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. Up to one week 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 (*) next to the number(s) of the question(s) you would like regraded.

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 2 3 4 5 6 7 8 9 0
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1. The activation energy difference necessary to produce a rate difference of 1000:1 is:
   - 4.1 kcal/mole
   - 13.5 kcal/mole
   - 1.35 kcal/mole
   - 2.7 kcal/mole

2. The pKₐ of H₂O is:
   - 7
   - 60
   - 15.6
   - 14

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

4. The electronegativity of N is:
   - 2.5
   - 3.0
   - 3.5
   - 4.0

5. The pKₐ of H₂O is:
   - 7
   - 60
   - 15.6
   - 14

6. In heptane, all of the carbon atoms have hybridization of:
   - sp
   - sp³
   - sp²
   - sp⁴

7. Draw electron-dot pictures for NH₃ and –OH including all lone pairs of electrons. Place your answers in the boxes below.

8. Using line notation, draw structures for the following compounds in the boxes provided.

   - 3-ethylheptane
   - 3-isopropylpentane
   - 3,3-diethylpenane
9. Label all carbon atoms in 2,3,3-trimethylpentane as primary, secondary, tertiary, or quaternary using the symbols: 1˚, 2˚, 3˚, 4˚. Use the structure provided in the box below.

![Structure](image)

10. Draw the expected potential-energy diagram for the rotation about the C3-C4 bond in 2-methylpentane. Only relative energy positions are required, you need not and should not include any energy values. Include the Newman projections of each staggered conformation. Include a Newman projection of the highest energy eclipsed conformation. Put your answer in the box below.

![Potential-Energy Diagram](image)
11. In the structures shown below, draw circles around all methyl groups and rectangles around all ethyl groups. Do not guess. A wrong answer will remove credit for a correct one.
12. Draw all possible constitutional isomers of $C_7H_{16}$ (as line notations, no atoms, only bond lines). Put your answers in the boxes below. But one and only one isomer in each of the boxes below. If you duplicate an isomer, neither answer will receive credit. There may be more boxes than you need. A bonus will be awarded for perfect answers.

[Boxes for drawings]