Question 1 (12 pts) Give the IUPAC name for the following structure.

Question 2 (25 pts) For the following structure:

a) Draw both chair conformations.

b) Determine the energy difference between the two chair conformations using the tables on the front page of this test. **Be sure to clearly show each energy contribution that you take into account when answering this question**

c) Indicate the lower energy chair.

EXTRA CREDIT (5 pts) Which of these techniques forms the basis for the device that is used to detect traces explosives and/or narcotics at airport security checkpoints?

- mass spectrometry
- infrared spectroscopy
- proton nmr spectroscopy
- carbon nmr spectroscopy
Question 3 (6 pts.) Convert the following Newman projection into a 3-D/sawhorse structure

```
     Me
   /   
Pr  H  Et
   
Br  Me
```

Question 4 (25 pts.) For 3-methylhexane
a) Draw a line-angle structure
b) Draw Newman projections (only, no 3-D/sawhorse structures) corresponding to the lowest AND highest energy conformations for rotation around the C3-C4 bond, **draw the Newmans looking FROM THE C4 CARBON TO THE C3 CARBON** (i.e. with the C4 carbon in “front”)
c) Determine the energy difference between these conformations (use the data in the tables on the front page of this test), **be sure to clearly show each energy contribution that you take into account when answering this question**
Question 5  (22 pts.) Assign the BOTH IR spectra to ONE of the THREE provided structures A - C. ONE of the structures does not have a provided spectrum. On each spectrum, identify the peaks that are associated with a specific functional group or type of C-H bond by drawing the functional group or bond and drawing an arrow from the specific bond in the functional group that vibrates to the absorption peak, as appropriate.

the spectrum below corresponds to structure ______

the spectrum below corresponds to structure ______
Question 9 (26 pts) Provided are spectra for a compound with molecular formula C_{10}H_{14}

a) Give the degrees of unsaturation ________________

b) On the infrared spectrum, indicate which peaks correspond to which functional groups

[Image of infrared spectrum with peaks labeled: 1941, 1803, 1598, 1354, 1031, 779, 762 cm\(^{-1}\).]

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c) draw the structure and clearly indicate which hydrogens correspond to which signals in the proton nmr spectrum

[Image of proton nmr spectrum with signals at 1H, 1PPM, 2H, 3H, and 5H indicated.]