MAGNETISM

SYNOPSIS

- Magnetism is a property of attraction by virtue of which, a substance attracts few other substances.
- Substance like Magnetite (Fe_3O_4) naturally acquired the ability of attracting substances like Iron, Nickel, Cobalt etc, It is called a natural magnet or load stone.
- Substances that are attracted by load stone are known as Ferro-magnetic substance.
- Weber explained the concepts of Magnetism & Magnetostatics, with the imagination of monopoles.
- When a piece of loadstone is suspended freely, it comes to rest along a line called 'Magnetic meridian'. Which is almost along the line joining North and South poles of the earth. This property is known as directive property.

MAGNET

- A piece of a magnetic substance, which exhibits directive property, is called a magnet.
- The power of attraction is maximum at the end points of the magnet, these end points are known as poles.
- The north seeking end is called north pole and the south seeking end is called south pole.
- The shortest distance joining the poles of the magnet is known as 'magnetic length'. It is denoted by 2l. It is a vector and its direction is $\xrightarrow[SN]{}$ always along south to north pole.
- The magnetic length is 5 / 6 times the geometric length of the magnet.
- S.I. unit of pole strength is A) weber B) ampere meter
- **In this book all formule are given, by taking *ampere meter* as the unit of pole strength. If you find** weber **as unit in problems, convert that in to *ampere meter.***
- 1 weber = μ_0 ampere meter.
  where μ_0 is permeability of free space
  $\mu_0 = 4\pi \times 10^{-7}$ weber / A m (or) henry m^{-1}
- Pole strength is a scalar.
  Its dimensional formula is [$M^0 L^1 T^0 A^1$]

PROPERTIES OF POLES

- Like poles repel and unlike poles attract.
- Around a pole there exist a region called magnetic field in which the influence of the pole is felt.
- Pole concept is fictious, in reality monopole does not exist.

MAGNETIC MOMENT

- The product of pole strength and magnetic length is equal to magnetic moment M = m.2l.
  Its unit is ampere m^2 and Dimensional formula is [$M^0L^2T^0A^1$].
  It is a vector, its direction is always along $\xrightarrow[SN]{}$ south to north.
- When two magnets are placed at an angle θ with each other and with like pole together, the resultant magnetic moment is

$$\sqrt{M_1^{\,2} + M_2^{\,2} + 2M_1M_2\text{Cos}\theta}$$

- When two magnets are placed at an angle θ with each other and with unlike pole together, the resultant magnetic moment is

$$\sqrt{M_1^{\,2} + M_2^{\,2} - 2M_1M_2\text{Cos}\theta}$$

- If a bar magnet of moment M is bend at the mid-point so that parts makes an angle θ with each other, then the resultant magnetic moment is
  $M^1 = M \text{ Sin } (\theta/2)$
- A bar magnet of moment M is bent so that angle at the center of the arc is θ, then the new magnetic moment is $\dfrac{2M \sin(\theta/2)}{\theta}$ (θ is in radians)
- A bar magnet of moment M is bent into a semi circular arc. Then the new magnetic moment is $\dfrac{2M}{\pi}$.
- When a bar magnet is cut into two equal pieces along the axis, then magnetic length does not change, pole strength become half and magnetic moment become half.
- When a bar magnet is cut into two equal pieces along the equator, then magnetic length become half, pole strength does not change and magnetic moment become half.

COULOMB'S LAW

- The force between two poles is directly proportional to the product of pole strengths and inversely proportional to the square of the distance between them.
- If two poles of strengths m_1, m_2 amp m are separated by a distance d, then

$$F \alpha \frac{m_1 m_2}{d^2}$$

$$F = \left(\frac{\mu_0}{4\pi}\right)\left(\frac{m_1 m_2}{d^2}\right)$$

where μ_0 is the permeability of free space,
$\mu_0 = 4\pi \times 10^{-7}$ henry/m (or) wb/ampere meter

- If $m_1 = m_2 = 1$ A m ; and distance between them is 1 m in vaccum then the force between them is 10^{-7} N
- If $m_1=m_2=1$ weber and d = 1m in vaccum, then

$$F=\frac{10^7}{16\pi^2} \text{ newton.}$$

- If two poles m_1, m_2 ($m_2>m_1$) are separated by a distance d, then distance of neutral point from smaller pole is

$$x = \frac{d}{\sqrt{\frac{m_2}{m_1}} \pm 1}, \text{ where } m_2 > m_1$$

+ used for like poles
- for unlike poles

- For like poles neutral point is in between the poles and for unlike poles neutral point is outside.

MAGNETIC LINES OF FORCE

- 1. It is an imaginary path followed by unit north pole.
  2. Lines of force do not intersect with each other. Because if they intersect, at the point of intersection field should possess different directions and it is not possible.
  3. The number of lines per unit area normally is directly proportional to the field strength.
  4. If the field lines are parallel with equal spacing then it is said be uniform.
  5. The tangent drawn to the line of force at a given point represents the direction of field strength.
  6. For isolated north pole field lines are radially diverging.
  7. For isolated south pole, field lines are radially converging.
  8. For a bar magnet they are curved lines out side the magnet, and inside they are straight lines.

MAGNETIC FIELD STRENGTH

- The force experienced by unit north pole of one weber is called magnetic field strength.
H = F / m newton $weber^{-1}$ (or) A m^{-1}
The C.G.S. unit of field strength is oersted

$$1 \text{ A/m} = \frac{250}{\pi} \text{ oersted}$$

- It is also known as magnetizing field and magnetic field intensity.
- It is independent of the medium and in reality does not exist.
- For a pole of strength m ampere meter in vacuum, the field strength at a distance d is

$$H = \frac{1}{4\pi}\frac{m}{d^2}$$

- The force experienced by a pole of strength m weber is F = m H

INTENSITY OF MAGNETISATION

- **Magnetic flux**:It is equal to the total number of magnetic lines of force through a given area.
Its S.I. unit is weber and C.G.S. unit is maxwell
1 weber = 10^8 maxwell

MAGNETIC FLUX DENSITY:

- The number of magnetic flux lines passing per unit area of cross section normal to the cross section is called magnetic flux density.
$B=\varphi / A$
weber $metre^{-2}$ = tesla. It can be measured in terms of newton / A m
Its C.G.S. unit is gauss
1 gauss = 10^{-4} tesla
- Its dimensional formula is $[M^1L^0T^{-2}A^{-1}]$
- It is also known as magnetic induction and magnetic field.
- The relation between B and H is
$B_0 = \mu_0 H$ in vacuum and
$B = \mu$ H in a material medium
Where is μ the absolute permiability of the medium
- The Magnetic field induction due to a pole of pole strength *m* by at distance is given by

$$B_0 = \left(\frac{\mu_0}{4\pi}\right)\frac{m}{d^2}$$

- The force experienced by a pole of strength m ampere meter in a field of induction B is F = m B

FIELD OF A BAR MAGNET

- For bar magnets field lines are from north to south pole outside the magent and inside from south to north.And these lines of force are closed loops.

The magnetic induction at a point on the axial line is B = $\left(\frac{\mu_0}{4\pi}\right)\frac{2Md}{\left(d^2-l^2\right)^2}\ \left(S\longrightarrow N\right)$

For a short bar magnet

i.e. $l <<<< d$

then B = $\left(\frac{\mu_0}{4\pi}\right)\frac{2M}{d^3}$

- The direction of magnetic induction on the axial line is along $\xrightarrow[SN]{}$ from south to north.
- The magnetic induction at a point on the equatorial line at a distance d from the centre is

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

for a short bar magnet $l <<<< d$ then B = $\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3}$

- The direction of magnetic induction on the equatorial line is along from north to south pole
- At any point in the plane of axial and equatorial lines

B = $\left(\frac{\mu_0}{4\pi}\right)\sqrt{(3\cos^2\theta+1)}\ \frac{M}{d^3}$

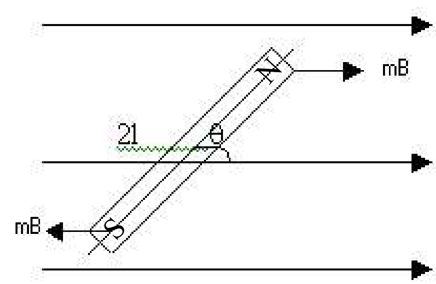
$\theta = 0^0$ axial line

$\theta = 90^0$ equatorial line

- For a short bar magnet $B_{AX} = 2\ B_{EQ}$

COUPLE ON A BAR MAGNET & P.E.

- When a bar magnet of moment M and length 2l is paced in a uniform field of induction B. Then each pole experiences a force mB in opposite directions.



As a result the bar magnet experiences a couple and moment of couple is developed.

- Moment of couple acting on the bar magnet = Force x perpendicular distance
C = m 2l B $\sin\theta$ (or) C = M B $\sin\theta$
Where θ is the angle between magnetic moment and magnetic field.
In vector notation $\vec{C} = \vec{M}\times\vec{B}$
- When the bar magnet is either along or opposite to the direction of magnetic field then moment of couple=0.
- When the bar magnet is perpendicular to the direction of applied magnetic field, then the moment of couple is maximum. i.e. C = MB
- The work done to deflect a bar magnet in a uniform magnetic field is MB $(\mathrm{Cos}\theta_1 - \mathrm{Cos}\theta_2)$.
- When a bar magnet kept suspended in a uniform magnetic field is turned through an angle θ the work done on magnet is change in Potential Energy

$W = MB\ (1\text{-}\mathrm{Cos}\ \theta)$

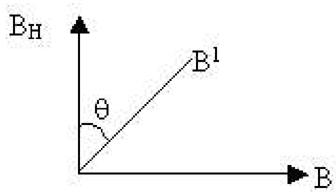
When released, this workdone converts into rotational KE

$MB(1\text{-}\mathrm{Cos}\theta) = (\tfrac{1}{2})I\omega^2$

- When a bar magnet is held at an angle θ with the magnetic field, the potential energy possessed by the magnet is U= - M B cos θ
- When the bar magnet is parallel to the applied field, then $\theta = 0^0$ and potential energy is - MB.
- When the bar magnet is perpendicular to the applied field, then $\theta = 90^0$ and potential energy is zero
- When the bar magnet is anti-parallel to the applied field, then $\theta = 180^0$ and potential energy is maximum ie U = +MB

TANGENT LAW

- A freely suspended (or) pivoted magnetic needle comes to rest in the direction of earths magnetic meridian.
- The field along the magnetic meridian at the equator of the earth is the horizontal component (B_H) of earths magnetic induction B_H = 0.38 gauss
- When a magnetic needle is placed in a combination of two mutually perpendicular magnetic fields, then it comes to rest along the resultant fields.
- When a freely suspended magnet is subjected to an external magnetic field B perpendicular to B_H. Then the needle comes to rest making an angle θ with B_H.



then $B = B_H \tan\theta$

This is known as **Tangent law**

- Tangent law is the main principle used in Deflection magneto meter and Tangent galvanometer.

DEFLECTION MAGNETO METER

- Deflection magnetometer is used to compare magnetic moments and to verify inverse square law.
- In Tan A position, arms of D.M.M. are in east-west position, magnet is placed so that its axial line passes through the center of the compass. If the deflection is θ_A then

$$\frac{\mu_0}{4\pi}\frac{2Md}{(d^2-l^2)^2} = B_H \mathrm{Tan}\theta_A$$

For a short bar magnet

$$\left(\frac{\mu_0}{4\pi}\right)\frac{2M}{d^3} = B_H \mathrm{Tan}\theta_A = B_{AX}$$

- In Tan B position, arms of D.M.M. are in north-south position; magnet is placed so that its equatorial line passes through the center of the compass.

If the deflection is θ_B then

$$\frac{\mu_0}{4\pi}\frac{M}{(d^2+l^2)^{3/2}} = B_H \mathrm{Tan}\theta_B$$

For a short bar magnet

$$\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3} = B_H \mathrm{Tan}\theta_B = B_{EQ}$$

- **VERIFICATION OF INVERSE SQUARE LAW:**

(a) **Dipole Method (Gauss method):**

For a given bar magent at a given distance d in Tan A position, the deflection is θ_A, for the same magnet at same distance in TanB position the deflection is θ_B.

$$\frac{B_{AX.}}{B_{Eq}} = \frac{\mathrm{Tan}\theta_A}{\mathrm{Tan}\theta_B} = 2$$

If this is true at all deflections then the law is said to be verified.

This is known as inverse square law

- **Comparison of magnetic moments equal distance method:**

In tan A position both the magnets are placed one after the other at equal distance from the compass. The average deflections are θ_1 and θ_2 respectively. Then

$$\frac{M_1}{M_2} = \frac{Tan\,\theta_1}{Tan\,\theta_2}$$

In tanB position also, similarly

$$\frac{M_1}{M_2} = \frac{Tan\,\theta_1}{Tan\,\theta_2}$$

But Tan A position is more accurate than Tan B position

- **Comparison of magnetic moments null method:** In Tan A position both the magnets are simultaneously used with their like poles facing each other. And distances are adjusted so that net deflection is zero.

$$\frac{M_1}{M_2} = \frac{d_2}{d_1}\frac{(d_1^2-l^2)^2}{(d_2^2-l^2)^2}$$

For a short bar magnet l is neglected, then

$$\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3$$

In Tan B position both the magnets are simultaneously used with their unlike poles on the same side of the scale. And distances are adjusted such that net deflection is zero.

$$\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3 = \frac{(d_1^2+l^2)^{3/2}}{(d_2^2+l^2)^{3/2}}$$

For a short bar magnet l is neglected, then

$$\frac{M_1}{M_2}=\left(\frac{d_1}{d_2}\right)^3$$

- Null method is more accurate than equal distance method, because error due to measurement of deflection is avoided.

NULL POINTS

- The point at which the earths horizontal component is balanced by external magnetic field is called a null point.
- When a bar magnet is placed along the magnetic meridian so that its north pole is pointing geographic north (**N - N** position) neutral or null points are obtained on the equatorial line on either side of the center of the magnet.
- At the null point in **N - N** position B_H is balanced by the field on the equatorial line of the short bar magnet $B_H = \left(\frac{\mu_0}{4\pi}\right)\frac{M}{d_e^{\,3}}$

  Where d_e is the distance of the null point from the center of the magnet on the equatorial line.
- When a bar magnet is placed along the magnetic meridian so that its north pole is pointing south (**N - S** position) neutral or null points are obtained on the axial line.
- At the null point in **N - S** position B_H is balanced by the field on the axial line of the short bar magnet $B_H = \left(\frac{\mu_0}{4\pi}\right)\frac{2M}{d_a^{\,3}}$ Where d_a is the distance of the null point from the center of the magnet on the axial line.
- When a very long bar magnet is placed vertically on a horizontal plane, only one neutral point is obtained. If the north pole touching the plane then neutral point is in the south and if the south pole touching the plane then neutral point is in the north.
- If the distance of neutral point is d, then

  $B_H = B = \left(\frac{\mu_0}{4\pi}\right)\frac{m}{d^2}$

VIBRATION MAGNETOMETER

- It is an instrument
  a) To determine the horizontal component of earth's magnetic induction at a given place.
  b) To compare the magnetic moments of two bar magnets.
  c) To compare the horizontal components of earth's magnetic induction at different places.
- When a bar magnet is suspended feely in a uniform magnetic field, moment of couple is applied by the external force and restoring torque is developed by the earth's magnetic field (B_H). As a result the magnet execute angular simple harmonic motion.
- The deflecting couple acting on the magnet is $I\alpha$
- Restoring torque developed by earth's magnetic induction is $MB_H \sin\theta$.
- $I\alpha = \overline{M}B_H \sin\theta$ (θ is the angular displacement)
- Time period $T = 2\pi\sqrt{\frac{\theta}{\alpha}}$
- A freely suspended bar magnet experiences a torque and executes angular S.H.M. Time period of oscillation is $T = 2\pi\sqrt{\frac{I}{MB_H}}$

  where I moment of inertia, M magnetic moment and B_H Horizontal component of earth magnetic induction $I = m\frac{(l^2+b^2)}{12}$ for a thin bar magnet

  $I = \frac{ml^2}{12}$ where m is mass of the magnet
- For small percentage changes in moment of inertia

  $$\frac{\Delta T}{T}\times 100 = \frac{1}{2}\frac{\Delta I}{I}\times 100$$
- For small percentage changes in magnetic moment

  $$\frac{\Delta T}{T}\times 100 = \frac{-1}{2}\frac{\Delta M}{M}\times 100$$
- If T_1, T_2 are the time peroiods of two magnets of moments Comparision of magnetic moments: $M_1 M_2$ then $M_1 / M_2 = (T_2 / T_1)^2$
- If T_1 is the time period with like ples of two magnets together and T_2 is the time period with unlike poles together, then

  $$\frac{T_1}{T_2}=\left(\frac{M_1+M_2}{M_1-M_2}\right)^{1/2} \qquad \frac{M_1}{M_2}=\frac{T_2^{\,2}+T_1^2}{T_2^{\,2}-T_1^2}$$

- Comparision of earths magnetic fields at different places: $B_{H1} / B_{H2} = (T_2 / T_1)^2$
- By using the same magnet in D.M.M. and in vibration magnet meter the value of magnetic moment and B_H can be determined.

When the bar magnet is used in vibration magnetometer, its time period is

$$T = 2\pi\sqrt{\frac{I}{MB_H}} \Rightarrow MB_H = 4\pi^2\frac{I}{T^2}$$

When a magnet is placed at a distance d in TanA position of D.M.M.

$$\frac{\mu_0}{4\pi}\frac{2Md}{(d^2-l^2)^2} = B_H \tan\theta$$

$$M = \frac{2\pi(d^2-l^2)^2}{T}\sqrt{\frac{2\pi I \tan\theta}{\mu_0 d}}$$

$$B_H = \frac{1}{T(d^2-l^2)^2}\sqrt{\frac{2\pi I d\mu_0}{\tan\theta}}$$

- **Magnetic permiability:** is the ratio of megentic induction to magentic field strength in a medium

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

μ indicates the ability of a medium to allow the magnetic lines of force.

CONCEPTUAL QUESTIONS

1. An isolated magnetic pole
   1) Is an imagination 2) Is made of atom
   3) Made of an e^- 4) Exists only in space
2. The North pole of the earth's magnet is near
   1) Geographical north
   2) Geographical south
   3) At the center of the earth
   4) does not exist
3. The lines of force of a bar magnet are
   1) Parallel and straight 2) Concentric circles
   3) Curved lines 4) Curved closed loops
4. Magnetic lines of force
   1) Donot intersect 2) Are closed loops
   3) Are imaginary 4) All of these
5. Two bar magnets are placed on a piece of cork which floats on water. The magnets are so placed that their axis are mutually perpendicular. Then the cork
   1) Rotates 2) moves a side
   3)oscillates 4) rotates and oscillates
6. The direction of magnetic moment is
   1) along $\overrightarrow{SN}$ 2) along $\overrightarrow{NS}$
   3) Perpendicular to $\overrightarrow{SN}$
   4) Can not be detected
7. The dimentional formula for magnetic moment is
   1) $M^0L^2T^0A^1$ 2) $M^0L^1T^0A^2$
   3) $M^0L^2T^0A^2$ 3) $M^0L^0T^1A^1$
8. When a bar magnet of magnetic moment $\overline{M}$ is placed in a magnetic field of induction field strength $\overline{B}$, each pole experiences a force of $\overline{F}$ then the distance between the South and North pole of the magnet measured inside it is
   1. MBF 2. $\frac{MB}{F}$ 3. $\frac{F}{MB}$ 4. $\frac{FB}{M}$
9. The time period of a freely suspended magnetic needle does not depend upon
   1. Length of the magnet 2. Pole strength
   3. Horizontal component of earth's magnetic field
   4. Length of the suspension
10. A magnetic needle is kept in a non uniform magnetic field. It experiences
    1) A force and a torque
    2) A force but not a torque
    3) Torque but not a force
    4) Neither a torque nor a force
11. The restoring force for a magnet oscillating in the vibration magnetometer is provided by
    1. Horizontal component of earth's magnetic field
    2. Gravity
    3. Torsion in the suspended thread
    4. Magnetic field of magnet
12. A very long magnet is held vertically with its south pole on a table. A single neutral point is located on the table to the
    1)East of the magnet 2)North of the magnet
    3)West of the magnet 4)South of the magnet
13. In working with the deflection magnetometer ,the proportional error will be minimum when the deflection is
    1) 90^0 2) 60^0 3) 30^0 4) 45^0
14. A magnet is kept fixed with its length parallel to the magnetic meridian. An identical magnet is parallel to this such that its center lies on perpendicular bisector of both. If the second magnet is free to move, it will have ,
    1)Translatory motion only
    2) Rotational motion only
    3) Both translatory and rotational motion
    4) Vibrational motion only
15. When a D.M. is arranged in Tan A position, a short bar magnet produced a deflection of 60^0. If the same magnet is set at the same distance in Tan B position, the deflection in the D.M. is
    1. 60^0 2. 30^0
    3. Less than 45^0 4. Greater than 45^0

16. The electric and magnetic field differ in that ..
1) Electric lines of force are closed curves while magnetic field lines are not
2) Magnetic field lines are closed while electric lines are not
3) Electric lines of force can give direction of the electric field while magnetic lines can not
4) Magnetic lines can give direction of magnetic field while electric lines can not.

17. In the working of deflection magnetometer, the deflection can never be
1) 90^0 2) 60^0 3) 30^0 4) 45^0

18. A magnetic field is produced and directed along y-axis. A magnet is placed along x-axis .The direction of the torque on the magnet is
1) in the x-y plane 2) Along z-axis
3) Along y-axis 4) torque will be zero

19. In both Tan A and Tan B positions the bar magnet is always placed
1) Parallel to the magnetic needle of the deflection magnetometer
2) Parallel to the aluminum pointer of the deflection magnetometer
3) Perpendicular to the aluminum pointer
4) Parallel to the arm having the wooden scale

20. A magnetic needle suspended by a silk thread is oscillating in the earth's magnetic field. If the temperature of the needle is increased by 500^0C, then
1) The time period decreases
2) The time period increases
3) The time period remain unchanged.
4) The needle stops vibrating

21. Tangent law is apllicable only when
1) Applied field is parallel to the earth's horizontal component
2) Applied field is anti-parallel to the earth's horizontal component
3) Applied field is perpendicular the earth's horizontal component inhorizontal plane
4) Applied field is normal to the earth's horizontal component

22. In the following, the most sensitive method to compare the magnetic moment of two bar magnets with a deflection magnetometer is
1. tan A null method 2. tan A equidistant
3. tan B equidistant 4. tan B null method

23. Deflction magnetometer is held in tan B position. A magnet placed on one of its arms produces no deflection. This implies that the axis of the magnet is
1. in the east - west direction
2. in the north-south direction
3. perpendicular to the wooden bench
4. None

KEY

1.1	2. 2	3.4	4.4	5. 4
6.1	7.1	8.2	9.4	10.1
11.1	12. 2	13.4	14.1	15.3
16.2	17.1	18.2	19.2	20.2
21. 3	22. 1	23. 2		

LEVEL-I

1. The length of a magnet is 16 cm. Its pole strength is 250 milli. amp.m. When it is cut into four equal pieces parallel to its axis, the magnetic length, pole strength and moments of each piece are: (respectively)
1. 4 cm; 62. 5 milli amp. m; 250 milli amp . cm^2.
2. 8.cm ; 500 milli amp.m; 400 milli amp. cm^2
3. 16 cm; 250 milli amp.m; 4000 milli amp. cm^2.
4. 16 cm; 62.5 milliamp.m; 0.01 $A.m^2$

2. The length of a bar magnet is 16 cm. Its pole strength is 250 milli amp.m. When it is cut into four equal parts parallel to its equitorial line, the magnetic length, pole strength moment of each piece are .... respectiely.
1. 4 cm; 62. 5 milli amp. m; 250 milli amp . cm^2.
2. 4.cm ; 250 milli amp.m; 0.01 $A.m^2$
3. 4 cm; 250 milli amp.m; 2000 $A.m^2$.
4. 8 cm; 500 milli amp.m; 2000 $A.m^2$

3. The magnetic moment of a bar magnet is 3.6×10^{-3} $A.m^2$. Its pole strength is 120 milli amp. m. Its magnetic length is
1. 3cm 2. 0.3cm 3.3 3.33cm 4. 3x10^{-2} cm

4. A steel wire of length 0.28 m is magnetised and is found to have moment of 0.308 $A.m^2$. If it is bent into a semi circle, its new magnetic moment is
1. 0.196Am^2 2. 0.308Am^2
3. 0.392Am^2 4. 0.09Am^2

5. The geometric length of a bar magnet of pole strength 80 A.m. and magnetic moment 4 amp m^2. is 6 cms. the distance between the two poles of the magnet is
1. 6 cm 2. 5 cm 3. $\frac{5}{6}$ cm 4. $\frac{6}{5}$ cm

6. Three identical bar magnets each of magnetic moment M are arranged in the form of an equilateral triangle such that at two vertices like poles are in contact.The resultant magnetic moment will be
1) Zero 2) 2M 3) $\sqrt{2}$ M 4) $M\sqrt{3}$

7. A thin bar magnet of length 'L' and magnetic moment M is bent at the mid-point so that the two parts are at right angles. The new magnetic length and magnetic moment are respectively.
1) $\sqrt{2}L, \sqrt{2}M$ 2) $\frac{L}{\sqrt{2}}, \frac{M}{\sqrt{2}}$
3) $\sqrt{2}L, \frac{M}{\sqrt{2}}$ 4) $\frac{L}{\sqrt{2}}, \sqrt{2}M$

8. A magnet of magnetic moment M is in the form of a quadrant of a circle. If it is straightened, its new magnetic moment will be

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

9. The magnetic moment of a bar magnet of length 20cm is $3.6\times10^{-6}Am^2$. The magnetic length is 90% of its geometric length. The pole strength is
1) 2×10^{-5} Am 2) 1.8×10^{-4} Am
3) 7.2×10^{-8} Am 4) 0.55×10^{-4} Am

10. Three identical bar magnets, each of pole strength 10A-m and length 10cm are placed in a uniform field of induction 0.05 wb/m^2. If the three magnets are fastened end to end along the same axis with opposite poles touching each other, resulting magnetic moment in Am^2 is
1) 3 2) 9 3) 6 4) 8

11. A long thin magnet of moment M is bent into a semi circle. The decrease in the Magnetic moment is
1) $2M/\pi$ 2) $\pi M/2$
3) $M(\pi-2)/\pi$ 4) $M(2-\pi)/2$

12. A bar magnet of magnetic moment M is bent in '$\sqcup$' shape such that all the parts are of equal lengths. Then new magnetic moment is

1) M/3 2) 2M 3) $\sqrt{3}M$ 4) $3\sqrt{3}M$

13. The force of repulsion between two similar magnetic poles each of strength 2.Am at a distance 2m from each other in vacuum is
1. 10^{-5} N 2. 10^{-7} N 3. 10^{-3} N 4. 2×10^{-7} N

14. Two magnetic poles of equal pole strengths each of 1.732 Am. should be placed at.... cms apart so that the force of attraction between then is 0.5 dynes.

1. 6 2. 2.45 3. 24.5 4. $\sqrt{3}$

15. When the magnetic poles placed in air repel each other with a force of 4×10^{-6} N. When the space between them is filled with a medium the repulsive force becomes 2.24×10^{-5} N. The relative permeability of the medium is

1. $\frac{5}{28}$ 2. 5.6 3. 8.96×10^{-11} 4. 56

16. A magnet has a pole strength of 1000 milli amp.m. The magnetic field intensity at a distance of 10 cm from its North pole is

1. $\frac{25}{\pi}$ A/m 2. $\frac{\pi}{25}$ A/m

3. $\frac{100}{\pi}$ A/m 4. $\frac{\pi}{100}$ A/m

17. The magnetic field intensity due to a magnet is $\frac{100}{4\pi}$ A/m. The induction field strength due to it is

1. 1×10^{-5} T 2. $\frac{4\pi}{10^3}$ T

3. $\frac{10^3}{4\pi}\times100$ T 4. $\frac{10^{-5}}{4\pi}$ T

18. The magnetic field intensity at a distance of 20 cm from a pole strength 40 A.m. in air is......... A/m; The induction field strength at that point is ...... tesla.

1. $\frac{10^3}{4\pi}$; 10^{-4} 2. $\frac{4\pi}{10^3}$; 10^{-4}

3. 10^{-4}; $\frac{10^3}{4\pi}$ 4. 10^4; $\frac{4\pi}{10^3}$

19. The magnetic induction at distance of 0.1 m from a strong magnetic pole strength 1200 A.m is
1. 12×10^{-3} T 2. 12×10^{-4} T
3. 1.2×10^{-3} T 4. 24×10^{-3} T

20. P and Q are two unlike magnetic poles. Induction due to 'P' at the location of 'Q' is B, and induction due to 'Q' at the location of P is $\frac{B}{2}$.
The ratio of pole strengths of P and Q is

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

21. The dimensions of a bar magnet are 10 cm x 2 cm x 1 cm. Its pole strength is 200 A.m. Its intensity of magnetisation is
1. 10^{-4}A/m 2. 2×10^{-4}A/m 3. 2×10^{-6}A/m 4. 10^{6}A/m

22. A bar magnet of pole strangth 50 A.m. is cut into 10 equal parts parallel to its axial line. The intensity of magnetisation of each piece will be....

1. $\frac{1}{10}$th of initial value 2. 10 times initial value
3. Does not change 4. Become half

23. Two short magnets each of moment 10 $A\text{-}m^2$ are placed in end - on position so that their centres are 0.1m apart. The force between them is
1.0.4N 2. 0.5N 3.0.6N 4.0.8N

24. The magnetic field intensity due to a bar magnet is 100 A.m^{-1}. The magnetic induction field strength due to it is,

1. $\frac{4\pi}{10^7}$T 2. $\frac{4\pi}{10^5}$T 3. $\frac{10^3}{4\pi}$T 4. $\frac{10^5}{4\pi}$T

25. The mass of iron rod is 110gm, its magnetic moment is 20 Am^{-2}. The density of iron is $8gm/cm^3$. The intensity of magnetization is
1) $2x10^5$ Am^{-1} 2) $2.26x10^6$ Am^{-1}
3) $1.6x10^6$ Am^{-1} 4) 1.4×10^6 Am^{-1}

26. A magnet has a dimensions of 25 cm x 10 cm x 5 cm and pole strength of 200 milli amp.m. The intensity of magnetisation due to it is
1. 6.25A/m 2. 62.5A/m 3. 40A/m 4. 4A/m

27. The magnetic induction field strength due to a short bar magnet at a distance 0.20 m on the equtorial line is $20x10^{-6}$ tesla. The magnetic moment of the bar magnet is
1. $3.2A.m^2$. 2. $6.4A.m^2$. 3. $1.6A.m^2$. 4. $16A.m^2$.

28. A short bar magnet produces a field of induction 160×10^{-6} T at certain point on the axial line. The induction field strength on the same line at a point twice the distance of the first is
1. 20×10^{-5} T 2. 2×10^{-5}T
3. 20×10^{-4} T 4. 2×10^{-7}T

29. The pole strength of a horse shoe magnet is 90 Am and distance between the poles is 6 cm. The magnetic induction at mid point of the line joining the poles is,
1)$10^{-2}\boldsymbol{T}$ 2)Zero 3) $2\times10^{-2}\boldsymbol{T}$ 4)$10^{-4}\boldsymbol{T}$

30. The magnetic induction field strength due to a short bar magnet of moment 3.6 $A.m^2$. at a distance of 0.2 m on the equatorial line is
1. 4.5×10^{-4} T 2. 9×10^{-4} T
3. 9×10^{-5} T 4. 4.5×10^{-5} T

31. In problem No. 31, the induction field strength at a distance 0.2 m on the axial line is
1. 4.5×10^{-4} T 2. 9×10^{-4} T
3. 9×10^{-5} T 4. 4.5×10^{-5} T

32. If area vector $\overline{A} = 3\overline{i} + 2\overline{j} + 5\overline{k}\ m^2$ flux density vector $\overline{B} = 5\overline{i} + 10\overline{j} + 6\overline{k}\,(web/m^2)$. The magnetic flux linked with thecoil is
1. 31Wb 2. 9000Wb 3. 65Wb 4. 100Wb

33. A magnetic pole of pole strength 9.2 A m. is placed in a field of induction $50x10^{-6}$ tesla. The force experienced by the pole is
1. 46N 2. $46x10^{-4}$N 3. $4.6x10^{-4}$N 4. 460N

34. If each pole of a bar magnet of magnetic moment 7.8 A m^2 experiences a force of $15.6x10^{-5}$ N, When placed in a magnetic field of induction $0.4x10^{-5}$ tesla. Then the length of the magnet is
1. 20m 2. 2m 3. 0.2m 4. 0.10m

35. Two magnetic poles of pole strengths 324 milli amp.m. and 400 milli amp. m. are kept at a distance of 10 cm in air. The null point will be at a distance of ...... cm, on the line joining the two poles, from the weak pole if they are like poles.
1. 4.73 2. 5 3. 6.2 4. 5.27

36. The force acting on a pole of strength of 20 A.m. is $8x10^{-4}$ N. when placed in a magnetic field. The magnetic induction field strength is
1. $4x10^{-5}$ tesla 2. $0.4x10^{-4}$ T
3. 0.4 gauss 4. All

37 The force acting on each pole of a magnet when placed in a uniform magnetic field of 7 A/m is $4.2x10^{-4}$ N. If the distance between the poles is 10 cm. the moment of the magnet is
1. $\frac{15}{\pi}$ Am^2 2. $\frac{\pi}{15}$ Am^2
3. 7.5×10^{-12} Am^2 4. $6x10^{-6}$ Am^2

38. The pole strength of a bar magnet is 2 Am. If the field at poles are 0.2 T and 0.22 T, then the force acting on the bar magnet is
1. 0.4N 2. 0.04N 3. 0.44N 4. 0.8N

39. The absolute permeability of a medium is 8.792×10^{-6} henry/m. Its relative permeability is
1. 0.7 2. 7 3. 70 4.6×10^{-8}

40. A bar magnet of length 16 cm has a pole strength of 500 milli amp.m. The angle at which it should be placed to the direction of external magnetic field of induction 2.5 gauss so that it may experience a torque of $\sqrt{3}$ $x10^{-5}$ N.m. is
1. π 2. $\frac{\pi}{2}$ 3. $\frac{\pi}{3}$ 4. $\frac{\pi}{6}$

41. A magnet of length 10 cm and pole strength $4x10^{-4}$ A.m. is placed in a magnetic field of induction $2x10^{-5}$ weber m^{-2}. such that the axis of the magnet makes an angle 30^0 with the lines of induction. The moment of the couple acting on the magnet is
1. $4x10^{-10}$ Nm 2. $8x10^{-10}$ Nm
3. $4x10^{-6}$ Nm 4. $\sqrt{3}$ $x10^{-11}$ Nm

42. A magnet of length 30 cm with pole strength 10 A.m. is freely suspended in a uniform horizontal magnetic field of induction $40x10^{-6}$ tesla. If the magnet is deflected by 60^0 from its equilibrium position. The restoring couple acting on it is
1. $10.39x10^{-5}$ Nm 2. $\sqrt{3}$ $x10^{-5}$ Nm
3. $6x10^{-5}$ Nm 4. $\sqrt{5}\times10^{-5}$ Nm

43. A bar magnet of moment $4Am^2$ is placed in a nonuniform magnetic field. If the field strength at poles are 0.2 T and 0.22 T then the maximum couple acting on it is
1. 0.8Nm 2. 0.88Nm 3.0.4 Nm 4. 0.44Nm

44. A magnet of moment $4Am^2$ is kept suspended in a magnetic field of induction $5\times10^{-5}T$. The workdone in rotating it through 180^0 is
1. $4\times10^{-4}J$ 2. $5\times10^{-4}J$
3. $2\times10^{-4}J$ 4. $10^{-4}J$

45. A magnet is in stable equilibrium in a uniform magnetic field. If it is deflected by 60^0 workdone is equal to W. In deflecting the magnet further by 30^0, workdone is

1. $\frac{W\sqrt{3}}{2}$ 2. $\frac{W}{4}$ 3. $\frac{W}{2}$ 4. W

46. A magnet of moment $4Am^2$ is suspended in a uniform magnetic field of induction 5×10^{-4} N/Am with its axis at right angles. When the magnet is released from its position, the K.E that it gains in passing to the stable equilibrium position is

1. $10^{-4}J$ 2. $10^{-3}J$
3. $2\times10^{-3}J$ 4. $5\times10^{-4}J$

47. A short bar magnet placed in a uniform magnetic field experiences a maximum couple of 4 x 10^{-5} N-m. The magnet is turned through 45°. The couple acting in the new equilibrium position is
1. 2 x 10^{-5} Nm 2. 2.828 x 10^{-5} Nm
3. 1.414 x 10^{-5} Nm 4. 3.6×10^{-5} Nm

48. Two magnets of magnetic moments M and $\sqrt{3}M$ are joined to form a cross (+). The combination is suspended freely in a uniform magnetic field. In equilibrium position the angle between the magnetic moment M and the field is.
1) 30^0 2) 45^0 3) 60^0 4) 90^0

49. A bar magnet of magnetic moment 1.5 J/T lies aligned with the direction of a uniform magnetic field of 0.22 T. The work done in turning the magnet so as to align its magnetic moment opposite to the field and the torque acting on it in this position are respectively.
1) 0.33J, 0.33N-m 2) 0.66J, 06.66N-m
3) 0.33J, 0 4) .0.66J ,0

50. When a bar magnet is placed perpendicular to a uniform amgnetic field, it is acted upon by a coulple 1.732×10^{-5} Nm. The angle through which the magnet should be turned so that the coulple acting on it becomes 1.5×10^{-5} Nm is

1. 60^0 2. 45^0 3. 30^0 4. 75^0

51. A bar magnet of length 0.2 m and pole strength 5 A.m. should be kept in a uniform magnetic field of induction 15 tesla at angle .... radians to the field so that the torque experienced by it wil be 7.5 N-m

1. $\frac{\pi}{2}$ 2. $\frac{\pi}{3}$ 3. $\frac{\pi}{6}$ 4. $\frac{\pi}{4}$

52. A bar magnet of magnetic moment $2Am^2$ is free to rotate about a vertical axis passing through its center. The magnet is released from rest from east - west position. Then the KE of the magnet as it takes N-S position is $(B_H = 25\mu T)$

1. $25\mu J$ 2. $50\mu J$ 3. $100\mu J$ 4. $12.5\mu J$

53. A dipole of magnetic moment 2 A-m^2 is deflected through 30^0 from magnetic meridian. If earth's horizontal component of magnetic field H=30 A/m. The deflecting couple is
1. 3.8 x 10^{-5} N-m 2. 38 x 10^{-5} N-m
3. 1.9 x 10^{-5} N-m 4. 38 x 10^{-7} N-m

54. A bar magnet of 5 cm long having a pole strength of 20 A.m. is deflected through 30^0 from the magnetic meridian. If H = $\frac{320}{4\pi}$ A/m, the deflecting couple is
1. 1.6 x 10^{-4} Nm 2. 3.2 x 10^{-5} Nm
3. 1.6 x 10^{-5} Nm 4. 1.6 x 10^{-2} Nm

55. The rate of change of torque 'τ' with deflection θ is maximum for a magnet suspended freely in a uniform magnetic field of induction B when θ is equal to

1. 0^0 2. 45^0 3. 60^0 4. 90^0

56. A bar magnet is at right angles to a uniform magnetic field. The couple acting on the magnet is to be one fourth by rotating it from the position. The angle of rotation is
1) Sin^{-1}(0.25) 2) 90^0-Sin^{-1}(0.25)
3) Cos^{-1}(0.25) 4) 90^0- Cos^{-1}(0.25)

57. A magnet of moment 1.2Am^2 is kept suspended in a magnetic field of induction 2×10^{-6} T. The work done in rotating it through 120^0 is.

1. $2.4\times10^{-6}J$ 2. $4.8\times10^{-6}J$
3. $1.2\times10^{-6}J$ 4. $3.6\times10^{-6}J$

58. A short bar magnet placed with its axis at 30^0 with a uniform external magnetic field of 0.16 T experience a torque of magnitude 0.032 N m. If the bar magnet is free to rotate its potential energies when it is in stable and unstable equilibrium are respectively.
1) -0.064J, +0.064J 2) -0.032J, +0.032J
3) +0.064J, -0.128J 4) 0.032J, -0.032J

59. A magnetic dipole is under the influence of two magnetic fields having an angle of 120^0 between them. One of the fields has a magnitude $1.2\times10^{-2}T$. If the dipole comes to stable equilibrium at an angle of 30^0 with this field, then magnitude of the other field is
1) 8.484x10^{-2}T 2) 0.6 x10^{-2}T
3) 4.242x10^{-3}T 4) 4.242x10^{-5}T

60. A short magnet placed end on to a compass needle with its center at 0.15m from the needle deflects through 45^0. The distance that the magnet should be moved away so that the deflection decreases by 15^0 is $\left(take\ \left(\sqrt{3}\right)^{1/3} = 1.2\right)$

1) 0.18m 2) 0.2 m 3) 0.24 m 4) 0.03 m

61. A deflectio magneto meter is in Tan A position in a region where the earth's horizontal component of magnetic induction is 60×10^{-6} T. When a magnet is placed at a suitable distance, a deflection of 45^o is obtained. The induction field strength due of the magnet is

1. 60×10^{-5} T 2. 6×10^{-5} T
3. 0.6×10^{-5} T 4. 6×10^{-6} T

62. Magnetic induction at a point on the axial line of a short bar magnet is B towards east. If the magnet is turned through 90^0 in clock wise direction, then magnetic induction at the same point is (Neglect earth's magnetic field)

1. $\frac{B}{4}$ towards east 2. $\frac{B}{2}$ towards west
3. $\frac{B}{2}$ towards north 4. $\frac{B}{2}$ towards south

63. Two magnets have their magnetic moments in the ratio 27 : 64. Find the ratio of the distances at which they should be placed on either side of a deflection magneto meter in (a) Tan A and (b) Tan B position so as to give a null deflection

1. 3 : 4 2. 4 : 3 3. 9 : 8 4. 9 : 16

64. A short bar magnet is kept at a distance of 30 cm from the centre of compass box when D.M. which is in Tan A position the deflection is 45^0. If the horizontal component of earth's field strength is 30 A/m. the magnetic moment of the magnet is

1. 0.162π Am^2 2. 1.62π Am^2
3. 162π Am^2 4. 16.2π Am^2

65. Two magnets when placed in Tan A position at the same distance gave deflections of 30^0 and 60^0. The ratio of their magnetic moments is

1. 3 : 1 2. 1 : 3 3. 1 : 2 4. 2 : 1

66. Two short magnets are kept in opposite arms of the D.M. at 12 cm and 16 cm. If there is no deflection in the needle, the ratio of the magnetic moments is

1. 3 : 4 2. 4 : 3 3. 9 : 14 4. 27 : 64

67. When a short bar magnet is kept at a distance of 20 cm from the centre of D.M., in Tan A position, the deflection is 45^0, if H=30 A/m. The moment of the magnet is

1. 1.5×10^{-2} Am^2 2. 1.51Am^2
3. 3.01Am^2 4. 1.31Am^2

68. A short magnet when placed at a distance of 15 cm in Tan A. position produces 60^0 deflection. If the magnet is cut into 3 equal parts and one of them is kept at the same distance in Tan A position, the deflection is

1) 20^0 2) 30^0 3) 45^0 4) 60^0

69. Two short bar magnets with magnetic moments 8Am^2 and 27Am^2 were placed 35cm apart along their common axial line with their like poles facing each other. The neutral point is

1. midway between them
2. 21 cm from weaker magnet
3. 14 cm from weaker magnet
4. 27 cm from weaker magnet

70. When a 'D.M.' is set in Tan A position, the deflection is 30^o for a magnet 'A' placed at a distance 40 cm from the mid point of the 'D.M.'. When the D.M. is kept in Tan B positon another magnet 'B' produces a deflection of 60^o, when placed at the same distance. The ratio of the magnetic moments of A and B is

1. 1 : 2 2. 1 : 3 3. 2 : 3 4. 1 : 6

71. The ratio of magnetic moments of two bar magnets is 5 : 2. If the deflection produced by the first magnet in the 'D.M.' is 60^o. The deflection due to the second magnet kept at the same distance is

1. Greater than 45^o 2. Less than 45^o
3. Less than 30^o 4. Greater than 90^o

72. Two short magnets have the same pole strengths but one is twice as long at the other. The shorter one is placed at a distance of 0.2 m. from magnetometer, set in Tan A position. The distance at which the other must be placed on the other side of the magnetometer so that there may be no deflection is

1. 0.252cm. 2. 25.2cm.
3. 12.5cm. 4. None

73. A short bar magnet is placed with its south pole facing geographic south and the distance between the null points is found to be 16 cm. When the magnet is turned pole to pole at the same place then the distance between the null points will be

1. will be same along the axial line
2. will be same along the equatorial line
3. will be $16 \times 2^{1/3}$ times on the axial line
4. will be $16 \times 2^{1/3}$ times on the equatorial line

74. If the moments of inertia of two bar magnets are same, and if their magnetic moments are in the ratio 4 : 9 and if their frequencies of oscillations are same, the ratio of the induction field strengths in which they are vibrating is

1. 2 : 3 2. 3 : 2 3. 4 : 9 4. 9 : 4

75. Two magnets have their moments of inertia in the ratio 1 : 4; magnetic mometns in the ratio 4 : 9. They are vibrating in the same magnetic field of induction 0.4 gauss. If the time period of first magnet is 0.9 sec. The period of oscillation of 2nd magnet is
1. 1.2s 2. 0.65s 3. 0.3s 4. 2.4s
76. If the strength of the magnetic field is increased by 21% the frequency of a magnetic needle oscillating in that field.
1) Increased by 10 2) Decreases by 10%
3) Increases by 11% 4) Decreased by 21%
77. Two bar magnets are placed together in a vibration magnetometer their time period is 3 second. If one magnet is reversed, the combination takes 4s for one vibration.The ratio of their magnetic moments is
1. 3 : 1 2. 5 : 18 3. 18 : 5 4. 25 : 7
78. When two similar bar magnets are suspended one after the other in stirrup of a vibration magnetometer, make 10 vibrations and 12 vibrations in one minute respectively. If the magnetic moment of the first magnet is 2.5 amp. m^2. the magnetic moment of the 2nd magnet is
1. 3.6 Am^2 2. 2.5 Am^2 3. 3.0 Am^2 4. 5.0 Am^2
79. A bar magnet of length 'l' breadth 'b' mass 'm' suspended horizontally in the earths magnetic field, oscillates with period T .If 'l' ,m,b are doubled with pole strength remaining the same, the new period will be
1) 8T 2) 4T 3) $\frac{T}{2}$ 4)2T
80. A magnetic needle kept in a uniform magnetic field of induction 0.5 x 10^{-4} tesla. It makes 30 oscillations per minute. If it is kept in a field of induction 2 x 10^{-4} tesla. Then its frequency is
1. 1 oscillation/s 2. 60 oscillations/s
3. 15 oscillations/min 4. 15 oscillations/s
81. A magnet freely suspended in a vibration magnetometer makes 30 vibrations per minute at one place and 20 vibrations per minute at another place. If the value of B_H at second place is 0.27 tesla. The value of B_H at other place is
1. 0.12 T 2. 2.1 T 3. 5.4 T 4. 0.61 T
82. A magnetic needle has a frequency of 60 oscillations per minute in the earth horizontal field. When a field B supports the earth's horizontal field its frequency increases by 30 oscillations per minute. Then the ratio of the field B to that of earth is,
1) 4:7 2) 7:4 3) 5:4 4) 4:5
83. A magnet is suspended horizontally in the earth's field. The period of oscillation in the place is T. If a piece of wood of the same moment of inertia as the magnet is attached to it, the new period of oscillation would be
1) $\frac{T}{\sqrt{2}}$ 2) T/2 3) T/3 4) $\sqrt{2}T$
84. Three identical magnetic monopoles of pole strength m each are so placed such that they are at the three vertices of an equilateral triangle of side 6cm .The intensity of magnetic induction at the centroid is
1) 50m 2) 0.50cm 3) zero 4) unity

KEY

1.4	2.2	3.1	4.1	5.2
6.2	7.2	8.4	9.1	10.1
11.3	12.1	13.2	14.3	15.2
16.1	17.1	18.1	19.1	20.3
21.4	22.3	23.3	24.2	25.4
26.3	27.3	28.2	29.3	30.4
31.3	32.3	33.3	34.3	35.1
36.4	37.1	38.2	39.2	40.3
41.1	42.1	43.1	44.1	45.4
46.3	47.2	48.3	49.4	50.3
51.3	52.2	53.1	54.3	55.1
56.2	57.4	58.1	59.2	60.4
61.2	62.3	63.1	64.2	65.2
66.4	67.2	68.2	69.3	70. 4
71.2	72.2	73.3	74. 4	75. 1
76.1	77.4	78.1	79. 4	80.1
81.1	82.3	83.4	84. 3	

LEVEL-II

1. Two magnetic poles have their strengths in the ratio 3 : 2. They are kept at a distance of 0.6 m in air and the force of repulsion is found to be 0.06 dynes. The pole strengths are (in amp. m)
1. 1.8, 1.2 2. 18, 12 3. 6, 4 4. 0.6, 3.6
2. When two magnetic poles one of which is four times greater than the other in pole strength, are placed 5 cm apart in air. They exert a mutual force of 144 mg.wt. on each other. The pole strengths of the poles are (in amper metre) (g=10 m/s^2)
1. 6, 3 2. 9, 3 3. 12, 3 4.18, 6
3. A magnet of magnetic moment 1.525x10^{-3} amp.m^2. is placed in a magnetic field of induction field strength 0.1 gauss, perpendicular to the field direction. Then each pole experiences a force of 0.305 dynes. The distance between the two poles of the magnet is
1. 0.5x10^{-2} cm 2. 0.5x10^{-1}cm
3. 0.5cm 4. 5cm
4. When a bar magnet of magnetic moment 40 A.m^2. is placed in a magnetic field of induction 40x10^{-6} T, each pole experiences a force of 1.2x10^{-5} N. The distance between the two poles of the magnet is
1. 1.3333m 2. 1.333m
3. 13.33m 4. 133.3m

5. The couple acting on a bar magnet of pole strength 2 A.m. when kept in a magnetic field of intensity 10 A/m, such that axis of the magnet makes an angle 30^0 with the direction of the field is $80\times10^{-7}\,Nm$. The distance between the poles of the magnet is

1. $\frac{2}{\pi}$ m 2. $\frac{\pi}{2}$ m 3. 63.36m 4. $\frac{1}{2\pi}$ m

6. A bar magnet of moment 'M' is bent into a shape  with all segments are equal. It's new magnetic moment will be

1. $\frac{M}{\sqrt{3}}$ 2. $\frac{M}{\sqrt{5}}$ 3. $\frac{M}{\sqrt{2}}$ 4. $\frac{2M}{\sqrt{3}}$

7. A short magnet produces a deflection of 30^0 when placed at some distance in Tan A position of the magneto meter. If another magnet of same length and double the pole strength is kept at the same distance in Tan B position, the deflection produced is

1. 30^0 2. 60^0 3. 45^0 4. 0^0

8. When two short magnets having magnetic moments in the ratio 27 : 8 are placed on opposite sides of deflection magneto meter, there is no deflection in the D.M. The distance of the stronger magnet from the centre is 15 cm. The distance of the weaker magnet from the centre is

1. 15cm 2. 7.5cm 3. 10cm 4. 10/ 3cm

9. When the short magnets having magnetic moments in the ratio 125 : 216, are placed on the opposite arms of the D.M. then there is no deflection in the D.M. The distance between the centres of the magnets is 22 cm. The distance of the weaker magnet from the center of D.M is

1. 11 cm 2. 16 cm 3. 18 cm 4. 10 cm

10. A pivoted magnetic compass needle is free to rotate in a horizontal plane in earth's magnetic field. Another magnetic field of induction 0.54 x 10^{-4} tesla is applied at right angles to the earth's field B_H=0.36x10^{-4} tesla. The angle through which the needle deflects is

1. 50^0 2. 60^0
3. Less than 60^0 but greater than 45^0
4. Greater than 60^0

11. A short bar magnet of magnetic moment $12.8\times10^{-3}\,Am^2$ is arranged in the magnetic meridian with its south pole pointing geographic north. If B_H=0.4 gauss, the distance between the null points is

1. 4 cm 2. 8cm 3. 12 cm 4. 16cm

12. A short bar magnet is placed with its south pole pointing geographic North at a place where B_H=0.4 gauss. The length of the magnet is 10 cm and pole strength is 16 amp.m^2. The distance of each null point from the centre will be

1. 0.2cm on axial line 2. 0.8cm on axial line
3. 0.4cm on axial line 4. 0.2cm on equitoriall line

13. Two north poles each of pole strength 8Am are placed at corners A and C of a square ABCD. The pole that should be placed at B to make D as null point is

1. North pole of pole strength $8\sqrt{2}Am$
2. North pole of pole strength $16\sqrt{2}Am$
3. South pole of pole strength $8\sqrt{2}Am$
4. South pole of pole strength $16\sqrt{2}Am$

14. A magnetised wire is bent into an arc of a circle subtending an angle 60^0 at its centre. Then its magnetic moment is X. If the same wire is bent into an arc of a circle subtending an angle 90^0 at its centre then its magnetic moment will be

1. $\frac{x\sqrt{2}}{3}$ 2. $\frac{x}{3}$ 3. $\frac{(2\sqrt{2})x}{3}$ 4. $\frac{3x}{2\sqrt{2}}$

15. A very long bar magnet of time period T is cut into four equal parts by cutting it perpendicular to the length. Then the time period of one small part is,

1) T 2) $\frac{T}{16}$ 3) $\frac{T}{4}$ 4) $\frac{T}{8}$

16. The length of a magnet of moment 5A-m^2 is 14 cm. The magnetic induction at a point, equidistant from both the poles is 3.2x10^{-5} Wb/m^2. The distance of the point from either pole is

1) 25 cm 2) 10 cm 3) 15 cm 4) 5 cm

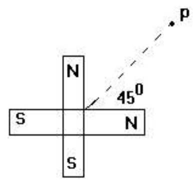
17. A bar magnet is placed with its North pole pointing North. Neutral point is at a distance 'd' from the center of magnet. The net magnetic induction at the same distance on the axial line of the magnet

1) $2B_H$ 2) $3B_H$ 3) B_H 4) $7B_H$

18. A deflection magnetometer is arranged in tan A position. When a bar magnet is placed deflection is observed to be 'θ' and period of oscillation of the needle is 'X'. when the magnet is removed and magnetic needle is made to oscillate in presence of earth's magnetic field then its period is 'Y', then $\frac{X}{Y}$ is

1) $Tan\ \theta$ 2) $\sqrt{Cos\theta}$ 3) $\sqrt{Sin\ \theta}$ 4) $Cos\ \theta$

19. Two short bar magnets of equal dipole moments M each are fastened perpendicular at their centers as shown in figure. The magnitude of the magnetic field at 'P' at a distance from their common center as shown in figure is



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

20. A bar magnet of magnetic moment M_1 is suspended by a wire in a magnetic field. The top of the wire is rotated through 180^0, then the magnet rotated through 45^0. Under similar conditions another magnet of magnetic moment M_2 is rotated through 30^0, the ratio $M_1:M_2$ is

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

21. A bar magnet with poles 25cm apart and pole strength 14.4 A-m rests with its center on a frictionless pivot. If it is held in equilibrium at 60^0 to a uniform magnetic field on induction 0.25 T by applying a force R at right angles to its axis 10cm from the pivot, the value of F in Newton is (nearly)

1) 3.9N 2) 7.8N 3) 15.6N 4) 31.2N

22. An iron rod of cross sectional area 4 sq.cm. is placed with its length parallel to a magnetic field of intensity 1600 Amp/m. The flux through the rod is $4\text{x}10^{-4}$ Weber. Then the permeability of the material of the rod is [in weber /(amp-m)]

1) 0.625 2) 6.25
3) $0.625\text{x}10^{-3}$ 4) 0.0625

23. The force between two magnetic poles reduces to 'a' newtons, if distance between them is increased to 'n' times and it increases to 'b' newtons if the distance between them is 1/n the of the original value. Then a:b is

1) $1:n^2$ 2) $n^2:1$ 3) $n^4:1$ 4) $1:n^4$

24. The magnetic moment of a bar magnet is 0.256 amp.m^2. Its pole strength is 400 milli amp. m. It is cut into two equal pieces and these two pieces are arranged at right angles to each other with their unlike poles in contact (or like poles in contact). The resultant magnetic moment of the system is

1. $\sqrt{2}\times 256\times 10^{-3}$ Am^2 2. 250 x $10^{-3}Am^2$

3. $\frac{256}{\sqrt{2}}\times 10^{-3}$ Am^2 4. $\frac{128}{\sqrt{2}}\times 10^{-3}$ Am^2

25. A South pole and North pole of each strength 'm' are placed at the two corners of an equilateral triangle of side 'a'. The resultant magnetic induction field strength at the third vertex is

1. 0 (zero) 2. $\frac{2\mu_0}{4\pi}\frac{m}{d^2}$ 3. $\frac{\mu_0}{4\pi}\frac{m}{d^2}$ 4. $\frac{3\mu_0}{4\pi}\frac{m}{d^2}$

26. Two short bar magnets of magnetic moments 0.125 Am^2. and 0.512 Am^2. are placed with their like poles facing each other. If the distance between the centres of the magnet is 0.26 m, The distance of neutral point from the weaker magnet is

1. 0.13m 2. 0.2m 3. 0.26m 4. 0.1m

27. Two short bar magnets each of magnetic moment 2 Am^2. are arranged anti parallel at a distance of 20 cms. with the line joining their centres perpendicular to their axes. The magnetic induction at the mid point of the line joining their centres is

1. 0 2. 05 $\times 10^{-4}$ T
3. 0.25 $\times 10^{-4}$ T 4. 1 $\times$ 10^{-4} T

28. Two points A and B are equal distant from the centre of a small bar magnet. Point 'A' is on the axial line and point B is on the line bisecting the magnet at right angles. If the distance of the points from the magnet is much greater than the length of the magnet the ratio of the fields at point A and B is

1. 2 :1 2. 1 : 2 3. 1 : 1 4. 4 : 1

29. The ratio of the magnetic moments of two bar magnets is 4 : 5. If the deflection produced by the first one in magneto meters is 45^o, the deflection due to second magnet kept at the same distance is

1. $0 < \theta < 30^o$ 2. $30^o < \theta < 45^o$

3. $45^o > \theta > 60^o$ 4. $60^o > \theta > 45^o$

30. The magnetic moment of a dipole is $2Am^2$, The magnetic induction in air at a distance of 10cm form the dipole on a line making an angle of 60^0 withthe axis of dipoles

1. $\sqrt{7}\times 10^{-5}T$ 2. $\sqrt{7}\times 10^{-4}T$

3. $\sqrt{7}/2 \times 10^{-4}T$ 4. $\sqrt{7}/2 \times 10^{-5}T$

31. A thin straight strip of length 5cm and magnetic moment 0.5 Am^2 was bent such that there is a gap of 1 cm at its ends. Then the magnetic moment of this will be:

1) 0.1 Am^2 2) 0.2 Am^2 3) 0.05 Am^2 4) 0.25 Am^2

32. Two magnets placed one over the other produce a deflection of 30^0 in Tan A position. When the second magnet is reversed pole to pole, deflec-

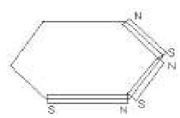
tion becomes 60^0, Then $\frac{M_1}{M_2}$ is

1) 3 : 2 2) 2 : 3 3) 1 : 2 4) 2 : 1

33. A bar magnet is placed with its North pole pointing North. Neutral point is at 12 cm. Another magnet is now placed on the first magnet, then the neutral point is found to be at 8 cm. The ratio of their magnetic moment is.
1) 3 : 2 2) 27 : 19 3) 9 : 4 4) 9 : 5

34. The ratio of magnetic fields on the axial line of a long magnet at distances of 10cm and 20cm is 12.5:1. The length of the magnet is
1)5cm 2) 10cm 3)10m 4)15 m

35. Three indentical thin bar magnets each of moment M are placed along three adjacent sides of a regular hexagon as shown in figure. The resultant magnetic moment of the system is



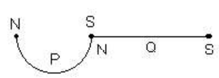
1. M 2. $M\sqrt{3}$ 3. $M\sqrt{2}$ 4. $2M$

36. A magnetic needle of pole strength $20\sqrt{3}Am$ is pivoted at its centre. Its N-pole is pulled eastward by a string. The tension required to produce a deflection of 30^0 from magnetic meredian is $\left(B_H = 10^{-4}T\right)$

1. $4\times10^{-3}N$ 2. $2\times10^{-3}N$

3. $\frac{2}{\sqrt{3}}\times10^{-3}N$ 4. $4\sqrt{3}\times10^{-3}N$

37. A magnet of length 2L and moment 'M' is axially cut into two equal halves 'P' and 'Q'. The piece 'P' is bent in the form of semi circle and 'Q' is attached to it as shown. Its moment is



1. $\frac{M}{\pi}$ 2. $\frac{M}{2\pi}$

3. $\frac{M\left(2+\pi\right)}{2\pi}$ 4. $\frac{M\pi}{\left(2+\pi\right)}$

KEY

1. 1	2.3	3. 3	4.4	5.1
6.2	7.1	8.3	9. 4	10.3
11.3	12.1	13.4	14.3	15.3
16.1	17.2	18.2	19.2	20.1
21.2	22.3	23.4	24.4	25.3
26.4	27.1	28.1	29.4	30.2
31.1	32.4	33.2	34. 2	35. 4
36. 2	37.3			

HINTS

1. $\frac{m_1}{m_2} = \frac{3}{2}$: F = $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{m_1 m_2}{d^2}\right)$ = 6 x10^{-7} N
2. Same method as above
3. $2L = \frac{MB}{F}$
4. Same as above
5. $2l = \frac{\tau}{mBSin\theta}$
8. For stronger magnet the distance will be more
M_1 / M_2 = 27/8 AND d_2 = 15 cm
$$\frac{M_1}{M_2} = \frac{d_1^{\ 3}}{d_2^{\ 3}}$$
9. $\frac{M_1}{M_2} = \frac{d_1^{\ 3}}{d_2^{\ 3}}$ = 125 / 216 AND $d_1 + d_2$ = 22cm
NOW find d_1
10. B = B_H $Tan\theta$
11. B_H = $\left(\frac{\mu_0}{4\pi}\right)$ 2 $\frac{M}{d_a^{\ 3}}$ THEN find 2 d_a
12. Find M = m 2L and use the formula given above
15. $I_2 = I_1$ / 4, $M_2 = M_1$ / 4
$$\frac{T_2}{T_1} = \sqrt{\frac{I_2 M_1}{I_1 M_2}}$$
16. $\sqrt{(d^2 + l^2)}$ = ?
$$B = \frac{\mu_0}{4\pi}\frac{M}{(d^2 + l^2)^{3/2}} = 3.2 \times 10^{-5}$$
17. B_H = $\left(\frac{\mu_0}{4\pi}\right)$ $\frac{M}{d_a^{\ 3}}$ = B
On the axial line net magnetic induction is
B_H + 2B = 3 B_H
20. Couple per unit twist is same
21. FR = MB sinθ
22. $\mu = \frac{\phi}{AH}$
24. $M_1 = M_2$ = M / 2 Use the formula

$\sqrt{M_1^2 + M_2^2 + 2M_1M_2 \cos\theta}$

25. Each pole develope a field B and angle be tween them will be 120^0. Therefore the result ant field at the third corner is B

B = $\left(\frac{\mu_0}{4\pi}\right)\frac{m}{d^2}$

26. $\frac{M_1}{x^3} = \frac{M_2}{(d-x)^3}$

27. At the given point filds are equitorial line fields and they are opposite to each other. Therefore the net resultant field is zero

28. $B_{ax} = 2\, B_{EQ}$

29. Deflection Tan θ is directly proportional to Magneticmoment M

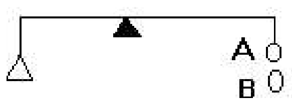
31. M = Pole strength x Straight line distance between poles

32. $\frac{M_1 - M_2}{M_1 + M_2} = \frac{Tan30^0}{Tan60^0}$, Now find M_1 / M_2

33. $\frac{M_1}{M_1 - M_2} = \left(\frac{d_1}{d_2}\right)^3$

LEVEL-III

1. A small-magnetized sphere A of pole strength m is counter poised by a pan in a balance. Another sphere B of the same mass as A is place below A so that their centers are at a distance 1cm. If A and B are unlike poles of same strength to restore counter increased by 500 gm. The pole strength of each sphere is



1) 1.4 Am 2) 9.8 A-m 3) 0.7 A-m 4) 70Am

2. At two points separated by a distance of 3cm, the magnetic field strength due to a short magnet on its axial line are in the ratio 512:125. Then the distance of magnet from the first point is
1) 8cm 2)11cm 3)4cm 4) 5cm

3. A short magnet of moment M is placed on the X-axis at x=-d and another identical magnet is placed at y=-d. Their magnetic moments are directed in the positive and negative X-directions respectively. The induction field at the origin (in Tesla) is
1) $\frac{\mu_0}{4\pi} \times \frac{3M}{d^3}$ 2) $\frac{\mu_0}{2\pi} \times \frac{3M}{d^3}$
3) $\frac{\mu_0}{8\pi} \times \frac{3M}{d^3}$ 4) $\frac{\mu_0}{2\pi} \times \frac{M}{d^3}$

4. A magnet is suspended in the magnetic meridian with an untwisted wire. The upper end of a wire is rotated through 180^0 to deflect the magnet through 30^0 from the magnetic meridian. When the magnet is replaced by another magnet, the upper end of the wire rotated through 270^0 to deflect the magnet 30^0 from the magnetic meridian. The ratio of the magnetic moments is
1) 1:1 2) 8:5 3) 2:3 4) 5:8

5. Two short bar magnets of moments 1.08A.m^2 and 1.92A. m^2 are placed along two lines drawn on the table at right angles to each other, the centres of the magnets are respectively 0.3m and 0.4m from the points of intersection. The magnetic induction at the point of intersection of the lines is
1. 10^{-4} T 2. 10^{-5} T
3. 14 $\times$ 10^{-5} T 4. 0.35 $\times$ 10^{-6} T

6. Two short bar magnets of same magnetic moments each of $\overline{M}$ = 0.25 amp. m^2. are arranged parallel to each other 1 metre apart. The induction field strength at the centre of the line joining the two centres of the magnet is.
1. 10^{-7} T 2. 2 $\times$ 10^{-7} T
3. zero 4. 4 $\times$ 10^{-7} T

7. In above problem the two bar magnets are arranged anti parallel to each other 1 m apart the induction field strength at the centre of the line joining the centres is
1. zero 2. 2x10^{-5} T 3. 10^{-5} T 4. 4x10^{-7} T

8. Two short bar magnets of moments 512Am^2 and 1000Am^2 are placed on a line 18cm apart. The magnetic field is zero at a point Q between them. The field at Q when one magnet is reversed pole to pole is
1. 0.28 T 2. 0.4T 3. 0.1T 4. 0.2T

9. The magnetic needle of a vibration magnetometer completes 10 oscillations in 92s. When a small magnet is placed in the magnetic meridian 10cm due north of the needle completes 15 oscillations in 69s. The magnetic moment of the magnet $(B_H = 0.3G)$ is
1. $0.9Am^2$ 2. $0.45Am^2$
3. $0.225Am^2$ 4. $4.5Am^2$

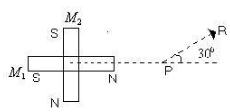
10. A bar magnet is placed with its North pole pointing North. Neutral point is at a distance 20cm from the centre of the magnet. The net magnetic induction at a distance 10cm on the axial line of the magnet is
1. $3B_H$ 2. $7B_H$ 3. $15B_H$ 4. $17B_H$

11. A bar magnet produces a neutral point at P. If the magnet is turned through 180^0, the needle at P makes $10\sqrt{2}$ oscillations per minute. If the magnet is removed altogether frequency of ocillation of the needle at P is
1. 20 oscilations/minute
2. 10 oscilations/minute
3. 30 oscilations/minute
4. zero

12. A suspended bar magnet of moment $3Am^2$ is deflected through an angle of 60^0 in a magnetic field of induction 4×10^{-5} T and then released. If its angular velocity at that instant of its passing through its equilibrium position is 1/2 rads^{-1}, the moment of inertia of the magnet is
1. $24\times10^{-5}kgm^2$ 2. $12\times10^{-5}kgm^2$
3. $48\times10^{-5}kgm^2$ 4. $64\times10^{-5}kgm^2$

13. Two short bar magnets of equal magnetic moments of $10Am^2$ one kept parallel at the two opposite corners of a square of side 1m. The field strength at any one of the other corners is
1. $1\times10^{-6}T$ 2. $2\times10^{-6}T$
3. $3\times10^{-6}T$ 4. $4\times10^{-6}T$

14. Two short bar magnets of moments M_1 and M_2 are placed one on the other as shown in the fugure. The resultant magnetic induction R at the point P is making 30^0 as shown in the figure.The ratio of the magnetic moments of the magnets is



1. $2:\sqrt{3}$ 2. $\sqrt{3}:2$ 3. $\sqrt{3}:1$ 4. $1:\sqrt{3}$

15. Three magnets of same length but moments M, 2M and 3M are arranged in the form of an equilateral triangle with opposite poles nearer, the resultant magnetic moment of the arrangement is
1. 6M 2. zero 3. $\sqrt{3}M$ 4. $\frac{\sqrt{3}}{2}M$

16. When a bar magnet is placed at some distance along the axis of the magnetic needle of an oscillation magnetometer located in earth's magnetic field, the needle makes 14 oscillation per minute. If the bar magnet is turned so that its poles exchange their positions, the needle makes 20 oscillations per minute. If the magnet is completely removed, the frequency of the needle is
1. 20 oscillations/minute
2. 15 oscillations/minute
3. 5 oscillations/minute
4. 10 oscillations/minute

17. A short bar magnet is kept along the magnetic meridian with its north pole pointing north. A neutral point is located at a distance 'd' from the centre. The ratio of magnetic inductions at a distance d/2 and 2d from the centre of the magnet on the equitorial line is
1. 1 : 4 2. 4 : 1 3. 8 : 1 4. 1 : 8

18. In a deflection magnetometer experiement in Tan A position, a short bar magnet placed at 18cm from the centre of the compass needle produces a deflection of 30^0. If another magnet of same length but 16 times pole strength that of first magnet is placed in Tan B position at 36cm, then the deflection is
1. 30^0 2.45^0 3. 60^0 4. 75^0

19. A vibration magnetometer consists of two indentical bar magnets placed one over the other such that they are mutually perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field is 4s. If one of the magnets is removed, then the period of oscillation of the the other in the same field is
1. 2 sec 2. $2\sqrt{2}$ sec
3. 4 sec 4. $4\sqrt{2}$ sec

20. Two short magnets with pole strengths of 900Am and 100Am are placed with their axes in the same vertical line, with similar poles facing each other. Each magnet has a length of 1cm. When seperation between the nearer poles is 1cm. The weight of upper magnet is supported by the repulisve force between the magnets.If $g=10ms^{-2}$, then the mass of upper magnet is
1) 1.6 kg 2) 2.4 kg 3) 3.3 kg 4) 4.8 kg

Key

1.4	2.4	3.1	4.4	5.2
6.4	7.1	8. 2	9. 4	10. 4
11. 2	12. 3	13. 1	14. 2	15. 3
16. 4	17. 3	18. 1	19. 2	20. 3

HINTS

1. W = $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{m_1m_2}{d^2}\right)$

2. $\frac{B_1}{B_2}=\left(\frac{D}{D+x}\right)^3$

3. Make a diagram. you will find that axial and equitorial fields are in the same direction.
Then the resulatant field = $B_{ax} + B_{EQ}$
4. Couple per unit twist is same in both cases.

NEW PATTERN QUESTIONS

1. A bar magnet of pole strength 20 A. m. is cut into four equal parts breath wise. Then observe the following statements carefully and choose the correct answer.
(A) Length becomes 1/4 th, pole strength will be same. Intensity of magnetisation will be same.
(B) Length becomes 1/4 th, pole strength will be 1/4 th. Intesity of magnetisation also becomes 1/4 th.
1. 'A' alone is correct
2. 'B' alone is correct
3. Both A and B are correct
4. Both A and B are false

2. Select the correct answer.
a) When 'n' identicial magnets are arranged in the form of closed polygon with unlike poles nearer, the resultant magnetic moment is zero.
b) If one magnet is removed from the resultant magnetic moment becomes 'M'.
c) If one magnet is reversed in the polygon, the resultant magnetic moment of combination becomes 2M
1) *a, b* and *c* are correct
2) *a* and *b* are correct but *c* is wrong
3) only *a* is correct
4) *a, b* and *c* are wrong

3. **Assertion (A) :** When small holes are made in the body of the magnet, its magnetic moment decreases.
Reason (R) : For a magnet Intensity of magnetisation remains constant and on making holes, magnetised volume decreases, hence magnetic moment decreases
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

4. Match the following:

Physical quantity	***Unit***
a) Magnetic moment	e) Amp-m
b) Magnetic flux density	f) Amp/m
c) Intensity of magnetic field	g) N-m^3/wb
d) Pole strength	h) Gauss

1) a-e, b-f, c-g, d-h 2) a-g, b-h, c-f, d-e
3) a-g, b-f, c-h, d-e 4) a-e, b-f, c-h, d-g

5. Assertion (A): A magnet remains stable, If it aligns itself with the field
Reason (R): The P.E. of a bar magnet is minimum, if it is parallel to magnetic field
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

6. When a bar magnet is suspended freely in a uniform magnetic field, identify the correct statements
a. The magnet experiences only couple and undergoes only rotatory motion.
b. The direction of torque is along the suspension wire.
c. The magnitude of torque is maximum when the magnet is normal to the field direction
1) only *a* and *c* are correct
2) only *a* and *b* are correct
3) only *b* and *c* are correct
4) all are correct

7. **Assertion (A) :** In deflection magnetometer a short magnetic needle is arranged in the compass box
Reason (R) : The magnetic needle is found in the uniform magnetic field produced by earths and bar magnets
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

8. Arrange the following in the descending order of their resultant magnetic moments consider two magnets of same moment
(a) They are kept one upon the other with like poles in contact
(b) They are kept upon the other with unlike poles in contact
(c) They are arranged in perpendicular directions
(d) They are inclined 60^0 with like poles in contact
1. a, c, d, b 2. a, b, c, d
3. a, d, c, b 4. d, b, c, a

9. Among the following statements:
(A) The resultant induction at a point on the axial line of a bar magnet is parallel to magnetic moment.
(B) The resultant induction at a point on the equatorial line is antiparallel to magnetic moment
1. A true & B false 2. A false & B true
3. A and B are true 4. A and B are false

10. When a bar magnet is suspended in an uniform magnetic field, then the torque acting on it will be

List-I	***List-II***
a) maximum	e) $\theta = 45^0$ with the field
b) half of the maximum	f) $\theta = 60^0$ with the field
c) $\sqrt{3}/2$ times of maximum	g) $\theta = 30^0$ with the field
d) $1/\sqrt{2}$ times of maximum	h) $\theta = 90^0$ with the field

11. Among the following statements:
A) In tanA position of deflection magnetometer B and B_H are perpendicular
B) In tan B position of deflection magnetometer B and B_H parallel
1) A true & B false 2) A false & B true
3) A and B are true 4) A and B are false

12. Among the following statements:
A) A magnet of moment M is bent into a semicircle,then its magnetic moment decreases
B) Magnetic moment is directed parallel to axial line from south pole to north pole
1) A true & B false 2) A false & B true
3) A and B are true 4) A and B are false

13. **Assertion (A):** Poles of a magnet can never be separated.
Reason (R) : Since, each atom of a magnetic meterial is a magnet in itself.
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

14. **Assertion (A) :** To protect any instrument from external magnetic field, it is put inside an iron box.
Reason (R) : Iron is a magnetic substance
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

15. **Assertion (A) :** The net magnetic flux coming out of a closed surface is always zero.
Reason (R) : Unlike poles of equal strength exist together
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true and R is not correct explanation of A.
3. A is true, But R is false
4. A is false, But R is true

KEY

1. 1	2. 1	3. 2	4. 2
5. 1	6. 4	7. 1	8. 1
9. 3	10.1	11. 1	12. 3
13.1	14. 2	15.1	

PREVIOUS EAMCET QUESTIONS

1. A short bar Magnet with its north pole facing North forms a neutral point '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 is B_H)

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

2. The similar bar Magnets P and Q each of magntic moment 'M' are taken. If 'p' is cut along its axial line and Q along its equatorial line all the four pieces obtained have each of

1. Equal pole strength 2 Magnetic moment $\frac{M}{4}$
3. Magnetic Moment $\frac{M}{2}$ 4. Magnetic Moment M

3. There is no. couple acting when two bar magnets are placed co-axially seperated by a distance because.
1. There are no forces on the poles.
2. The forces are parallel and their lines of action do not cincide
3. The forces are perpendicular to each other.
4. The forces act along the same line.

4. The pole strength of a 12 cm long bar Magnet is 20 A. m. The Magnetic induction at a point 10 cm along from the centre of the magnet on its axial line is
1. 0.1 x 10^{-2} T 2. 2.2 x 10^{-2} T
3. 3.3 x 10^{-2} T 4. 11 x 10^{-2} T

5. Two indentical bar Magnets each having Magnetic Moment of 'M' are kept at a distance of 2d with their axes perpendicular to each other in a horizontal plane. The Magnetic induction in a midway between them is

1. $\frac{\mu_o}{4\pi}.\left(\sqrt{2}\right)\frac{M}{d^3}$ 2. $\frac{\mu_o}{4\pi}.\left(\sqrt{3}\right)\frac{M}{d^3}$
3. $\frac{\mu_o}{4\pi}.\frac{M}{d^3}$ 4. $\frac{\mu_o}{4\pi}.\left(\sqrt{5}\right)\frac{M}{d^3}$

6. A bar Magnet of Magnetic Moment 3.0 amp.m^2 is placed in a uniform Magnetic induction field 2x 10^{-5} T. If each pole of the magent experience a force of 6x 10^{-4} N, the length of the magnet is

1. 05 m 2. 0.3 m 3. 0.2 m 4. 0.1 m

7. A bar magnet when placed at an angle of 30^o to the direction of Magnetic field induction 5 x 10^{-4} T experiences a moment of couple of 25 x 10^{-6} N-m. If the length of the Magnet is 5 cm, its pole strength is

1. 2 x 10^{-2} amp. m 2. 5x 10^{-2} amp m

3. 2 amp m 4. 5 amp m

8. Two short Magnets having Magnetic moments in the ratio 27 : 8 when placed on opposite sides of a deflection magnetometer shows no deflection. If the distance of weaker magnet is 0.12 m from the centre of D.M. The distance of the strongest magnet from the centre is ......m

1. 0.06 2. 0.08 3. 0.12 4. 0.18

9. The magnetic field strength at a point at a distance 'd' from the centre on the axial line of a very short bar magnet of Magnetic moment 'M' is 'B'. The Magnetic induction at a distance 2d from the centre on the equatorial line of a Magnetic Moment 8M will be

1. 4B 2. $\frac{B}{2}$ 3. $\frac{B}{4}$ 4. 2B

10. When a Magnet is placed with its North pole facing North direction, in the map of Magnetic field, Null point will be

1. On its equatorial line

2. On its axial line

3. On the making 45^o with axial line

4. At a distance twice the length of the Magnet on axial and equatorial line of the Magnet.

11. The null points are on the axial line of a bar Magnet when it is placed such that its south pole points.

1. South 2. East 3. North 4. West

12. If two bar Magnets of different Magnetic lengths have equal moments then the pole strength is

1. equal for both mangets

2. lesser for short Magnet

3. More for longer Magnet

4. More for short Magnet

13. The null point on the equatorial line of a bar magnet when the north pole of the magnet is pointing.

1. North 2. South 3. East 4. West

14. A bar Magnet of pole strength 2 amp. m is kept in a magnet field of induction 4 x 10^{-5} web/m^2 such that the axis of magnet makes on angle 30^o with the direction of the field. The couple acting on the magnet is found to be 80 x 10^{-7} N-m. Then the distance between the two poles of the magnet is

1. 20 2. 2 m 3. 3 cm 4. 20 cm

15. In a delfection magnetometer experiment, in tan A position, a short bar Magnet placed at 18 cm from the centre of compass needle produces a deflection of 30^o. Ifr another magnet of same length but 16 times pole strength as that of first magnet is placed in tan B position at 36 cm, the deflection will be

1. 0^o 2. 30^o 3. 45^o 4. 60^o

16. A bar magnet of magnetic moment 2.0 amp. m^2 is free to rotate about a vertical axis passing through its centre. The magnet is released from rest from east - west position. Then the kinetic energy of the magnet as it takes North- South position is (horizontal compoment of earth's magnetic field is 25 μ T)

1. 25 μ J 2. 50 μ J 3. 100 μ J 4. 12.5 μ J

17. In a deflection magnetometer experiment, the delfections produced seperately by two short bar magnets kept at the same distance are 45^o and 30^o. Then the ratio of the magnetic moments of the two magnets is

1. $\sqrt{3}$:2 2. $\sqrt{3}$:1 3. $\sqrt{2}$:1 4. 1: $\sqrt{3}$

18. The moment of a magnet is 1 micro wb.m. The force acting on each ple of the magnet when placed in a magnetic field of strength 0.38 oersteds is 1.024 x 10^{-4} N. The distance between the two poles of the Magnet is

1. 1.56 cm 2. 0.37 x 10^{-4} cm

3. 2.34 cm 4.1.17 cm

19. A bar magnet of moment $\overline{M}$ is in a magnetic field of induction $\overline{B}$. Then the couple is

1. $\overline{M} \times \overline{B}$ 2. $\overline{B} \times \overline{M}$ 3. $\overline{M} \cdot \overline{B}$ 4. $\overline{B} \cdot \overline{M}$

20. A magnet of length 0.1 m has a pole strength of 4 amp.m. If it is making an angle 45^o with the direction of uniform magnetic induction field strength of 4web/m^2, the torque experienced by it is.

1. 1.13 N-m 2. 1.6 N.m

3. 0.8 N.m 4. 1.32 N.m

21. A short bar magnet produces magnetic fields of equal induction at two points on the axial line and the other on the equatorial line. Then the ratio of the distance is

1. $\frac{1}{2^3}$ 2. 1 : 2 3. $\frac{1}{2^3}:2$ 4. $\frac{1}{2^3}:1$

22. A bar magnet of length 10 cm experiences a torque of $\frac{\sqrt{2}}{10}$ N. m. in a uniform magnetic field of induction 0.4 web/m^2. When it is suspended making an angle 45^o with the field. The pole strength of the magnet is amp. m.

1. 50 2. 10 3. 2.5 4. 5

23. A long magnet of Magnetic moment 'M' and a pole strength 'm' is broken into two halves of equal length along the equatorial line. The magnetic moment of each half is

1. Zero 2. 2M 3. M 4. $\frac{M}{2}$

24. In the experiment to verify inverse square law with deflection Magnetometer, the value of $\frac{\text{Tan}\theta_A}{\text{Tan}\theta_B}$ will come out as

1. 0.25 2. 0.5 3. 1 4. 2

25. If a bar magnet of moment is suspened in a uniform magnetic field $\overline{B}$ it is given an angluar deflection, w.r.t equllibrium postion. Then the restoring troque on the magnet is

1. MB sin θ 2.M B cos θ

3. MB tan θ 4. MB^2 sin θ

26. The ratio of the magnetic moment of two short magnets when they give zero deflection in tan B position when placed at 12 cm and 18 cm from centre of a delfection magnetometer is.

1. $\frac{8}{27}$ 2. $\frac{27}{8}$ 3. $\frac{9}{7}$ 4. $\frac{4}{9}$

27. The magnets of same Magnetic moment 'M' and different lengths are placed in tan A position. The fields at equal distances from them are.

1. greater for long magnet

2. greater for samaller magnet

3. equal for both 4. None

28. S.I. unit of Magnetic flux is

1. ampere-meter 2. amp. m^2

3. weber 4. weber/m^2

29. A bar magnet of pole strength 20 A.m. is divided into 4 equal parts by slicing it along lines parallel to length and breadh, passing through centre. The pole strength of each piece is-------- A.m.

1. 80 2. 10 3. 20 4. 40

30. The tangents of the deflections produced in tan A and tan B positions of a short magnet at equal distances are in the ratio

1. 1 : 1 2. 1 : 4 3. 2 : 1 4. 1 : 2

31. The magnetic induction at a point on the axial line of a magnet in tan A method is 200 wb/m^2. At the same point in tan B method, the magnetic induction will be

1. 400 wb/m^2 2. 200 wb/m^2

3. 100 wb/m^2 4. 50 wb/m^2

32. A magnetised wire of magnetic moment 'M' and length 'l' is bent in the form of a semicircle of radius 'r'. The new magnetic moment is

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

33. Two points A and B equidistant from the centre of a small bar magnet. Point 'A' is on the axial line and point 'B' is on the equatorial line. Then the magnetic fields at point 'A' and 'B' are in the ratio of

1.2 : 1 2. 1 : 2 3. 1 : 1 4. 1 : 4

34. Three identical bar magnets of magnetic moment 'M' are placed in the form of an equlateral Δ le of side 'd' with 'n' pole of one touching the south pole of the other. The net magnetic moment of the system is

1. M 2. $\frac{M}{d}$ 3. $\frac{\sqrt{3}}{2}M$ 4. Zero

35. Two north poles of pole strengths 4 amp.m and 16 amp m are seperated by a distance of 20 cm. The positon of the neutral point between them 4 A. m. is

1. 20 cm 2. 18 cm 3. 10 cm 4. 6.33 cm

36. When a bar magnet is placed at 90^o in a uniform magnetic field, if is acted upon by a maximum couple. For the couple to be half the maximum value, the magnet should be inclined to the magnetic field at an angle of

1. 45^o 2. 60^o 3. 15^o 4. 30^o

37. A bar magnet has a magnetic moment of 0.4 amp.m^2 on cutting it into two equal halves along equatorial line then each half will hve a magnetic moment of

1. 04 ap. m^2 2. 0.8 amp.m^2

3. 0.2 amp. m^2 4. 0

38. A bar magnet of magnetic moment 'M' is cut into two equal parts along its axis. The magnetic moment of each part is

1. M 2. $\frac{M}{2}$ 3. 2 M 4. None

39. An iron speciman has relative permeability of 600 when placed in uniform magneti field of intensity 110 amp. turn/m. Then the magnetic flux density inside is....... tesla.

1. 18.29×10^{-3} 2. 8.29×10^{-2}

3. 66×10^{3} 4. 7.536×10^{-4}

40. Maximum P.E. of magnet of moment 'M' situated in a magnetic field of induction $\overline{B}$, is

1. $\frac{1}{2}$ MB 2. $\frac{M}{B}$ 3. 2 MB 4. MB

41. The work required to rotate a magnetic needle by 60^o from equilibrium position in a uniform magnetic field is W. The torque required to hold it in that position is

1. $\frac{\sqrt{3}}{2}$ W 2. W 3. $\frac{W}{2}$ 4. $\sqrt{3}$ W

42. In an experiment with vibration magnetometer the value of $4\pi^2 \frac{I}{T^2}$ for a short bar magnet is observed as 36×10^{-4}. In the experiment with deflection magnetometer with the same magnet the value of $\frac{4\pi d^3}{2\mu_0}\text{Tan}\theta$ is observed as 10^{8} / 36. The magnetic moment of the magnet used is

1) 50 A m^2 2) 100 Am^2

3) 200 Am^2 4) 1000A m^2

43. A magnet of moment M, is cut into two equal parts. The two partsa are placed perpendicular to each other so that their north poles touch each other. The resultant magnetic moment is

1) M$\sqrt{2}$ 2) M / $\sqrt{2}$ 3) M$\sqrt{3}$ 4) M / $\sqrt{3}$

44. A thin magnetic iron rod of length 30 cm is suspended in a uiniform magnetic field. Its time period is 4 s. If it is broken in to three equal parts the time period of oscillation of one part in seconds, when suspended in the same magnetic field is

1) 4 / 3 **2) 2/ $\sqrt{3}$** **3) $\sqrt{3}$** **4) 4 / $\sqrt{3}$**

45. A magnet of length 10 cm and magnetic moment 1Am2 is placed along the side of an equlateral triangle of the side AB of length 10 cm. The magnetic induction at C is

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

46. A magnet , freely suspended in a vibration magnetometer makes 40 oscillations per minute at a place A and 20 oscillations per minute at B.If B_H at B is 36X10 -6 T,then its value at A is

1) 36 X 10^{-6} T 2) 72 X 10^{-6} T

3) 144 X 10^{-6} T 4) 288 X 10^{-6} T

47. A magnetised wire of magnetic moment M is bent into an arc of a circle that subtends an angle of 60^0 at the centre. The equivalent magnetic moment is

1) M / π 2) 2M / π

3) 3M / π 4) 4M / π

48. Two poles of same strength attract each other with a force of magnitude F when placed at the corners of an equilateral triangle. if a nothr ploe of the same strength is placed at the third vertex, it experiences a force of magnitude

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

KEY

1.4	2.3	3.4	4.1	5.4
6.4	7.3	8.4	9.2	10.1
11.3	12.4	13.1	14.4	15.2
16.2	17.2	18.2	19.1	20.1
21.4	22.4	23.4	24.4	25.1
26.1	27.1	28.3	29.2	30.3
31.3	32.2	33.1	34.4	35.4
36.4	37.3	38.2	39.4	40.3
41.4	42.3	43.2	44. 1	45.1
46.3	47.3	48.2		