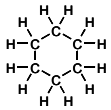
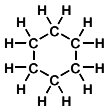
Cycloalkanes



cyclohexane

The C-C-C bond angles in cyclopropane are 60°.

cyclopropane

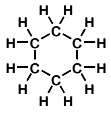


cyclohexane

incorrect		correct
0%	A. Very sure this is true	100%
20%	B. Somewhat sure this is true	80%
40%	C. Maybe this is true	60%
40%	D. Maybe this is false	60%
20%	E. Somewhat sure this is false	80%
0%	F. Very sure this is false	100%

The C-C-C bond angles in cyclohexane are 120°.

cyclopropane



cyclohexane

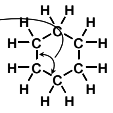
A. Very sure this is true
B. Somewhat sure this is true
C. Maybe this is true

D. Maybe this is false
E. Somewhat sure this is false
F. Very sure this is false

3

What are the C-C-C bond angles in cyclohexane?

cyclopropane

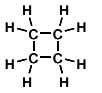


cyclohexane

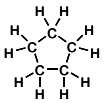
4

What are the shapes of these cycloalkanes?

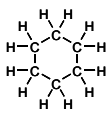
cyclopropane



cyclobutane

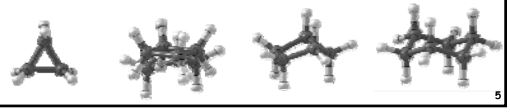


cyclopentane



cyclohexane

	cyclopropane	cyclobutane	cyclopentane	cyclohexane
planar	60°	90°	108°	120°
actual	60°	88°	105°	109.5°

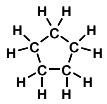


5

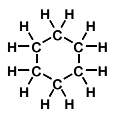
Which of these cycloalkanes is most stable?

A

B

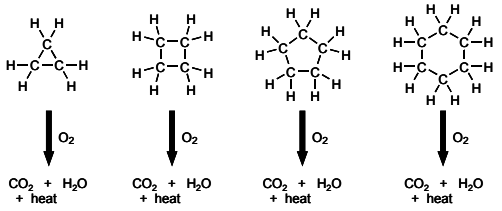


C



D

Which of these cycloalkanes is most stable?

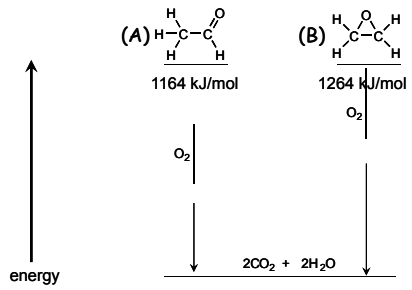


$\Delta H°/CH_2$ (kJ/mole) = 697 686 664 659

$\Delta H°/CH_2$ in unstrained alkanes ($CH_3—(CH_2)_n—CH_3$) = 659 kJ/mole

strain energy (kJ/mole) = 116 110 42 no strain energy

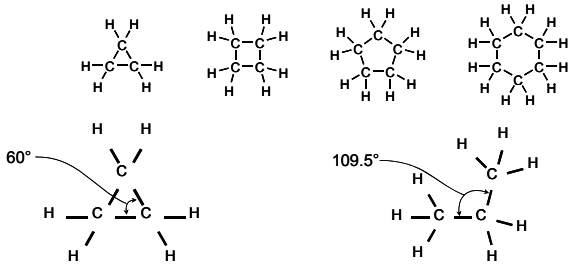
The heats of combustion for ethylene oxide acetaldehyde are given below. Which of these compounds is more stable?



8

What are the origins of ring strain?

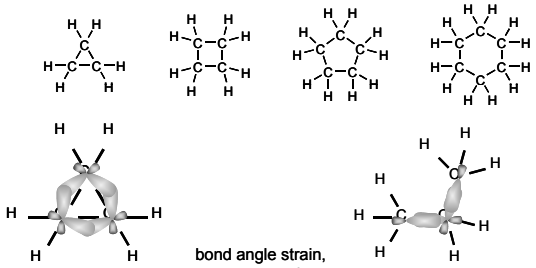
strain energy	116 kJ (27.7 kcal)/mol	110 kJ (26.3 kcal)/mol	42 kJ (10 kcal)/mol	no strain energy



9

What are the origins of ring strain?

strain energy	116 kJ (27.7 kcal)/mol	110 kJ (26.3 kcal)/mol	42 kJ (10 kcal)/mol	no strain energy

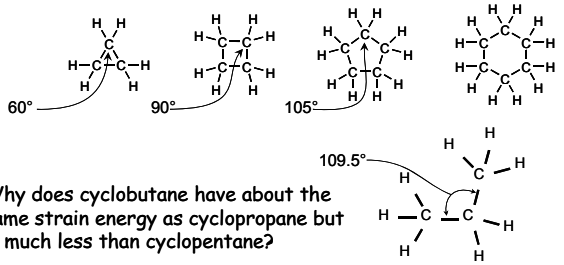


bond angle strain, electrons are further from the nuclei

10

1. Bond angle strain. 2. Torsional strain.

strain energy	116 kJ (27.7 kcal)/mol	110 kJ (26.3 kcal)/mol	42 kJ (10 kcal)/mol	no strain energy

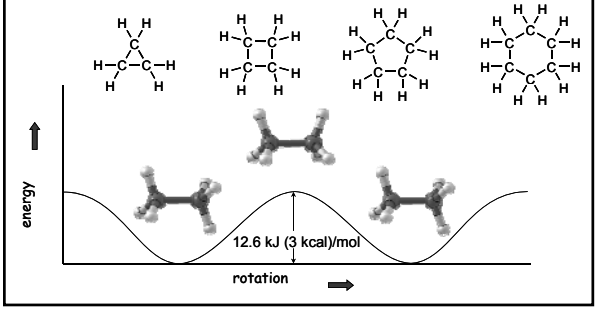


Why does cyclobutane have about the same strain energy as cyclopropane but is much less than cyclopentane?

11

1. Bond angle strain. 2. Torsional strain.

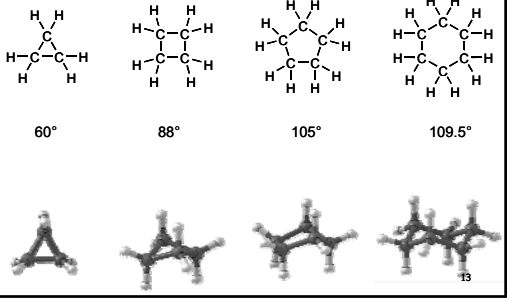
strain energy	116 kJ (27.7 kcal)/mol	110 kJ (26.3 kcal)/mol	42 kJ (10 kcal)/mol	no strain energy



Why are cyclobutane and cyclopentane puckered?

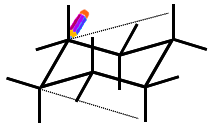
A. Bond angle strain. B. Torsional strain.

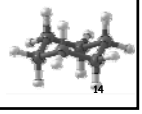
strain energy	116 kJ (27.7 kcal)/mol	110 kJ (26.3 kcal)/mol	42 kJ (10 kcal)/mol	no strain energy
C-C bond angles	60°	88°	105°	109.5°



13

How can we draw a cyclohexane ring?

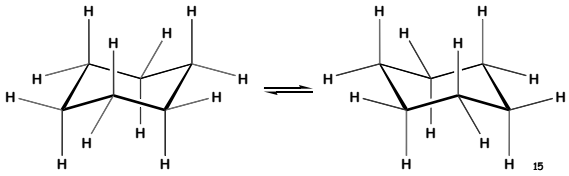




14

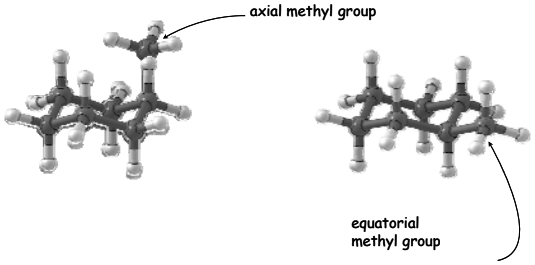
How many chemically different kinds of C-H bonds are there in cyclohexane?

A. 1 B. 2 C. 3 D. 4 E. 6 F. 12



15

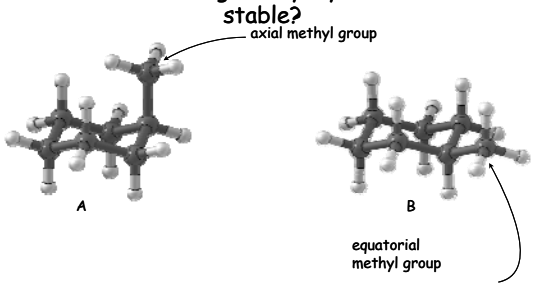
How many methylcyclohexanes are there?



A. 1 B. 2 C. 3 D. 4 E. 6 F. 12

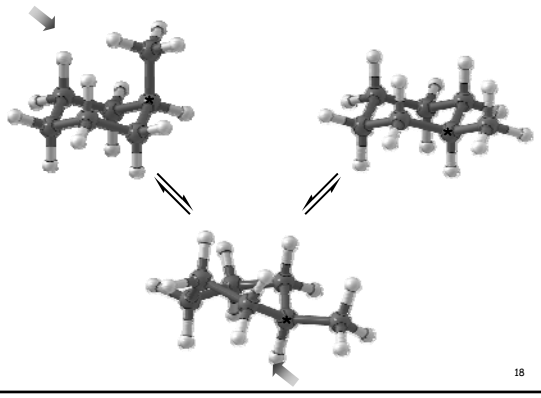
16

Which of the following methyl cyclohexanes is most stable?



17

How many methylcyclohexanes are there?



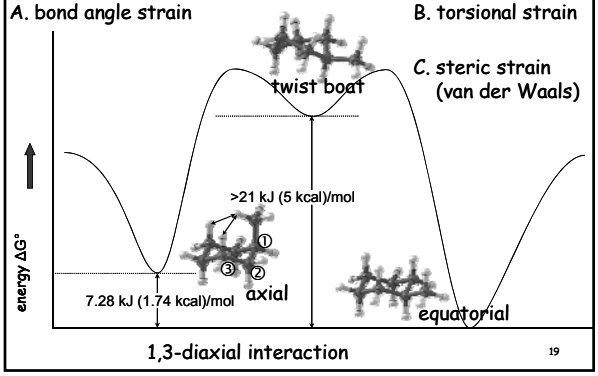
18

Why is the axial conformation less stable than the equatorial conformation?

A. bond angle strain

B. torsional strain

C. steric strain (van der Waals)



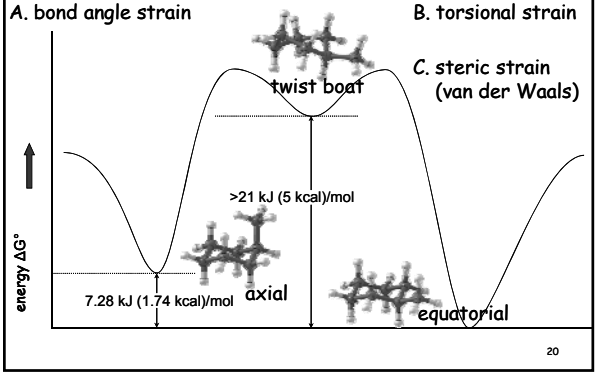
19

Why is the twist boat conformation less stable than the equatorial or axial conformation?

A. bond angle strain

B. torsional strain

C. steric strain (van der Waals)



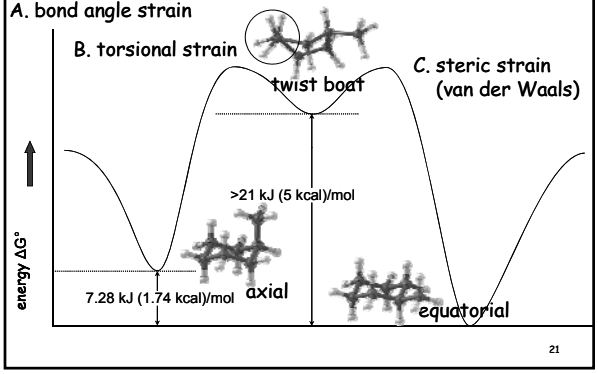
20

Why is the twist boat conformation less stable than the equatorial or axial conformation?

A. bond angle strain

B. torsional strain

C. steric strain (van der Waals)

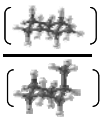


21

What is the approximate axial/equatorial K_{eq} at RT?

A. ≈ 0.031 B. ≈ 0.16 C. ≈ 1.8 D. ≈ 19 E. ≈ 230 F. ≈ 21000

when $\Delta G° = 5.7$ KJ/mol then $K_{eq} = 10^1$

$K_{eq} =$  $= 10^{7.28/5.7} = 10^{1.28} \approx 19$

22

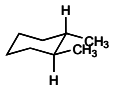
How much of the equatorial conformation of methylcyclohexane would be present at room temperature?

$\Delta G° = -RT/n\ K_{eq}$

5% 95%

23

How many different 1,2-dimethylcyclohexane structures exist in the chair conformation?



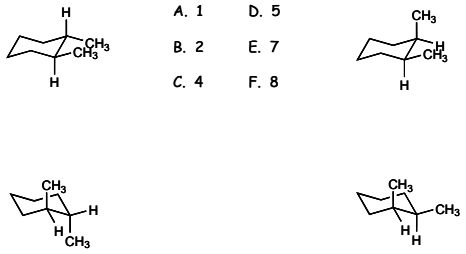
A. 1 D. 5

B. 2 E. 7

C. 4 F. 8

24

How many different 1,2-dimethylcyclohexane structures exist in the chair conformation?



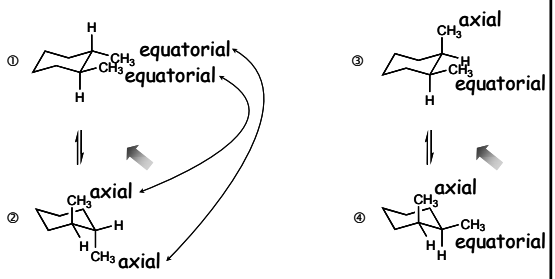
A. 1 D. 5

B. 2 E. 7

C. 4 F. 8

25

Which of these represent different conformations?



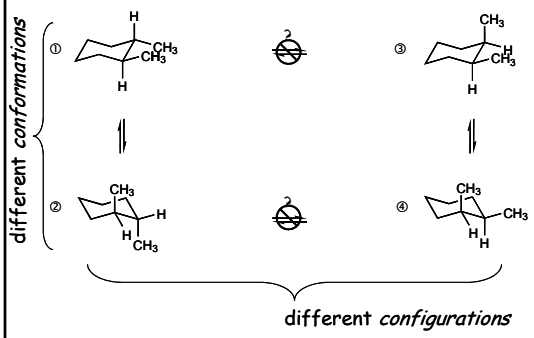
A. ① + ②

B. ① + ③

C. ① + ④

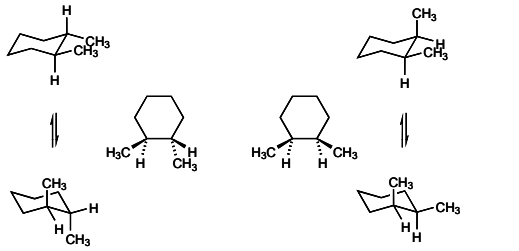
26

Are ① and ③ or ② and ④ interconvertable by a conformational change?



27

Do these different configurations have different names?

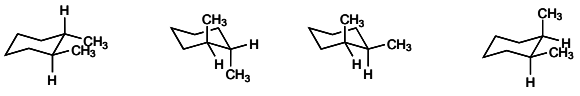


trans-1,2-dimethylcyclohexane

cis-1,2-dimethylcyclohexane

28

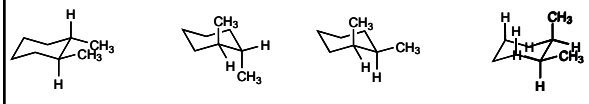
Which of the following isomers is the most stable?



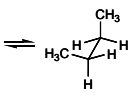
A B C D

29

How can the stabilities of these isomers be estimated?

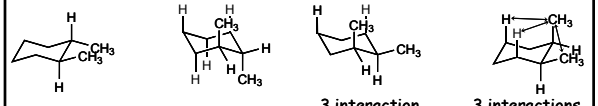


a gauche butane interaction



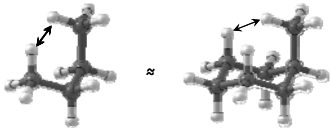
30

How can the stabilities of these isomers be estimated?



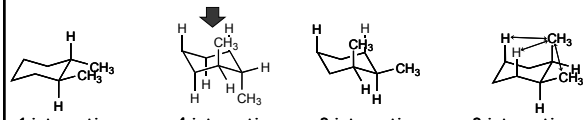
3 interaction 3 interactions

a gauche butane interaction ≈ one diaxial interaction



31

How many gauche butane interactions are present in *trans diaxial*-1,2-dimethylcyclohexane?



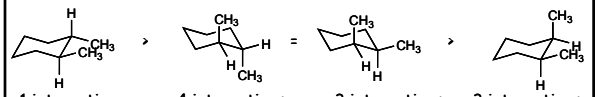
1 interaction 4 interactions 3 interaction 3 interactions

A = 0 B = 1 C = 2 D = 3 E = 4

a gauche butane interaction ≈ one diaxial interaction

32

What is the order of stability of these different isomers?



1 interaction 4 interactions 3 interactions 3 interactions

increasing stability

a gauche butane interaction ≈ one diaxial interaction

33

text