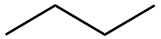
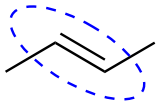
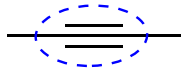
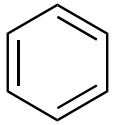
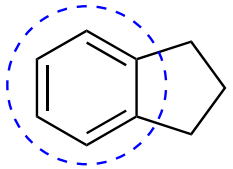
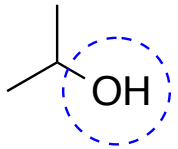
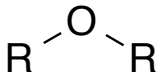
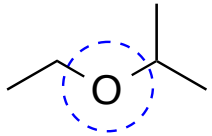
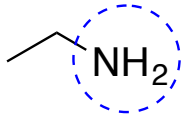
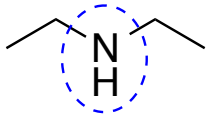
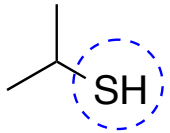
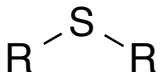
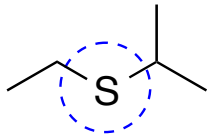
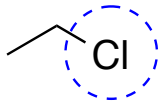
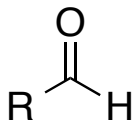
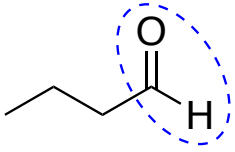
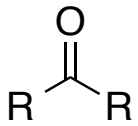
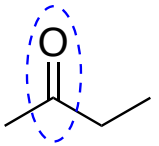
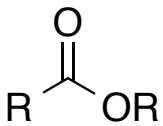
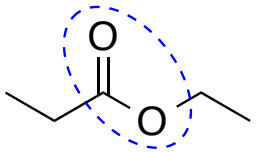
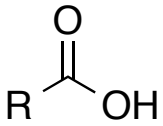
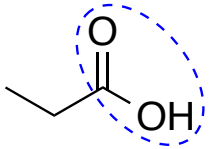
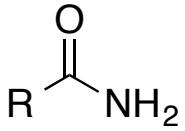
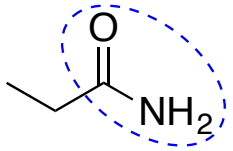
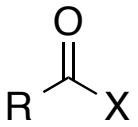
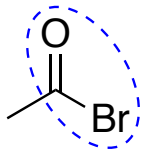
Organic Functional Groups

Hydrocarbons		
Name	**Functional Group**	**Examples**
Alkane (not really a functional group)	$R-H$	
Alkene	$R_2C=CR_2$	
Alkyne	$RC\equiv CR$	
Arene (Aromatic)		

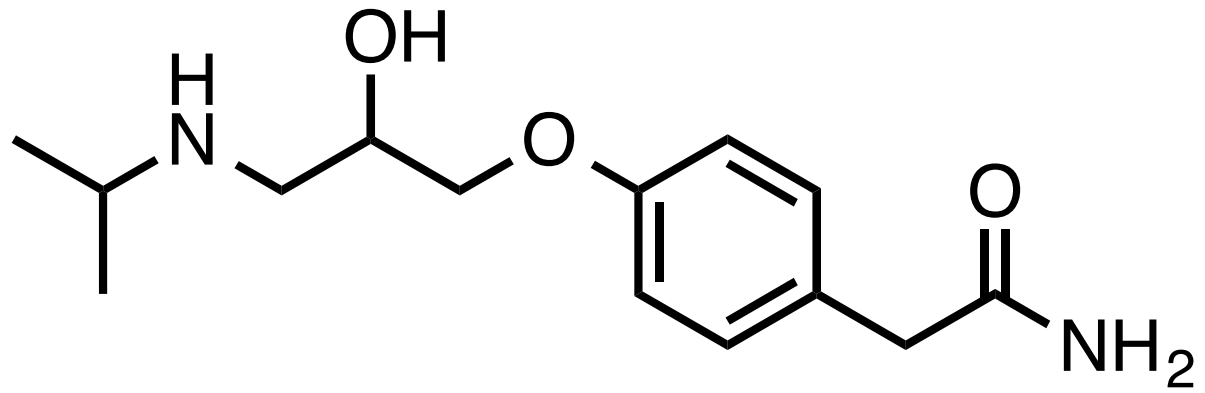
Organic Functional Groups

Heteroatom Containing		
Alcohol (hydroxy group)	R–OH	
Ether		
Amine (amino group)	$R–NH_2$ R_2NH R_3N	 
Thiol (mercapto group)	R–SH	
Sulfide		
Halide	R–X (X = F, Cl, Br, I)	

Organic Functional Groups

Carbonyl (C=O) Containing		
Aldehyde		
Ketone		
Ester		
Carboxylic Acid		
Amide		
Acid Halide		

Identify the functional groups in **Atenolol**, a beta-blocker used to treat high blood pressure.



atenolol

Heroin, a morphine derivative and highly addictive opioid is shown below. Click on the _____ in the molecule below.

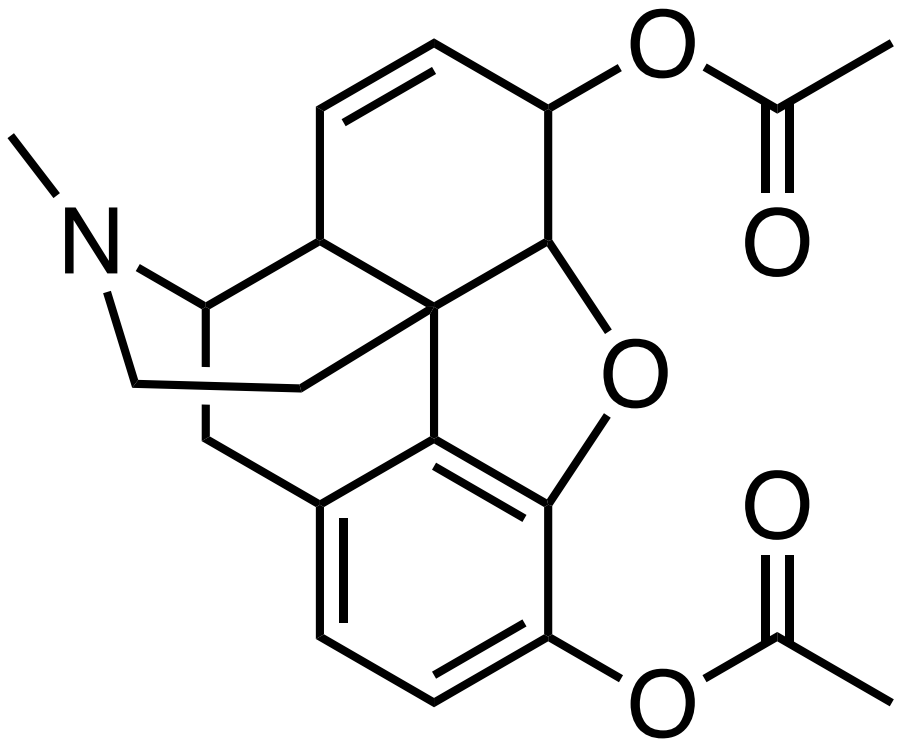
Amine

Alkene

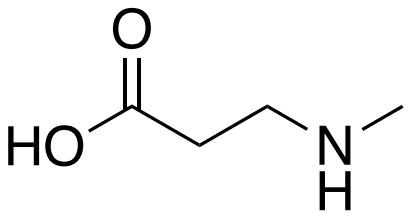
Arene

Ester

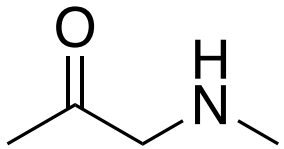
Ether



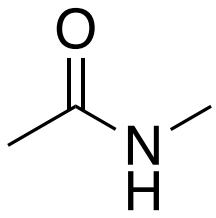
Which of the following compounds contain both a ketone and an amine functional group? You may select more than one answer.



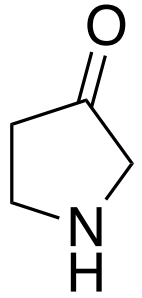
A



B

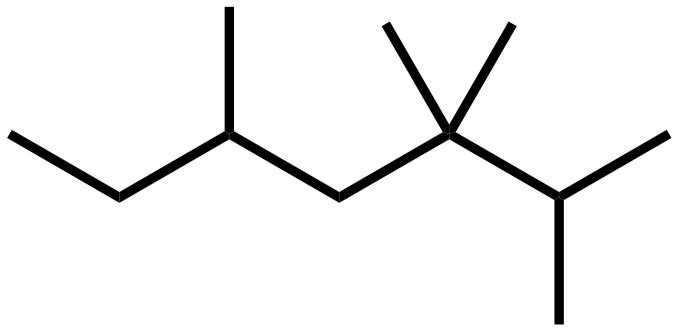


C

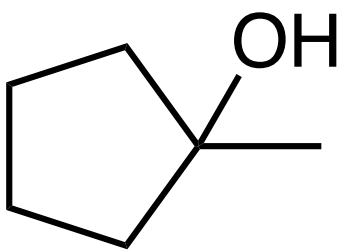


D

Click on every secondary carbon in the molecule below.



How would you best classify the following alcohol?



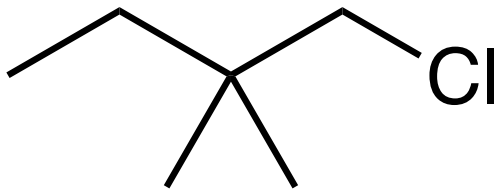
A. Primary alcohol

B. Secondary alcohol

C. Tertiary alcohol

D. Quaternary alcohol

How would you best classify the following chloride?



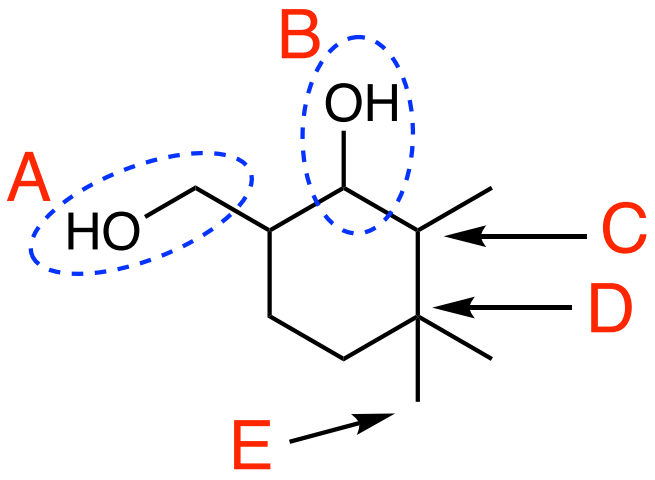
A. Primary chloride

B. Secondary chloride

C. Tertiary chloride

D. Quaternary chloride

Match the following with the appropriate term.



Tertiary Alcohol _____

Primary Alcohol _____

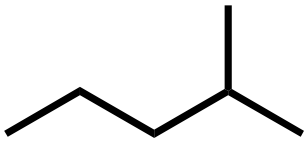
Primary Carbon _____

Tertiary Carbon _____

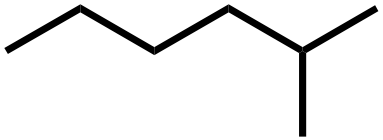
Quaternary Carbon _____

Which molecule below is isohexane?

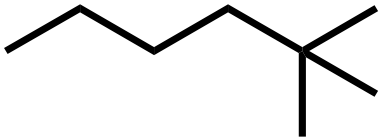
A



B

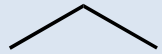
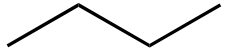
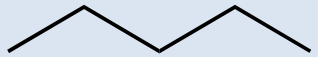
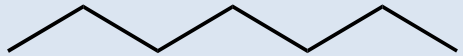
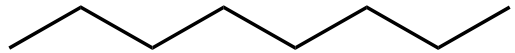
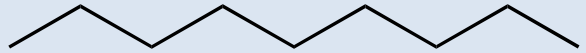


C



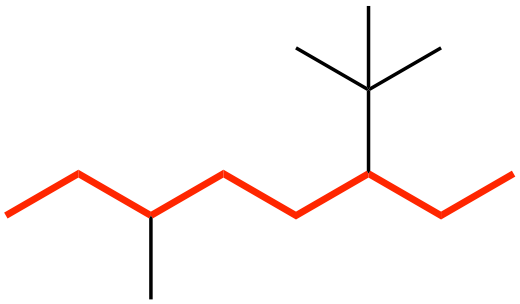
D

Alkanes

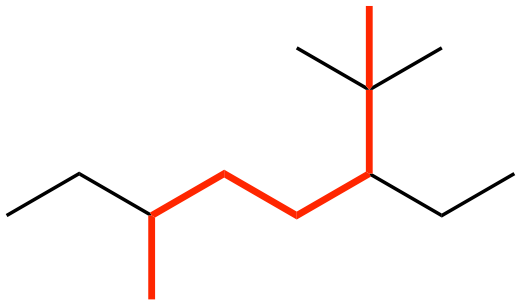
Name	# of Carbons	Condensed Structure	Skeletal Structure
Methane	1	CH_4	None
Ethane	2	CH_3CH_3	
Propane	3	$CH_3CH_2CH_3$	
Butane	4	$CH_3(CH_2)_2CH_3$	
Pentane	5	$CH_3(CH_2)_3CH_3$	
Hexane	6	$CH_3(CH_2)_4CH_3$	
Heptane	7	$CH_3(CH_2)_5CH_3$	
Octane	8	$CH_3(CH_2)_6CH_3$	
Nonane	9	$CH_3(CH_2)_7CH_3$	
Decane	10	$CH_3(CH_2)_8CH_3$	

Memorize the C1-C10 Names!

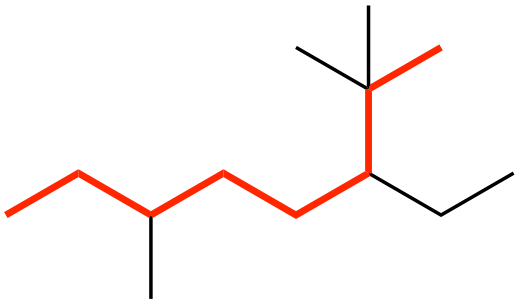
What is the correct parent chain in the compound below?



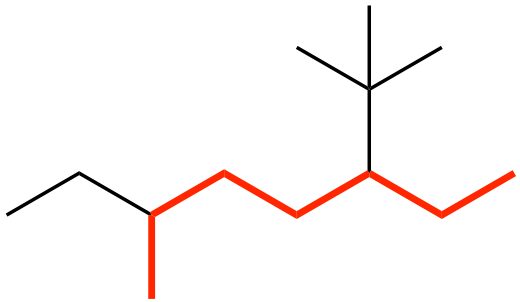
A



B

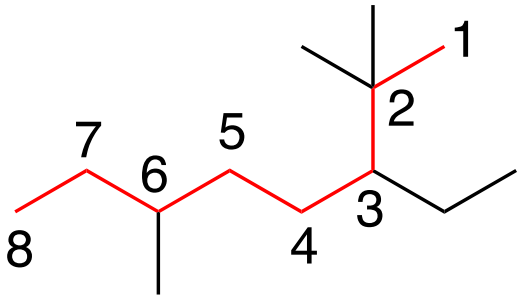


C

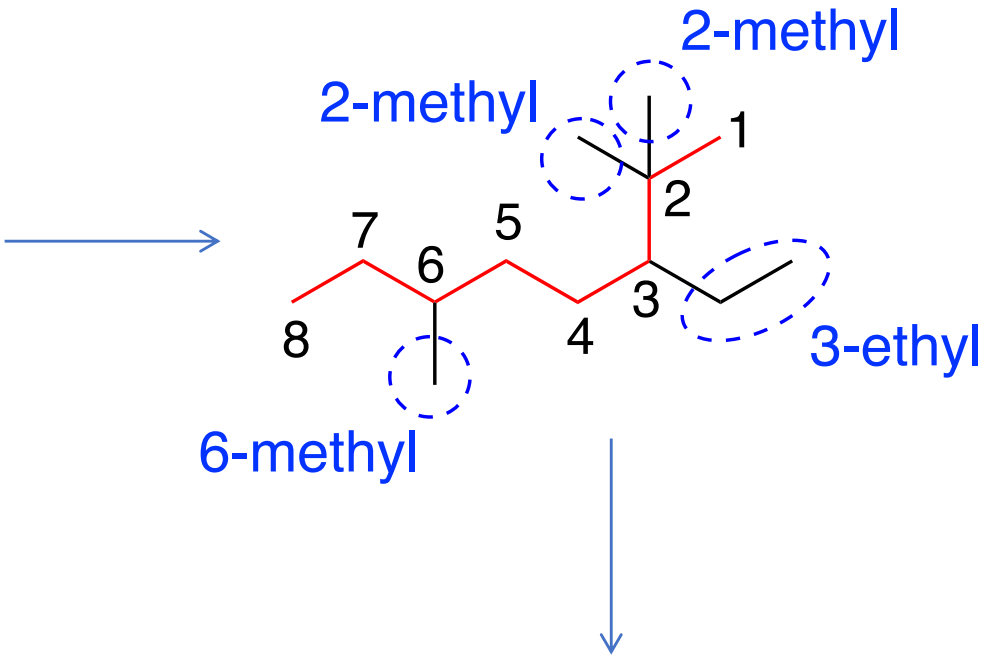


D

IUPAC Name

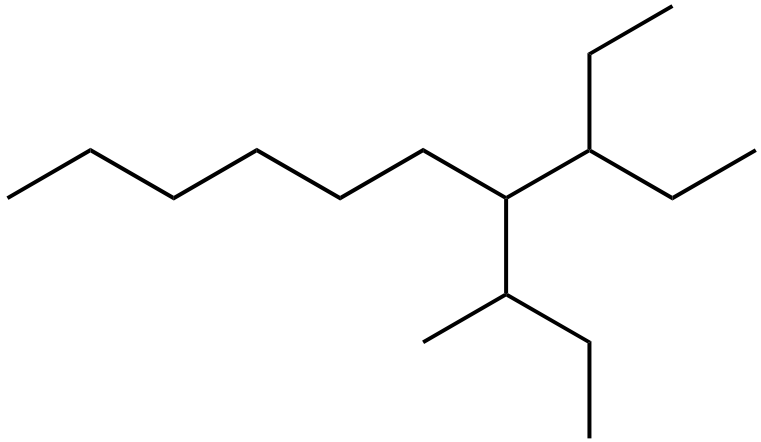


Parent = octane



3-ethyl-2,2,6-trimethyloctane

What is the correct IUPAC name for the compound below?



A. 4-sec-butyl-3-ethyldecane

B. 3-ethyl-4-(1-methylpropyl)decane

C. 4-(1-ethylpropyl)-3-methyldecane

D. 4-isopentyl-3-methyldecane

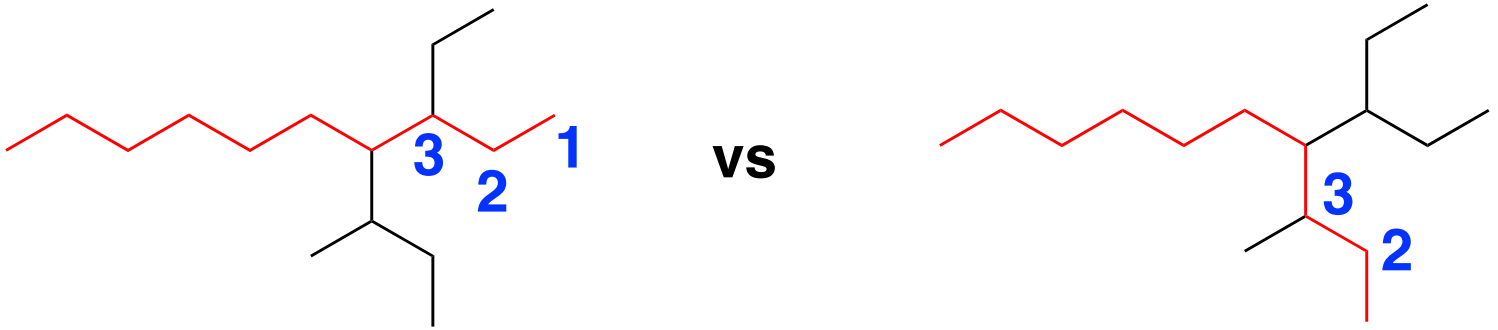
Solution

What is the correct IUPAC name for the compound below?

Find the longest carbon chain – 10 Carbons

Two or more chains of equal length:

1. Pick the one that has the most substituents – both have two substituents
2. Pick the one that gives the first substituent the lowest possible number – both have the first substituent on C#3
3. Compare the two 1st substituents and give alphabetical priority.

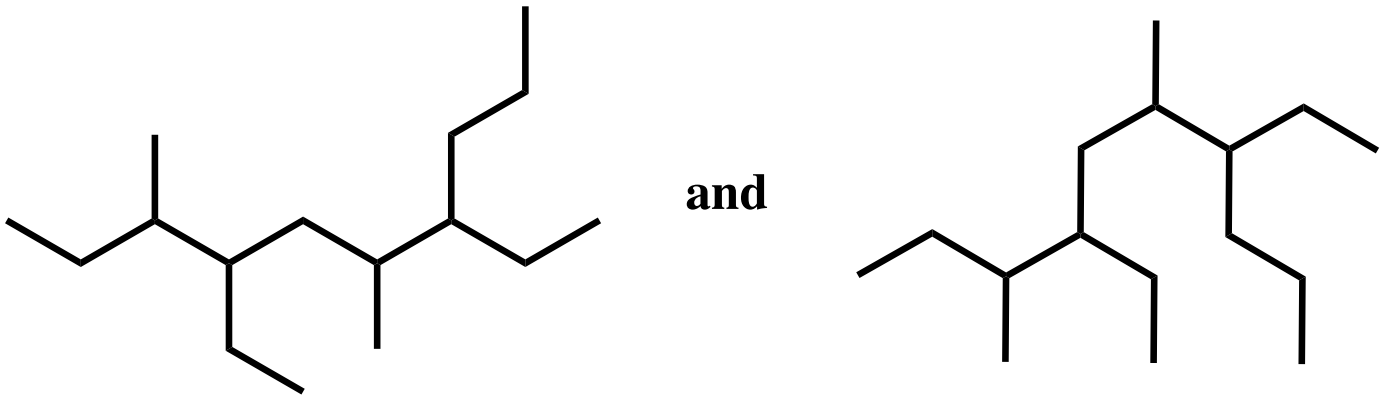


3-ethyl (better)

3-methyl

Are the two compounds below identical or constitutional isomers?

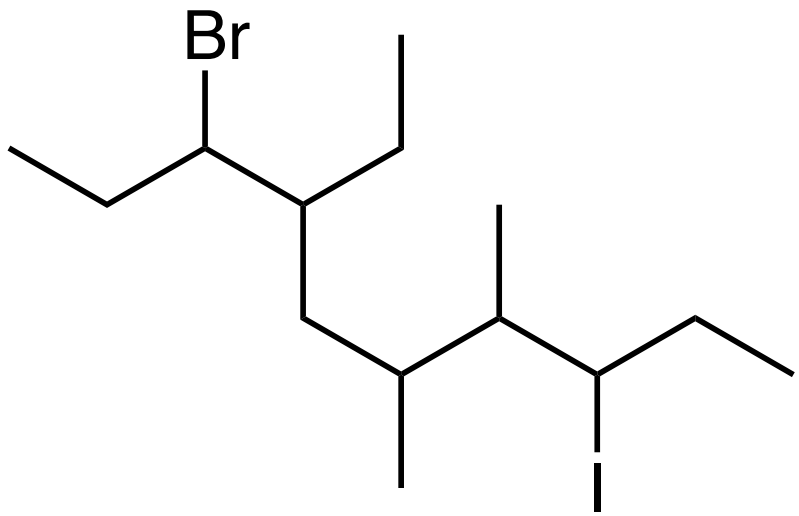
Constitutional Isomers = Compounds with the same molecular formula, but a different atom connectivity.



A. Identical

B. Constitutional Isomers

What is the correct IUPAC name for the compound below?



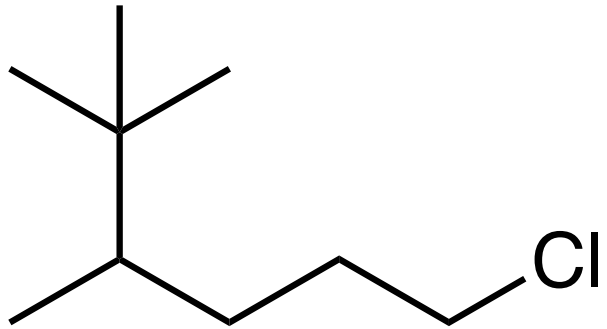
A. 3-bromo-4-ethyl-8-iodo-6,7-dimethyldecane

B. 8-bromo-7-ethyl-3-iodo-4,5-dimethyldecane

C. 3-iodo-4,5-dimethyl-7-ethyl-8-bromodecane

D. 3-bromo-4-ethyl-6,7-dimethyl-8-iododecane

What is the correct IUPAC name for the compound below?



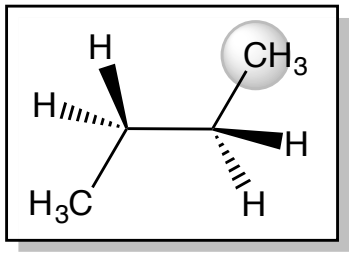
A. 1-chloro-4-tert-butylpentane

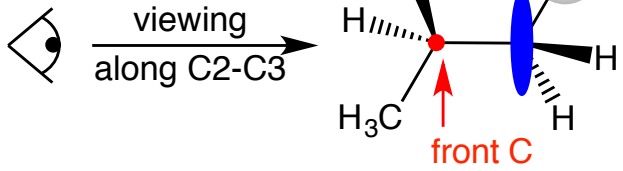
B. 4-tert-butyl-1-chloropentane

C. 1-chloro-4,5,5-trimethylhexane

D. 6-chloro-2,2,4-trimethylhexane

Conformational Analysis of Butane





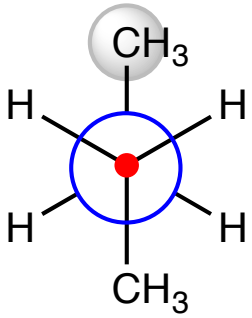
Conformational Energies

CH_3/CH_3 Gauche – 0.9 kcal/mol

H/H Eclipse – 1.0 kcal/mol

H/CH_3 Eclipse – 1.4 kcal/mol

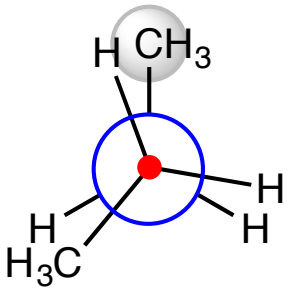
CH_3/CH_3 Eclipse – 2.6 kcal/mol



E_{rel} =

θ =

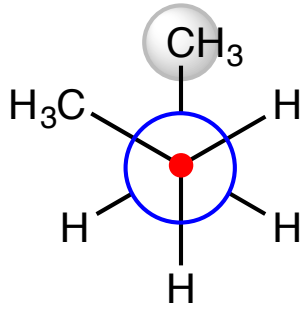
60°



E_{rel} =

θ =

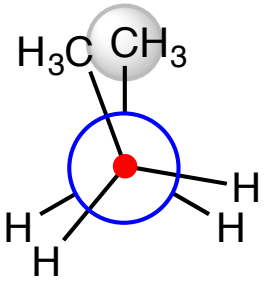
60°



E_{rel} =

θ =

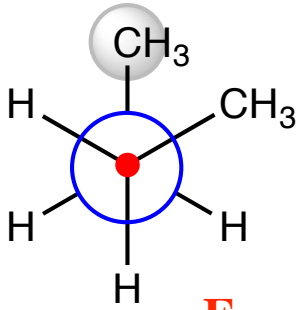
60°



E_{rel} =

θ =

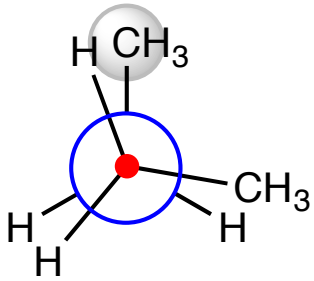
60°



E_{rel} =

θ =

60°

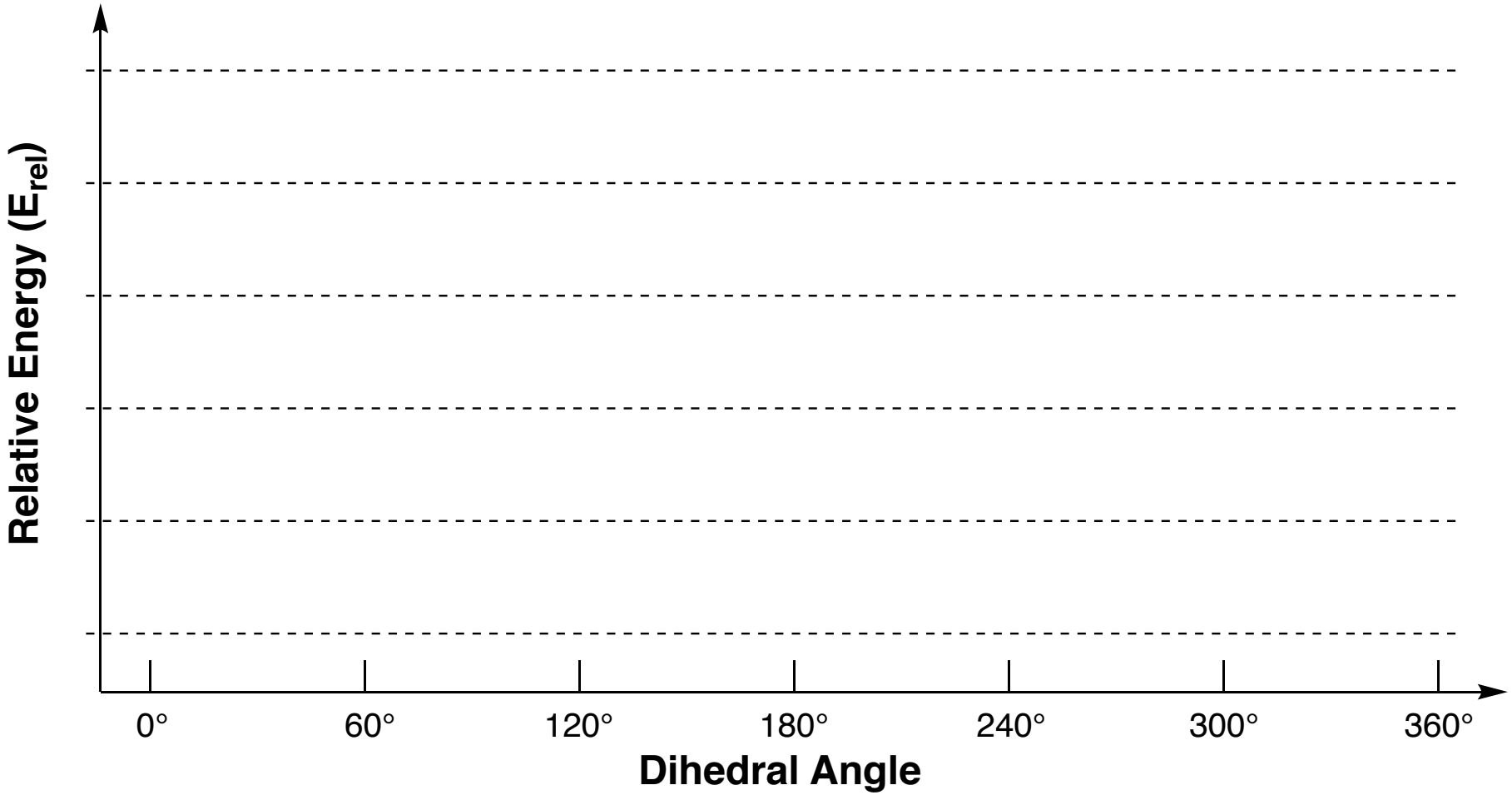


E_{rel} =

θ =

60°

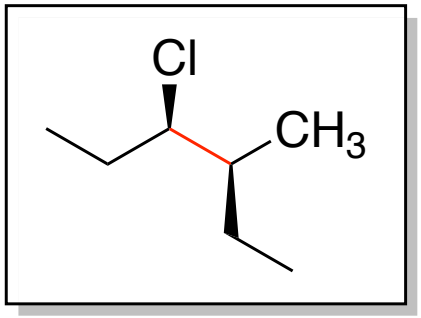
Butane Conformations – Energy Diagram

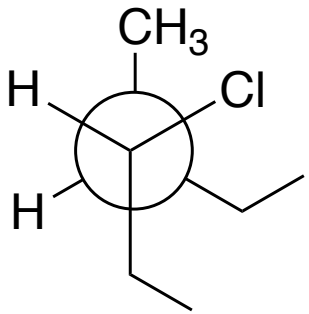


Strain Types

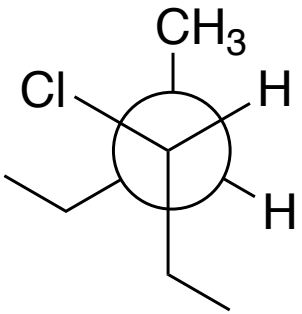
- Torsional – Caused from eclipsing atoms separated by 3 bonds.
- Steric – repulsion between atoms separated by more than 3 bonds.
- Angle – results from a deviation in ideal bond angle.

Which of the following is the correct Newman projection for the molecule shown below? *View along the bond in red.*

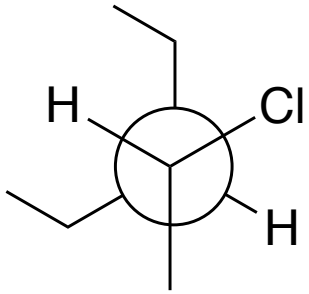




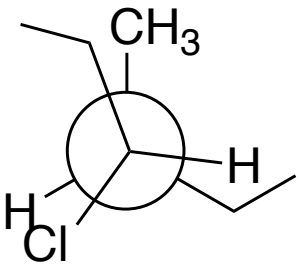
A



B

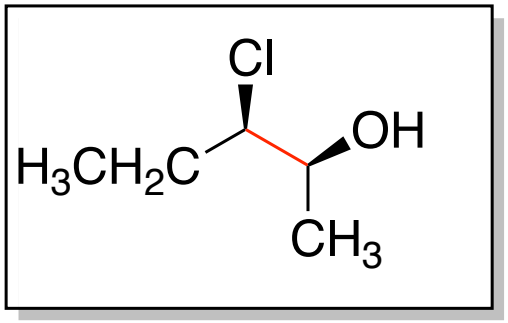


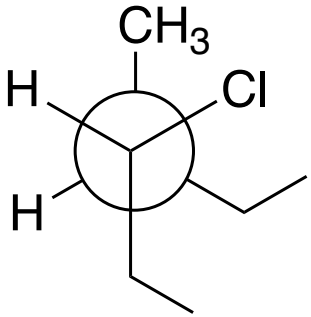
C



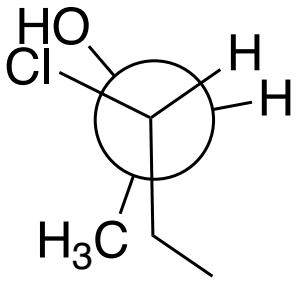
D

Which of the following is the correct Newman projection for the molecule shown below? *View along the bond in red.*

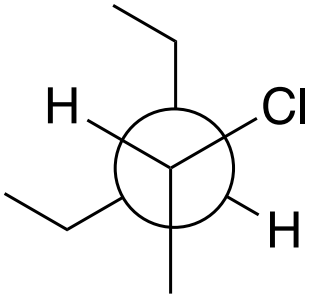




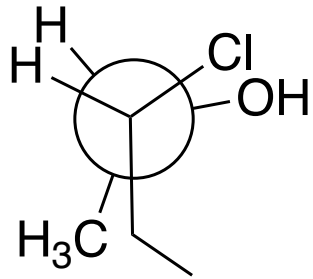
A



B

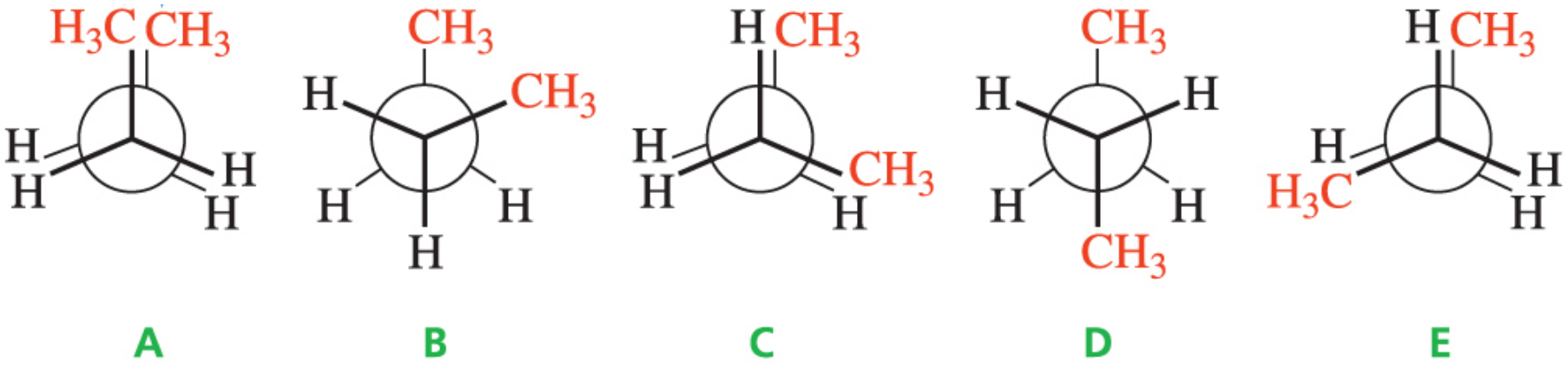


C



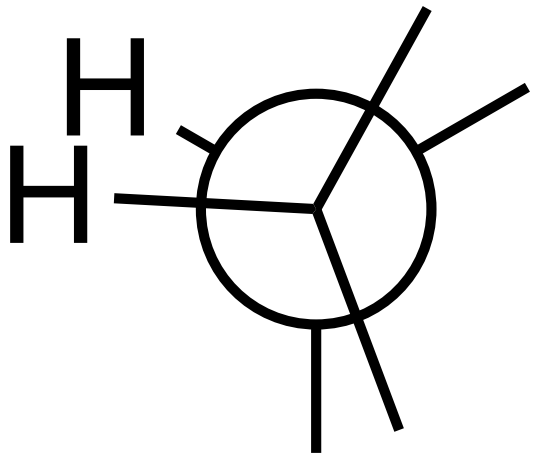
D

At room temperature, butane will exist in the highest percentage of which of the following conformations?

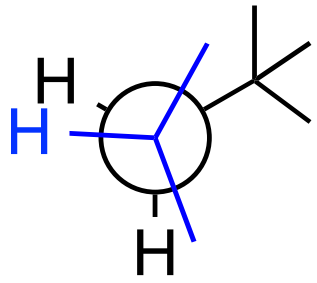


A B C D E

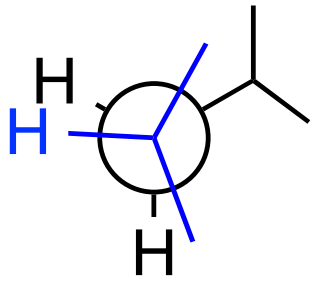
Calculate the relative energy (E_{rel}) for the following eclipsed conformation in kcal/mol.



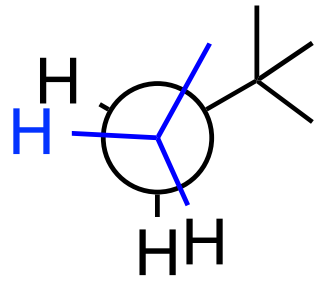
Which eclipsed conformation shown below would you expect to have the highest energy?



A



B



C