

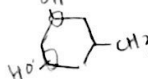
Chem 221001 Organic Chemistry

Exam 2

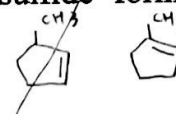
November 17, 2020

1. Which of the following compounds has a stereoisomer that is meso compound? Give the structure of the meso compound. (8%)

(a) 2,3-dimethylhexane (b) 2,4-dibromo-3-methylpentane (c) 2,5-dichlorohexane
(d) 1,3-dihydroxy-5-methylcyclohexane



2. Compound A with a molecular formula C_6H_{10} , contains three methylene units. A reacts with one equivalent of H_2 over Pd/C to yield B. A reacts with aqueous acid to form a single product C and undergoes hydroboration/oxidation to form a pair of enantiomers, D and E. Ozonolysis of A followed by reaction with dimethyl sulfide forms F with molecular formula $C_6H_{10}O_2$. Propose structures for A-F. (18%)

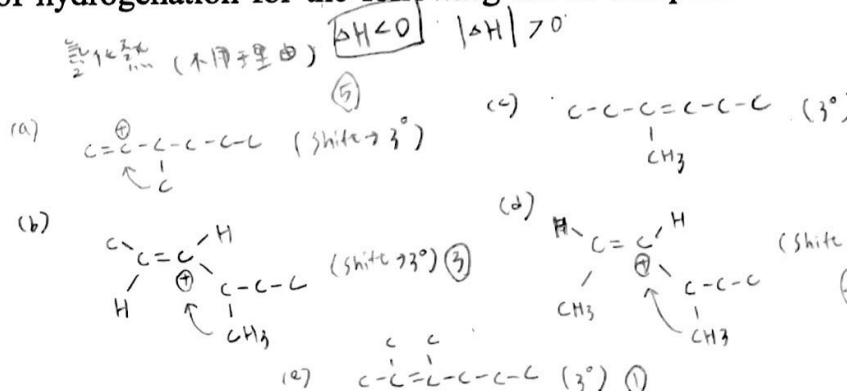


3. Draw the structure of a compound with molecular formula C_8H_{14} that reacts with excess of hydrogen over Pd/C to form a meso compound with molecular formula C_8H_{16} . (4%)

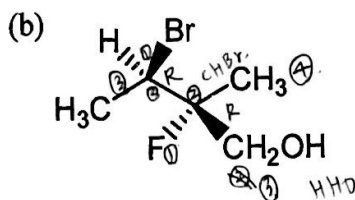
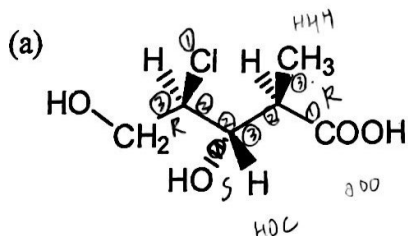


4. Give the order of decreasing heat of hydrogenation for the following set of compounds. (4%)

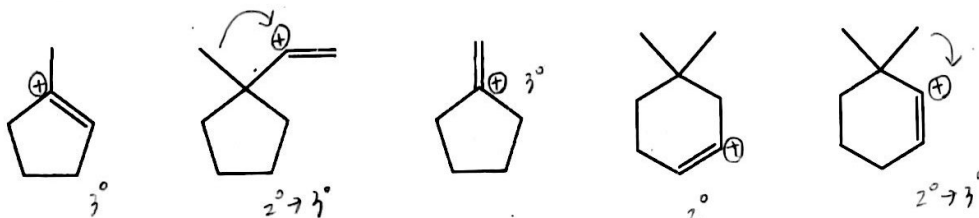
(a) 3-methyl-1-hexene
(b) (E)-4-methyl-2-hexene
(c) 3-methyl-3-hexene
(d) (Z)-4-methyl-2-hexene
(e) 2,3-dimethyl-2-hexene



5. Convert the following perspective formulas to Fischer projections. Label each chiral carbon atom as (R) or (S). (14%)



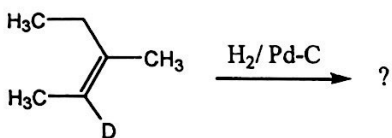
6. Which of the following compound(s) is/are likely to rearrange when react(s) with H_2O in the presence of H_2SO_4 ? Provide a brief reason for each case. (12%)



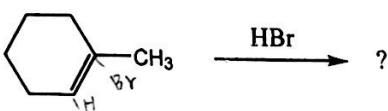
7. The specific rotation of (*S*)-2-bromobutane is +23.1. What is the composition of enantiomers in a sample of 2-bromobutane that has an observed specific rotation of -13.9? (4%)

8. Provide necessary reactant, reagent(s) or major product to complete each of the following reactions. (20%)

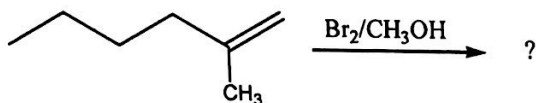
(a)



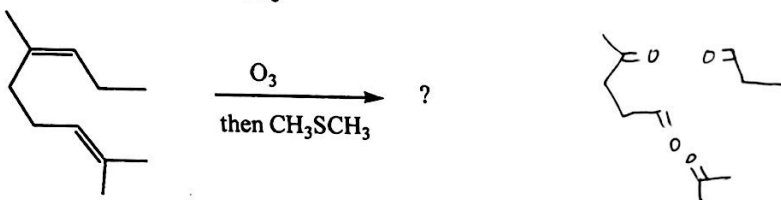
(b)



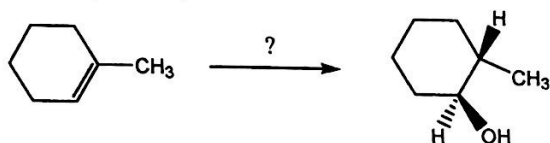
(c)



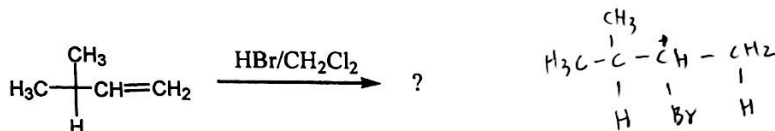
(d)



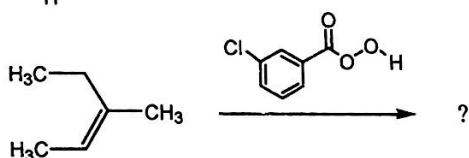
(e)



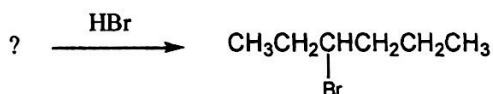
(f)



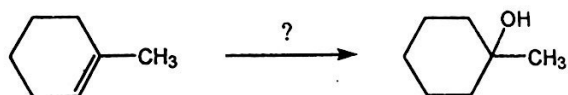
(g)



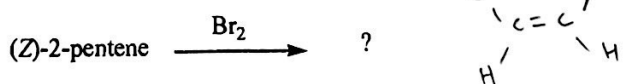
(h)



(i)

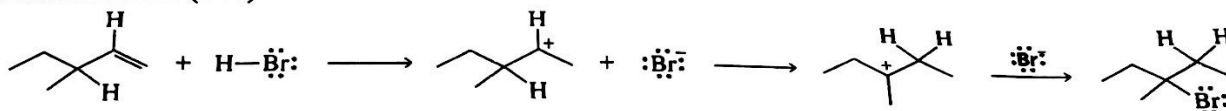


(j)



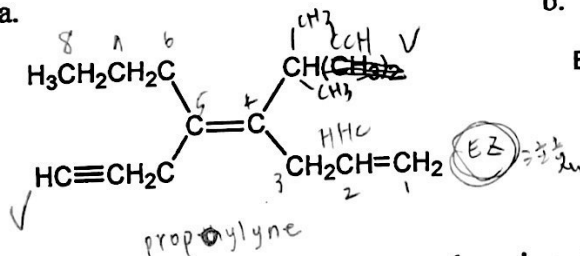
9. What is the equilibrium constant for a reaction that is carried out at 25 °C with $\Delta H^\circ = -20$ kcal/mol and $\Delta S^\circ = 5.0 \times 10^{-2}$ kcal/mol °K?. Gas constant is 1.986 cal/mol °K. (3%)

10. Use curved arrows to show the flow of electrons that occurs in each step of the following mechanism. (6%)

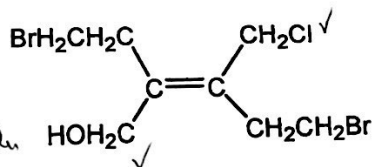


11. Give a systematic name for each of the following compounds. (6%)

a.

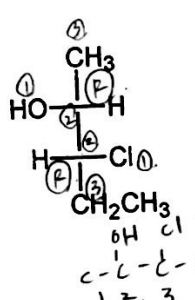


b.

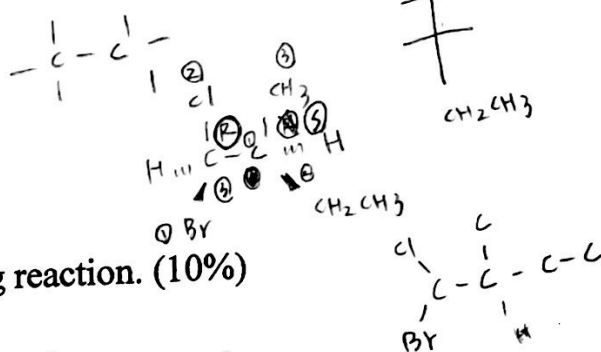
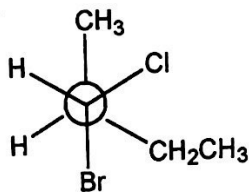


12. Name the following compounds using *R,S* designations. (6%)

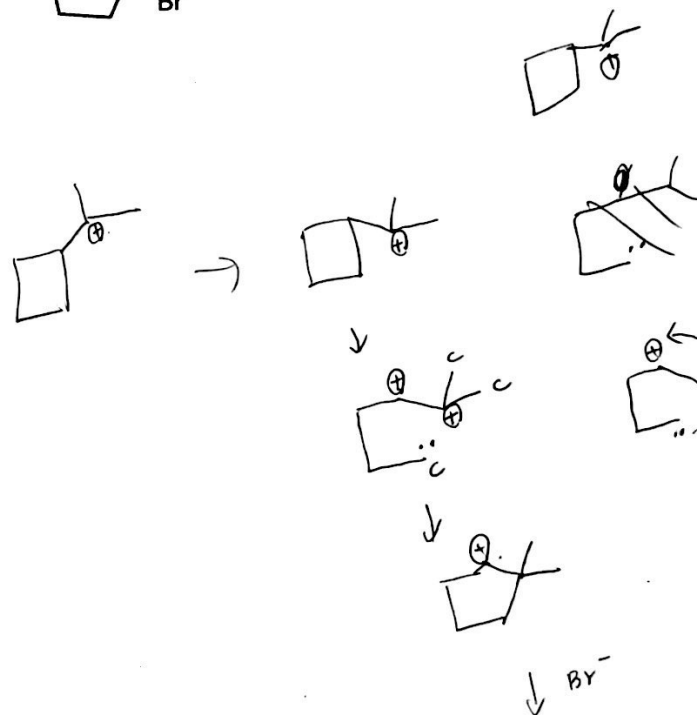
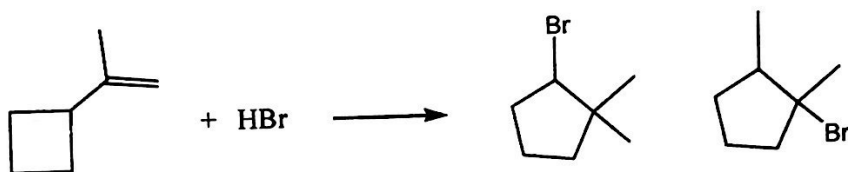
a.



b.



13. Propose a stepwise mechanism for the following reaction. (10%)



國立清華大學試卷

| 記 | | 分 | |
|----|-----|----|------|
| 1 | 7 | 2 | 15 |
| 3 | 0 | 4 | 4 |
| 5 | 14 | 6 | 10 |
| 7 | 4 | 8 | 13.5 |
| 9 | 1.5 | 10 | 6 |
| 11 | 4 | 12 | 6 |
| 13 | 8 | 14 | |
| 15 | | 16 | |
| 17 | | 18 | |
| 19 | | 20 | |
| 總分 | | 93 | |

系 (化學 23)

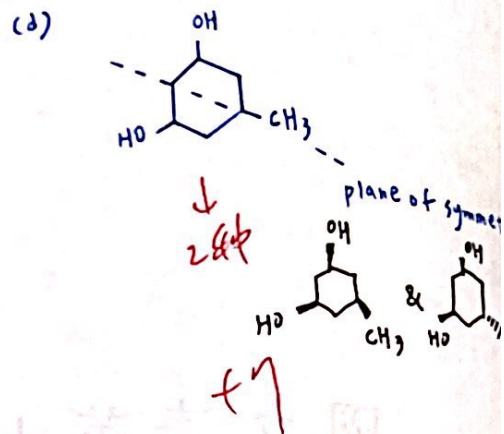
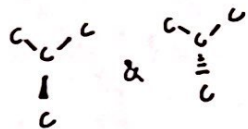
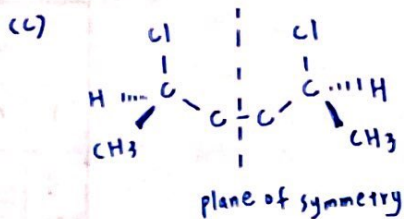
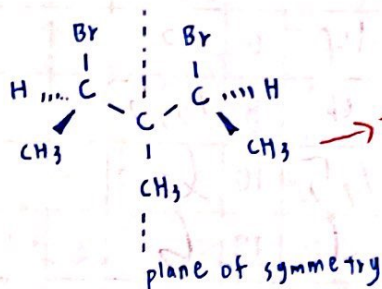
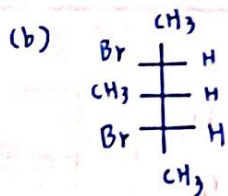
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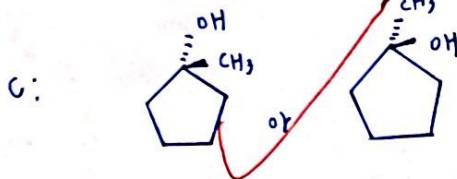
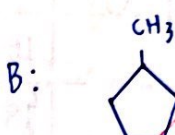
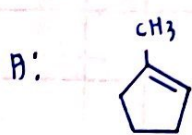
姓名 張小萱

日期 109.11.17

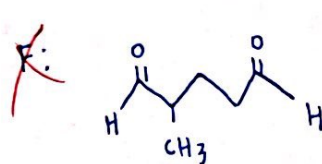
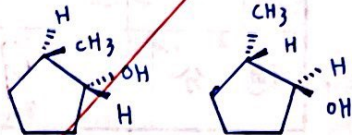
1. (b), (c), (d)



2,

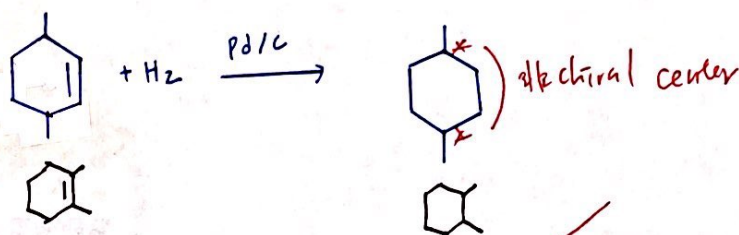


D&E:



+15

3,

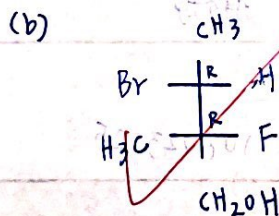
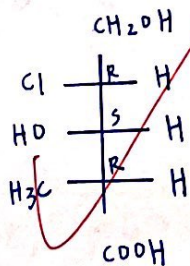


+0

4, heat of hydrogenation: (a) > (d) > (b) > (c) > (e)

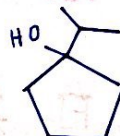
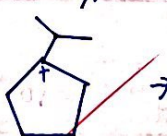
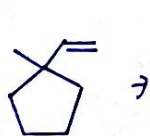
+4

5, (a)



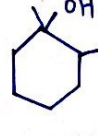
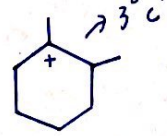
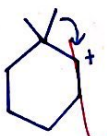
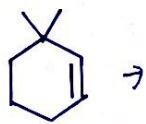
+14

6, ①



ring expansion

②



+10

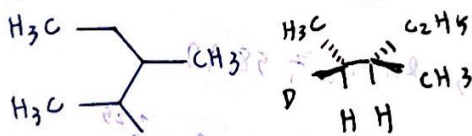
$\eta_1 \frac{13.9}{23.1} = 0.6 \Rightarrow 60\% \text{ (R) excess} \Rightarrow$

+13.5

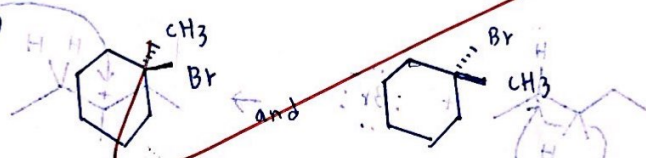
20% (S)-2-bromobutane

80% (R)-2-bromobutane

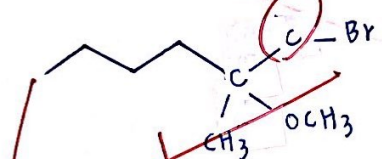
8. ~~(A)~~



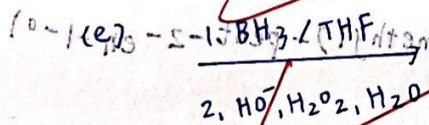
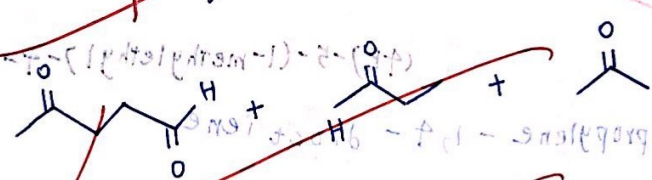
(b)



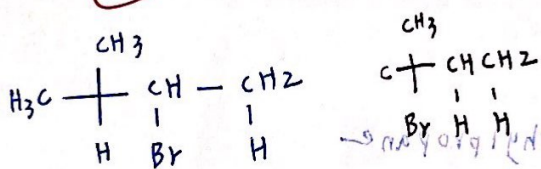
(c)



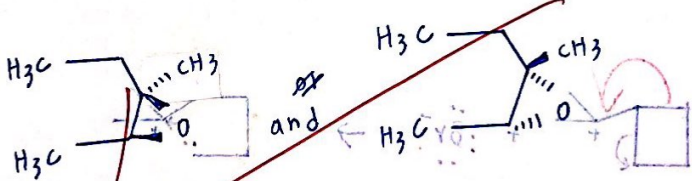
(d)



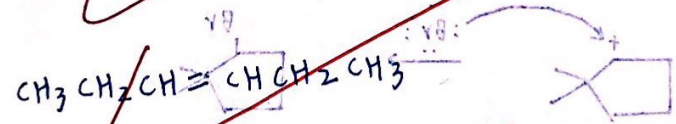
~~(f)~~



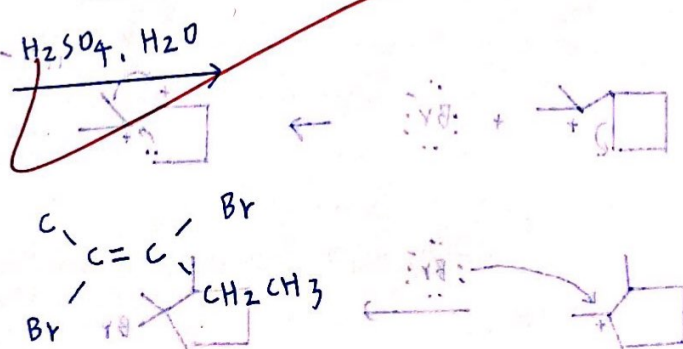
(g)



(h)



(i)



9, $\Delta G^\circ = \Delta H^\circ + T\Delta S^\circ = -RT \ln K_{eq}$

11,5

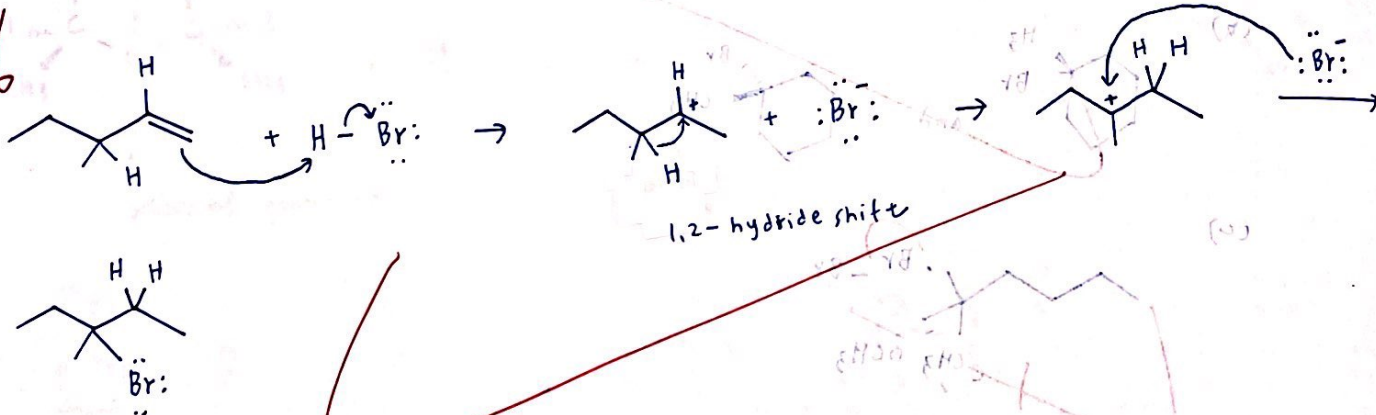
$\Delta G = -20 + 298 \times 5 \times 10^{-2} = -5.1 \text{ kcal/mol}$

$-5.1 = -1.986 \times 10^{-3} \times 298 \times \ln K_{eq}$

$\ln K_{eq} = 8.62$

$K_{eq} = 5.53 \times 10^3$

10, 16



(4E)-5-(1-methylethyl)-4-propyl-octa-4,7-diene

11, (a) (E)-4-(1-methylethyl)-6-propyl-1,4-octadiene

(b) (E)- (2E)-5-bromo-2-(2-bromoethyl)-3-(1-chloromethyl)-pent-2-en-1-ol

16

12, (a) (2R,3R)-3-chloro-2-pentanol

(b) (1R,2S)-1-bromo-1-chloro-2-methylbutane

13, 17

