

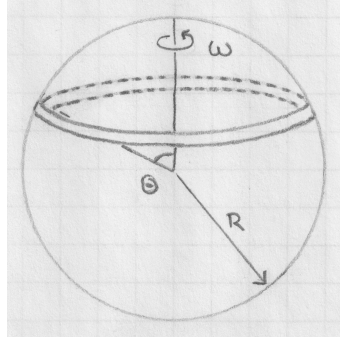
[lex64] **Magnetic moment of rotating charged spherical shell**

A spherical shell of radius  $R$  is uniformly charged with charge density  $\sigma > 0$  and rotates with angular velocity  $\omega$  about its axis as shown. The rotating charge represents a current and thus produces a magnetic dipole moment  $\mathbf{m}$  directed vertically up.

(a) Express its magnitude  $m$  as a function of  $\omega$ ,  $R$ , and  $Q$  (the total charge on the shell).

(b) If the shell has uniform mass density and total mass  $M$ , find the ratio  $m/L$  of the magnetic moment and the angular momentum, also known as gyromagnetic ratio.

Hint: For part (a) split the shell into concentric rings. The current in each ring is the charge divided by the period of rotation.



**Solution:**