

## Para and Diamagnetic

*Recommended for Chapter(s): 19*

### Demo #041

#### Procedure

1. (Prep) Hang one vial on one side of the stir stick and the other vial on the other side of the stir stick.
2. (Prep) Place the thumbtack that is inserted into the middle of the stir stick into the whole in the middle of the cork in the Erlenmeyer flask.
3. (Prep) Adjust the vials so that the stir stick is not touching the cork.
4. Place the neodymium magnet next to each of the vials and have students observe what happens.

#### Safety

1. Neodymium magnets are very strong; make sure to not get your finger between the magnet and any magnetic materials. Make sure to keep the magnet away from credit card, electronic devices, and pacemakers.

#### Clean Up

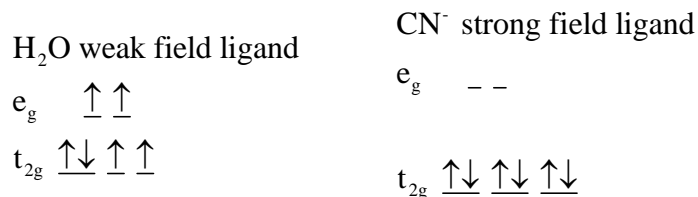
1. Return the materials to the cart in the demonstration library room.

#### Stockroom Notes

1. Return items to demonstration tub.
2. Return tub to the demonstration library.

#### Discussion

The two vials that are used in this demonstration contain  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  ( $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ ) which is green and  $\text{K}_4[\text{Fe}(\text{CN})_6]$  ( $[\text{Fe}(\text{CN})_6]^{4-}$ ) which is yellow. In both of these compounds iron exists in a +2 state. This results in the following electron configuration:  $\text{Fe}^{2+} = [\text{Ar}]3d^6$ . The difference between the two complex ions is that  $\text{H}_2\text{O}$  is a weak field ligand and  $\text{CN}^-$  is a strong field ligand. This results in the following crystal field diagrams.



Since  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  has unpaired electrons, it is a paramagnetic complex and it is pulled into a magnetic field which is seen by the demo. On the other hand ( $[\text{Fe}(\text{CN})_6]^{4-}$  has all

paired electrons making it diamagnetic which will make it be repelled from a magnetic field. Diamagnetic properties are much weaker than paramagnetic properties, therefore, the diamagnetic  $[\text{Fe}(\text{CN})_6]^{4-}$  appears to be unaffected by the magnet during the demonstration.

*Materials for demo 041*

1. Vial containing  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  (green)
2. Vial containing  $[\text{Fe}(\text{CN})_6]^{4-}$  (yellow)
3. Magnet
4. Tupperware to store vials and magnet
5. 250 mL Erlenmeyer flask
6. Cork
7. Coffee stirrer with thumb tack in middle