4} = 1s$

10. If two identical bar magnets each of length 'ℓ', pole strength 'm' and magnetic moment 'M' are placed perpendicular to each other with their unlike poles in contact, the magnetic moment of the combination is **[EAMCET 2005 E]**

1) $\dfrac{M}{\sqrt{2}}$ 2) $\ell m\left(\sqrt{2}\right)$ 3) $2\ell m\left(\sqrt{2}\right)$ 4) 2M

Ans: 2

Sol: when two magnets of magnetic moments M_1 and M_2 are placed perpendicular to each other, then the resultant magnetic moment = $M_R = \sqrt{M_1^2 + M_2^2}$

But $M_1 = M_2 = M = \ell m$

$\therefore\ M_R = \sqrt{2}M = \sqrt{2}m\ell$

11. The magnetic induction and the intensity of magnetic field inside an iron core of an electromagnet are one Wb m^{-2} and 150 Am^{-1} respectively. The relative permeability of iron is : $\left(\mu_0 = 4\pi\times10^{-7}\,\text{Henry/m}\right)$ **[EAMCET 2004 E]**

1) $\dfrac{10^6}{4\pi}$ 2) $\dfrac{10^6}{6\pi}$ 3) $\dfrac{10^5}{4\pi}$ 4) $\dfrac{10^5}{6\pi}$

Ans: 4

Sol: We know that $B = \mu H = \mu_0\mu_r H$

Where μ_0 = permeability of free space or air

μ_r = relative permeability

$\therefore\ \mu_r = \dfrac{B}{\mu_0 H} = \dfrac{1}{\left(4\pi\times10^{-7}\right)(150)} = \dfrac{10^5}{6\pi}$

12. The magnetic needle of a vibration magnetometer makes 12 oscillations per minute in the horizontal component of earth's magnetic field. When an external short bar magnet is placed at some distance along the axis of the needle in the same line, it makes 15 oscillations per minute. If the poles of the bar magnet are interchanged, the number of oscillations it makes per minute is **[EAMCET 2004 E]**

1) $\sqrt{61}$ 2) $\sqrt{63}$ 3) $\sqrt{65}$ 4) $\sqrt{67}$

Ans: 2

Sol: The frequency of a vibration magnetometer is

$n_1 = \dfrac{1}{2\pi}\sqrt{\dfrac{MB}{I}} = 12$ ………………(1)

If an external magnet is placed near the magnet along the axis

$n_2 = \dfrac{1}{2\pi}\sqrt{\dfrac{M\left[B+B_1\right]}{I}} = 15$ ………(2)

If the poles of the magnet are reversed $n_3 = \dfrac{1}{2\pi}\sqrt{\dfrac{M\left[B-B_1\right]}{I}}$ …….(3)

Dividing (1) and (2) $B_1 = \dfrac{9}{16}B$ ………..(4)

Sub (4) in (1) and (3) and simplifying $n_3 = \sqrt{63}$

13. A vibration magnetometer consists of two identical bar magnets placed one over the other such that they are perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field is $2^{5/4}$ seconds. One of the magnets is removed and if the other magnet oscillates in the same field, then the time period in seconds is **[EAMCET 2003]**

1) $2^{1/4}$ 2) $2^{1/2}$ 3) 2 4) $2^{5/4}$

Ans : 3

Sol: We know, time period $T = 2\pi\sqrt{\frac{I}{MB}}$

When the magnets are perpendicular, $T_1 = 2\pi\sqrt{\frac{2I}{\sqrt{2}MB}} = 2^{5/4}$

When one agent is removed $T_2 = 2\pi\sqrt{\frac{I}{MB}}$

$\therefore \frac{T_2}{2^{5/4}} = \frac{1}{2^{1/4}} \Rightarrow T_2 = 2s$

14. The magnetic susceptibility of a material of a rod is 499. Permeability of vacuum is $4\times10^{-7}\,H/m$ .Absolute permeability of the material of the rod in henry/ meter is **[EAMCET 2003]**

1) $\pi\times10^{-4}$ 2) $2\pi\times10^{-4}$ 3) $3\pi\times10^{-4}$ 4) $4\pi\times10^{-4}$

Ans: 3

Sol: We know that $\mu_r = 1+\chi = 1+4990 = 500$

Absolute permeability $\mu = \mu_r\mu_0 = (500)(4\pi\times10^{-7})$

$= 2\pi\times10^{-4}$

15. A thin magnetic iron rod of length 30 cm is suspended in a uniform magnetic field. Its time period of oscillation is 4s. It is broken into three equal parts. The time period in seconds of oscillation of one part when suspended in the same magnetic field is **[EAMCET 2002 E]**

1) $\frac{1}{\sqrt{3}}$ s 2) $\frac{2}{3}$ s 3) $\frac{4}{3}$ s 4) $\frac{4}{\sqrt{3}}$ s

Ans: 3

Sol: Time period $T = 2\pi\sqrt{\frac{I}{MB}} = 4s$

When the magnet is cut into 3 equal parts parallel to its length, moment of inertia becomes I/3 and magnetic moment also becomes M/3. Therefore time period remains same.

When the magnet is cut into 3 equal parts perpendicular to its lengths, moment of inertia.

$I_1 = \frac{m\ell^2}{12} = \left[\frac{m}{3}\right]\left[\frac{\ell}{3}\right]^2\left[\frac{1}{12}\right] = \frac{I}{27}$

$\therefore \frac{T}{T_1} = \sqrt{\frac{I}{I_1}\times\frac{M_1}{M}} = 3 \Rightarrow T_1 \frac{T}{3} = \frac{4}{3}s$

16. Consider the following two statements A and B identify the correct choice in the given answers

A : Paramagnetism is explained by Domain Theory

B : Susceptibility of a Diamagnetic substance is independent of temperature **[EAMCET 2002 E]**

1) Both A and B are correct 2) Both A and B are wrong
3) A is correct and B is wrong 4) A is wrong and B is correct
Ans: 4

Sol. Paramagnetism is not explained by domain theory. Susceptibility of a diamagnetic substance is independent of temperature but para and ferromagnetic substances depends on temperature

17. A magnet of length 10 cm and magnetic moment 1A-m^2 is placed along the side AB of an equilateral triangle ABC. If the length the side AB is 10cm. The magnetic induction at the point C is $\left(\mu_0 = 4\pi\times10^{-7}\,H/m\right)$ **[EAMCET 2001 E]**

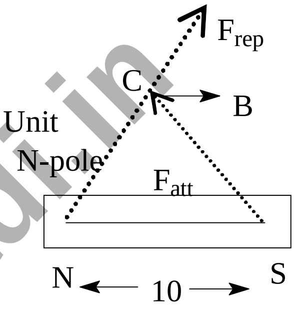
1) 10^{-9}T 2) 10^{-7}T 3) 10^{-5}T 4) 10^{-4}T
Ans: 4

Sol: Magnetic induction at the point 'C' is equal to the force experienced by unit N-pole placed at that point.

$\therefore$ B = resultant force = $\frac{\mu_0}{4\pi}.\frac{m}{d^2}$

$$m = \frac{M}{(2\ell)} = \frac{1}{0.1} = 10AM$$

$$B = \left(10^{-7}\right)\left(\frac{10}{0.01}\right) = 10^{-4}T$$



18. A magnet freely suspended in a vibration magnetometer makes 40 oscillations per minute at a place B. If the horizontal component of earth's magnetic field at A is $36\times10^{-6}T$, then its value at 'B' is **[EAMCET 2001]**

1) 9×10^{-6}T 2) 10^{-6}T 3) 144×10^{-6}T 4) 36×10^{-6}T
Ans: 1

Sol: The frequency of oscillating magnet in a vibration magnetometers is

$$n = \frac{1}{2\pi}\sqrt{\frac{MB}{I}} \text{ as } n \propto \sqrt{B}$$

$$\frac{n_A}{n_B} = \sqrt{\frac{B_A}{B_B}} \Rightarrow \frac{40}{20} = \sqrt{\frac{36\times10^6}{B_B}}$$

$$\therefore\ B_B = 9\times10^{-6}T$$

19. A short bar magnet with its north pole facing north forms a neutral point at P in the horizontal plane. If the magnet is rotated by 90° in the horizontal plane, the net magnetic induction at P is (Horizontal component of earth's magnetic field = B_H) **[EAMCET 2000]**

1) 0 2) 2 B_H 3) $\frac{\sqrt{5}}{2}B_H$ 4) $\sqrt{5}B_H$

Ans: 4

Sol: When the north pole of short bar magnet is facing North pole of the earth, at the neutral point p, which is on equatorial line.

$$B_H = \frac{\mu_0}{4\pi}\frac{M}{d^3} = B_1 \ldots\ldots\ldots\ldots(1)$$

When the magnet is rotated by 90°, the magnetic induction at P which is on axial line

$B_H = \frac{\mu_0}{4\pi}\frac{2M}{d^3} = B_2$ ....(2)

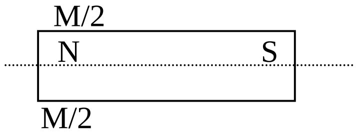
$\therefore$ Net magnetic induction at P is $B_{result} = \sqrt{B_1^2 + B_2^2} = \sqrt{5}\ B_H$

20. Two similar bar magnets P and Q each of magnetic moment M are taken. If P is cut along its axial line and Q is cut along its equatorial line, all the four pieces obtained have each of **[EAMCET 2000]**

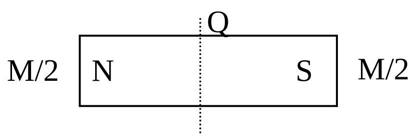
1) Equal pole strength
2) Magnetic moment M/4
3) Magnetic moment M/2
4) Magnetic moment M

Ans: 3

Sol: When P is cut along its axial line, each piece will have magnetic moment M/2



When Q is cut along the equatorial line, each piece will have magnetic moment M/2



21. There is no couple acting when two bar magnets are placed coaxially separated by a distance because **EAMCET 2000]**

1) There are no forces on the poles
2) The forces are parallel and their lines of action do not coincide
3) The forces are perpendicular to each other
4) The forces act along the same line

Ans: 4

Sol: When the magnets are placed coaxially at a certain distance of separation, no couple acts on it as the forces act along the same line.

22 The pole strength of a 12 cm long bar magnet is 20 A-m. The magnetic induction at a point 10 cm away from the centre of the magnet on its axial line is $\left[\frac{\mu_0}{4\pi} = 10^{-7}\,Hm^{-1}\right]$ **[EAMCET 2000]**

1) $1.1\times10^{3}T$
2) $2.2\times10^{2}T$
3) $1.1\times10^{-2}T$
4) $2.2\times10^{-2}T$

Ans: 1

Sol: We known $2\ell = 12cm = 0.12m$

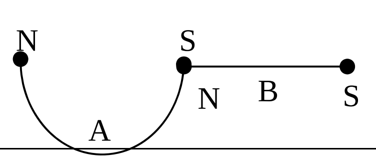
$m = 20$ Am and $d = 0.1m$

On axial line = B = $\frac{\mu_0}{4\pi}\cdot\frac{2Md}{\left(d^2-\ell^2\right)^2}$

$$\therefore\ B = \frac{\left(10^{-7}\right)(2)(0.12)(20)(0.1)}{\left[(0.1)^2-(0.06)^2\right]^2} = \frac{48\times10^{-9}}{4096\times10^{-8}} = 1.1\times10^{-3}T$$

MEDICAL

23. A magnet of length L and M is cut into two halves (A and B) perpendicular to its axis. One piece A is bent into a semicircle of radius R and is joined to the other piece at the poles as show in figure. Assuming that the magnet is in the form of a thin wire



initially, the moment of the resulting moment is given by : **[EAMCET 2009 M]**

1) $\frac{M}{2\pi}$ 2) $\frac{M}{\pi}$ 3) $\frac{M(2+\pi)}{2\pi}$ 4) $\frac{M\pi}{2+\pi}$

Ans: 3

Sol:

Initially as the magnet is made into two pieces the magnetic moment of each piece = $\frac{M}{2}$

But the half A is bent in the form of a semi circular arc

$$\therefore\ M_1 = \frac{2\left(\frac{M}{2}\right)\sin\left(\frac{180}{2}\right)}{\pi} = \frac{M}{\pi}$$

[Since when a magnet is bent at an angle 'θ' at the centre $M_R = \frac{2M\sin\left(\frac{\theta}{2}\right)}{\theta}$]

$M_2 = \frac{M}{2}$

$\therefore\ M_{res} = M_1 + M_2$ [since both are in same direction]

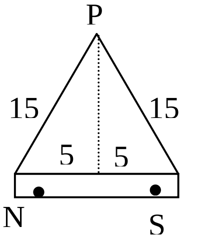
$= \frac{M}{\pi} + \frac{M}{2} = \frac{M(2+\pi)}{2\pi}$

24. A bar magnet of 10 cm long is kept with its north N-pole pointing north. A neutral point is formed at a distance of 15 cm from each pole. Given the horizontal component of earth's field is 0.4 Gauss, the pole strength of the magnet is **[EAMCET 2009 M]**

1) 9 amps-m 2) 6.75 amps-m 3) 27 amps-m 4) 13.5 amps-m

Ans: 4

Sol: Given $2\ell = 10\text{cm} = 0.1\text{m}$



$d^2 = 15^2 - 5^2 = 200$

$\Rightarrow d^2 + \ell^2 = 200 + 25 = 225$

$\therefore\ \left(d^2+\ell^2\right)^{3/2} = 15^3$

We know $B_H = \frac{\mu_0}{4\pi}\frac{(m)(2\ell)}{\left(d^2+\ell^2\right)^{3/2}}$

$\Rightarrow 0.4\times10^{-4} = \frac{10^{-7}(m)(0.1)}{15^3\times10^{-6}} \Rightarrow m = 13.5\text{Am}$

25. Two bar magnets are placed in a vibration magnetometer and allowed to vibrate. They make 15 oscillations per minute when their similar poles are on the same side, while they make 20 oscillations per minute when their opposite poles lie on the same side. The ratio of their magnetic moment is **[EAMCET 2008 M]**

1) 7.25 2) 25 : 7 3) 25 : 16 4) 16 : 25

Ans: 1, 2

Sol: From the relation $n = \frac{1}{2\pi}\sqrt{\frac{MB_H}{I}}$

$\therefore \quad \frac{n_1}{n_2} = \sqrt{\frac{M_1 + M_2}{M_1 - M_2}} \quad [\text{If } M_1 > M_2]$

$\therefore \frac{4}{3} = \sqrt{\frac{M_1 + M_2}{M_1 - M_2}}$

On simplifying $\frac{M_1}{M_2} = \frac{25}{7}$

$\frac{n_1}{n_2} = \sqrt{\frac{M_1 + M_2}{M_2 - M_1}} \quad [\text{If } M_2 > M_1]$

$\frac{4}{3} = \sqrt{\frac{M_1 + M_2}{M_2 - M_1}}$

On simplifying $\frac{M_1}{M_2} = \frac{7}{25}$

26. A short bar magnet placed at a ceratin distance from a deflection magnetometer in tan A position produces a deflection of 60°. The magnet is now cut into three equal pieces. If one piece is kept at the same distance in ‘tanA’ position from the deflection magnetometer, then the deflection produced is **[EAMCET 2008 M]**

1) 10° 2) 20° 3) 30° 4) 60°

Ans : 3

Sol: In tanA position $B = \frac{\mu_0}{4\pi}\frac{2M}{d^3} = B_H \tan\theta$

$\therefore \quad \frac{\tan\theta_2}{\tan\theta_1} = \frac{M_2}{M_1}$

When the magnet is cut into n equal pieces magnetic moment of each piece becomes $\frac{M}{n}$

$\therefore \frac{\tan\theta_2}{\tan\theta_1} = \frac{M}{3\times M} \Rightarrow \tan\theta_2 = \frac{1}{\sqrt{3}} \Rightarrow \theta_2 = 30°$

27. A bar magnet suspended freely in a uniform magnetic field is vibrating with a time period of 3 seconds. If the field strength is increased to 4 times of the earlier field strength, the time period will be (in second) **[EAMCET 2007 M]**

1) 12 2) 6 3) 1.5 4) 0.75

Ans: 3

Sol: $T = 2\pi\sqrt{\frac{I}{MB_H}} \Rightarrow T \propto \frac{1}{\sqrt{B_H}}$

$\therefore \frac{T_2}{T_1} = \sqrt{\frac{B_{H_1}}{B_{H_2}}} \Rightarrow \frac{T_2}{3} = \sqrt{\frac{1}{4}}$

$\Rightarrow T_2 = \frac{3}{2} = 1.5 \text{ s}$

28. A bar magnet of magnetic moment M_1 is axially cut into two equal parts. If these two pieces are arranged perpendicular to each other, the resultant magnetic moment is M_2. Then the value of $\frac{M_1}{M_2}$ is **[EAMCET 2007 M]**

1) $\frac{1}{2\sqrt{2}}$ 2) 1 3) $\frac{1}{\sqrt{2}}$ 4) $\sqrt{2}$

An s : 4

Sol: When the bar magnet is cut into two equal parts magnetic moment of each part = $\frac{M_1}{2}$

When the magnets are placed perpendicular to each other the resultant magnetic moment is

$$M_2 = \sqrt{\left(\frac{M_1}{2}\right)^2 + \left(\frac{M_1}{2}\right)^2} = \sqrt{2}\frac{M_1}{2} = \frac{M_1}{\sqrt{2}}$$

$$\therefore \frac{M_1}{M_2} = \frac{M_1}{M_1/\sqrt{2}} = \sqrt{2}$$

29. The magnetic induction at a distance 'd' from the magnetic pole of the unknown strength 'm' is B. If an identical pole is now placed at a distance of 2d from the first pole, the force between the two poles **[EAMCET 2006 M]**

1) mB 2) $\frac{mB}{2}$ 3) $\frac{mB}{4}$ 4) 2mB

Ans : 3

Sol: Magnetic induction at a distance 'd' from the magnetic pole of the unknown strength =

$$B = \frac{\mu_0}{4\pi}\frac{m}{d^2} \quad \text{.........(1)}$$

$$F = \frac{\mu_0}{4\pi}\frac{m_1 m_2}{d^2} = \frac{\mu_0}{4\pi}\frac{m^2}{4d^2} = \frac{mB}{4} \quad \text{.........[from (1)]}$$

30. Two short bar magnets P and Q are arranged such that their centres are on the X-axis and are separated by a large distance. The magnetic axes of P and Q are along X and Y axes respectively. At a point R, midway between their centres; if B is the magnitude of induction due to Q, the magnitude of total induction at R due to the both magnets is **[EAMCET 2006 M]**

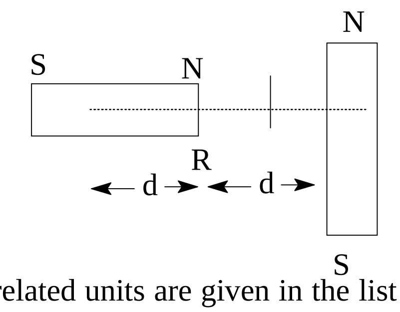
1) 3B 2) $\sqrt{5}$B 3) $\frac{\sqrt{5}}{2}$B 4) B

Ans: 2

Sol:

Induction at $R = \sqrt{B^2_{axial} + B^2_{equatorial}}$

$$\sqrt{\left(\frac{\mu_0}{4\pi}.\frac{2M}{d^3}\right)^2 + \left(\frac{\mu_0}{4\pi}.\frac{M}{d^3}\right)^2} = \sqrt{5}B$$



31. some physical quantities are given in the list 1 the related units are given in the list II. Match the correct pairs in the lists **[EAMCET 2005 M]**

List – I	List – II
a) Magnetic field intensity	(e) Wbm^{-1}
b) Magnetic flux	(f) Wbm^{-2}

c) Magnetic potential (g) Wb
d) Magnetic induction (h) Am^{-1}
1) a-e; b-f; c-g; d-h 2) a-h; b-g; c-e; d-f 3) a-h; b-e; c-g; d-f 4) a-f; b-g; c-e; d-h
Ans: 2

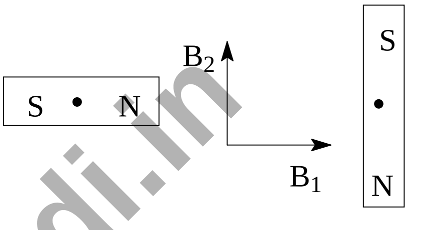
Sol: --

32. Two identical short bar magnets, each having magnetic moment of 10 Am^2, are arranged such that their axial lines are perpendicular to each other and their centres be along the same strength line in a horizontal plane. If the distance between their centres is 0.2 m, the resultant magnetic induction in Tesla at a point midway between them is $\left(\mu_0 = 4\pi\times10^{-7}\,H/m\right)$ **[EAMCET 2005 M]**

1) $\sqrt{2}\times10^{-7}$ 2) $\sqrt{5}\times10^{-7}$ 3) $\sqrt{2}\times10^{-3}$ 4) $\sqrt{5}\times10^{-3}$
Ans: 4

Sol:

Resultant magnetic moment = $\sqrt{B_1^2 + B_2^2}$



$$B_1 = \frac{\mu_0}{4\pi}\frac{2M}{d^3}, \quad B_2 = \frac{\mu_0}{4\pi}\frac{M}{d^3}$$

$$\therefore\ B = \sqrt{5}\frac{\mu_0}{4\pi}\frac{M}{d^3} = \frac{\sqrt{5}\times10^{-7}\times10}{\left(10^{-1}\right)^3} = \sqrt{5}\times10^{-3}$$

33. Two magnetic isolated north poles each of strength 'm' Ampere-meter are placed one at each of the two vertices of an equilateral triangle of side 'a'. The resultant magnetic induction at the third vertex is : (μ_0 is permeability of free space) **[EAMCET 2004 M]**

1) $\frac{\mu_0}{4\pi}\left(\frac{m}{a^2}\right)$ 2) $\frac{\mu_0}{4\pi}\frac{\sqrt{2}m}{a^2}$ 3) $\frac{\mu_0}{4\pi}\frac{\sqrt{3}m}{a^2}$ 4) $\frac{\mu_0 m}{2\pi a^2}$
Ans: 3

Sol: Resultant magnetic induction at the third vertex = $\sqrt{B_1^2 + 2B_1B_2\cos\theta + B_2^2}$

Given $B_1 = B_2 = B = \frac{\mu_0}{4\pi}\frac{m}{d^2}, \theta = 60°$

$$\therefore\ B_{res} = \sqrt{3}B = \sqrt{3}\left[\frac{\mu_0}{4\pi}\frac{m}{d^2}\right]$$

34. A bar magnet used in a vibration magnetometer is heated by 36%. The time period of the magnet (Neglecting the changes in the dimension of the magnet) **[EAMCET 2004 M]**

1) increase by 36% 2) decreases by 36% 3) increases by 25% 4) decreases by 25%
Ans: 3

Sol: Let $M_1 = M \quad M_2 = \frac{64M}{100}$

We know that $T = 2\pi\sqrt{\frac{I}{MB_H}}$

$$\therefore\ T \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{M_1}{M_2}} = \sqrt{\frac{M\times100}{64M}}$$

$$\frac{T_2}{T_1} = \frac{10}{8} = \frac{5}{4}$$

$$\therefore \left(\frac{T_2 - T_1}{T_1}\right) \times 100 = \left(\frac{5}{4} - 1\right) \times 100 = 25\%$$

35. The period of oscillation of a magnet at a plane is 4 seconds. When it is demagnetised, so that the pole strength becomes 4 times the initial value, the period of oscillation in second is

[EAMCET 2003 M]

1) 1/3 2) 1 3) 2 4) 4

Ans: 3

Sol: $T = 2\pi\sqrt{\frac{I}{MB_H}}$

Let $M_1 = m, \quad M_2 = 4M$

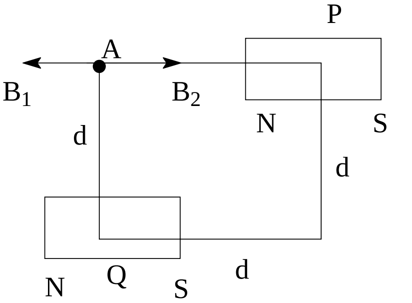
$$\therefore \frac{T_2}{T_1} = \sqrt{\frac{M_1}{M_2}} = \sqrt{\frac{M}{4M}}$$

$$\therefore \frac{T_2}{T_1} = \frac{1}{2} \Rightarrow \frac{T_1}{T_2} = 2$$

36. Two short bar magnets of magnetic moments ‘M’ each are arranged at the opposite corners of a square of a side ‘d’, such that their centres coincide with the corners and their axes are parallel. If the like poles are in the same direction, the magnetic induction at any of the other corners of the square is **[EAMCET 2003 M]**

1) $\frac{\mu_0}{4\pi}.\frac{M}{d^3}$ 2) $\frac{\mu_0}{4\pi}.\frac{2M}{d^3}$ 3) $\frac{\mu_0}{2\pi}.\frac{4M}{d^3}$ 4) $\frac{\mu_0}{4\pi}.\frac{3M}{d^3}$

Ans: 1



Sol: Magnetic induction at the corner A because of magnet p

$B_P = \frac{\mu_0}{4\pi}\frac{2M}{d^3}$ [since on axial line]

Magnetic induction at the corner A because of magnet α

$B_Q = \frac{\mu_0}{4\pi}\frac{2M}{d^3}$ [since on equatorial line]

Resultant magnetic induction at the $B_P - B_Q = \frac{\mu_0}{4\pi}\frac{M}{d^3}$

37. In an experiment with vibration magnetometer the value of $\frac{4\pi^2 I}{T^2}$ for short bar magnet is observed as 36×10^{-4}. In the experiment with deflection magnetometer with the same magnet, the value of $\left(\frac{4\pi d^3}{2\mu_0}\right)\tan\theta$ is observed as $\frac{10^8}{36}$. The magnetic moment of the magnet used, is

[EAMCET 2002 M]

1) 50 A – m^2 2) 100 A – m^2 3) 200 A – m^2 4) 1000 A – m^2

Ans: 2

Sol: From vibration magnetometer

$T = 2\pi\sqrt{\frac{I}{MB}} \Rightarrow MB_H = \frac{4\pi^2 I}{T^2}$ ……………….(1)

From deflection magnetometer $B = B_H \tan\theta \Rightarrow \frac{\mu_0}{4\pi}\frac{2M}{d^3} = B_H \tan\theta$

$\frac{M}{B_H} = \left(\frac{4\pi d^3}{2\mu_0}\right)\tan\theta$ ……………..(2)

Multiplying (1) and (2)

$M^2 = \frac{M}{B_H} \times MB_H = \left(36\times10^{-4}\right)\left(\frac{10^8}{36}\right) = 10^4$

$\therefore$ m = 100 A – m^2

38. Both light and sound waves produced diffraction. It is more difficult to observer diffraction with light waves because **[EAMCET 2001 M**

1) Light waves do not require medium   2) Wavelength of light waves is far smaller
3) Light waves are transverse wave   4) Speed of light is far greater

Ans: 2

Sol. As the wavelength of light waves is very less, it s difficult to observer diffraction with light waves.

39. A magnetized wire of magnetic moment M is bent into an arc of a circle that subtends an angle of 60° at the centre. The equivalent magnetic moment is **[EAMCET 2001 M]**

1) $\frac{M}{\pi}$ 2) $\frac{2M}{\pi}$ 3) $\frac{3M}{\pi}$ 4) $\frac{4M}{\pi}$

Ans: 3

Sol. We know $M_{resultant} = \frac{2M\sin\frac{\theta}{2}}{\theta}$

$M_{resultant} = \frac{2M(\sin 30°)}{(\pi/3)} = \frac{3M}{\pi}$

40. Two identical short bar magnets each having magnetic moment M are placed at a distance of 2d with their axes perpendicular to each other in a horizontal plane. The magnetic induction at a point midway between them is **[EAMCET 2000 M]**

1) $\frac{\mu_0}{4\pi}\left(\sqrt{2}\right)\frac{M}{d^3}$ 2) $\frac{\mu_0}{4\pi}\left(\sqrt{3}\right)\frac{M}{d^3}$ 3) $\left(\frac{2\mu_0}{\pi}\right)\times\frac{M}{d^3}$ 4) $\frac{\mu_0}{4\pi}\sqrt{5}\frac{M_3}{d^3}$

Ans: 4

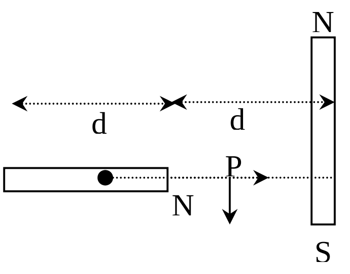
Sol. $M_{axial} = \frac{\mu_0}{4\pi}, \frac{2M}{d^3}$

$M_{equatorial} = \frac{\mu_0}{4\pi}, \frac{M}{d^3}$

Resultant moment at the point which is midway between the magnets.

$M_{res} = \sqrt{M_{axial}^2 + M_{equatorial}^2}$

$\Rightarrow M_{res} = \left(\frac{\mu_0}{4\pi}\right)\left(\frac{M}{d^3}\right)\sqrt{5}$



41. A bar magnet when placed at an angle of 30° to the direction of magnetic field induction of $5\times10^{-2}T$, experiences a moment of couple $2.5\times10^{-6}N-m$. If the length of the magnet is 5 cm, its pole strength is: **[EAMCET 2000 M]**

1) $2\times10^{2}A-m$ 2) $5\times10^{2}A-m$ 3) 2 A – m 4) 5 A – m

Ans: 3

Sol. $B=5\times10^{-2}T$

$\tau=25\times10^{-6}Nm$; θ = 30°

$2\ell=5cm=5\times10^{-2}m$

$\therefore$ pole strength m = $\dfrac{\tau}{(2\ell)(B)(\sin\theta)}=2Am$

42. A bar magnet of magnetic moment 3.0 A- m^2 is placed in a uniform magnetic induction field of $2\times10^{5}T$. If each pole of the magnet experiences a force of $6\times10^{-4}N$ the length of the magnet is **[EAMCET 2000 M]**

1) 0.5 m 2) 0.3 m 3) 0.2 m 4) 0.1 m

Ans: 4

Sol. M = 3 Am^2

B = $2\times10^{-5}T$

We know force on a pole

$F=(m)B=\left(\dfrac{M}{2\ell}\right)B$

$\therefore\ 2\ell=\dfrac{MB}{F}=0.1m$

43. Two short magnets having magnetic moments in the ratio 27 : 8, when placed on opposite sides of a deflection magnetometer, it show no deflection. If the distance of the weaker magnet is 0.12m from the centre of deflection magnetometer, the distance of the stronger magnet from the centre is **[EAMCET 2000 M]**

1) 0.06 m 2) 0. 08 m 3) 0. 12 m 4) 0. 18 m

Ans: 4

Sol. $M_1:M_2=27:8$

$\dfrac{M_1}{M_2}=\dfrac{d_1^3}{d_2^3}\Rightarrow d_1=\dfrac{3}{2}(0.12)=0.18m$