Your answers to this exam are to be only your own work. You may use no written information during this test period other than the five pages of this exam. You may not use the back of any pages for answers. You may not use any electronic device during the exam (e.g. cell phones).
Up to one week (exactly 168 hours) after your exam is returned you may submit it for regrading if and only if you have made NO marks on the exam except for a star (*) ON THIS PAGE next to the number(s) of the question(s) you would like regraded.

your signature (read the above before signing)

To request regrading, sign below and check the appropriate boxes.

your signature
I would like the questions marked with a star (*) regraded (check box at right) □
If you feel that we have made an addition error in your score, check the box at the right □
1. The activation energy difference necessary to produce a rate difference of 100:1 is:
   - 4.1 kcal/mole
   - 13.5 kcal/mole
   - 1.35 kcal/mole
   - 2.7 kcal/mole

2. The pKₐ water is:
   - 7
   - 4.7
   - 15.7
   - 14

3. Hybridization of an s and three p orbitals results in:
   - 3 sp hybrid orbitals
   - 3 sp² hybrid orbitals
   - 2 sp hybrid orbitals
   - 3 sp³ hybrid orbitals

4. The energy difference between guače and anti butane is:
   - 2.9
   - 1.7
   - 0.9
   - 3.2

5. The energy difference between axial and equatorial methylcyclohexane is:
   - 2.9
   - 1.7
   - 0.9
   - 3.2

6. Draw an example of a fused bicyclic hydrocarbon with formula C₇H₁₂.

7. Using line notation, draw structures for the following compounds in the boxes provided. Circle all centers of chirality (do not guess, wrong answers will count against correct ones).

   2,3,2-dimethylheptane  3-methylhexane  cis-1,2-dimethylcyclopropane
8. Draw circles around all of the secondary carbon atoms in the structure below:

9. Draw circles around all of the tertiary carbon atoms in the structure below:

10. Draw Newman projections for gauche and anti butane using the drawings below as a starting point. Label each.
11. Draw all possible constitutional isomers of C\textsubscript{7}H\textsubscript{16} (as line notations, no atoms, only bond lines). Put your answers in the boxes below. Put one and only one isomer in each of the boxes below. Each correct answer will receive 1 point. However, if an isomer is given more than once, none of them will count. There may be more boxes than you need. A bonus will be awarded for perfect answers to this question.
12. Provide a drawing and no more than 15 words that clearly shows and explains why axial methylcyclohexane is less stable than is the equatorial isomer. (Each word over 15 will result in one point being subtracted from the score for this question.)

13. There are several centers of chirality in the structures provided below. Determine for each if it is R or S, place your answer in a circle near the center, and draw a line from the circle to the center. Do not guess, as each wrong answer will cancel credit for a correct one. There are more circles than you need.