Chemistry 2541
Spring 2013; Midterm 1 Exam

This exam has 9 problems on 7 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) Key

Scores:

Problem 1 15

Problem 2 14

Problem 3 12

Problem 4 5

Problem 5 6

Problem 6 4

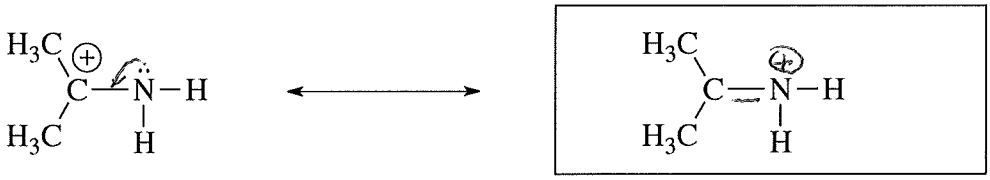
Problem 7 12

Problem 8 12

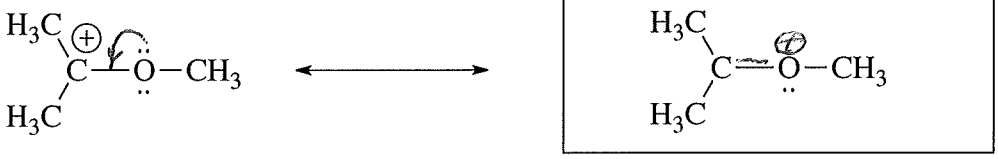
Problem 9 20

Total: 100

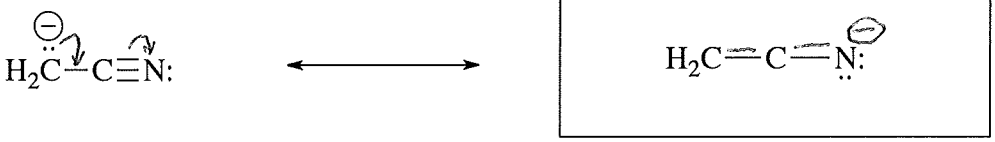
1. (15 pts) In the provided boxes, finish drawing of the **most important resonance contributing structures** for each of the following species by placing missing bonds or formal charges at appropriate position. (3 pts each structure; no partial credit)



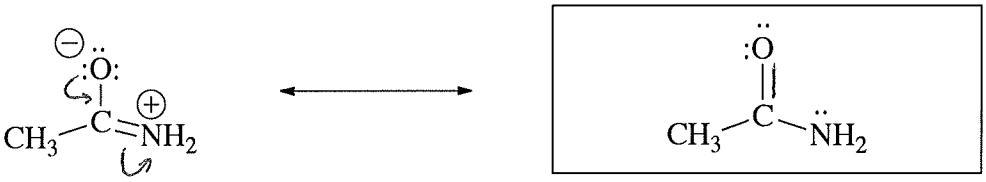
3 pts



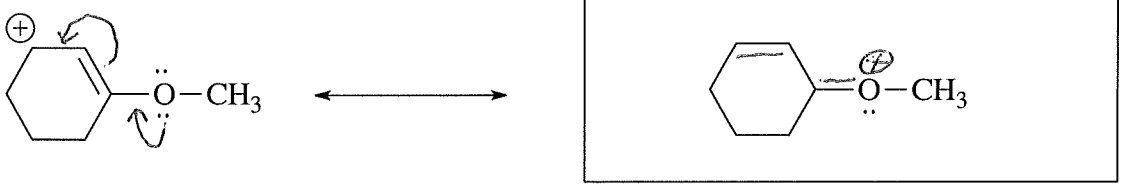
3 pts



3 pts



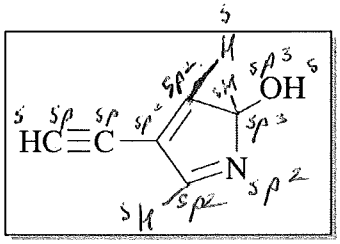
3 pts



3 pts

15 pts

2. (14 pts) Answer the following questions about the molecule shown in the box (write numbers after each question; 2 pts each answer; no partial credit; use 0 if there is no such bonds in the molecule):



Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals: 2 (2 pts each)

Number of σ bonds formed by overlap of sp^3 and sp^3 orbitals: 0

Number of σ bonds formed by overlap of sp^2 and sp orbitals: 1

Number of σ bonds formed by overlap of s and sp^3 orbitals: 2

Number of σ bonds formed by overlap of sp^2 and sp^2 orbitals: 3

Total number of σ bonds: 13

Total number of π bonds: 4

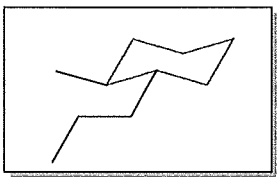
3. (12; 3 pts each) Circle the correct **IUPAC** name for each of the compounds shown in the boxes:

$(CH_3)_3CCH_2CH(C_2H_5)CH_2C(CH_3)_3$

(4-ethyl-2,2,6,6-tetramethylheptane) 1-*tert*-butyl-4-ethyl-5,5-dimethylhexane

3-ethyl-1,1,1,5,5,5-hexamethylpentane 2,2,4,6,6-pentamethylheptane

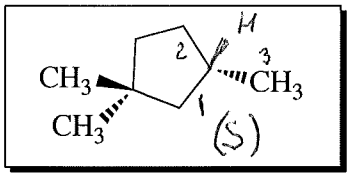
3 pts



cis-1-ethyl-2-methylcyclohexane *trans*-1-ethyl-2-methylcyclohexane

cis-1-methyl-2-propylcyclohexane (*trans*-1-methyl-2-propylcyclohexane)

3 pts

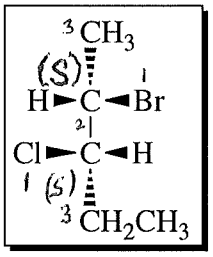


(*R*)-1,1,3-trimethylcyclopentane (*S*)-1,1,3-trimethylcyclopentane

(1*S*,3*R*)-1,1,3-trimethylcyclopentane (1*R*,3*S*)-1,1,3-trimethylcyclopentane

(1*S*,3*S*)-1,1,3-trimethylcyclopentane (1*R*,3*R*)-1,1,3-trimethylcyclopentane

3 pts



(*R*)-2-bromo-3-chloropentane *meso*-2-bromo-3-chloropentane

(2*S*,3*S*)-2-bromo-3-chloropentane (2*S*,3*R*)-2-bromo-3-chloropentane

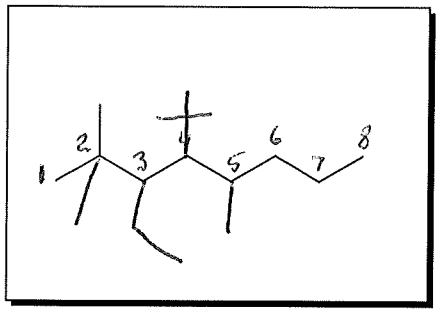
(2*R*,3*S*)-2-bromo-3-chloropentane (2*R*,3*R*)-2-bromo-3-chloropentane

3 pts

4. (5) Finish the drawing the ***line-angle structure*** of the following compounds in the provided box (*no partial credit*):

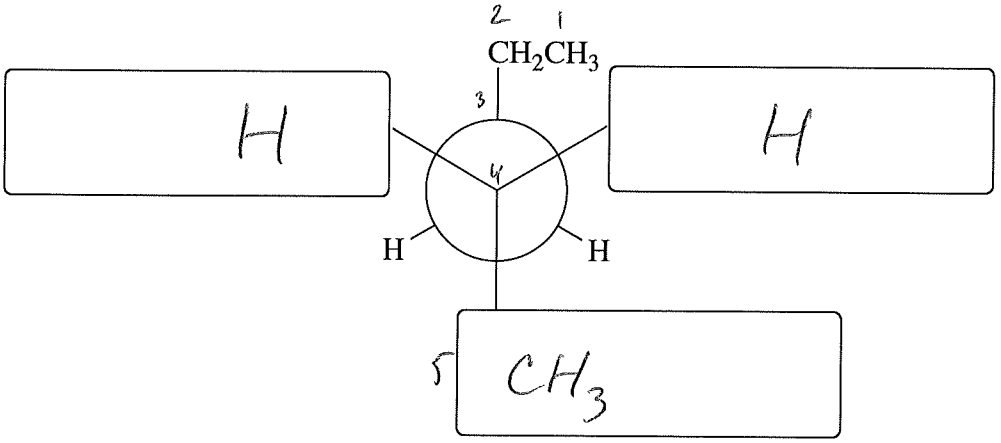
2,2,5-trimethyloctane

4-(*tert*-butyl)-3-ethyl-2,5-dimethyloctane:

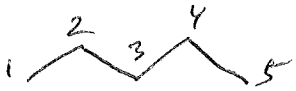


5pts, No partial credit

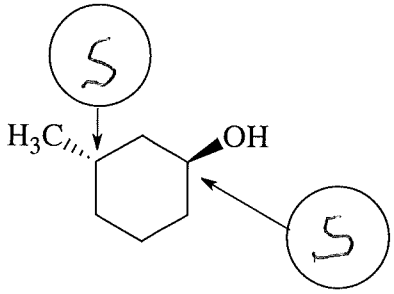
5. (6) Finish the drawing of the **Newman projection** of the ***most stable*** **conformation** of ***n*-pentane** by placing appropriate substituents (H or alkyl) in the boxes on the bonds (2 pts each substituent)
NOTE: please use a *condensed* structure for the alkyl groups, for example, CH_3, CH_3CH_2, $(CH_3)_3C$, etc.

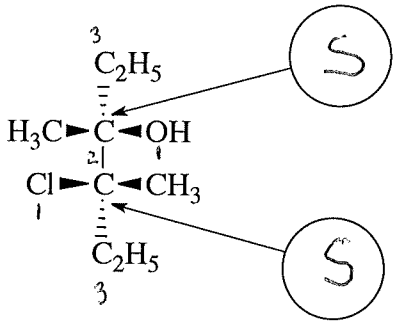


2pts each



6. (4) Assign the ***R*,*S*** configuration to each **stereocenter** in the following compounds (1 pts each stereocenter; use the provided circles for your answers):



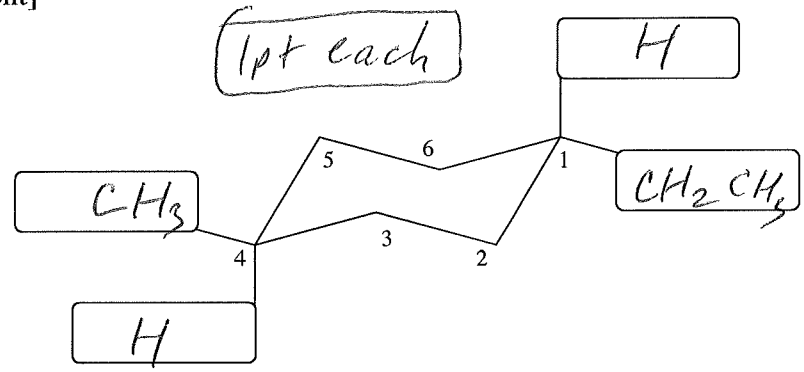


1pt each

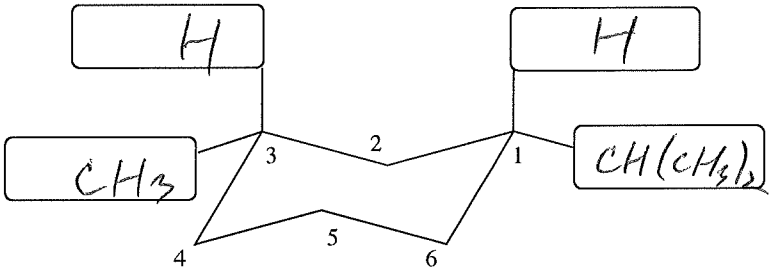
7. (12 pts) Complete the three-dimensional drawing of the ***most stable*** chair conformation for each of the following compounds. Use the provided, numbered cyclohexane ring; make sure to place the **correct axial** and **equatorial** substituents (H or alkyl) on the *appropriately numbered carbon atom of the ring*. Please use only the following symbols for the substituents in your answers: **H, CH_3, CH_2CH_3, $CH(CH_3)_2$, $C(CH_3)_3$**. [1 pt each substituent]

1pt each

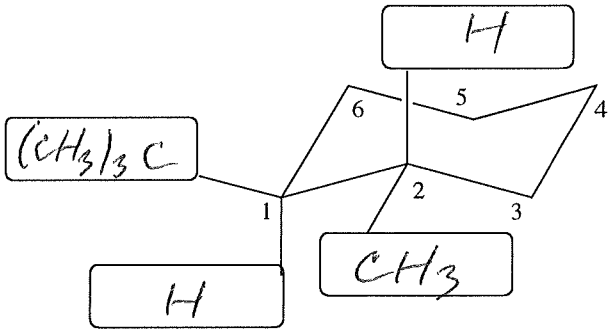
***trans*-1-ethyl-4-methylcyclohexane:**



***cis*-1-isopropyl-3-methylcyclohexane:**

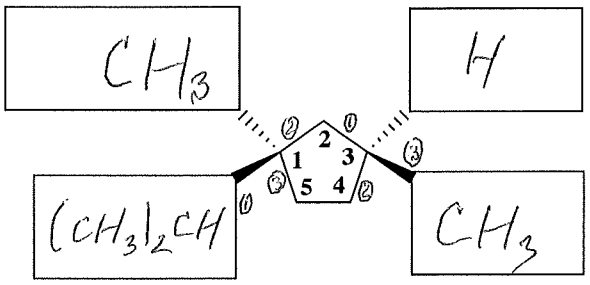


***trans*-1-*tert*-butyl-2-methylcyclohexane:**

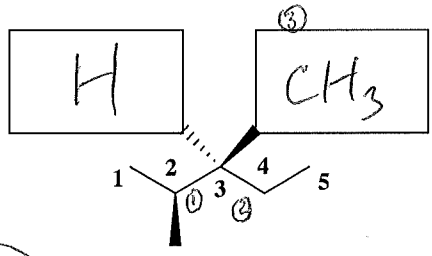


8. (12 pts) Finish drawing the structures of the following compounds by placing missing fragments in the boxes [same as in previous problem, use a condensed structure for the alkyl groups; 2 pts each box]:

(1*R*,3*S*)-1-isopropyl-1,3-dimethylcyclopentane



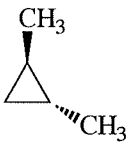
(*S*)-2,3-dimethylpentane

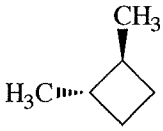


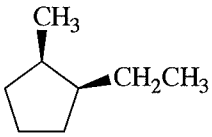
2pts each box

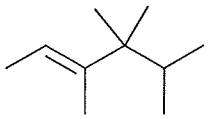
9. (20, 4 pts each) For each of the following questions (a)-(e) **circle** the item that is the correct answer.

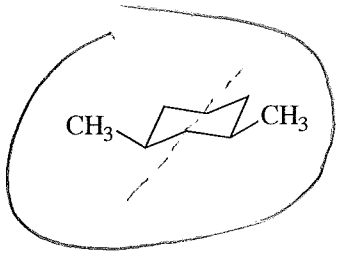
(a) Which one of the following molecules is a **meso** compound?







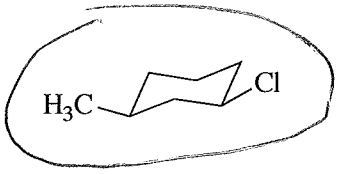


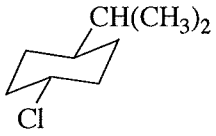


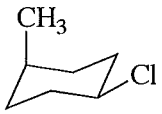
(b) Which one of the following compounds has a **polar covalent bond**?

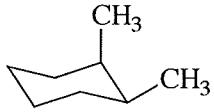
$CH_3CH_2CH_3$  C_2H_5OH $CH_3CH{=}CH_2$ $HB(CH_3)_2$

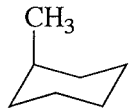
(c) Which one of the following molecules is **chiral**?



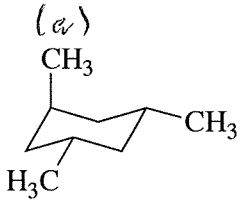


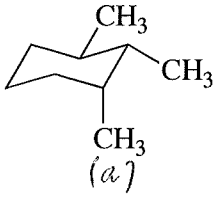


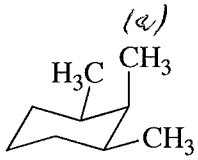


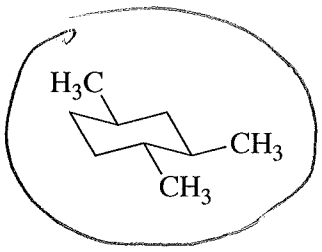


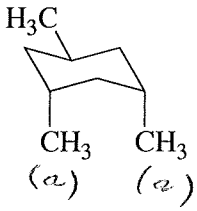
(d) Circle the molecule that has the *lowest* **diaxial** interactions (the most stable conformation):



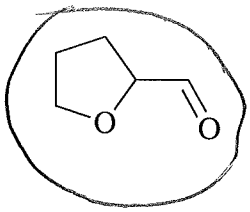


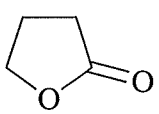


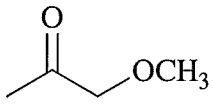




(e) Which of the following compounds is an **aldehyde**?







CH_3CO_2H