

Magnetism and Matter — NEET Physics PYQ (2005-2020)

Class 12 Physics · 18 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2020 · Q171

1. An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 A m^{-1} . The permeability of the material of the rod is : ($\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$)

- (A) $2.4\pi \times 10^{-4} \text{ T m A}^{-1}$
- (B) $8.0 \times 10^{-5} \text{ T m A}^{-1}$
- (C) $2.4\pi \times 10^{-5} \text{ T m A}^{-1}$
- (D) $2.4\pi \times 10^{-7} \text{ T m A}^{-1}$

NEET 2017 (Gujarati paper) · Q161

2. Two reasons for using soft iron as the material for electromagnets.

- (A) high permeability and low retentivity
- (B) low permeability and low retentivity
- (C) high permeability and high retentivity
- (D) low permeability and high retentivity

NEET 2016 Phase 2 · Q28

3. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W . Now the torque required to keep the magnet in this new position is

- (A) $W/\sqrt{3}$
- (B) $\sqrt{3}W$
- (C) $\sqrt{3}W/2$
- (D) $2W/\sqrt{3}$

NEET 2016 Phase 1 · Q3

4. The magnetic susceptibility is negative for:

- (A) diamagnetic material only
- (B) paramagnetic material only
- (C) ferromagnetic material only
- (D) paramagnetic and ferromagnetic materials

NEET 2013

5. A bar magnet of length l and magnetic dipole moment M is bent in the form of an arc of a circle of radius r subtending an angle of 60° at the centre. The new magnetic dipole moment will be

- (A) M
- (B) $(3/\pi)M$
- (C) $(2/\pi)M$
- (D) $M/2$

AIPMT 2012 Mains

6. A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3} \text{ J}$ of work to turn it through 60° . The torque needed to maintain the needle in this position will be

- (A) $2\sqrt{3} \text{ J}$
- (B) 3 J
- (C) $\sqrt{3} \text{ J}$
- (D) $(3/2) \text{ J}$

AIPMT 2011 Mains

7. A short bar magnet of magnetic moment 0.4 J T^{-1} is placed in a uniform magnetic field of 0.16 T . The magnet is in stable equilibrium when the potential energy is

- (A) -0.082 J
- (B) 0.064 J
- (C) -0.064 J
- (D) Zero

8. There are four light-weight-rod samples, A, B, C, D separately suspended by threads. 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?

- (A) A is of a non-magnetic material
- (B) B is of a paramagnetic material
- (C) C is of a diamagnetic material
- (D) D is of a ferromagnetic material

9. A closely wound solenoid of 2000 turns and area of cross-section $1.5 \times 10^{-4} \text{ m}^2$ carries a current of 2.0 A. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be

- (A) $3 \times 10^{-3} \text{ N m}$
- (B) $1.5 \times 10^{-3} \text{ N m}$
- (C) $1.5 \times 10^{-2} \text{ N m}$
- (D) $3 \times 10^{-2} \text{ N m}$

10. The magnetic moment of a diamagnetic atom is

- (A) Much greater than one
- (B) 1
- (C) Between zero and one
- (D) Equal to zero

11. Electromagnets are made of soft iron because soft iron has

- (A) High retentivity and low coercive force
- (B) Low retentivity and high coercive force
- (C) High retentivity and high coercive force
- (D) Low retentivity and low coercive force

12. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 s in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

- (A) 4 s
- (B) 1s
- (C) 2 s
- (D) 3s

13. A bar magnet having a magnetic moment of $2 \times 10^4 \text{ J T}^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4} \text{ T}$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is:

- (A) 12 J
- (B) 6 J
- (C) 2 J
- (D) 0.6 J

14. If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is:

- (A) repelled by the north pole and attracted by the south pole
- (B) attracted by the north pole and repelled by the south pole
- (C) attracted by both the poles
- (D) repelled by both the poles

15. Curie temperature is the temperature above which

- (A) Ferromagnetic material becomes diamagnetic material
- (B) Ferromagnetic material becomes paramagnetic material
- (C) Paramagnetic material becomes diamagnetic material
- (D) Paramagnetic material becomes ferromagnetic material

16. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show

- (A) anti ferromagnetism
- (B) no magnetic property
- (C) diamagnetism
- (D) paramagnetism

17. Above Curie temperature :

- (A) a ferromagnetic substance becomes paramagnetic
- (B) a paramagnetic substance becomes diamagnetic
- (C) a diamagnetic substance becomes paramagnetic
- (D) a paramagnetic substance becomes ferromagnetic

18. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by μ_d , μ_p and μ_f respectively, then :

- (A) $\mu_d \neq 0$ and $\mu_f \neq 0$
- (B) $\mu_p = 0$ and $\mu_f \neq 0$
- (C) $\mu_d = 0$ and $\mu_p \neq 0$
- (D) $\mu_d \neq 0$ and $\mu_p = 0$

Answer key and explanations

1. Answer: (A) $2.4\pi \times 10^{-4} \text{ T m A}^{-1}$

$\mu = \mu_0(1 + \chi) = 4\pi \times 10^{-7} \times 600 = 2400\pi \times 10^{-7} = 2.4\pi \times 10^{-4} \text{ T m A}^{-1}$. The magnetising field of 1200 A m^{-1} is not needed for permeability.

2. Answer: (A) high permeability and low retentivity

An electromagnet should become strongly magnetised by a small current (high permeability) and lose its magnetism when the current is switched off (low retentivity and coercivity). High retentivity suits permanent magnets such as steel, not electromagnets.

3. Answer: (B) $\sqrt{3}W$

Work to rotate from 0° to 60° is $W = MB(1 - \cos 60^\circ) = MB/2$, so $MB = 2W$. Torque at 60° is $MB \sin 60^\circ = 2W \times \sqrt{3}/2 = \sqrt{3}W$. Using $\sin 60^\circ$ with $MB = W$ gives $\sqrt{3}W/2$.

4. Answer: (A) diamagnetic material only

A diamagnetic material develops magnetisation opposite to the applied field, so its susceptibility is small and negative. Paramagnetic and ferromagnetic materials are magnetised along the field and have positive susceptibility.

5. Answer: (B) $(3/\pi)M$

Pole strength stays m with $M = ml$. The arc length $l = r(\pi/3)$, so $r = 3l/\pi$. The poles are now joined by a chord subtending 60° , whose length equals r , so $M' = m \times 3l/\pi = 3M/\pi$.

6. Answer: (B) 3 J

Work to turn from 0° to 60° is $W = MB(1 - \cos 60^\circ) = MB/2 = \sqrt{3} \text{ J}$, so $MB = 2\sqrt{3} \text{ J}$. The torque to hold it there is $\tau = MB \sin 60^\circ = 2\sqrt{3} \times \sqrt{3}/2 = 3$ (in N m).

7. Answer: (C) - 0.064 J

$U = -MB \cos \theta$; stable equilibrium is $\theta = 0$, so $U = -MB = -0.4 \times 0.16 = -0.064 \text{ J}$. $+0.064 \text{ J}$ is the unstable (antiparallel) equilibrium.

8. Answer: (B) B is of a paramagnetic material

Feeble attraction towards a magnet is the signature of a paramagnetic material. Feeble repulsion indicates diamagnetic (so the first sample is diamagnetic, not non-magnetic), strong attraction indicates ferromagnetic, and the unaffected sample is non-magnetic, not ferromagnetic.

9. Answer: (C) $1.5 \times 10^{-2} \text{ N m}$

Magnetic moment $m = NIA = 2000 \times 2.0 \times 1.5 \times 10^{-4} = 0.6 \text{ A m}^2$. Torque $\tau = mB \sin 30^\circ = 0.6 \times 5 \times 10^{-2} \times 0.5 = 1.5 \times 10^{-2} \text{ N m}$. Using $\cos 30^\circ$ or dropping the factor N leads to the other values.

10. Answer: (D) Equal to zero

In a diamagnetic atom the orbital and spin magnetic moments of the electrons cancel completely, so the net (permanent) magnetic moment is zero. A moment between zero and one or greater than one would describe paramagnetic or ferromagnetic atoms.

11. Answer: (D) Low retentivity and low coercive force

An electromagnet must lose its magnetism as soon as the current is switched off, so it needs low retentivity, and it must be easy to demagnetise, so low coercivity. High retentivity and high coercivity suit permanent magnets.

12. Answer: (A) 4 s

$T \propto 1/\sqrt{B}$. The opposing field reduces the net horizontal field to $24 - 18 = 6 \mu\text{T}$. $T' = 2 \times \sqrt{(24/6)} = 4 \text{ s}$. Adding the fields ($42 \mu\text{T}$) would give a shorter period.

13. Answer: (B) 6 J

Work = $MB(\cos 0^\circ - \cos 60^\circ) = 2 \times 10^4 \times 6 \times 10^{-4} \times \frac{1}{2} = 6 \text{ J}$. The value 12 J is MB itself, which would be the work only for a 90° turn.

14. Answer: (D) repelled by both the poles

Diamagnetic materials get a weak induced moment opposite to the applied field, so they are pushed towards weaker field regions. This happens regardless of which pole is used, so they are repelled by both poles.

15. Answer: (B) Ferromagnetic material becomes paramagnetic material

Above the Curie temperature, thermal agitation destroys the alignment of the domains, and a ferromagnet behaves as a paramagnet. It does not become diamagnetic, because the atoms still carry permanent magnetic moments.

16. Answer: (D) paramagnetism

Above the Curie temperature thermal agitation destroys the domain alignment and a ferromagnet becomes paramagnetic. It does not become diamagnetic or lose all magnetic response.

17. Answer: (A) a ferromagnetic substance becomes paramagnetic

Above its Curie temperature a ferromagnet loses its domain alignment because thermal agitation wins, and it behaves as a paramagnet. Curie temperature is a property of ferromagnets; paramagnets do not turn ferromagnetic or diamagnetic on heating.

18. Answer: (C) $\mu_d = 0$ and $\mu_p \neq 0$

Atoms of diamagnetic substances have no net permanent dipole moment, while atoms of paramagnetic and ferromagnetic substances do. So $\mu_d = 0$ and $\mu_p \neq 0$; any option with $\mu_d \neq 0$ or $\mu_p = 0$ is wrong.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.