Question 1

Which best describes the relationship between the following two structures?

A structural isomers
B different structures and not isomers
C stereoisomers
D the same thing

trans-1,3-diethylcyclohexane = trans-1,3-diethylcyclohexane = OR

cis-1,3-diethylcyclohexane
Question 2
MC191

What is the energy difference between the two chair conformations of the following molecule?

A  1.5 kcal/mol
B  3.7 kcal/mol
C  0.55 kcal/mol
D  3.15 kcal/mol

<table>
<thead>
<tr>
<th>ECLIPSING Interactions</th>
<th>Energy kcal/mol</th>
<th>GAUCHE Interactions</th>
<th>Energy kcal/mol</th>
</tr>
</thead>
<tbody>
<tr>
<td>H/H</td>
<td>~1.0</td>
<td>Me / Me</td>
<td>~0.9</td>
</tr>
<tr>
<td>H/Me</td>
<td>~1.4</td>
<td>Et / Me</td>
<td>~0.95</td>
</tr>
<tr>
<td>Me / Me</td>
<td>~2.6</td>
<td>i-Pr / Me</td>
<td>~1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>t-Bu / Me</td>
<td>~2.7</td>
</tr>
</tbody>
</table>

draw the 2 chairs and determine the energy cost associated with the various substituents. Remember that 1 axial group "cost" is roughly the same as two gauche interactions with a methyl group. Don't forget the Me/Et gauche interaction on the RED chair.

1 Et group axial, energy cost = 2 x (Me/Et) = 1.9 kcal/mol
1 Me group axial, energy cost = 2 x (Me/Me) = 1.8 kcal/mol

TOTAL energy cost = 3.7 kcal/mol

1 i-Pr group axial, energy cost = 2 x (Me/i-Pr) = 2.2 kcal/mol
1 Me/Et gauche, energy cost = 0.95 kcal/mol

TOTAL energy cost = 3.15 kcal/mol

DIFFERENCE = 3.7 - 3.15 = 0.55 kcal/mol
Question 3
MC23h

which of the provided compounds has this IR spectrum?

B would have 2 peaks due to N-H at ca. 3300, and also a broad weak band around 3000 (not observed), and would also not have C=O etc.

C would also have O-H (not observed), would not have benzene peak at ca. 1600.

D would not have carboxylic acid O-H at ca. 3000 cm\(^{-1}\).
Question 4
MC19i

Which is the lowest energy conformation of the following structure?

A this is a conformation of a different molecule, THIS ONE >>>

B 1 Et axial, energy cost ~ (2 x 0.95) = 1.9 kcal/mol
1 Me axial, energy cost ~ (2 x 0.9) = 1.8 kcal/mol
TOTAL energy associated with substituents in B = 3.7 kcal/mol

C 1 Et axial, energy cost ~ (2 x 0.95) = 1.9 kcal/mol
1 Et/Me gauche interaction cost = 0.95
TOTAL energy associated with substituents in B = 2.85 kcal/mol
THUS C IS LOWER IN ENERGY THAN B

D this is a conformation of a different molecule, THIS ONE >>>
Question 5
MCir3
which of the provided compounds has this IR spectrum?

- not an alcohol RO-H centered at ca. 3300
- broad COO–H centered at ca. 3000
- C=O at ca. 1720
- not an aldehyde because it also has the broad -OH signal

A  B  C  D
which of the provided compounds has this IR spectrum?

A would not have benzene peak at 1600 and no sp2 C-H

C would have N-H peaks at ca. 3300 and also strong C=O at ca. 1640

D would have carboxylic acid O-H centered ca. 3000
Question 7
MC23f
Identify the structure with the following IR spectrum

2 peaks ~3350 & 3200 probable -NH2
C=O, ~1650 cm⁻¹, probable amide

A
B
C
D

would not have C=O stretch
no broad -OH observed at ca. 3300
no broad -OH observed at ca. 3000
Question 8

Identify the Newman projection that represents the HIGHEST energy conformer for rotation around the C3-C4 bond in 2,2,3,5,5-pentamethylhexane. You need to identify the Newman projection that has C3 at the FRONT.

\[ R = \text{CH}_2\text{C(Me)}_3 \quad \text{and} \quad R = \text{CH}_2\text{C(Me)}_3 \]

1) start by drawing the structure

2) identify the bond we are concerned with, and "look" with C3 at the front, as shown

3) identify the 3 groups that are attached to the atom at the front (C3) and at the back (C4)

4) the HIGHEST energy conformation will be a fully eclipsed, with the largest substituents (t-Bu) eclipsing

Answer C =

Answer A is the correct conformation, but with C4 in the front!!!!

Answers B and D look down the C2-C3 and C3-C2 bonds, respectively