Questions

1. When a substance is kept in a magnetic field, it gets weakly repelled by the field. Which of the following represents its susceptibility?

A. -0.0004

B. -4

C. 0.0004

D. 4

The material gets repelled by the magnetic filed, this means that it gets oppositely magnetized to that of the external field.

$\Rightarrow \vec{I}$ and $\vec{H}$ have opposite signs.

As, $\vec{I} = \chi \vec{H}$,

$\therefore$ Magnetic susceptibility (χ) is negative for the material.

Also, $|I| << |H|$

$\Rightarrow \left|\frac{I}{H}\right| << 1$

$\therefore |\chi| << 1$

So, χ is negative and $|\chi| << 1$.

Hence, option (A) is correct.

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2.

The magnetic moment of a magnet of dimensions $(10 \text{ cm} \times 4 \text{ cm} \times 1 \text{ cm})$ is 4 A-m^2. Its intensity of magnetisation is :

A. 10^3 A/m

B. 10^2 A/m

C. 10^5 A/m

D. 10^4 A/m

$$|I| = \frac{|M|}{V}$$

$|M| \rightarrow$ Magnetic moment

$V \rightarrow$ Volume

$$|I| = \frac{4}{10 \times 10^{-2} \times 4 \times 10^{-2} \times 10^{-2}}$$

$$|I| = 10^5 \text{ A/m}$$

Hence, option (C) is the correct answer.

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3.

An ideal solenoid having 40 turns cm^{-1} has an aluminum core, and carries a current of $2.0\ \mathrm{A}$. Calculate the magnetic field B at the centre. The susceptibility χ of aluminium $= 2.3 \times 10^{-5}$.

A. $3.2\pi \times 10^{-4}\ \mathrm{T}$ ✔

B. $1.6\pi \times 10^{-4}\ \mathrm{T}$ ✘

C. $0.8\pi \times 10^{-4}\ \mathrm{T}$ ✘

D. $\pi \times 10^{-4}\ \mathrm{T}$ ✘

$n = 40$ turns $\mathrm{cm}^{-1} = 4000$ turns m^{-1}

$i = 2A,\ \chi = 2.3 \times 10^{-5}$

Magnetization is given by,

$I = \chi H = \chi n i = (2.3 \times 10^{-5} \times 4000 \times 2)$

$I = 0.18\ \mathrm{Am}^{-1}$

Now, $B = \mu_0(H + I)$

$B = 4\pi \times 10^{-7}(8000 + 0.18)$

$B = 3.2\pi \times 10^{-4}\ \mathrm{T}$

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4.

An iron rod of susceptibility 599 is subjected to a magnetizing field of $1200 \mathrm{~Am}^{-1}$. The permeability of the material of the rod is :

Take, $\mu_0 = 4\pi \times 10^{-7} \mathrm{~TmA}^{-1}$

A. $2.4\pi \times 10^{-3} \mathrm{~TmA}^{-1}$

B. $2.4\pi \times 10^{-5} \mathrm{~TmA}^{-1}$

C. $2.4\pi \times 10^{-7} \mathrm{~TmA}^{-1}$

D. $2.4\pi \times 10^{-4} \mathrm{~TmA}^{-1}$

Given:

$H = 1200 \mathrm{~A/m}$
$\chi = 599$

Now,

$\mu_r = 1 + \chi = 1 + 599 = 600$

So,

$\mu = \mu_0\ \mu_r$

$\Rightarrow \mu = 4\pi \times 10^{-7} \times 600$

$\Rightarrow \mu = 2.4\pi \times 10^{-4} \mathrm{~TmA}^{-1}$

Hence, option (D) is correct.

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5.

A dip needle vibrates in the vertical plane perpendicular to the magnetic meridian. The time period of vibration is found to be $2\ \text{sec}$. The same needle is then allowed to vibrate in the horizontal plane and the time period is again found to be $2\ \text{sec}$. Then the angle of dip is

- A. 0°
- B. 30°
- C. 45°
- D. 90°

In a vertical plane, perpendicular to magnetic meridian the time period is given by

$$T = 2\pi\sqrt{\frac{I}{MB_V}} \quad \ldots\ldots\ldots(i)$$

In the horizontal plane,

$$T = 2\pi\sqrt{\frac{I}{MB_H}} \quad \ldots\ldots\ldots(ii)$$

Given, $T = 2$ in both the cases.

Equating equation (i) and (ii) we conclude that $B_V = B_H$ at the given place.

Now $\tan\delta = \frac{B_V}{B_H} = 1$

$\therefore \delta = 45^\circ$

Hence, option (C) is the correct answer.

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