Chemistry 125 Third Examination

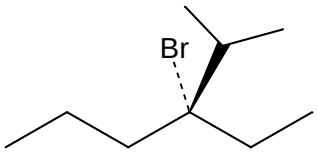
Name _____

November 18, 1998

The exam budgets 50 minutes, but you may have 70 minutes to finish it. Good answers can fit in the space provided.
Read each question carefully to see what it asks for, and be sure to answer all of its parts.
Your goal should be to answer the questions, not to show how much you know.

1 . (1 min) Give the **average bond energy** for a C-C single bond: _____kcal/mole.

2 . (5 min) Give the **complete, systematic name** for the following isomer of $C_9H_{19}Br$.



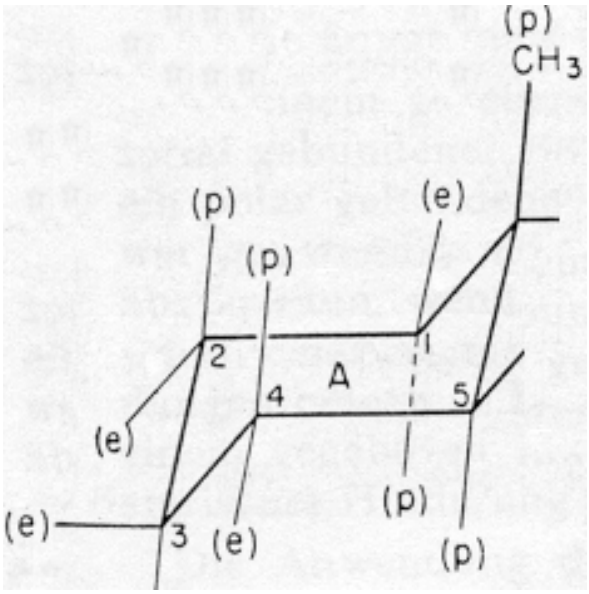
3 . (3 min) If you could not look up any values, what **three measurements** would you make to determine the **heat of formation** for a hydrocarbon? **How** would you use the three values to get ΔH_f?

4 . (3 min) **Name** the **Six** sources of strain energy calculated by molecular mechanics in *Chem3DPro*.

5 . (3 min) **Explain** how two sources of strain energy compete to determine the conformation of cyclopentane.

6 . (5 min) Here is a portion of a drawing of a steroid molecule taken from the 1950 paper that earned Barton his Nobel Prize for introducing organic conformational analysis.

For purposes of this question **pretend that the drawing shows a chair form of methylcyclohexane**.



a) Barton labeled the bonds *polar* (p) and *equatorial* (e). **What do we call them now?**

Polar =

Equatorial =

b) Fix this figure by **putting a small 'x'** through every bond whose direction is wrong by more than about 15 degrees and **redrawing it**.
(Don't redraw the labels, just the erroneous bonds.)

c) Complete names of the constitutional and configurational relationships between the **"p" hydrogens on carbons 2 and 4** of this structure:

Configurationally _____topic. Configurationally _____topic.

d) Circle the class(es) of reagents that might react faster with one of these two "p" hydrogens than the other.

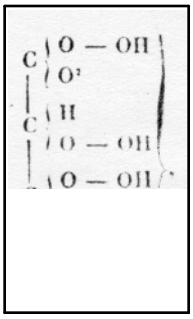
Achiral Reagents Resolved Chiral Reagents No Conceivable Reagent

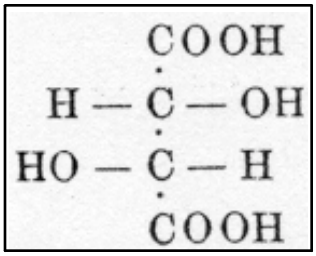
7 . (5 min) **Explain** how the energy difference between the conformational isomers of *n*-butane can be used to estimate the energy difference between the methylcyclohexane chair in Question 5 and the isomer formed by flipping the ring to interchange p and e bonds. Estimate the value of this energy difference in **kcal/mole**.

There is surely no more venerable set of compounds in the annals of structural organic chemistry than

Tartaric Acid and its Isomers.

8 . (7 minutes) Here are an alphabetical list of **chemists**, a chronological list of **dates**, and a random list of **names or formulas** for tartaric acid and related compounds.





Wasserstoff	3,0015
Kohle	36,8060
Sauerstoff	60,1895
	100,0000.

Berzelius

Bijvoet

Couper

Fischer

Lavoisier

Pasteur

van't Hoff

1789

1830

1848

1857

1858

1877

1891

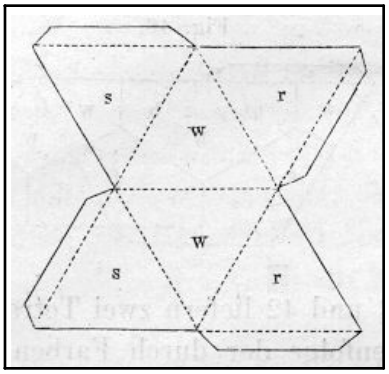
1949

oxydable tartarous radical

moldy racemic acid

sodium rubidium tartrate

sodium ammonium tartrate



Draw STRAIGHT lines connecting each **date** with the proper **chemist** and **formula or name**.
(The lines for 1789 are drawn as an example. Draw carefully so there can be no ambiguity.)

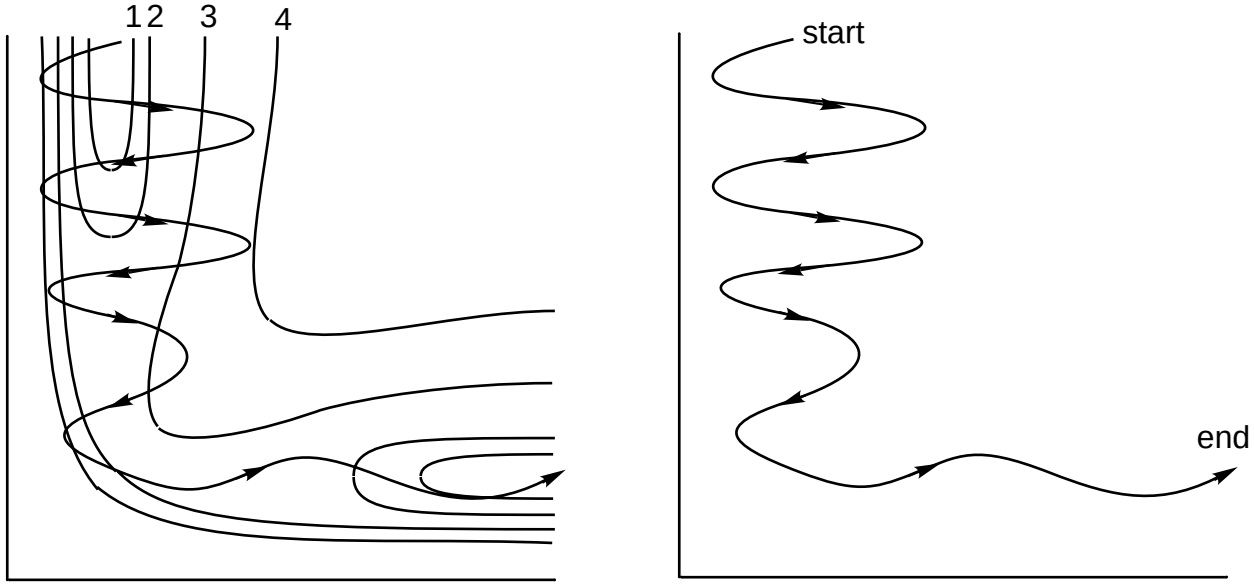
HINT: One chemist needs two dates, 1848 and 1857. The latter date was not mentioned in lecture.

9. (12 min) Choose **Four (4 only)** examples from the previous page. For each of the four **explain briefly** (~ two sentences) how the work in which the compound or figure appeared made an important contribution to the **development of organic structural theory**.

10. (2 min) In 1951 a chemist named Buchanan noted that, "standard text books [are] about equally divided in naming dextro-rotatory tartaric acid D(+) or L(+)."

Explain the source of this confusion in nomenclature.

11. (4 min) The diagram on the left shows a hypothetical trajectory superimposed on a potential energy surface (PES). The lowest-energy contour is labeled 1; the highest is labeled 4. For clarity the trajectory is shown on the right without the PES.



a) **What chemical system** might this PES describe? _____

b) **Label the axes** of the PES.

c) In words **describe what the atoms are doing** during this trajectory.