Problem set 6

1. Give three stable isotopes that have odd numbers of both protons and neutrons.

2. Heteropolymetallates are structures in which a heteroatom is enclosed inside cavities formed by MO_6 octahedra, and is bonded to the oxygen atoms of the adjacent MO_6 octahedra. These compounds have been used as catalysts in the petrochemical industry and as flame retardants. The first well-characterised example was the α-Keggin ion, $[PW_{12}O_{40}]^{3-}$. The structure may be broken down as follows. Three WO_6 octahedra are arranged in a triangular fashion sharing edges. Four of these units are arranged tetrahedrally, sharing corners. The tetrahedral hole in the centre is occupied by the P atom.

Sketch the 3 edge-sharing WO_6 octahedra. Count the number of O atoms. How many must be corner-sharing? Indicate these on your diagram. Which O atom bonds to the heteroatom? Which O form double bonds to W? What is the oxidation state of W?

[Hint: an image search for "Keggin" on Google may help your analysis]

3. What is the most abundant third-row transition metal in the oceans? In what form do you expect it to be in? Calculate how much of this metal is dissolved in the world's oceans (volume ~1.37 billion km^3). Given the abundance of this metal compared to some of the first-row transition metals, would you expect some forms of life to utilize the metal?

4. Explain why both ReO_3 and the tungsten bronzes are good conductors.