

TEST

JEE Mains PYQS Magnetism & matter (Physics Master Academy)

QUESTIONS

SECTIONS

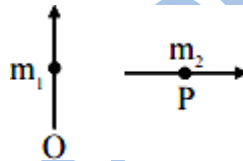
1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

SECTION INSTRUCTIONS

This section contains 25 MCQs. +4 for every correct answer and - 1 for every incorrect answer.

1 Two short magnetic dipoles m_1 and m_2 each having magnetic moment of 1 Am^2 are placed at point O and P respectively. The distance between OP is 1 meter. The torque experienced by the magnetic dipole m_2 is due to the presence of m_1 is ____



- 1
- 2
- 3
- 4

Correct: +4 · Incorrect: -1

2 Statement 1: The ferromagnetic property depends on temperature. AT high temperature ferromagnet becomes paramagnet.
Statement 2: At high temperature, the domain wall area of a ferromagnetic substance increases.

In the light of the above statements, choose the most appropriate answer from the options given below:

- Statement 1 is true but Statement 2 is false
- Both Statement 1 and Statement 2 are true
- Both Statement 1 and Statement 2 are false
- Statement 1 is false but Statement 2 is true

3 The magnetic susceptibility of a material of a rod is 499. Permeability in vacuum is $4\pi \times 10^{-7}$ H/m. Absolute permeability of the material of the rod is

- $4\pi \times 10^{-4}$ H/m
- $2\pi \times 10^{-4}$ H/m
- $3\pi \times 10^{-4}$ H/m
- $\pi \times 10^{-4}$ H/m

Correct: +4 · Incorrect: -1

4 Which of the following statements are correct?

- Electric monopoles do not exist whereas magnetic monopoles exist
- Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and closed.
- Magnetic field lines are completely closed within a toroid
- Magnetic field lines inside a bar magnet are not parallel
- $\chi = -1$ is the condition for a perfect diamagnetic material, where χ is its magnetic susceptibility.

Correct: +4 · Incorrect: -1

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

- 6.4×10^{-2} J
- 9.2×10^{-3} J
- 7.2×10^{-2} J
- 11.7×10^{-3} J

Correct: +4 · Incorrect: -1

6 A magnet of total magnetic moment 10^{-2}

\hat{i}
Am² is placed in the time varying magnetic field. B

$(\cos \omega t)$ where $B = 1$ Tesla and $\omega = 0.125$ rad/s. The work done for reversing the direction of the magnetic moment at $t = 1$ second is

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- 0.01J
- 0.007J
- 0.028J
- 0.014J

Correct: +4 · Incorrect: -1

7 A magnetic dipole in a constant magnetic field has

- maximum potential energy when the torque is maximum
- zero potential energy when the torque is minimum
- zero potential energy when the torque is maximum
- minimum potential energy when the torque is maximum

Correct: +4 · Incorrect: -1

8 A 25cm long solenoid has radius 2cm and 500 total number of turns. It carries a current of 15A, If it is equivalent to a magnet of the same size and magnetization \vec{M} (magnetic moment/ volume), then $|\vec{M}|$ is

- $3000 \pi \text{ AM}^{-1}$
- $3 \pi \text{ AM}^{-1}$
- 30000 AM^{-1}
- 300 AM^{-1}

Correct: +4 · Incorrect: -1

9 A magnetic needle is kept in a non uniform magnetic field. It experiences

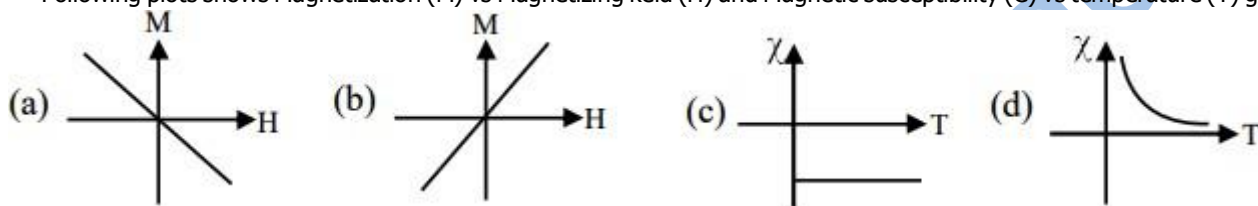
- neither a force nor a torque
- a torque but not a force
- a force but not a torque
- a force and a torque

10 A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60° . The torque needed to maintain the needle in this position will be

- $\sqrt{3}W$
- W
- $\sqrt{3}/2W$
- $2W$

Correct: +4 · Incorrect: -1

11 Following plots shows Magnetization (M) vs Magnetizing field (H) and Magnetic susceptibility (χ) vs temperature (T) graph



Which of the following combinations will be represented by a diamagnetic material?

- (a), (c)
- (a), (d)
- (b), (d)
- (b), (c)

Correct: +4 · Incorrect: -1

12 A long solenoid with 1000 turns/m has a core material with relative permeability 500 and volume 10^3cm^3 . If the core material is replaced by another material having relative permeability of 750 with same volume maintaining same current of 75A in the solenoid, the fractional change in magnetic moment of the core would be approximately $(x/499)$. Find the value of x .

- 200
- 225
- 250
- 275

Correct: +4 · Incorrect: -1

13 A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains

- increase in size but no change in orientation
- have no relation with external magnetic field
- decrease in size and changes in orientation
- may increase in size and change its orientation

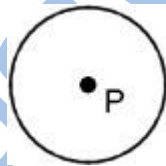
Correct: +4 · Incorrect: -1

14 In a ferromagnetic material, below the Curie temperature, a domain is defined as

- a macroscopic region with randomly oriented magnetic dipoles
- a macroscopic region with consecutive magnetic dipoles oriented in opposite direction
- A macroscopic region with saturation magnetization
- A macroscopic region with zero magnetization

Correct: +4 · Incorrect: -1

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



- \vec{B}
- zero
- much larger than $|\vec{B}|$ but parallel to \vec{B}
- much larger than $|\vec{B}|$ but opposite to \vec{B}

Correct: +4 · Incorrect: -1

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

- T: Large retentivity small coercivity
- P: Small retentivity large coercivity

T: Large retentivity large coercivity

P: Large retentivity large coercivity

Correct: +4 · Incorrect: -1

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

285 A/m

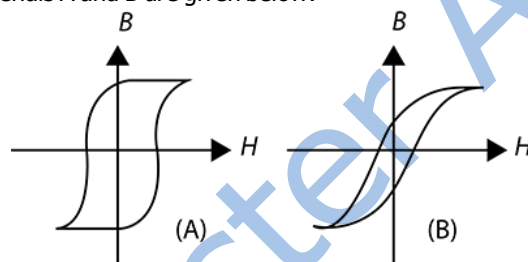
2600 A/m

520 A/m

1200 A/m

Correct: +4 · Incorrect: -1

18 Hysteresis loop for two magnetic materials A and B are given below:



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use:

A for transformers and B for electric generators

B for electromagnets and transformers

A for electric generators and transformers

A for electromagnets and B for electric generators

Correct: +4 · Incorrect: -1

19 A lighter plane of length 20m, wing span (distance from tip of one wing to the tip of other wing) of 15m and height 5m is lying towards east over Delhi. Its speed is 240 ms^{-1} . The earth's magnetic field over Delhi are $5 \times 10^{-5} \text{ T}$ with the declination angle

0° and dip of θ such that $\sin \theta = 2/3$. If the voltage developed is V_B between the lower and upper side of the plane and V_W between the tips of the wings then V_B and V_W are close to

$V_B = 40 \text{ mV}$; $V_W = 135 \text{ mV}$ with left side of pilot at higher voltage

$V_B = 45 \text{ mV}$; $V_W = 120 \text{ mV}$ with right side of pilot at higher voltage

$V_B = 40 \text{ mV}$; $V_W = 135 \text{ mV}$ with right side of pilot at higher voltage

- $V_B = 45 \text{ mV}$; $V_W = 120 \text{ mV}$ with left side of pilot at higher voltage

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20 An example of a perfect diamagnet is a superconductor. This implies that when a superconductor is put in a magnetic field of intensity B , the magnetic field B_s inside the superconductor will be such that

- $B_s = -B$
- $B_s = 0$
- $B_s = B$
- $B_s < B$ but $B_s \neq 0$

Correct: +4 · Incorrect: -1

21 Relative permittivity and permeability of a material ϵ_r and μ_r respectively. Which of the following values of these quantities are allowed for a diamagnetic material?

- $\epsilon_r = 0.5$, $\mu_r = 1.5$
- $\epsilon_r = 1.5$, $\mu_r = 0.5$
- $\epsilon_r = 0.5$, $\mu_r = 0.5$
- $\epsilon_r = 1.5$, $\mu_r = 1.5$

Correct: +4 · Incorrect: -1

22 Needles N_1 , N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet when brought close to them will

- attract N_1 and N_2 strongly but repel N_3
- attract N_1 strongly, N_2 weakly and repel N_3 weakly
- attract N_1 strongly but repel N_2 and N_3 weakly
- attract all three of them

Correct: +4 · Incorrect: -1

23 The materials suitable for making electromagnets should have

- high retentivity and low coercivity
- low retentivity and low coercivity
- high retentivity and high coercivity
- low retentivity and high coercivity

Correct: +4 · Incorrect: -1

24 A loop of a solid cylinder of same mass and radius are made of a permanent magnetic material with their magnetic moment parallel to their respective axes. But the magnetic moment of loop is twice of solid cylinder. They are placed in a uniform magnetic field in such a manner that their magnetic moments make a small angle with the field. If the oscillation periods of loop and cylinder are T_h and T_c respectively, then:

- $T_h = T_c$
- $T_h = 2 T_c$
- $T_h = 1.5 T_c$
- $T_h = 0.5 T_c$

Correct: +4 · Incorrect: -1

25 A magnetic needle of magnetic moment $6.7 \times 10^{-2} \text{ Am}^2$ and moment of inertia $7.5 \times 10^{-6} \text{ kgm}^2$ is performing simple harmonic oscillations in a magnetic field of 0.01 T . Time taken for 10 complete oscillations is:

- 6.98s
- 8.76s
- 6.65s
- 8.89s

Correct: +4 · Incorrect: -1

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ANSWERS

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1 1

2 Statement 1 is true but Statement 2 is false

3 $2\pi \times 10^{-4}$ H/m

4 Electric monopoles do not exist whereas magnetic monopoles exist

5 7.2×10^{-2} J

6 0.028 J

7 zero potential energy when the torque is maximum

8 30000 A m^{-1}

9 a force and a torque

10 $\sqrt{3}$ W

11 (a), (c)

12 250

13 may increase in size and change its orientation

14 A macroscopic region with saturation magnetization

15 zero

16 P: Large retentivity large coercivity

17 2600 A/m

18 B for electromagnets and transformers

19 $V_B = 45 \text{ mV}$; $V_W = 120 \text{ mV}$ with left side of pilot at higher voltage

20 $B_s = 0$

21 $\epsilon_r = 1.5$, $\mu_r = 0.5$

22 attract N_1 strongly, N_2 weakly and repel N_3 weakly

23 low retentivity and low coercivity

24 $T_h = T_c$

25 6.65s

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