Question Answers: Spin magnetic moment and Larmor precession

2A.

Torque on a magnetic dipole: When a magnetic dipole with moment

$\vec{\tau} = \vec{\mu} \times \vec{B}$

The magnitude of this torque is

$\tau = \mu B \mathrm{Sin}(\theta)$

This torque tries to align the magnetic moment with the field.

Work done in rotation:

$dW = \tau d\theta = \mu B \sin(\theta) d\theta$

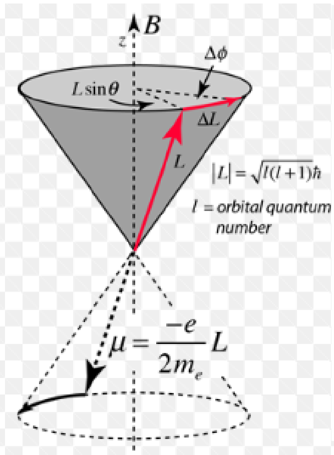
Total work done: The total work done to rotate the dipole is found by integrating the infinitesimal work:

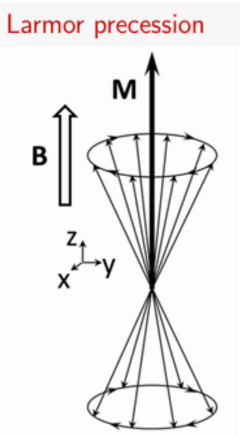
$W = \int_{\theta_1}^{\theta_2} \mu B sin(\theta) d\theta$

$W = -\mu B \{ Cos(\theta_2) - Cos(\theta_1) \}$

Magnetic Energy$= -\mu B \mathrm{Cos}\,\theta$ (If $\theta_2 = \theta, \theta_1 = 90$)

3A.





Torque, $\vec{\tau} = \vec{\mu} \times \vec{B}$

The magnitude of this torque is

$\tau = \mu B \sin(\theta)\ldots(1)$

$\tau = \frac{\Delta L}{\Delta t}$

$\tau = \frac{\Delta \phi}{\Delta t} L sin\,\theta (\Delta L = \Delta\phi L sin\,\theta,$ see figure)

$\tau = \omega L sin\,\theta \ldots(2)$

From (1) and (2)

$$\omega = \frac{\mu B}{L}\ , \mu = \frac{eL}{2m_e}$$

$hence, \omega = \frac{eB}{2m_e}$ or $\omega = \gamma B,$

$\gamma\ is\ gyromagnetic\ ratio$