Chemistry 125 Third Examination Name _____

November 17, 2006

1. (9 minutes) **Name one** person associated with each of the following concepts or accomplishments and **draw an unambiguous line** from each to the timeline so as to arrange them in proper chronological order.

Name	Concept	Year
_____	**Conservation of Mass**	1775
_____	**Dualism in Organic Chemistry**	
_____	**Equivalence of Hydrogen Positions in Benzene**	1800
_____	**Isomerism**	
_____	**Law of Multiple Proportions**	
_____	Modern symbols for the elements	1825
_____	Oxidation states of the elements	
_____	Preparation of Potassium	1850
_____	Purification of organic acids	
_____	Systematic nomenclature for hydrocarbon radicals	1875
_____	Tetravalence of Carbon	
_____	**Type Theory**	1900

2. (9 min) Describe briefly **a key experimental result** that helped support **each of three** (3 only) of the concepts **in bold face** in the list above. Be as specific as you can (try to use real compounds, for example). Answer on back of this page.

3. (4 min) What is the Bürgi-Dunitz 110° angle, and how was it determined?

4. (2 min) What did Couper consider to be the principal weakness of the Radical Theory?

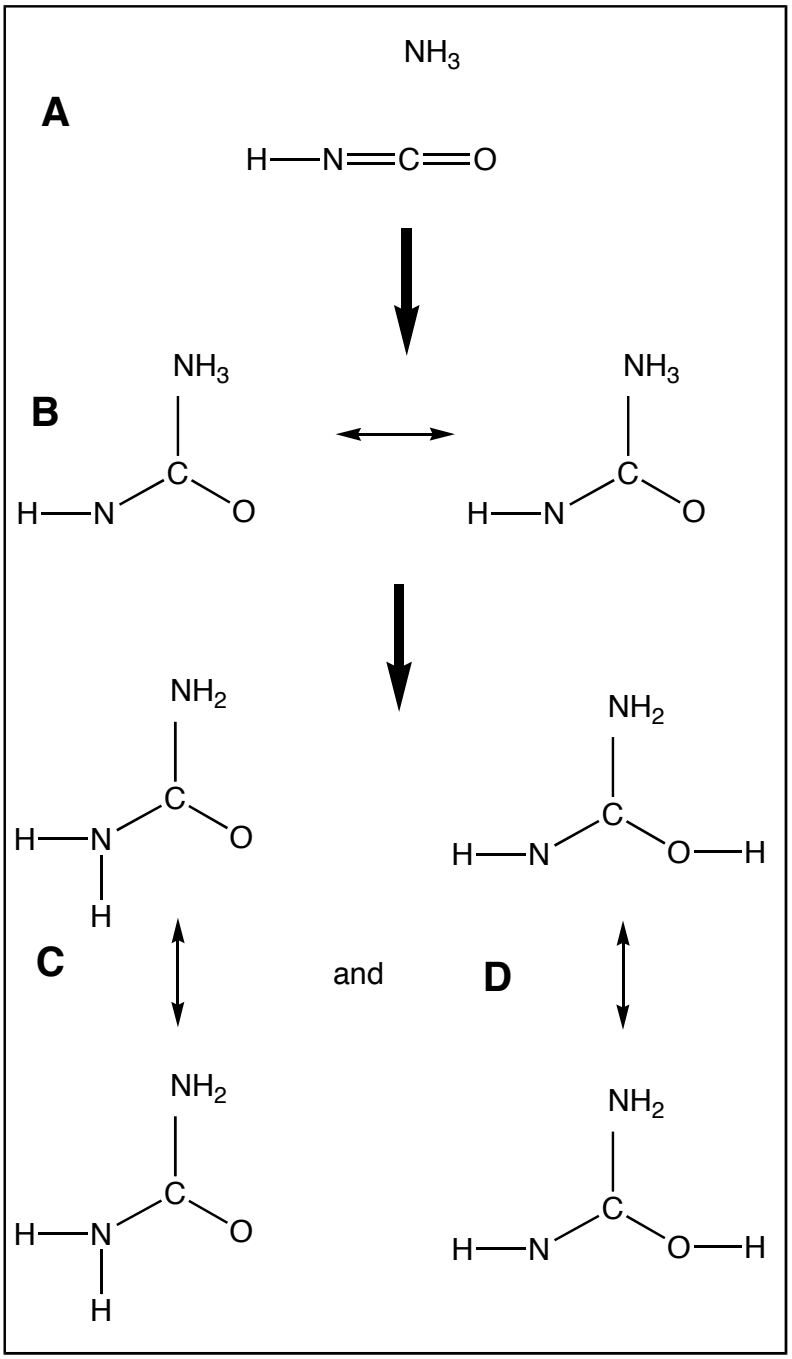
5. (2 min) What did organic chemists at the time consider to be the most important piece of chemical apparatus invented in the 1800s?

6. (2 min) What was the philosophical basis for Lieben's friendly criticism of Paternó's explanation for the possible existence of three isomers of dichloroethane?

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

(Note that there are **TWO** isomeric resonance-stablized **PRODUCTS**, one with a new N-H bond, the other 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. (4.5 min) **ADD BONDS and CHARGES** as necessary to complete **all** partial structures in this scheme.

B. (6 min) In **species A identify and label** plausible HOMO and LUMO and draw curved arrows to show formation of ONE of the resonance structures of species B. In the space below enumerate the **FACTORS** that makes these two molecular orbitals particularly reactive

HOMO

LUMO

C. (2 min) Identify plausible HOMO and LUMO **in ONE** of the resonance structures of **species B**.

D. (4.5 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".

8. (4 min) **Circle** the HOMO of F-CH_3 and **explain** your choice (solid and dashed contours have opposite sign).