Chemistry 124 Third Examination Name _____

November 10, 2010

The exam budgets 50 minutes, but you may have 60 minutes to finish it. Good answers can fit in the space provided. Question values correspond to allotted time. Don't waste too much time on cheap questions.

Read each question carefully to see what it asks for (bold face is used to help highlight questions).
Make sure you are answering the question, not just saying something vaguely relevant to its topic.

1. (18 minutes) It is common in the history of chemistry for an investigator (typically a young one) to propose a productive new way of looking at things that flies in the face of conventional wisdom, only to be doubted, cautioned, or belittled by a member of the establishment. **Provide examples of three (3) such stories** (one on this page, two on the next) saying what the **conventional Wisdom** was, **Who** made the new discovery or suggestion, what **Experimental Evidence** supported their new viewpoint, and **When** (within 10 years) the new suggestion was made. Your answers should also say **Who** the doubter(s) was or were and **How** they expressed their reservations or criticism. If you can't conjure up the right names, you can use Mr. X and Mr. Y for partial credit.

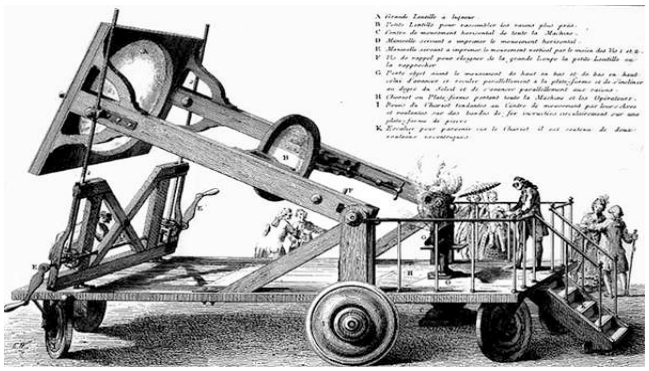
Hint - here are some names that might be useful to you (listed alphabetically):
J. J. Berzelius, S. Cannizzaro, A. S. Couper, A. Crum-Brown, J.-B. A. Dumas, A. Kekulé, W. Koerner, H. Kolbe, L. Leiserowitz, A. Lieben, E. Paternó, J. H. van't Hoff, C. A. Wurtz

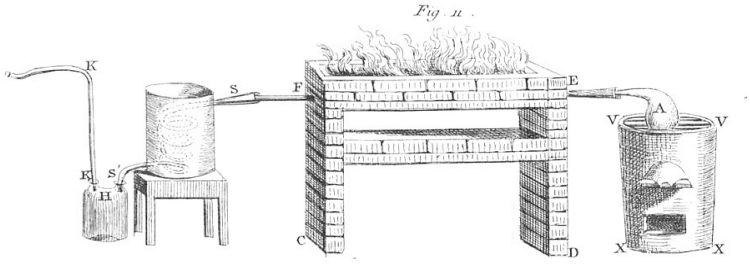
Story 1

Story 2

Story 3

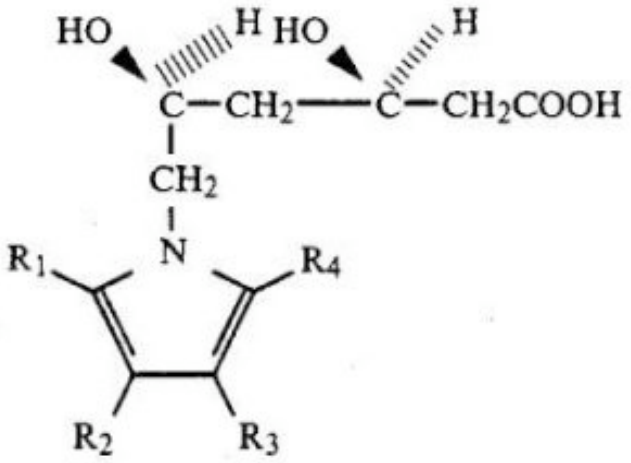
2. (5 min) **Circle one** of the following pieces of equipment and **explain** how it may have been used to help **prepare a specific element** from a compound. Do **one** only





3. (4 min) **Explain why** we have **two** names, butyl bromide and bromobutane, to describe the same compound and why one name has a **space**, but not the other.

4. On the right is a structural drawing from an important U.S. Patent.



A) (2 min) Say something that is good, and something that is bad about how the drawing depicts stereochemistry.

B) (3 min) On the structure above **label** the substituents on the **rightmost** stereogenic carbon with appropriate CIP priority numbers (1-4, with 1 high), and **give the symbol** to designate its absolute configuration.

C) (4 min) Suppose the ring containing a nitrogen atom were replaced by a COOH group to make the molecule symmetrical. Draw a **Fischer projection** of this new molecule **and explain** whether it has an enantiomer **and** whether it has a diastereomer.

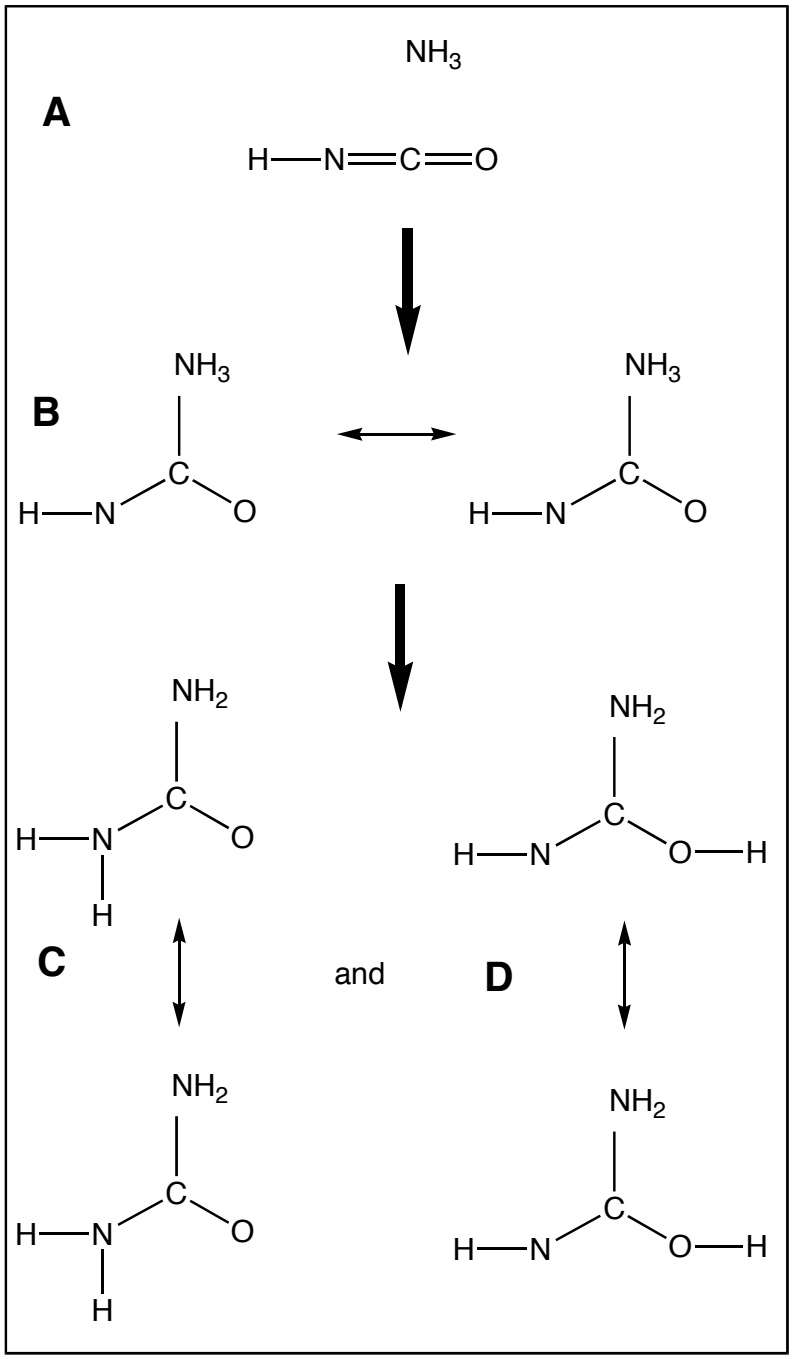
5. Four important species in the formation of urea from ammonia and cyanic acid are illustrated in this scheme: A → B → C + D.

(Note that species **A** includes two molecules and that there are **TWO** isomeric resonance-stabilized **PRODUCTS**: **C** with a new N-H bond, and **D** with a new O-H bond.)

All necessary atoms are shown in this scheme, but some of the structures need more bonds or charges.

A. (3 min) **ADD BONDS and CHARGES** as necessary to complete **all** partial structures in this scheme.

B. (5 min) Between the **pair of molecules in A identify and label** one plausible HOMO and one LUMO and carefully draw curved arrows to show how they react to form ONE of the resonance structures of species B. In the space below enumerate the **FACTORS** that makes these two molecular orbitals in **A** particularly reactive



HOMO

LUMO

5C. (3 min) Consider the **non-ionic** resonance structures for **C** and **D** of the scheme on the previous page. Explain **IN TERMS OF ORBITAL ENERGIES** which of them should be more stabilized by "resonance".

6. (3 min) Explain why the **difference** between the two 1860s versions of **Hofmann's croquet-ball molecular models** of dichloromethane is more interesting to us than it probably was to him.