Prachand NEET 2025

Physics

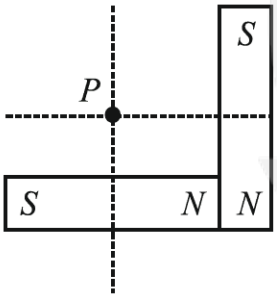
Magnetism and

Matter

DPP : 01

Q1 A long magnetic needle of length $2L$, magnetic moment M and pole strength m units is broken into two pieces at the middle. The magnetic moment and pole strength of each piece will be
(1) $\frac{M}{2}, \frac{m}{2}$
(2) $M, \frac{m}{2}$
(3) $\frac{M}{2}, m$
(4) M, m

Q2 Two identical bar magnets are placed perpendicular to each other as shown below;



Which of the following option best represents the direction of net magnetic field at point P ?
(1) ↗ (2) ↘
(3) ↙ (4) ↖

Q3 The relation between magnetic susceptibility χ_{m} and relative permeability μ_{r}, is
(1) $\chi_{\mathrm{m}} = \mu_{\mathrm{r}}$
(2) $\chi_m - 1 = \mu_r$
(3) $\mu_{\mathrm{r}} = 1 + \chi_{\mathrm{m}}$
(4) $\mu_{\mathrm{r}} = 1 - \chi_{\mathrm{m}}$

Q4 A bar magnet when placed at an angle of 30° to the direction of magnetic field induction of $5 \times 10^{-2}\ \mathrm{T}$, experiences a moment of couple $25 \times 10^{-6}\ \mathrm{N-m}$. If the length of the magnet is $5\ \mathrm{cm}$ its pole strength is
(1) $2 \times 10^{-2}\ \mathrm{A-m}$
(2) $5 \times 10^{-2}\ \mathrm{A-m}$
(3) $2\ \mathrm{A-m}$
(4) $5\ \mathrm{A-m}$

Q5 A bar magnet of magnetic dipole moment $8\ \mathrm{Am}^2$ has poles separated by $0.4\ \mathrm{m}$. Find the pole strength of bar magnet.
(1) $20\ \mathrm{A-m}$
(2) $40\ \mathrm{A-m}$
(3) $80\ \mathrm{A-m}$
(4) $100\ \mathrm{A-m}$

Q6 An iron rod of length L and magnetic moment M is bent in the form of a semicircle. Now its magnetic moment will be
(1) M
(2) $\frac{2M}{\pi}$
(3) $\frac{M}{\pi}$
(4) $M\pi$

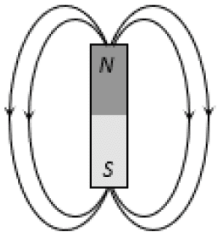
Q7 Material X has very large relative permeability (of the order of thousands). Which of the following can possibly be material X ?
(1) Iron (2) Aluminium
(3) Gold (4) Water

Q8 Given below are two Statements :
Statement I: The net magnetic flux through any closed surface is zero.
Statement II: If a bar magnet is cut into two pieces transverse to its length, its magnetic moment remains same.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both Statement I and Statement II are incorrect.

(2) Statement I is incorrect and Statement II is correct.
(3) Statement I is correct and Statement II is incorrect.
(4) Both Statement I and Statement II are correct.

Q9 The magnetic field lines due to a bar magnet are correctly shown in

(1)



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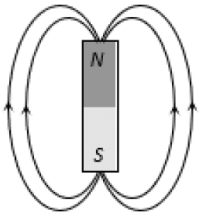

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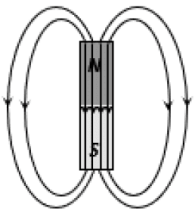

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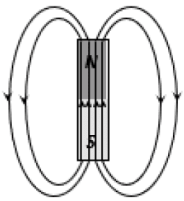


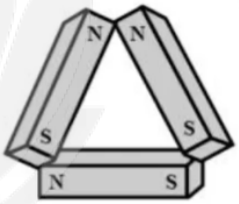
Q10 Like atoms of paramagnetic substances, atoms of ferromagnetic substances have a _____ magnetic moment.
(1) permanent (2) zero
(3) temporary (4) infinite

Q11 A short bar magnet of mag moment 4 JT^{-1} has magnetic length 4 cm. What is the magnitude of the magnetic field at a distance of 2 m from the centre of the magnet on its axial line?
(1) 10^{-4} T
(2) 10^{-5} T
(3) 10^{-6} T
(4) 10^{-7} T

Q12 A magnet of magnetic moment M is situated with its axis along the direction of a magnetic field of strength B. The work done in rotating it by an angle of 180° will be
(1) $-MB$ (2) $+MB$
(3) 0 (4) $+2MB$

Q13 Magnetic lines of force due to a bar magnet do not intersect because:
(1) a point always has a single net magnetic field
(2) the lines have similar charges and so repel each other
(3) the lines always diverge from a single force
(4) the lines need magnetic lenses to be made to intersect

Q14 Three identical bar magnets each of magnetic moment M are placed in the form of an equilateral triangle as shown.



The net magnetic moment of the system is:
(1) Zero
(2) $2\mathrm{M}$
(3) $\mathrm{M}\sqrt{3}$
(4) $3\mathrm{M}/2$

Q15 Relative permittivity and permeability of a material are ε_r and μ_r respectively. Which of the following values of these quantities are possible for a diamagnetic material?
(1) $\varepsilon_r = 0.5, \mu_r = 1.5$
(2) $\varepsilon_r = 1.5, \mu_r = 0.5$
(3) $\varepsilon_r = 0.5, \mu_r = 0.5$
(4) $\varepsilon_r = 1.5, \mu_r = 1.5$

Q16 Two identical thin bar magnets each of length l and pole strength m are placed at right angle to each other with north pole of one touching south pole of the other. Magnetic moment of the

system is
(1) ml
(2) $2ml$
(3) $\sqrt{2}ml$
(4) $\frac{1}{2}ml$

Q17 A magnetising field of 2×10^3 A m^{-1} produces a magnetic flux density of 8π Tesla in an iron rod. The relative permeability of the rod will be
(1) 10^2 (2) 10^0
(3) 10^1 (4) 10^4

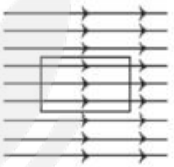
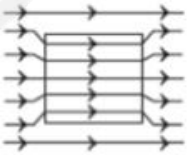
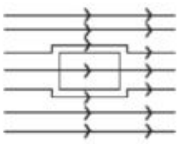
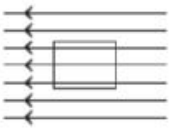
Q18 A bar magnet is held perpendicular to a uniform magnetic field. If the couple acting on the magnet is to be halved by rotating it, then the angle by which it is to be rotated is
(1) 30°
(2) 45°
(3) 60°
(4) 90°

Q19 A short bar magnet of magnetic moment 0.4 JT^{-1} is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is
(1) -0.082 J
(2) 0.064 J
(3) -0.064 J
(4) zero

Q20 A frog can be levitated in a magnetic field produced by a current in a vertical solenoid placed below the frog. This is possible because the body of the frog behaves as :
(1) Paramagnetic
(2) Diamagnetic
(3) Ferromagnetic
(4) Anti-ferromagnetic

Q21 The magnetic field at a point x on the axis of a small bar magnet is equal to the field at a point y on the equator of the same magnet. The ratio of the distances of x and y from the centre of the magnet is
(1) 2^{-3}
(2) $2^{-1/3}$
(3) 2^3
(4) $2^{1/3}$

Q22 **Assertion (A):** Relative magnetic permeability has no units and no dimensions.
Reason (R): $\mu_r = \mu/\mu_0$, where the symbols have their standard meaning.
(1) Both **Assertion (A)** and **Reason (R)** are true, and **Reason (R)** is a correct explanation for Assertion.
(2) Both **Assertion (A)** and **Reason (R)** are true, but **Reason (R)** is not a correct explanation of **Assertion (A).**
(3) **Assertion (A)** is true and **Reason (R)** is false.
(4) **Assertion (A)** is false and **Reason (R)** is true.

Q23 A uniform magnetic field parallel to the plane of paper, existed in space initially directed from left to right. When a bar of soft iron is placed in the field parallel to it, the lines of force passing through it will be represented by figure
(1) 
(2) 
(3) 
(4) 

Q24 Point A and B are situated perpendicular to the axis of a small bar magnet at large distance x and $3x$ from its centre on opposite sides. The ratio of the magnetic fields at A and B will be approximately equal to;
(1) $2:9$ (2) $1:9$

(3) $27:1$ (4) $9:1$

Q25 When a ferromagnetic substance is heated to a temperature above its Curie temperature, it
(1) behaves like a paramagnetic substance
(2) behaves like a diamagnetic substance
(3) remains ferromagnetic
(4) is permanently magnetised

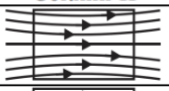
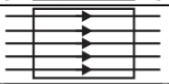
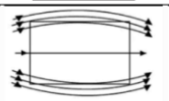
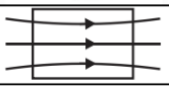
Q26 How is the magnetic susceptibility of any paramagnetic material related to absolute temperature T ?
(1) It is directly proportional to T.
(2) It remains constant.
(3) It is inversely proportional to T.
(4) It exponentially decays with T.

Q27 A domain in a ferromagnetic substance is in the form of a cube of side length $1\mu\text{m}$. If it contains 8×10^{10} atoms and each atomic dipole has a dipole moment of $9 \times 10^{-24}\ \text{A m}^2$, then magnetization of the domain is
(1) $7.2 \times 10^{5}\ \text{A m}^{-1}$
(2) $7.2 \times 10^{3}\ \text{A m}^{-1}$
(3) $7.2 \times 10^{9}\ \text{A m}^{-1}$
(4) $7.2 \times 10^{12}\ \text{A m}^{-1}$

Q28 There are four light weight rod samples A, B, C and D separately suspended by thread. A bar magnet is slowly brought near each sample and the following observations are noted
(i) A is feebly repelled
(ii) B is feebly attracted
(iii) C is strongly attracted
(iv) D remains unaffected
Which one of the following is true?
(1) C is of a diamagnetic material
(2) D is of a ferromagnetic material
(3) A is of a non-magnetic material
(4) B is of a paramagnetic material

Q29 A magnet of magnetic moment 50 $\hat{i}$ A-m^2 is placed along the *x*-axis in a magnetic field = (0.5 $\hat{i}$ + 3.0 $\hat{j}$) T. The torque acting on the magnet is;
(1) 175 $\hat{k}$ N-m
(2) 150 $\hat{k}$ N-m
(3) 75 $\hat{k}$ N-m
(4) 25 $\sqrt{37}\,\hat{k}$N-m

Q30 A uniform magnetic field exists in certain space in the plane of the paper and initially it is directed from left to right. When different rods, as mentioned in column I, are placed parallel to the field-direction, the magnetic field lines passing through the rods are shown in column II. Match the column I with column II

	Column-I		Column-II
A.	Ferromagnetic rod	P.	
B.	Diamagnetic rod	Q.	
C.	Paramagnetic rod	R.	
D.	Non- magnetic material	S.	

(1) A - R, B - S, C - Q, D - P
(2) A - R, B - Q, C - S, D - P
(3) A - S, B - R, C - Q, D - P
(4) A - P, B - R, C - S, D - Q

Answer Key

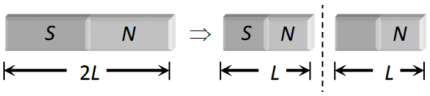
Q1	(3)
Q2	(4)
Q3	(3)
Q4	(1)
Q5	(1)
Q6	(2)
Q7	(1)
Q8	(3)
Q9	(4)
Q10	(1)
Q11	(4)
Q12	(4)
Q13	(1)
Q14	(2)
Q15	(2)
Q16	(3)
Q17	(4)
Q18	(3)
Q19	(3)
Q20	(2)
Q21	(4)
Q22	(1)
Q23	(2)
Q24	(3)
Q25	(1)
Q26	(3)
Q27	(1)
Q28	(4)
Q29	(2)
Q30	(4)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 **Text Solution:**

(3)



Pole strength of each part $= m$

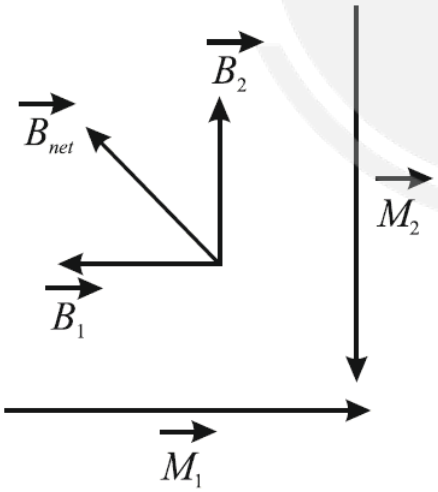
Magnetic moment of each part

$$= M' = m'L' = mL = \frac{M}{2}$$

Video Solution:

Q2 **Text Solution:**

(4)



Video Solution:

Q3 **Text Solution:**

(3)

The relation between magnetic susceptibility χ_m and relative permeability μ_r, is

$\mu_r = 1 + \chi_m$

Video Solution:

Q4 **Text Solution:**

(1)

$\tau = MB\sin\theta$

$25 \times 10^{-6} = M \times 5 \times 10^{-2} \sin 30^\circ$

Magnetic moment, $M = 10^{-3}$ A $-$ m^2

$mL = 10^{-3}$

$m \times 5 \times 10^{-2} = 10^{-3}$

$m = 2 \times 10^{-2}$ A-m

Video Solution:

Q5 **Text Solution:**

(1)

$M = m \times L$

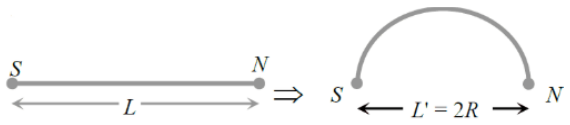
$m = \frac{M}{L} = \frac{8}{0.4} = 20\ A\ m$

Video Solution:

Q6 **Text Solution:**

(2)

On bending a rod its pole strength remains unchanged where as its magnetic moment changes.



Now, $L = \pi R \Rightarrow R = \frac{L}{\pi}$

New magnetic moment

$$M' = m(2R) = m\left(\frac{2L}{\pi}\right) = \frac{2M}{\pi}$$

Video Solution:

Q7 **Text Solution:**

(1)

Substances such are iron, nickel, steel, cobalt and their alloys are ferromagnetic substances with very large relative permeability (of the order of hundreds and thousands).

Aluminum is a paramagnetic material with relative permeability slightly greater than one.

Whereas gold and water are diamagnetic substances with relative permeability slightly less than one.

Video Solution:

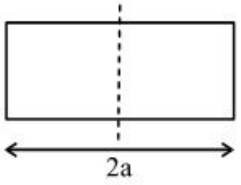
Q8 **Text Solution:**

(3)

Statement I is correct, this is statement of Gauss's law as $\phi_B = \sum_{net} \vec{B} . \overrightarrow{\Delta S} = 0$

Statement II is incorrect

$M = m \times 2a$



By cutting magnet transverse to its length , the length of each part becomes half hence its magnetic moment is also halved.

Video Solution:

Q9 **Text Solution:**

(4)

Inside the magnet, direction of magnetic field will be from south to north and outside the magnet the direction of magnetic field is from north to south.

Video Solution:

Q10 **Text Solution:**

(1)

The individual atoms of a paramagnetic and a ferromagnetic substance have a permanent magnetic moment. But in the absence of external magnetic field, the atoms are randomly oriented and the net magnetic moment of the material is thus, zero.

Video Solution:

Q11 **Text Solution:**

(4)

$$B = \frac{\mu_0}{4\pi}\frac{2M}{r^3} = 10^{-7} \times \frac{2\times 4}{(2)^3} = 10^{-7}\ T$$

Video Solution:

Q12 **Text Solution:**

(4)

Work done = change in potential energy of magnet

$$\begin{aligned} \mathrm{W} &= U_f - U_i \\ &= -MB\cos[\pi] + MB\cos[0] \\ &= 2MB \end{aligned}$$

Video Solution:

Q13 **Text Solution:**

(1)

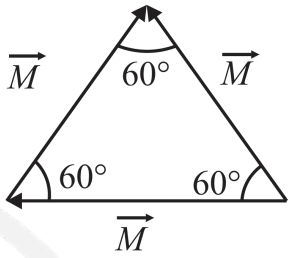
The tangent to the field line at a given point represents the direction of the net magnetic field B at that point.

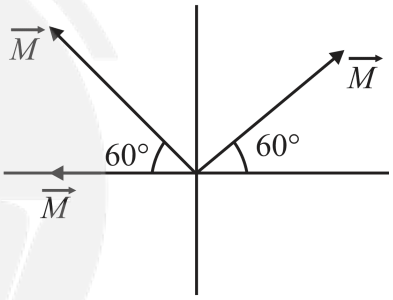
The magnetic field lines do not intersect, if they did, the direction of the magnetic field would not be unique at the point of intersection

Video Solution:

Q14 **Text Solution:**

(2)





$$M_{\text{net}} = \sqrt{M_x^2 + M_y^2}$$

$$M_x = M\cos 60^\circ - M\cos 60^\circ - M = -M$$

$$M_x = -M$$

and $M_y = M\sin 60^\circ + M\sin 60^\circ$

$$M_y = M\sqrt{3}$$

$$M_{net} = \sqrt{M^2 + (M\sqrt{3})^2} = \sqrt{4M^2}$$

$$= 2M$$

Video Solution:

Q15 **Text Solution:**

(2)

For any material $\varepsilon_r > 1$.

For diamagnetic material, $\mu_r < 1$.

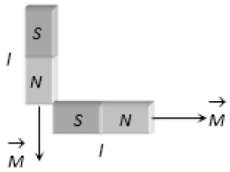
$\therefore$ option 2 is correct

Video Solution:

Q16 **Text Solution:**

(3)

Magnetic moment of each magnet is, $M = ml$



$$M_{\text{net}} = \sqrt{M^2 + M^2} = \sqrt{2}M = \sqrt{2}ml.$$

Video Solution:

Q17 **Text Solution:**

(4)

Here,

$H = 2 \times 10^3\,\text{Am}^{-1}, B = 8\pi\text{T}, \mu_0 = 4\pi \times 10^{-7}$

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

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

Video Solution:

Q18 **Text Solution:**

(3)

$\tau = \text{MBsin}\theta$

$\frac{\tau_1}{\tau_2} = \frac{\text{MBsin}\theta_1}{\text{MBsin}\theta_2}$

$\frac{\tau_1}{\tau_2} = \frac{\sin\theta_1}{\sin\theta_2}$

$\frac{\tau}{\frac{\tau}{2}} = \frac{\sin\ 90^\circ}{\sin\theta_2}$

$\sin\theta_2 = \frac{1}{2}$

$\theta_2 = 30^\circ$

So it is rotated by an angle, $\alpha = 90^\circ - \theta_2 = \ 90^\circ - 30^\circ = 60^\circ$

Video Solution:

Q19 **Text Solution:**

(3)

Potential energy of a magnet with magnetic moment $\vec{M}$ placed in a magnetic field $\vec{B}$ is given by

$U = -\vec{M} \cdot \vec{B} = -MB\cos\theta$

In stable equilibrium, U will be minimum so

$\theta = 0^\circ$

$U_{min} = -MB = 0.4 \times 0.16$

$= -0.064\ J$

Video Solution:

Q20 **Text Solution:**

(2)

To levitate a body, a force must be applied on it which at least balances the body's weight which will always pull the frog down, so force must act in the upward direction. Thus, the frog is repelled by the magnetic field.

Diamagnetic substances are only substances which are repelled by a magnetic field. This shows that the body of the frog behaves like diamagnetic substance.

Video Solution:

Q21 Text Solution:

(4)

Let the axial point is at x distance from the centre of the magnet and equatorial point is at y distance from the centre of magnet.

$B_{axial} = \frac{\mu_0}{4\pi}\frac{2M}{x^3}$

$B_{equatorial} = \frac{\mu_0}{4\pi}\frac{M}{y^3}$

Now,

$\frac{\mu_0}{4\pi}\frac{2M}{x^3} = \frac{\mu_0}{4\pi}\frac{M}{y^3}$

$\frac{x}{y} = 2^{1/3}$

Video Solution:

Q22 Text Solution:

(1)

$\mu_r = \frac{\mu}{\mu_0}$

Here, μ is magnetic permeability of medium, and μ_0 is magnetic permeability of vacuum. Relative magnetic permeability has no units and no dimensions.

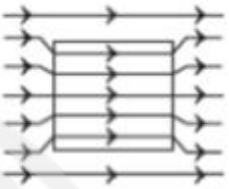
Both **Assertion (A)** and **Reason (R)** are true, and **Reason (R)** is a correct explanation for Assertion.

Video Solution:

Q23 Text Solution:

(2)

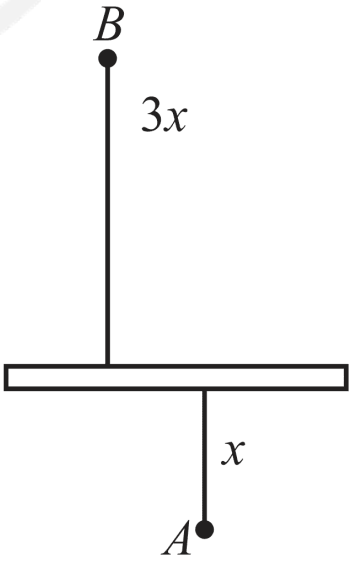
Maximum number of field lines will pass through the iron as it is a ferromagnetic material.



Video Solution:

Q24 Text Solution:

(3)



$B \propto \frac{1}{x^3}$

$\frac{B_A}{B_B} = \left(\frac{r_B}{r_A}\right)^3 = \left(\frac{3x}{x}\right)^3 = 27$

Video Solution:

Q25 **Text Solution:**

(1)

When a ferromagnetic substance is heated to a temperature above its Curie temperature, it behaves like a paramagnetic substance

Video Solution:

Q26 **Text Solution:**

(3)

$\chi \propto \frac{1}{T}$

Video Solution:

Q27 **Text Solution:**

(1)

The volume of the cubic domain is

$$V = \left(1 \times 10^{-6}\ \mathrm{m}\right)^3 = 1 \times 10^{-18}\ \mathrm{m}^3$$

Number of atoms in domain $(\mathrm{N}) = 8 \times 10^{10}$ atoms

Since each atom has a dipole moment $(\mathrm{m} = 9 \times 10^{-24}\ \mathrm{A\ m^2})$

$$\mathrm{m_{net}} = \mathrm{N} \times \mathrm{m} = 8 \times 10^{10} \times 9 \times 10^{-24}$$
$$= 72 \times 10^{-14}\ \mathrm{A\ m^2}.$$

Now the magnetisation

$$\mathrm{M} = \frac{\mathrm{m_{net}}}{\text{Domain volume}}$$
$$= \frac{72 \times 10^{-14}\ \mathrm{A\ m^2}}{10^{-18}\ \mathrm{m^3}} = 7.2 \times 10^5 \mathrm{Am^{-1}}$$

Video Solution:

Q28 **Text Solution:**

(4)

A is feebly repelled, so it is a diamagnetic substance.

B is feebly attracted, so it is a paramagnetic substance.

C is strongly attracted, so it is a ferromagnetic substance.

D remains unaffected, so it is a non magnetic substance.

Video Solution:

Q29 **Text Solution:**

(2)

$$\tau = \vec{m} \times \vec{B} = \left(50\ \hat{i}\right) \times \left(0.5\ \hat{i} + 3.0\ \hat{j}\right)$$
$$= 25 \times 0 + 150\ \hat{k}$$
$$= 150\hat{k}\, N\, m.$$

Video Solution:

Q30 **Text Solution:**

(4)

Maximum number of field lines will pass through ferromagnetic rod, so A -P

Diamagnetic substances are repelled by external magnetic field, so B - R

Paragnetic substances are weakly attracted by external magnetic field so C- S

For non magnetic material, D-Q

Video Solution: