CALIFORNIA STATE UNIVERSITY SAN MARCOS
DR. DE LEONE, PHYSICS 323

H.W. 2

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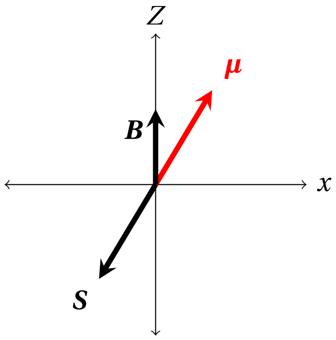
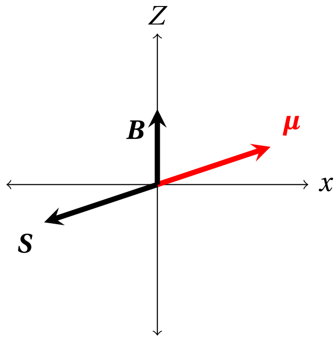
1 ELECTRON SPIN AND MAGNETIC MOMENT

Two spheres are spinning with the same angular momentum, but oriented differently. Which sphere experiences the larger force from the magnetic field?



(A)

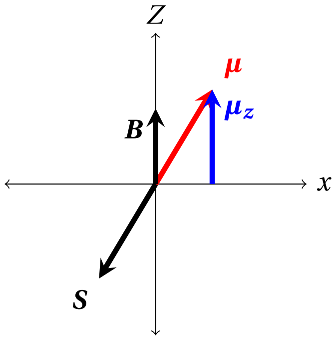


(B)

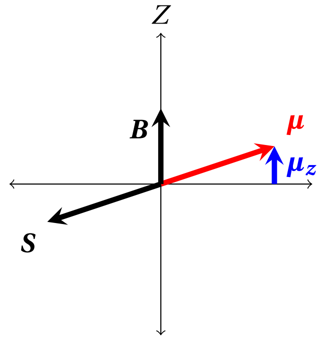
The magnitude of the Z component of the magnetic moment, $\vec{\mu}$ of the electron will determine the force on the atom in the homogeneous magnetic field, $\vec{B}$, **in a classical system**. As the Z component grows so does the force experienced on the electron until it is parallel with the field. The direction of the electron's magnetic moment's poles, with the direction of $\vec{\mu}$ being north, compared to the magnetic field's poles will determine the direction of the force. When the components are orthogonal the force is zero.

$$F_z \approx -g\frac{e}{2me}S_z\frac{\partial B_z}{\partial Z}$$

Because the magnetic field is decreasing there can be a net force on the electron in one direction or another.



(A)



(B)

We can also use the relation of $\vec{\mu} \cdot \vec{B} = |\vec{\mu}||\vec{B}|\cos\theta$, where theta is the angle between the magnetic moment and the direction of the $\vec{B}$ field. If the angle is $\frac{\pi}{2}$, the force is zero. If the angle is over $\frac{\pi}{2}$, then the force changes direction. The figure **A's** magnetic moment has a **larger** Z component in the direction of the field creating a **larger force** on the particle according to classical speculations.