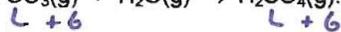


C. What is the general relationship between oxidation number and acid strength?

stronger acid has the higher oxidation number

D. On October 12, 2008, an oleum spill at a chemical plant in western Pennsylvania forced about 2,500 residents to evaluate. Oleum – also known as fuming sulfuric acid, $H_2SO_4 \cdot xSO_3$ – is especially dangerous because the sulfur trioxide escapes as a gas and reacts with moisture in the air to form sulfuric acid according to the reaction $SO_3(g) + H_2O(g) \rightarrow H_2SO_4(g)$.

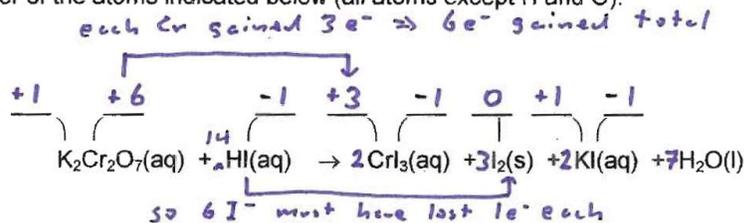


Is this a redox reaction? Explaining your reasoning.

No. No change in ON's => not a redox reaction.

4a. (Unit II) Titration with...

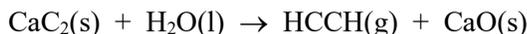
Titration with an aqueous solution of potassium dichromate is a useful procedure for determining the amount of iodide in solution. The *unbalanced* chemical equation for this reaction is given below. Assign the oxidation number of the atoms indicated below (all atoms except H and O).



Identify the oxidizing agent and the reducing agent in the above reaction.

oxidizing agent $K_2Cr_2O_7$ reducing agent HI

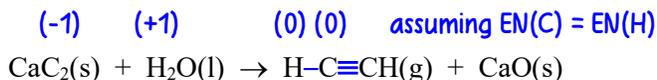
4b. (Unit II) Several years ago an undergraduate working in my lab needed acetylene gas, $HCCH(g)$, for an experiment. Normally acetylene is purchased in a tank like other gases, but in the published experiment he was trying to repeat, the researchers generated acetylene by adding calcium carbide to a large volume of water and collecting the acetylene gas, according to this reaction



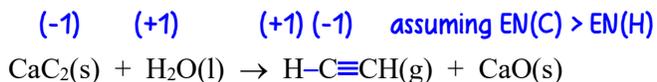
Additional information for this problem is given in the info sheet passed out with this exam.

A. Is this a redox reaction? Explain your reasoning.

Assigning oxidation numbers...



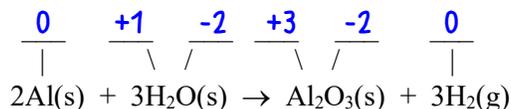
or



Either way, carbon is oxidized in this reaction.

5. (Unit II) We carried out the thermite reaction...

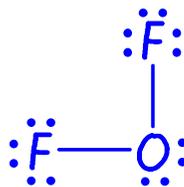
C. Write the oxidation numbers in the spaces provided.



ATOMS: Electronic Structure and Properties

2. (*Fall 2015*) Draw dot structures as instructed below, and answer any associated questions. Be sure to show all non-zero formal charges.

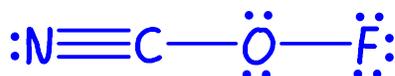
A. Draw the best dot structure you can for OF_2 .



B. Draw the best dot structure you can for HNNH , where the atoms are connected as written.



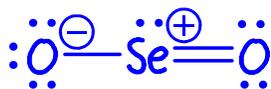
C. Draw the best dot structure you can for the hypothetical molecule NCOF which contains all of the nonmetal elements from the second row of the periodic table, except neon.



Which bond in NCOF do you expect to be the strongest? **the $\text{N}\equiv\text{C}$ bond**

Why? **The NC bond is a triple bond. The other two bonds are single bonds.**

D. Draw two dot structures for SeO_2 .



best dot structure you can
that obeys the octet rule



best dot structure you can
that exceeds the octet rule
to minimize formal charge

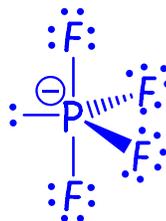
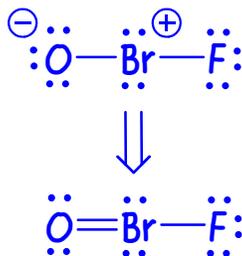
Would the molecular geometries corresponding to the two dot structures you drew above be the same or different? **the same**

Explain why or why not. **Both have three "things" around the central atom: two oxygen atoms and a lone pair, so the molecular geometry is the same (bent).**

3. (*Fall 2012*) Write the best dot structure you can and assign all non-zero formal charges for the following molecules/ions. Draw a box around the structure you consider to be the best (i.e. the one you want graded).

OBrF (Br is the central atom)

PF_4^-

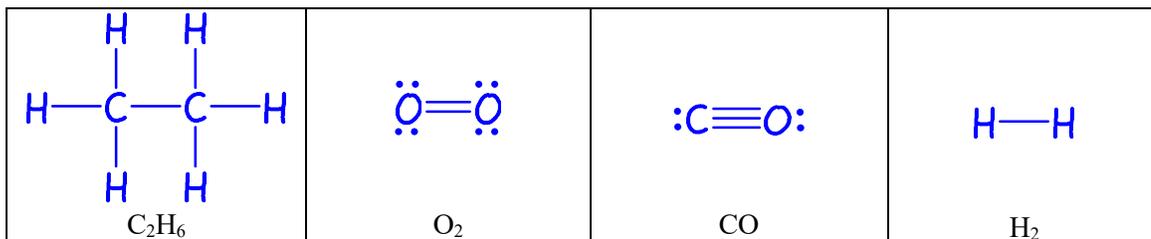


4. (**Fall 2012**) I really botched the question on the last exam involving the partial oxidation of hydrocarbons as a route to make hydrogen gas. Let's see if I can get it right this time. We'll keep things simple by considering the partial oxidation of ethane as shown in the following reaction:



And I do not want to leave out any important reactions and ΔH° values, so instead of using Hess's law, let's use the bond enthalpy data provided on the last page of the info sheet.

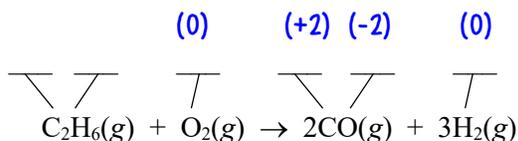
- A. First, write dot structures for C_2H_6 , O_2 , CO , and H_2 . You will need these dot structures for parts B and C.



~~B. Now calculate ΔH° for the partial oxidation of ethane.~~

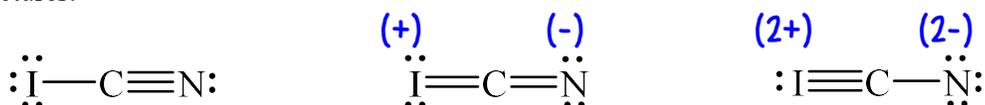
- C. Was ethane really oxidized in this reaction? Assign oxidation numbers.

Your answer will depend on how you assign oxidation numbers for carbon and hydrogen in C_2H_6 , but in either case carbon is oxidized to (+2) and oxygen is reduced to (-2).



Was C_2H_6 oxidized? _____ If so, did oxidation occur at C or H or both?

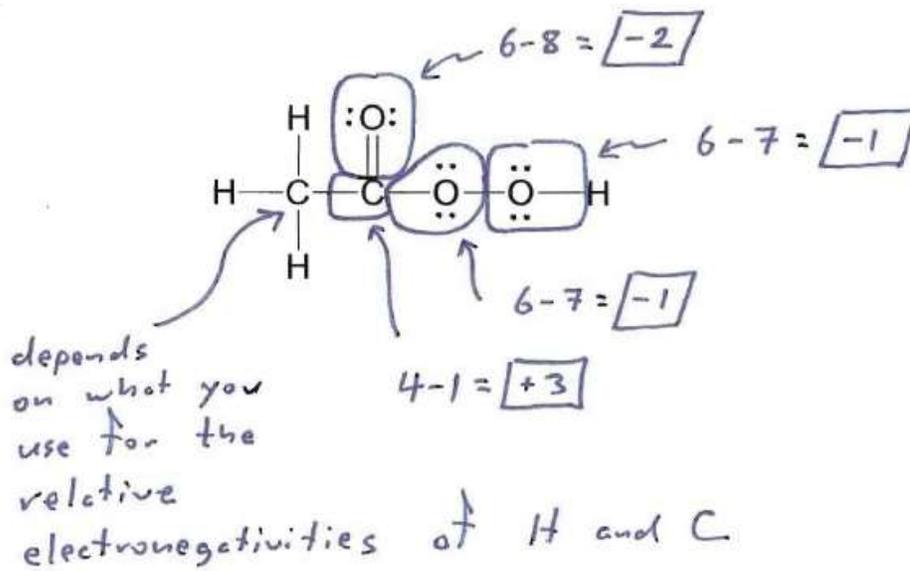
5. Resonance structures for the molecule ICN are given below. Assign nonzero formal charges for these dot structures.



Which dot structure is the best resonance structure for ICN?

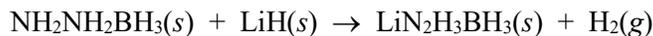


6. (Fall 2009) Assign the oxidation numbers for all of the carbon and oxygen atoms in the following organic reagent:

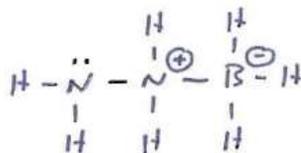


7. (Fall 2009) The previous question [\[on the exam\]](#) allowed you to demonstrate your ability to write dot structures and use them to deduce geometries and hybridization. The next two examples, drawn from the recent literature, are a bit more interesting, but the fundamental tools used to describe the electronic structure and physical geometry are the same.

- A. Hydrazine borane, $\text{NH}_2\text{NH}_2\text{BH}_3$, has been proposed as a material for storing hydrogen (*J. Am. Chem. Soc.* **2009**, *131*, 7444-7446). In combination with lithium hydroxide, hydrogen gas is released according to the reaction

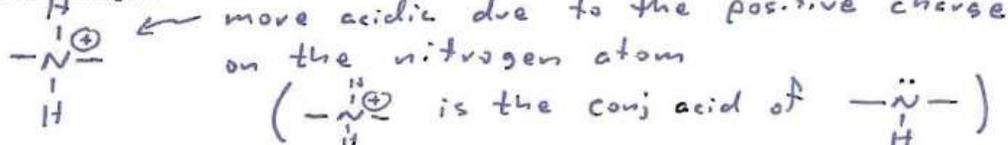


Write a dot structure for $\text{NH}_2\text{NH}_2\text{BH}_3$ and assign all nonzero formal charges.



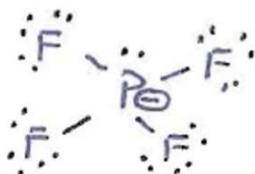
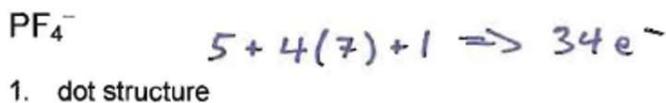
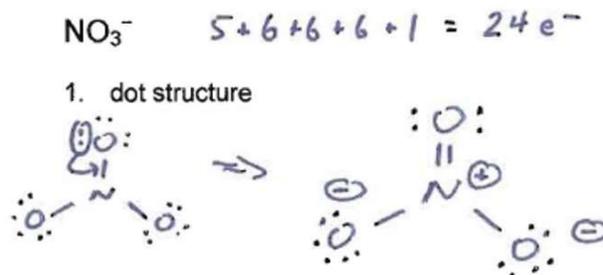
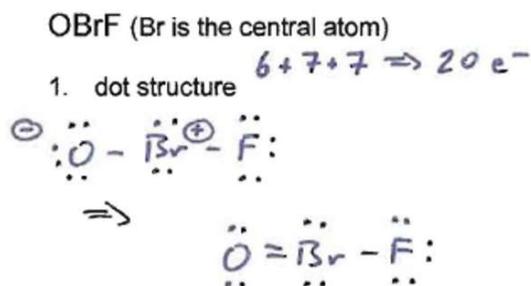
When $\text{NH}_2\text{NH}_2\text{BH}_3$ reacts to form $\text{NH}_2\text{NHBH}_3^-$, why is the hydrogen ion lost from the middle nitrogen instead of the outer nitrogen?

the outer nitrogen?



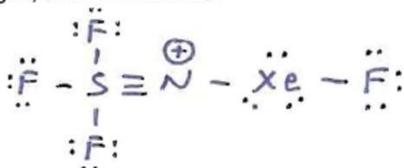
8. (Fall 2009) DOT STRUCTURES

- Write the best dot structure you can and assign all non-zero formal charges for each of the following molecules/ions. Draw a box around the structure you consider to be the best (i.e. the one you want graded).
- ~~Sketch the molecular geometry, using wedges for bonds coming out of the paper and dashed lines for bonds going into the plane of the paper. You only need to show the lone pairs on the central atom. Use arrows to show any expected distortions from the idealized geometry.~~
- ~~Give a descriptive name for the molecular geometry (atoms only): bent, T-shaped, see-saw, trigonal pyramidal, trigonal planar, trigonal bipyramidal, square planar, square pyramidal, tetrahedral, octahedral.~~
- ~~Give the hybridization about the central atom.~~

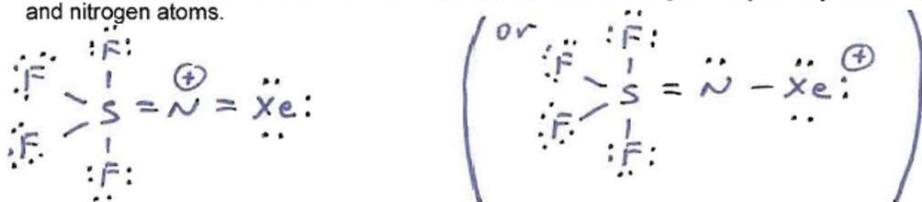


9. (Fall 2009) Xenon forms bonds with oxygen and fluorine, but compounds containing Xe-N bonds are rare (*J. Am. Chem. Soc.* **2009**, 131, 7272-7286). The cation $\text{F}_3\text{S}=\text{NXeF}^+$ was investigated and found to rearrange to form $\text{F}_4\text{S}=\text{NXe}^+$. In both ions the atoms are connected as S-N-Xe, and the multiplicity of the bonding between sulfur and nitrogen is indicated in the formulas.

- Write a good dot structure for $\text{F}_3\text{S}=\text{NXeF}^+$ and give the molecular geometry and hybridization of the sulfur, nitrogen, and xenon atoms.



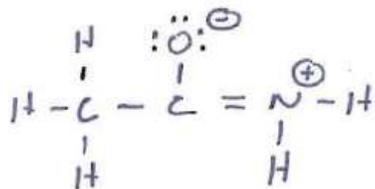
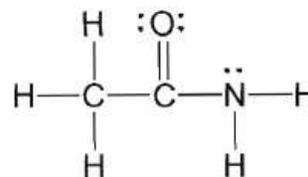
- Write a good dot structure for $\text{F}_4\text{S}=\text{NXe}^+$ and give the molecular geometry and hybridization of the sulfur and nitrogen atoms.



10. (Fall 2009, e4) A dot structure for methyl amide is shown on the right.

(8 points) A dot structure for methyl amide is shown on the right.

Draw a resonance structure for this dot structure.



Which structure do you think is the best resonance structure: the one given above, or the one you drew? Why?

the one given since it minimizes formal charge