

PHYSICS • CLASS 12

CHAPTER 5

Magnetism and Matter

NCERT SOLUTIONS



MAGNETIC MOMENT FROM TORQUE – EXERCISE 5.1

Q. A short bar magnet has its axis at 30° to a uniform external magnetic field of 0.25 T . It experiences a torque of magnitude $4.5 \times 10^{-2} \text{ J}$. Find the magnitude of its magnetic moment.

Answer: The torque on a magnetic dipole depends on its magnetic moment, the field and their angle.

$$\theta = 30^\circ$$

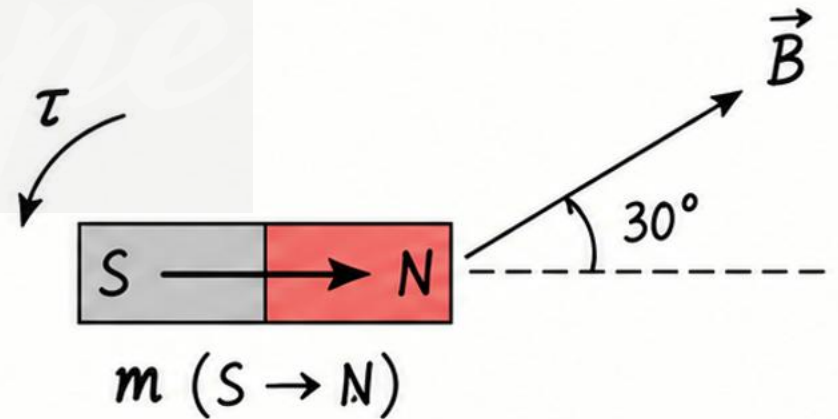
$$B = 0.25 \text{ T}$$

$$\tau = 4.5 \times 10^{-2} \text{ N m}$$

$$\tau = m B \sin \theta.$$

$$m = \frac{\tau}{B \sin \theta} = \frac{4.5 \times 10^{-2}}{(0.25)(\sin 30^\circ)}.$$

$$m = 0.36 \text{ A m}^2 = 0.36 \text{ J T}^{-1}.$$



STABLE AND UNSTABLE EQUILIBRIUM – EXERCISE 5.2

Q. A short bar magnet of magnetic moment 0.32 J T^{-1} is free to rotate in a uniform field of 0.15 T . Which orientation gives (a) stable and (b) unstable equilibrium? Find its potential energy in each case.

Answer: The magnet settles with its moment along the field; the opposite orientation is unstable.

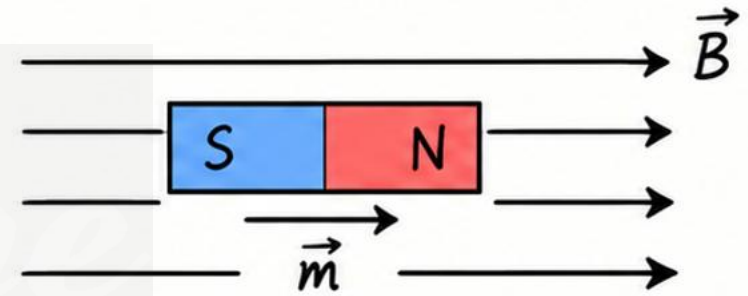
$$m = 0.32 \text{ J T}^{-1}; \quad B = 0.15 \text{ T}; \quad U = -mB \cos \theta.$$

(a) Stable: $\theta = 0^\circ$;

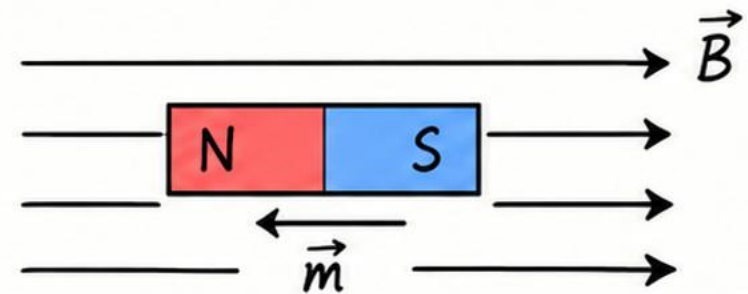
$$U = -(0.32)(0.15) \cos 0^\circ = -0.048 \text{ J}.$$

(b) Unstable: $\theta = 180^\circ$;

$$U = -(0.32)(0.15) \cos 180^\circ = +0.048 \text{ J}.$$



(a) Stable equilibrium ($\theta = 0^\circ$)



(b) Unstable equilibrium ($\theta = 180^\circ$)

SOLENOID AS A BAR MAGNET – EXERCISE 5.3

Q. A closely wound solenoid has 800 turns, area $2.5 \times 10^{-4} \text{ m}^2$ and current 3.0 A. Explain how it acts like a bar magnet. Find its magnetic moment.

Answer: Current loops give one end north-pole behaviour and the other south-pole behaviour, so the solenoid has a magnetic dipole moment. Viewed from an end, anticlockwise current makes that end N; clockwise makes it S.

Data:

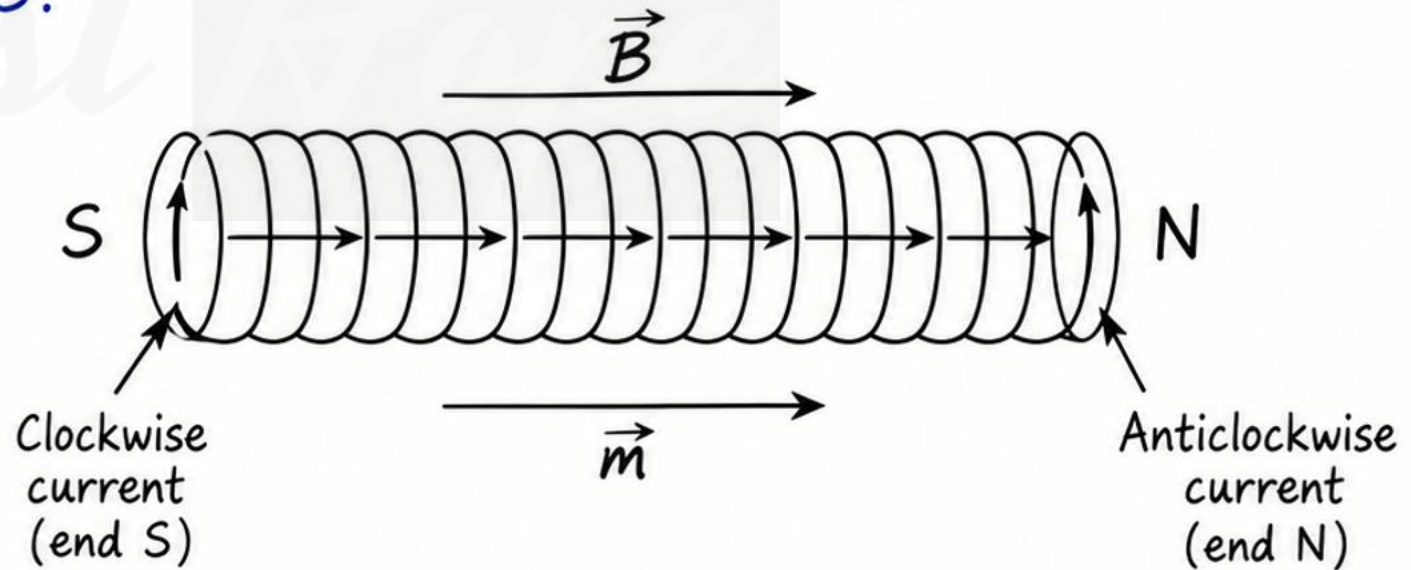
$$N = 800$$

$$A = 2.5 \times 10^{-4} \text{ m}^2$$

$$I = 3.0 \text{ A}$$

Working:

$$\begin{aligned} m &= NIA \\ &= (800)(3.0)(2.5 \times 10^{-4}) \\ &= 0.60 \text{ A m}^2 = 0.60 \text{ J T}^{-1} \end{aligned}$$





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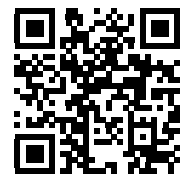


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