

## CEM 141 Exam III questions From lots of previous semesters

- (10) Write complete electronic configurations of Mg, Ca,  $Mg^{+2}$ , and  $Ca^{+2}$ .
- (5) What is the major **industrial** source of magnesium and calcium (not food)?
- (5) Why is calcium found 'in nature' usually as a +2 ion, and rarely in a neutral state? (translation: Why is the common oxidation state of Mg and Ca +2?)
- (10) Pick one of the two species (Ca or Mg). Tell me why it is important in bodily functions, and tell me two natural sources in my diet. (I am looking for the words that came from my lecture) For 6 points 'extra credit' give me the importance to bodily function and source of the other one. Label your answer as 3\*
- (10) Consider a neutral magnesium atom and a magnesium +2 ion.
  - Which of the species has a larger radius? Why?
  - Which has a larger ionization energy? Why?
- (10) Consider a neutral calcium atom and a neutral magnesium ion.
  - Which of these has a larger ionization energy? Why?
  - Consider the 2s orbital of each species. Are the same size? Why or why not?
- (10) Consider a  $N^{-3}$  ion and a  $O^{-2}$  ion.
  - Which species has a larger ionization energy? Explain using a complete sentence.
  - Which species is bigger? Explain using a complete sentence.
- (30) Consider the nitrite ion. The formula can be 'bought' for 3 points.
  - Draw all possible Lewis structures of the nitrite ion.
  - On each atom in each structure, clearly indicate the formal charge.
  - Which of the structures is more energetically stable? Why?
  - What is the bond order of each nitrogen-oxygen bond in the 'real' structure (not in each resonance structure)
- (10) Consider two molecules, calcium fluoride and calcium nitride.
  - Which species has larger bond dipoles? What is bond dipole a function of?
  - What type of bonding is involved in these two molecules?
  - Draw the Lewis structure of calcium fluoride.
- (10) There is a species (3 atoms) with a linear molecular geometry, with bond angles of  $180^\circ$ . What are ALL the possible hybridization schemes of the central atom? For each, give the associated electron domain geometry.
- (23) These questions all deal with  $ClO_2^{-1}$ . hint: Cl is the central atom.
  - Draw the most stable Lewis structure (show any resonance if it exists)
  - What is the electron domain geometry?
  - What is the molecular geometry?
  - What is the approximate bond O-Cl-O bond?
  - Is there an overall dipole moment?(2) Explain why or why not. (3)
  - what is the hybridization orbitals hybridization of the central Cl atom?
- (7) Consider the species OCS
  - Draw the most stable Lewis structure
  - How many sigma bonds are there in the species?
  - How many pi bonds are there in the species?
- (10) Boron trifluoride has no overall dipole moment, but bromine trifluoride does. Why is that? Be COMPLETE in your discussion. The answer will take more than one sentence. Pictures would REALLY help your argument.
- (12) Consider a species containing 3 atoms with a linear molecular geometry, with bond angles of  $180^\circ$ . What are ALL the possible hybridization schemes of the central atom? For each, give the associated electron domain geometry.
- (12) Consider a neutral magnesium atom and a magnesium +2 ion.
  - Which of the species has a larger radius?(2) Why?(4)
  - Which has a larger ionization energy? (2) Why? (4)
- (12) Consider the following elements: Oxygen, Phosphorus, Tellurium, Iodine, Boron.
  - Which two (when bonded) would form the most polar bond? EXPLAIN
  - Which one has the smallest ionic radius? EXPLAIN
  - Which one would you expect to have the most exothermic electron affinity? EXPLAIN

4. (12) Some straightforward questions (only give symbol, no explanation) about the minerals we eat:
- which is most abundant, being ~1.5-2% by weight?
  - Which mineral, coming from green veggies and seafood, helps the Ca in bones and teeth, and helps P in cell activity?
  - Which mineral, coming from meat, eggs and dairy products, promotes growth and heals wounds?
  - This 'normally' toxic chemical is actually important for the metabolism of glucose. We get it from meats and whole grains. What is it?

5. (32) The  $\text{SCN}^{-1}$  ion has many 'legitimate' Lewis structures. (C is central in all)

**CLEARLY LABEL YOUR ANSWERS**

- (8) Draw all of them (more than 2, less than 7)
  - (4) Clearly indicate the formal charge on every atom in each structure
  - (6) Clearly indicate which structure you believe is the most stable, and **defend** your answer.
  - (4) Redraw your most stable structure and draw in any bond dipoles.
  - Is there an overall dipole moment in your most stable structure?(2) Explain your answer (4)
  - (4) What is hybridization of the central atom in your most stable structure?
6. (20) Give the most probable Lewis structure for each of the following (4) and give the electron domain geometry(3) and molecular geometry of each.(3) **CLEARLY LABEL YOUR ANSWERS**
- $\text{BrCl}_5$
  - $\text{NaCN}$
1. (18) There were six transition metals (d-block) that were discussed in class that were essential to human life.
- (6) Name them
  - (12) Pick two of them and tell me why they are important (6) and where we get them (6) (what do we eat to get them)
2. (12) Consider an electron in the 3p orbital of a argon atom.
- (6) What two things effect the effective nuclear charge felt by the electron?
  - (6) Compare that 3p electron in potassium to a 3p electron in arsenic. Which has a greater affinity to the nucleus? (2) Why? (4)
3. (12) Of the species  $\text{NO}_2$ ,  $\text{NO}_2^+$  and  $\text{NO}_2^-$ . Which two species should have nearly the same bond lengths? Explain and justify your answer.
4. (10) Consider a  $\text{Na}^{+1}$  ion and a  $\text{F}^{-1}$  ion.
- Which species has a larger ionization energy? Explain using a complete sentence.
  - Which species is bigger? Explain using a complete sentence.
5. (15) Consider two molecules, magnesium chloride and nitrogen trichloride.
- (5) Which species has larger bond dipoles?(2) Why? (3)
  - (6) What type of bonding is involved in each species?
  - (4) Draw the Lewis structure of nitrogen trichloride.
6. (23) These questions all deal with  $\text{BrF}_3$ .
- (6) Draw the most stable Lewis structure (show any resonance if it exists)
  - (3)What is the bond order of each Br-F bond in the 'real' structure?
  - (3) What is the electron domain geometry?
  - (3) What is the molecular geometry?
  - (3) What is the approximate bond F-Br-F bond?
  - (5) Is there an overall dipole moment?(2) Explain why or why not. (3)
7. (10) Xenon diiodide has no overall dipole moment, but sulfur diiodide does. Why is that? Be COMPLETE in your discussion. The answer will take more than one sentence. Pictures would REALLY help your argument.