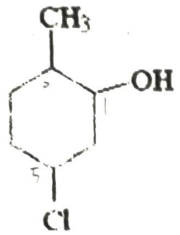
Name: _____ ; Student ID number: _____ ; Score: _____/300

I. Multiple choice (5 points each, total 145 points)

1. Give the IUPAC name for the following structure.

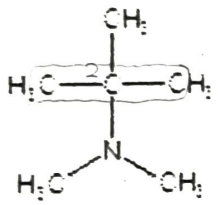
D



A) 3-chloro-6-methylcyclohexanol
B) 2-methyl-5-chlorocyclohexanol
C) 1-chloro-4-methylcyclohexanol
D) 5-chloro-2-methylcyclohexanol
E) 2-methyl-3-chlorocyclohexanol

2. Provide the IUPAC name of the compound.

E



A) N,N,1,1-tetramethylethanamine
B) N,N-dimethyl-2-butanamine
C) N,N,2-trimethyl-1-propanamine
D) N,N,2-trimethylpropanamine
E) N,N,2-trimethyl-2-propanamine

B 3. Identify the compound with the highest bond angle.

A) the C-O-C bond in an ether
B) the C-N-C bond in a secondary amine
C) the C-N-C bond in a quaternary amine
D) the C-O-C bond in an alcohol
E) They are all equal.

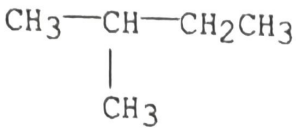
B 4. Identify the compound with the highest boiling point.

A) $CH_3CH_2OCH_2CH_3$
B) $CH_3CH_2CH(OH)CH_2OH$
C) $CH_3CH_2CH(NH_2)CH_2CH_3$
D) $CH_3CH_2CH_2CH_2Cl$

E) $CH_3CH_2CH_2CH_2Br$

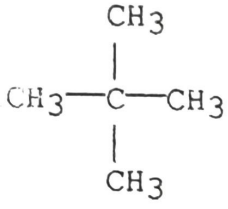
D 5. Which of the following has the greatest van der Waal's interaction between molecules of the same kind?

A)



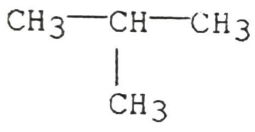
B) $CH_3CH_2CH_2CH_3$

C)



D) $CH_3CH_2CH_2CH_2CH_3$

E)



B 6. Which of the following is the most soluble in H_2O?

A) CH_3OCH_3

B) CH_3CH_2OH

C) CH_3CH_2Cl

D) $CH_3CH_2CH_2CH_2OH$

E) CH_3CH_2CHO

E 7. Among the butane conformers, which occur at the lowest energy minima on a graph of potential energy versus dihedral angle?

A) gauche only

B) eclipsed and totally eclipsed

C) gauche and anti

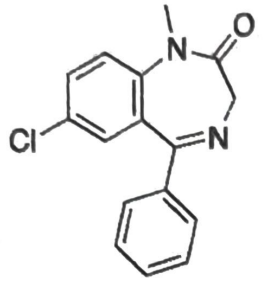
D) eclipsed only

E) anti only

C 8. Which of the following statements about the conformers that result from rotation about the C2-C3 bond of butane is correct?

A) The highest energy conformer is one in which methyl groups are eclipsed by hydrogens.
B) The gauche conformer is an eclipsed one.
C) Steric strain is absent in the eclipsed forms.
D) Torsional strain is absent in the eclipsed forms.
E) none of the above

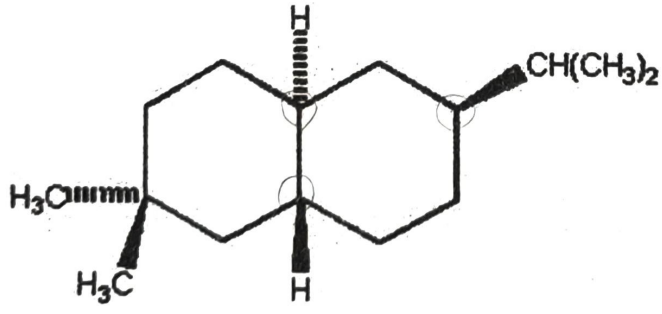
9. Structure of commonly used anti-anxiety drug, valium is shown below. What are the strongest intermolecular interactions present between molecules?



A) Van der Waals interactions
B) dipole-dipole interactions
C) hydrogen bonding
D) covalent bonding
E) ionic bonding

10. Which of the following <u>cannot</u> exhibit chirality?
A) 2, 3-dibromobutane
B) 1, 3-dibromobutane
C) 1, 2-dichlorobutane
D) 1, 4-dibromobutane
E) 1-bromo-2-chlorobutane

11. How many asymmetric centers are present in the compound shown below?



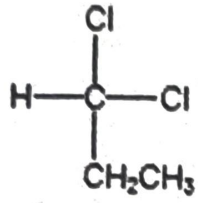
A) 1
B) 2
C) 3

D) 4

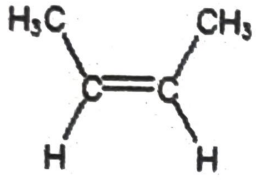
E) 5

12. Identify the compound(s) with asymmetric centers.

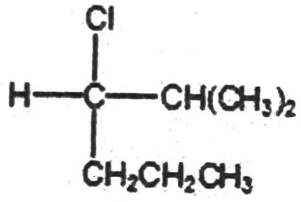
A)



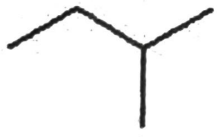
B)



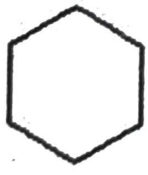
C)



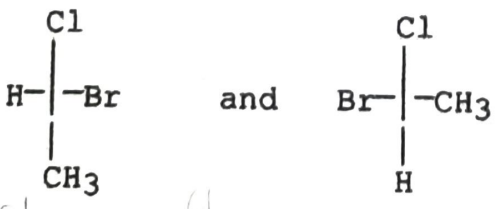
D)



E)



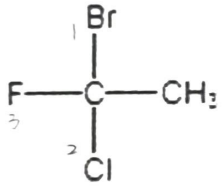
13. What is the relationship between the structures shown below?

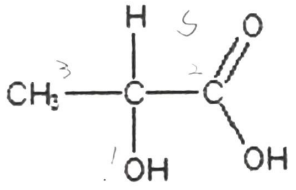


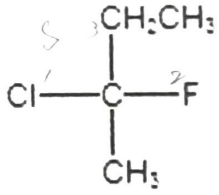
A) enantiomers
B) diastereomers
C) configurational isomers
D) identical compounds
E) constitutional isomers

14. The rate of the reaction of methyl chloride with hydroxide ion is linearly dependent on both the concentrations of methyl chloride and the concentration of hydroxide ion. At 30 °C, the rate constant for the reaction is $1.0 \times 10^{-5}\ M^{-1}s^{-1}$.
(a)What is the rate of the reaction when the concentration for CH_3Cl and ^-OH is 0.10 M, respectively.
(b)If the concentration of methyl chloride is decrease to 0.010 M, what is the rate of the reaction?
(A)$1.0 \times 10^{-5}\ M^{-1}s^{-1}$, $1.0 \times 10^{-5}\ M^{-1}s^{-1}$.
(B) $1.0 \times 10^{-5}\ M^{-1}s^{-1}$, $1.0 \times 10^{-6}\ M^{-1}s^{-1}$.
(C) $1.0 \times 10^{-7}\ M^{-1}s^{-1}$, $1.0 \times 10^{-8}\ M^{-1}s^{-1}$.
(D) $1.0 \times 10^{-6}\ M^{-1}s^{-1}$, $1.0 \times 10^{-8}\ M^{-1}s^{-1}$.
(E) $1.0 \times 10^{-6}\ M^{-1}s^{-1}$, $1.0 \times 10^{-7}\ M^{-1}s^{-1}$.

15. Identify the following compounds as *R* or *S*.

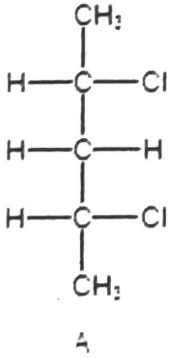




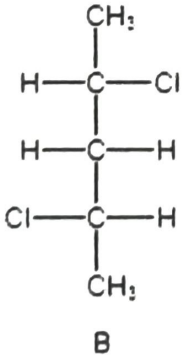


A) *S, S, R*
B) *S, R, S*
C) *R, S, S*
D) *S, S, S*
E) *R, R, R*

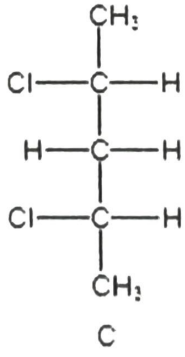
16. Identify all pairs of enantiomers.



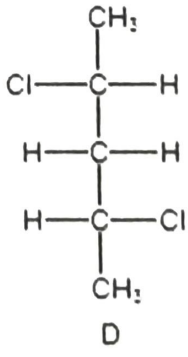
A



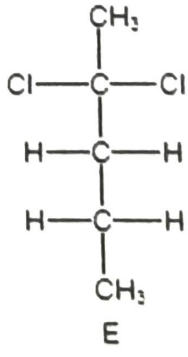
B



C



D

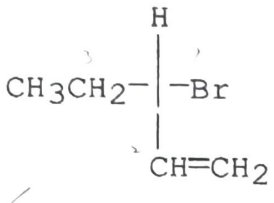


E

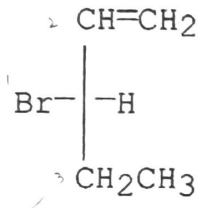
A) B and D, A and C
B) A and C
C) B and D
D) A and B, A and D, B and C, C and D
E) B and D, A and B, A and D, B and C, C and D

17. Which of the following compounds has an *R* configuration?

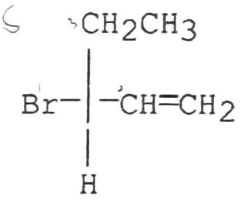
A)



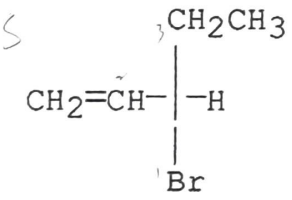
B)



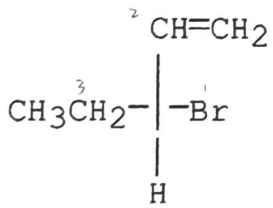
C)



D)

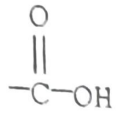


E)

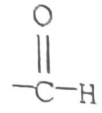


18. Which of the following groups has the highest priority using the Cahn, Ingold, Prelog rules?

A)



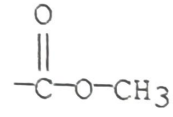
B)



C) —OH

D) —O—CH_3

E)



19. Which of the following is not true of enantiomers?

E

A) They have the same melting point.

B) They have the same boiling point.

C) They have the same chemical reactivity with non-chiral reagents.

D) They have the same density.

E) They have the same sign of specific rotation.

20. The specific rotation of a pure substance is -5.90°. What is the percentage of this isomer in a mixture with an observed specific rotation of -2.95°?

C

A) 25%

B) 50%

C) 75%

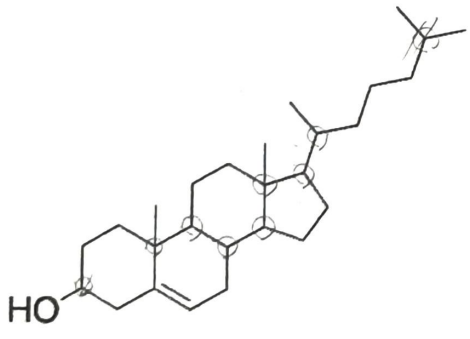
D) 80%

E) 0%

75 50%(−)
25 25(−)
25 25(+)

21. Structure of cholesterol is shown below. How many stereoisomers exist for this molecule?

E



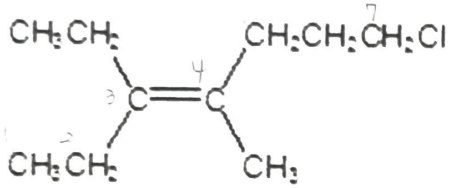
A) 8

B) 32
C) 64
D) 128
E) 256

22. What is the ratio of isopropylcyclohexane molecules that have the isopropyl group in an equatorial/axial position at equilibrium (Its ΔG^{o} value at 25 °C is -2.1 kcal/mol, R = 1.987 × 10^{-3} kcal $mol^{-1}K^{-1}$)?

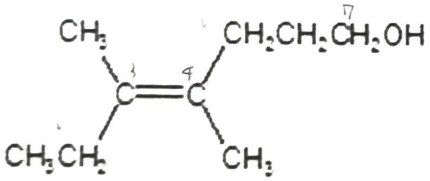
(A)Between 30-40
(B) between 20-30
(C) between 10-20
(D) between 40-50
(E) between 15-25

23. Name the structure.



A) 7-chloro-3-ethyl-4-methyl-3-heptene
B) 1-chloro-5-ethyl-4-methyl-3-heptene
C) 1-chloro-3-pentenyl-2-pentene
D) cis-7-chloro-3-ethyl-4-methyl-3-heptene
E) trans-7-chloro-3-ethyl-4-methyl-3-heptene

24. Name the structure.



A) *cis*-4,5-dimethyl-4-hepten-1-ol
B) *trans*-3,4-dimethyl-3-hepten-7-ol
C) *cis*-3,4-dimethyl-3-hepten-7-ol
D) *trans*-4,5-dimethyl-4-hepten-1-ol
E) *trans*-4,5-dimethyl-4-heptenol

25. Which of the following is <u>not</u> an electrophile?

A) H^{+}
B) BF_3

C) $^{+}NO_2$

D) Fe^{+3}

E) $CH_2{=}CH_2$

26. Which of the following is not a nucleophile?

A) $FeBr_3$

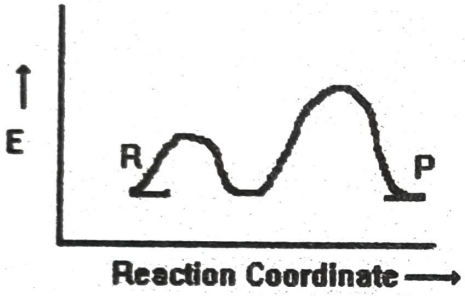
B) Br^-

C) CH_3NH_2

D)

E) CH_3OCH_3

27. How many transition states and intermediate are present in the following reaction diagram?



A) 3,1

B) 4,0

C) 2,2

D) 2,1

E) 1,1

$\Delta H^\circ - T\Delta S^\circ$

28. Which of the following contributes to make ΔG° more negative?

A) use of a catalyst

B) a more positive ΔH°

C) a more positive ΔS°

D) a larger rate constant

E) none of the above

29. How can the relative stability of alkenes of the same molecular formula be evaluated?

(A)By the enthalpy changes of their electrophilc additions to H-Br

(B)By the enthalpy changes of their catalytic hydrogenation

(C)By the enthalpy changes of their decomposition upon heating

(D)By the enthalpy changes of their methyl C-H bonds

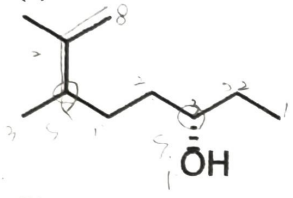
(E)None of the above

II. Provide suitable names, structure(s), or explanation(s) for the following questions. (total 155 points)

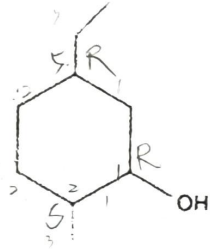
1. Draw the structure of following compounds: (5 pts each, total 30pts)
   (a) cis-1-ethyl-2-methylcyclohexane.
   (b) trans-1-ethyl-3-methylcyclohexane.
   (c) (*S*)-1-bromo-1-chloropropane.
   (d) (*2R,3S*)-2,3-dibromohexane.
   (e) (*Z*)-4-ethyl-3-methylheptene
   (f) 5-bromo-4-chloro-1-heptene

2. Provide an acceptable name for the compounds shown below. (5 pts each, total 30pts)

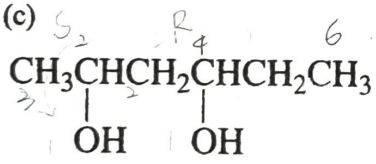
(a)



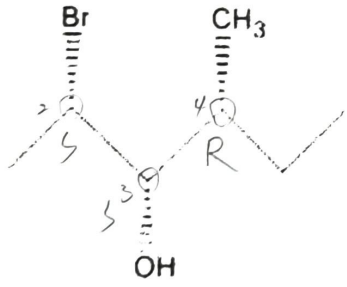
(b)



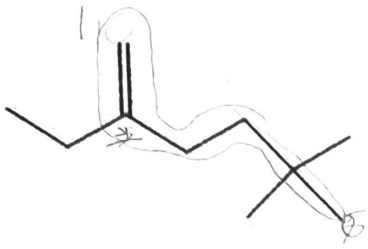
(c)



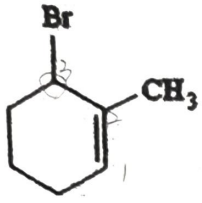
(d)



(e)

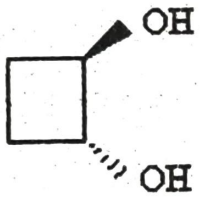


(f)

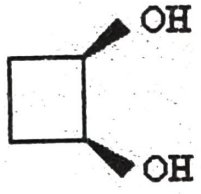


3. Are the following molecules shown chiral? If not, are they meso or not chiral not meso compounds?
(4 pts each, total 24pts)

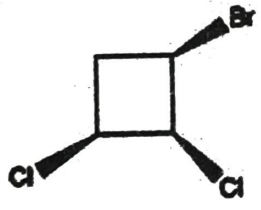
(a)



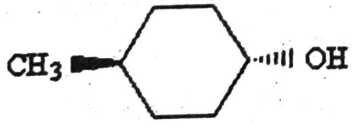
(b)



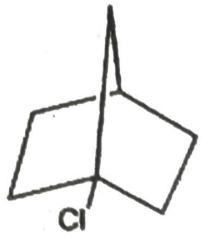
(c)



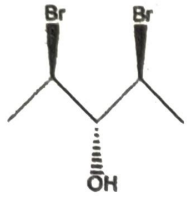
(d)



(e)



(f)

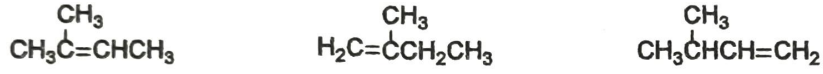


4. Draw out the more stable conformer of the following di-substituted, cyclohexanes (5 pts each, total 15 pts)

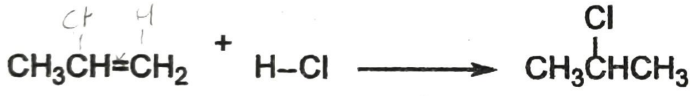
(a)*trans*-1,4-dimethylcyclohexane (b)*cis*-1-*tert*-butyl-3-methylcyclohexane

(c)*cis*-1,2-dimethylcyclohexane

5. (a)Rank the realtive stability of the following three alkenes. (b) Explain the stability difference. (4 pts each, total 8 pts)



6. (a) Calculate the enthalpy change for the following reaction. (b) Provide a reasonable mechanism. (c) Provide a reasonable reaction coordinate diagram (d) Provide the transition state structure (4 pts each, total 16 pts)



ΔH

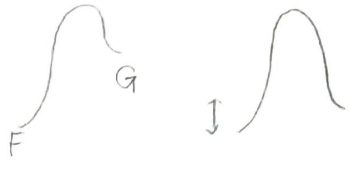
$CH_3CH{=}CH_2$, 62 kcal/mole

H-Cl, 103 kcal/mole

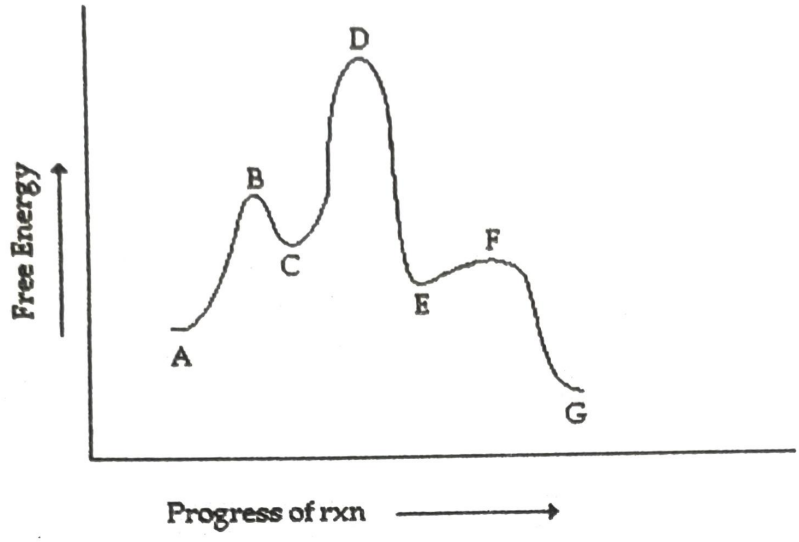
$CH_3CH_2CH_2$-H, 101 kcal/mole

, 85 kcal/mole

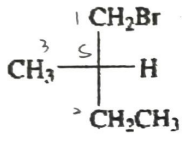
7. Consider the one-step conversion of F to G. Given that the reaction is endergonic by 5 kcal/mol and that the energy difference between G and the transition state for the process is 15 kcal/mol, sketch a reaction-energy profile for this reaction. Make sure to show how the given energy differences are consistent with your sketch. (4pts)

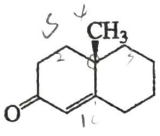


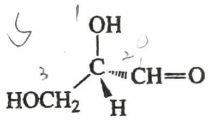
8. Consider the reaction coordinate diagram shown. **(a)** Which letters designate intermediates? **(b)** Which letters designate transition states? **(c)** Which step has the greatest activation energy in the forward direction? **(d)** Which step has the greatest rate constant in the forward direction? (3 pts each, total 12pts)

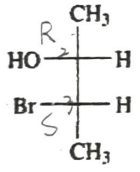


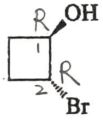
9. Label each asymmetric center as *R* or *S*. (2 pts each, total 16pts)

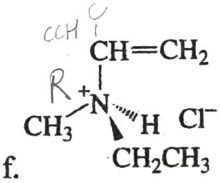
a. 

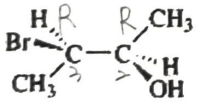
b. 

c. 

d. 

e. 

f. 

g. 

h.