CHM 201 Berg
Summer 2008
Test 1

1. Consider these isomeric alkanes: **n-hexane, 2,3-dimethylbutane,** and **2-methylpentane.**
Which of the following correctly lists these compounds in order of **<u>increasing</u>** normal boiling point?

a) 2,3-dimethylbutane < 2-methylpentane < n-hexane

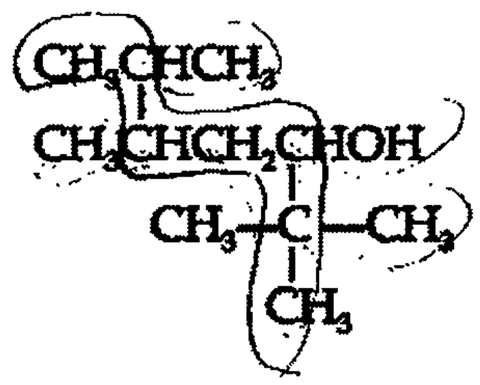
b) 2-methylpentane < n-hexane < 2,3-dimethybutane

c) 2-methylpentane < 2,3-dimethylbutane < n-hexane ✓

d) n-hexane < 2-methylpentane < 2,3-dimethylbutane

e) n-hexane < 2,3-dimethylbutane < 2-methylpentane

2. What is the **IUPAC** name of the following compound?



a) 3-isopropy-1-t-butyl-1-butanol

b) 2,2,5,6-tetramethyl-3-heptanol ✓

c) 5-propyl-2,3-dimethyl-3-hexanol

d) 1-t-butyl-3,4-dimethyl-1-pentanol

e) 1-t-butyl-3-isopropy-1-butanol

3. Which of the following describes the **most** stable conformation of <u>trans</u>-1-<u>tert</u>-butyl-3-methylcyclohexane?

a) Both groups are equatorial.

b) Both groups are axial.

c) The <u>tert</u>-butyl group is equatorial.

d) The <u>tert</u>-butyl group is axial and the methyl group is equatorial.

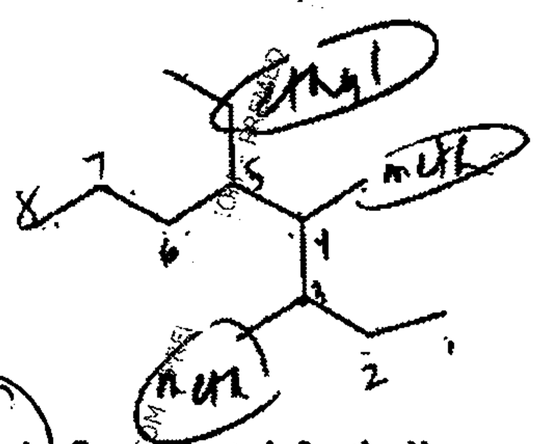
e) None of these is correct.

4. Which of the following statement(s) for dichlorocyclohexane is/are **correct**?

I. cis-1,2- is more stable than trans-1,2
II. cis-1,3- is more stable than trans-1,3.
III. cis-1,4- is more stable than trans-1,4.

a) I only
b) II only
c) III only
d) I and II only
e) I and III only

5. Provide the **IUPAC** name for the compound below.

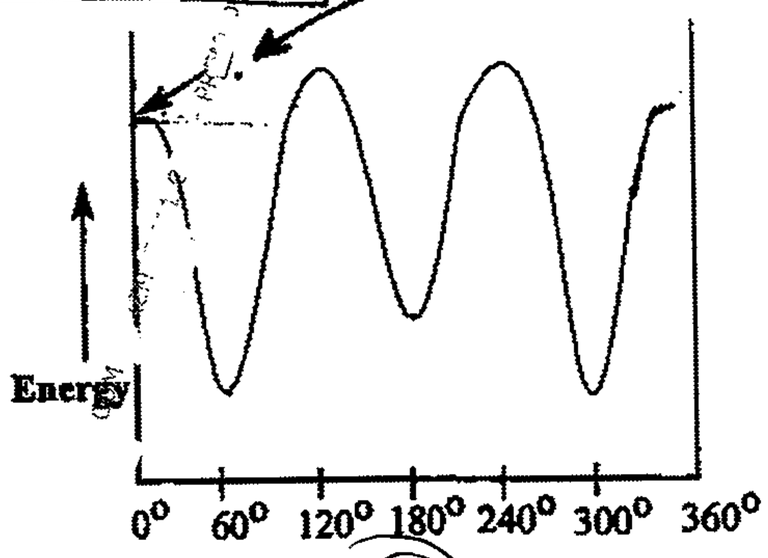


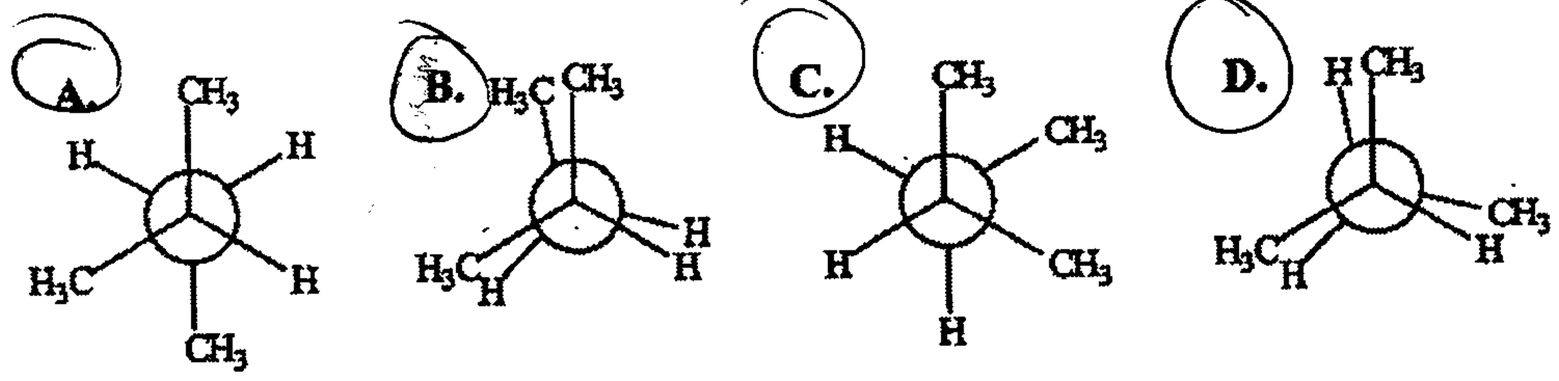
a) 2-sec-butyl-3 ethylhexane
b) 3-ethyl-2-sec-butylhexane
c) 5-ethyl-3,4-dimethyloctane
d) 3,4-dimethyl-5-ethyloctane
e) None of these is correct.

6. Which of the following compounds will react **most** rapidly with HCℓ?

a) 5-methyl-1-hexene
b) 4-methyl-1-hexene
c) (E)-5-methyl-2-hexene
d) (E)-2-methyl-3-hexene
e) 2-methyl-2-hexene

Consider the Newman projection for the conformation of 2-methylbutane to the indicated position on the potential energy diagram:





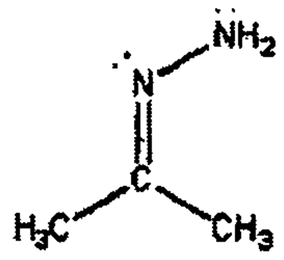
The energy maximum corresponds to the Newman projection labeled:

a) A
b) B
c) C
d) D
e) None of these is correct.

The most stable conformations of cyclobutane and cyclopentane are not planar. What kind of strain is relieved by the nonplanar conformations?

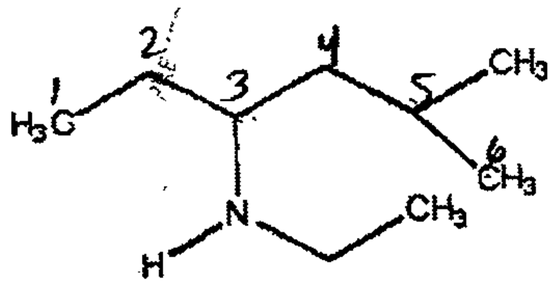
a) nearly all torsional
b) nearly all angle
c) transannular
d) combination of a and c
e) combination of all three (a,b, and c)

9. What is the CNN bond angle in the compound shown below?



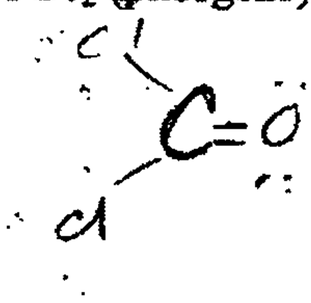
a) ~ 60 °
b) ~ 90 °
c) ~ 110 °
d) ~ 120 °
e) ~ 180 °

10. Provide the **IUPAC** name for the compound below.



a) N-ethyl-5-methyl-3-hexanamine
b) diethylisobutylamine
c) diethylsec-butylamine
d) 5-methyl-N-ethyl-3-hexanamine
e) None of these is correct.

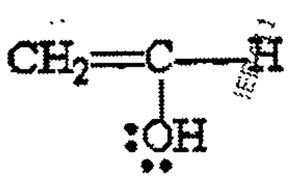
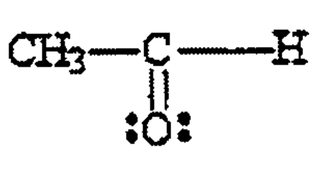
11. How many electrons will be represented by lines and /or dots in a Lewis structural formula for the poisonous gas, $COC\ell_2$ (phosgene)?

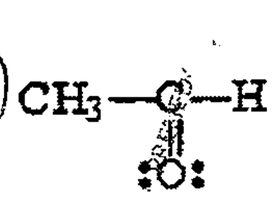
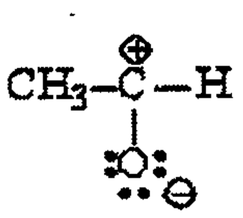


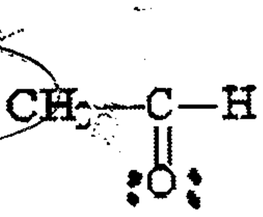
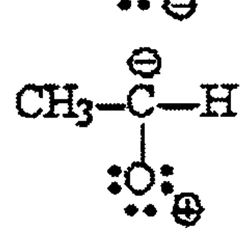
a) 8
b) 16
c) 20
d) 24
e) 26

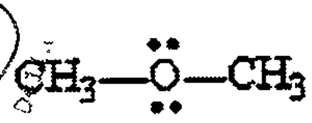
12. Which of the following pairs are resonance structures?

I. $CH_2=CHCH_3$ and 

II.  and 

III.  and 

IV.  and 

V.  and $CH_3CH_2\ddot{O}H$

a) I

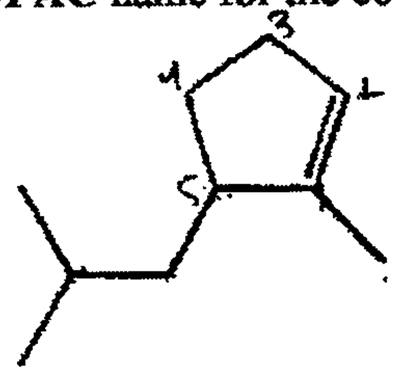
b) II

c) III

d) IV

e) V

13. What is the **IUPAC** name for the compound shown below?



a) 3-isobutyl-2-methylcyclopentene

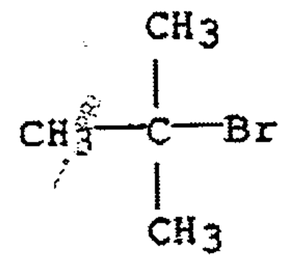
b) 5-isobutyl-1-methylcyclopentene

c) 1-isobutyl-2-methyl-2-cyclopentene

d) 2-isobutyl-1-methyl-5-cyclopentene

e) None of these is correct.

14. What is the **common** name for the following structure?



a) isobutyl bromide

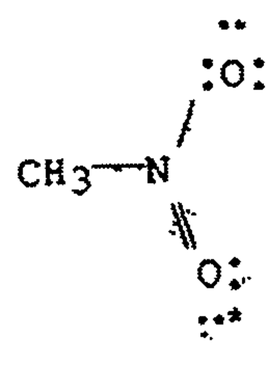
b) t-butyl bromide

c) neobutyl bromide

d) sec-butyl bromide

e) isopropyl methyl bromide

15. What are the formal charges on nitrogen and the starred oxygen atom in the following molecule?



a) N = -1, O = 0

b) N = +1, O = -1

c) N = +1, O = +1

d) N = -1, O = -1

e) N = +1, O = 0

FC (N) = 5 - 4 = +1

FC (O*) = 6 - 6 = 0

16. Which of the following is **true** of the solubility of an ether in water compared to the solubility of an alkane of comparable molecular mass?

a) The ether is less soluble than the alkane.

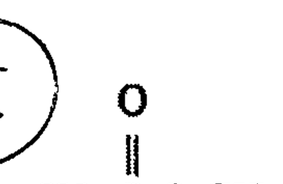
b) The ether and the alkane have the same solubility.

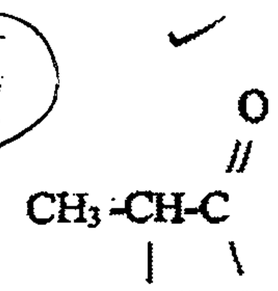
c) The ether is more soluble than the alkane.

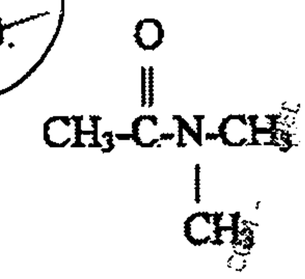
d) There is no general relationship between the solubility of the ether and that of the alkane.

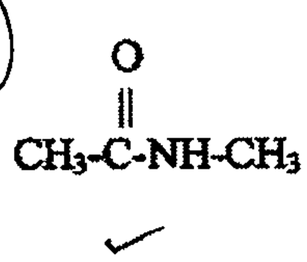
e) All ethers like all alkanes are completely insoluble in water.

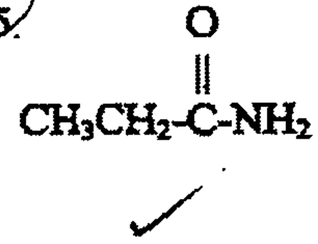
17. Which of the compounds shown below can form hydrogen bonds with other identical molecules?

1. 

2. 

3. 

4. 

5. 

a) 2 and 5 only

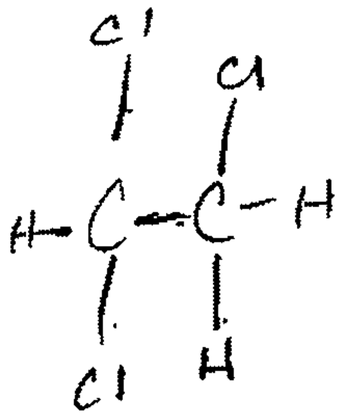
b) 1 and 2 only

c) [illegible] only

d) 3, 4, and 5 only

e) 2, 4, and 5 only

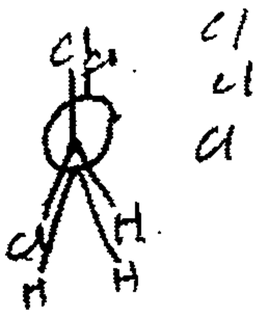
18. Which of the following statements is correct for rotation around the carbon-carbon bond of 1,1,2-trichloroethane?



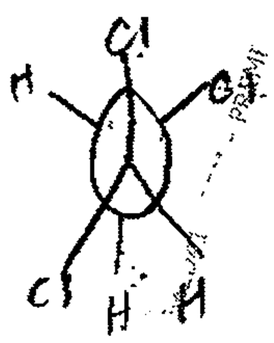
a) One full rotation produces three eclipsed conformations, all the same in energy.

b) One full rotation produces three eclipsed conformations, all of different energy.

c) One full rotation produces three eclipsed conformations, one of which is lower in energy than the other two of equal energy.



d) One full rotation produces three exactly staggered conformations, all with the same energy.



e) One full rotation produces three exactly staggered conformations, one of which is lower in energy than the other two of equal energy.

19. Consider the three step mechanism for the reaction of A through intermediates B and C to product D shown below:

$A \rightarrow B \quad E_a = 15$ Kcal / mol ; $\Delta H° = -3$ Kcal / mol

$B \rightarrow C \quad E_a = 10$ Kcal / mol , $\Delta H° = 13$ Kcal / mol

$C \rightarrow D \quad E_a = 2$ Kcal / mol ; $\Delta H° = -20$ Kcal / mol

Which of these steps is rate determining (rate-limiting)?

a) the reaction of A to B

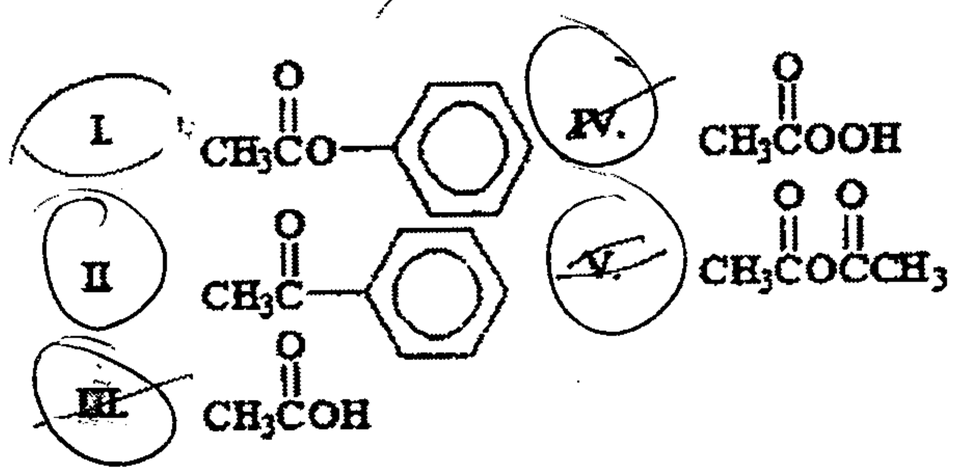
b) the reaction of B to C

c) the reaction of C to D

d) All three steps occur at the same rate; there is no rate determining step.

e) The most endothermic step is rate determining.

20. Which of the following compounds is an ester?



a) I

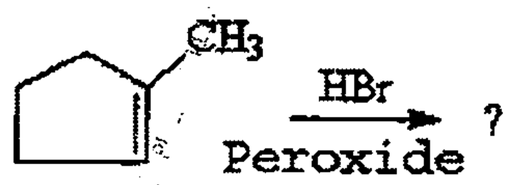
b) II

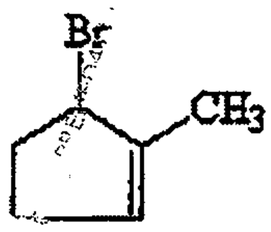
c) III

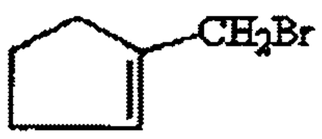
d) IV

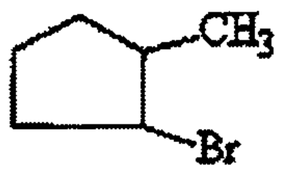
e) V

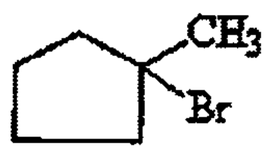
21. What is the **major** product of the following reaction?

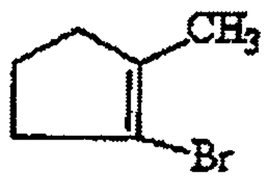


I. 

II. 

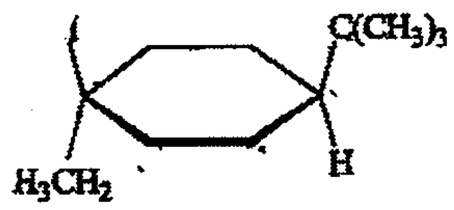
III. 

IV. 

V. 

a) I
b) II
c) III
d) IV
e) V

22. Provide the **IUPAC** name for the compound below.



a) trans-1- tert-butyl-4-ethylcyclohexane
b) cis-1-ethyl-isopropylcyclohexane
c) cis-1-tert-butyl-4-ethylcyclohexane
d) trans-1-ethyl-4-tert-butylcyclohexane
e) None of these is correct.

23. Consider the interaction of two hydrogen 1s atomic orbitals of the same phase. Which of the following statements is an **incorrect** description of this interaction?

a) A sigma bonding molecule orbital is formed.

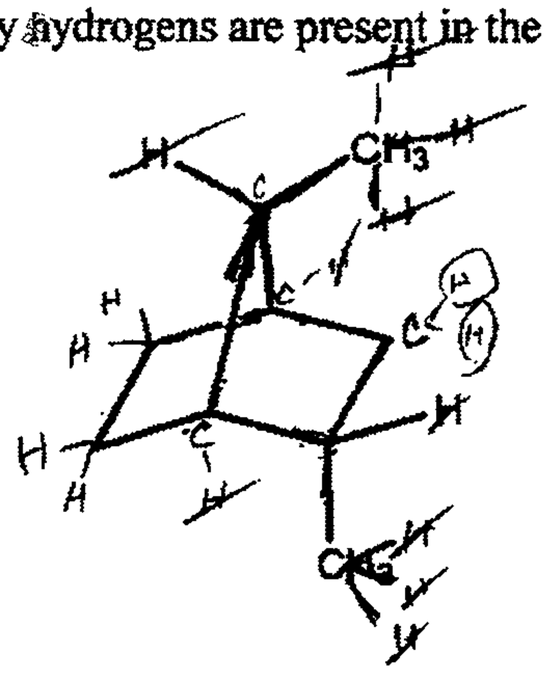
b) The bonding molecular orbital formed is lower in energy than a hydrogen 1s atomic orbital.

c) The bonding molecular orbital formed has a node between the atoms.

d) The bonding molecular orbital formed is cylindrically symmetric.

e) A maximum of two electrons may occupy the bonding molecular orbital formed.

24. How many secondary hydrogens are present in the hydrocarbon below?



a) 2

b) 6

c) 7

d) 8

e) 16

25. Which of the following **correctly** describes the reaction shown?

$$CH_2{=}CH_2 + HBr \rightarrow CH_3CH_2Br + \text{heat}$$

a) $\Delta H° > 0$ and $\Delta S° > 0$

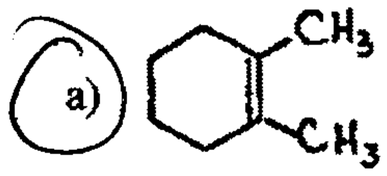
b) $\Delta H° > 0$ and $\Delta S° < 0$

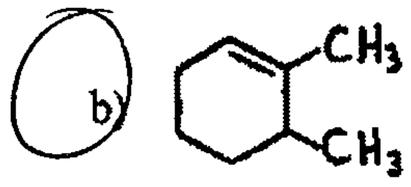
c) $\Delta H° < 0$ and $\Delta S° > 0$

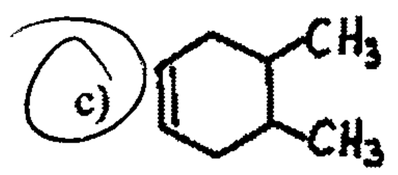
d) $\Delta H° < 0$ and $\Delta S° < 0$

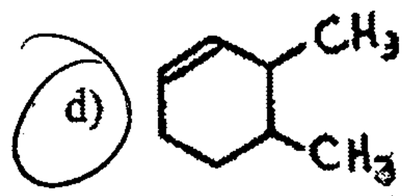
e) $\Delta H° = \Delta S° = 0$

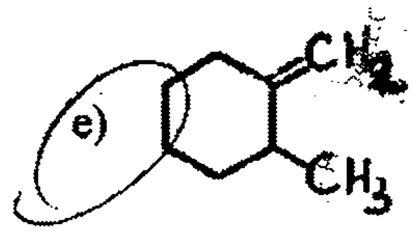
26. Which of the following isomers would have the **lowest** heat of hydrogenation?

a) 

b) 

c) 

d) 

e) 

27. **Which of the following names is a correct IUPAC name?**

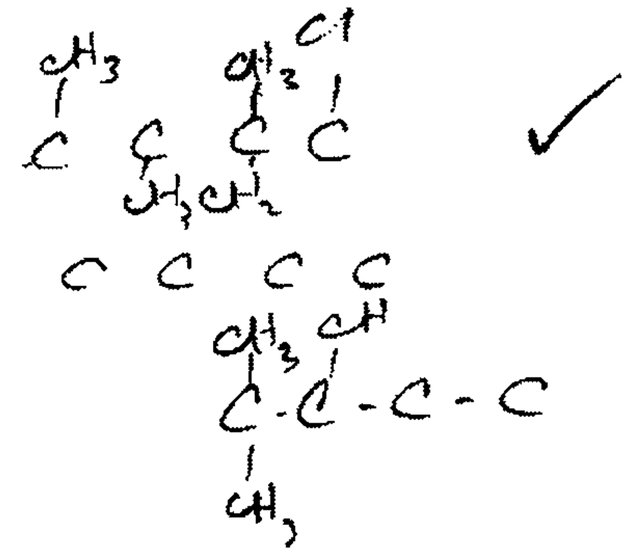
a) 3,4-dichloropentane

b) 1-chloro-2,4-methyl-3-ethylbutane

c) 2,3-dimethyl-2,2-diethylbutane

d) cis-1,3-dimethylpropane

e) 2-bromo-1-chloro-4,4-diethyloctane



28. How many constitutional (structural) isomers are possible for $C_3H_5Cl_3$?

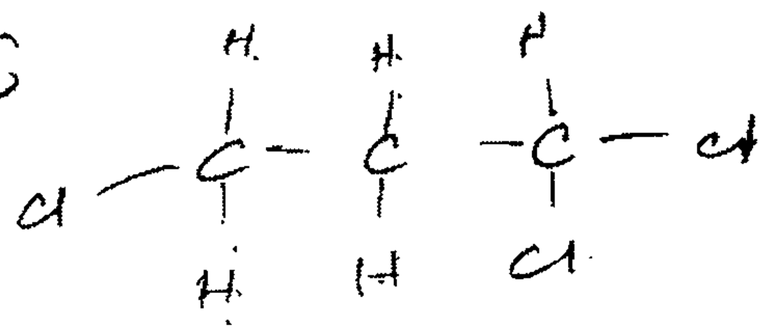
a) 1

b) 2

c) 3

d) 4

e) 5



29. **Consider the following molecule: $C_3NH_3Br_2$**

The structure could contain which of the following?

a) triple bond

b) three double bonds

c) a double bond and a ring

d) a double bond and two rings

e) Two of the above are possible.

30. **Which has the highest priority according to Cahn-Ingold rules?**

a) CH_3

b) $CH(CH_3)_2$

c) CH_2CH_2OH

d) CH_2OH

e) CH_3CH_2

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Answer Key

1. A
2. B
3. C
4. B
5. C
6. E
7. D
8. A
9. D
10. A
11. D
12. C
13. B
14. B
15. E
16. C
17. E
18. C
19. A
20. A
21. C
22. A
23. C
24. B
25. D
26. A
27. E
28. E
29. E
30. D