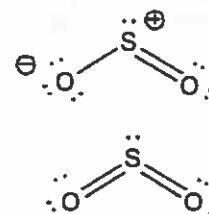


CHEM 1315 Reading Day Review

1. Two Lewis structures for sulfur dioxide are shown to the right. Which of the first four statements below is incorrect

- a) both structures are based on three electron pairs in σ -type orbitals
- b) the structures are resonance structures
- c) both structures predict the molecule to have a dipole moment
- d) neither structure requires the use of a d -orbital by sulfur
- e) none of these are incorrect



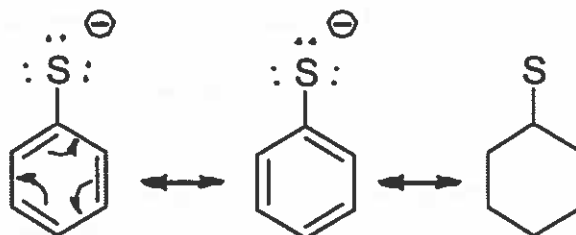
2. Which of the following should be most soluble in water? Molecular weights are in parentheses.

- a) $\text{CH}_3\text{CH}_2\text{F}$ (48)
- b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (60)
- c) $\text{CH}_3\text{CH}_2\text{Cl}$ (64)
- d) $\text{CH}_3\text{CH}_2\text{OCH}_3$ (60)
- e) $\text{CH}_3\text{CH}_2\text{Br}$ (109)

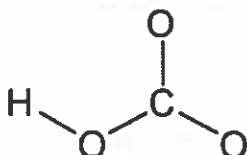
3. Which of the following molecules is not an ether?

- a)
- b)
- c)
- d)
- e) all are ethers

4. (5 pts) Draw a third resonance structure for the thiophenolate anion, using arrows to indicate the movement of electron pairs as appropriate.

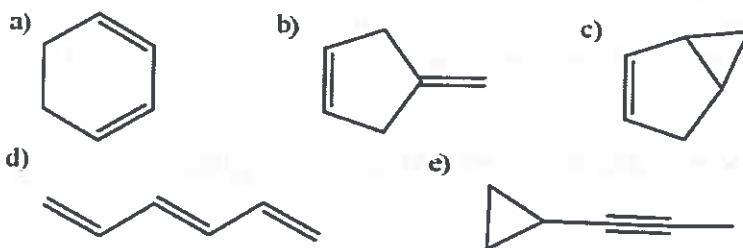


5. (7 pts) Draw resonance structures for the bicarbonate anion, HOCO_2^- , which are consistent with it having two carbon-oxygen bonds that are equivalent. For the first structure, complete the partial Lewis structure provided, adding electrons and formal charges as appropriate. Then draw additional resonance structures as necessary. Do not include arrows indicating movement of electron pairs.



6.

A compound of composition C_6H_8 reacts with molecular hydrogen in the presence of a catalyst to produce a new compound of composition C_6H_{10} . Which one of the following C_6H_8 constitutional isomers is consistent with this datum?



7.

What is the approximate dihedral angle between the two carbon-fluorine bonds in the most stable conformation of *trans*-1,2-difluorocyclohexane?

- a) 0° b) 60° c) 109° d) 120° e) 180°

8.

The C-C-C bond angles in the most stable conformation of cyclohexane are approximately

- a) 60° b) 120° c) 109° d) 180° e) none of these

9.

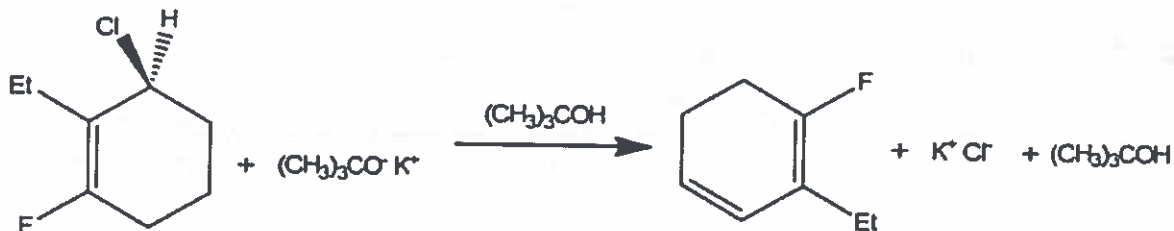
Which of the following statements is correct?

- a) Ethylene (ethene) is a stronger Brønsted-Lowry acid than acetylene (ethyne)
 b) Acidity increases as the pK_a becomes more positive
 c) The acidity of H-X (where X is a halogen) decreases as you go down the halogen column in the periodic table
 d) HF etches glass but it is none-the-less a weaker acid than HI, which does not etch glass
 e) none of the above are correct

10.

The following reaction is an example of:

- a) an elimination reaction b) an addition reaction c) a substitution reaction
 d) a rearrangement e) a combination of elimination and rearrangement

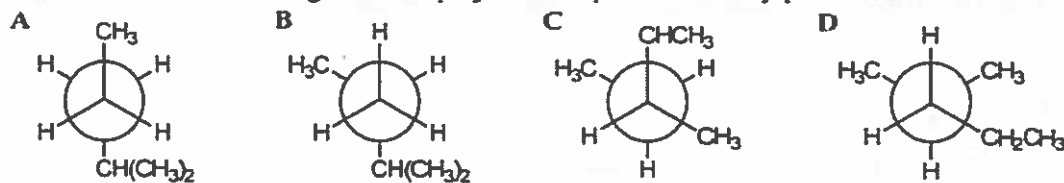


11.

Assuming that the absolute magnitudes of ΔH° and ΔS° are the same, which combination will result in the largest equilibrium constant at a given temperature?

- a) ΔH° negative, ΔS° negative b) ΔH° positive, ΔS° negative
 c) ΔH° negative, ΔS° positive d) ΔH° positive, ΔS° positive
 e) There is no direct relationship between ΔH° and ΔS° and K_{eq} at any temperature

12. Which of the following Newman projections represent 2-methylpentane?

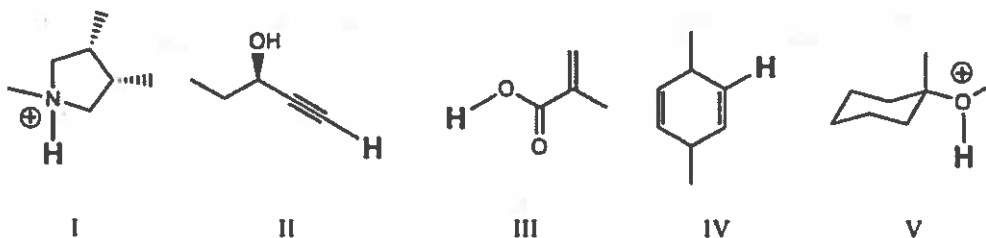


- a) A & B b) C & D c) A only d) D only e) A & D

13. The ionization constants (K_a) for $\text{CF}_3\text{CO}_2\text{H}$ and HF in water are 6.6×10^{-1} and 6.3×10^{-4} , respectively. However in liquid ammonia both acids are completely ionized. Which of the first four statements is not correct.

- a) The acidities are not differentiated in ammonia because ammonia is a stronger base than water
 b) NH_4^+ ion is the strongest acid that can exist in liquid ammonia.
 c) The acidities of the acids are indistinguishable in ammonia because they are leveled to the acidity of NH_4^+
 d) The conjugate bases CF_3CO_2^- and F^- are both stronger than the conjugate base of ammonia
 e) None of the above statements is incorrect

14. Rank the **bold-faced** hydrogens for the following compounds from most acidic to least acidic.



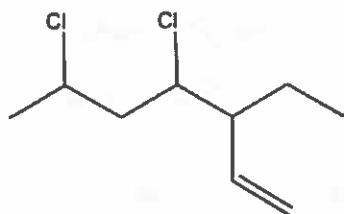
- a) I > II > III > IV > V
 b) III > V > II > I > IV
 c) V > II > IV > III > I
 d) III > I > V > II > IV
 e) V > III > I > II > IV

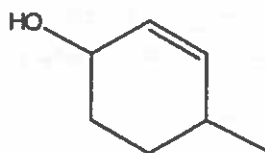
15. Which of the following four acid-base reactions would not have a $K_{eq} > 1$?

- a) $\text{CH}_3\text{Li} + \text{CH}_3\text{CH}_2\text{OH} = \text{CH}_4 + \text{CH}_3\text{CH}_2\text{OLi}$ (in hexane)
 b) $\text{CH}_3\text{CH}=\text{CH}_2 + \text{NaOH} = \text{CH}_3\text{CH}=\text{CHNa} + \text{H}_2\text{O}$ (in water)
 c) $\text{CH}_3\text{C}\equiv\text{CNa} + \text{H}_2\text{O} = \text{CH}_3\text{C}\equiv\text{CH} + \text{NaOH}$ (in water)
 d) $(\text{CH}_3)_2\text{CHOH} + \text{NaH} = (\text{CH}_3)_2\text{CHONa} + \text{H}_2$ (in isopropyl alcohol)
 e) all would have $K > 1$

16.

(8 pts) Give IUPAC acceptable names for the following compounds.





17.

(4 pts) Draw a bond-line structure of product A expected based on the indicated movement of electron pairs and the other products of the reaction.



A

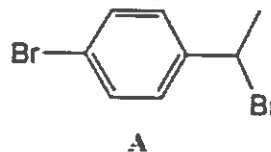
18.

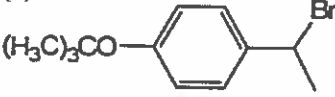
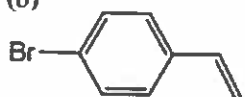
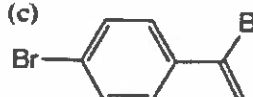
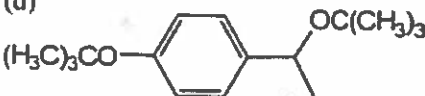
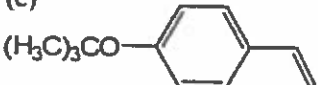
Bonus: (6 pts – total score not to exceed 100 pts) Trifluoroacetic acid ($\text{CF}_3\text{CO}_2\text{H}$, $\text{p}K_a = 0.18$) is a stronger acid than nitroacetic acid ($\text{O}_2\text{NCH}_2\text{CO}_2\text{H}$, $\text{p}K_a = 1.65$), however, nitromethane (CH_3NO_2 , $\text{p}K_a = 10.2$) is a much stronger acid than 1,1,1-trifluoroethane (CF_3CH_3 , $\text{p}K_a$ estimated to be 16-20 based on its computed proton affinity). Suggest why CH_3NO_2 is a stronger acid than CF_3CH_3 . Responses that use Lewis/resonance structures to illustrate the answer will receive maximum credit.

19. Which is the strongest nucleophile, i.e., most nucleophilic?

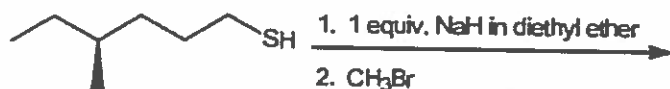
- (a) H_2O (b) CH_3O^- (c) CH_3CO_2^- (d) CH_3OCH_3 (e) OH^-

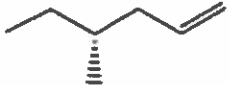
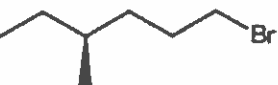

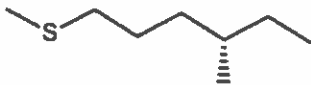

20. What is the major product from treatment of compound A with $(\text{CH}_3)_3\text{CO}^- \text{K}^+$ in $(\text{CH}_3)_3\text{COH}$ at 60°C ?



- (a)  (b)  (c) 
- (d)  (e) 

21. The product of the following two-step reaction sequence, which involves an acid-base reaction and an $\text{S}_{\text{N}}2$ reaction, is?

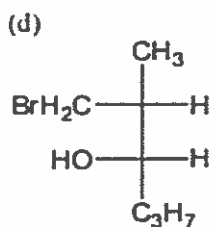
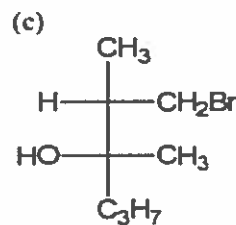
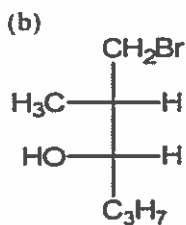
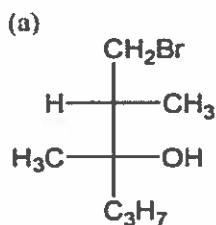
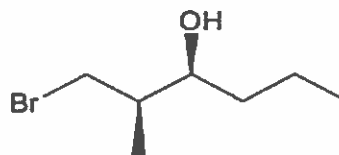


- (a)  (b)  (c) 
- (d)  (e) 

22. Which of the following is a polar, aprotic solvent?

- (a) diethyl ether
(b) chloroacetic acid
(c) hexane
(d) ethanol
(e) none of these

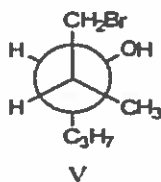
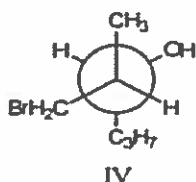
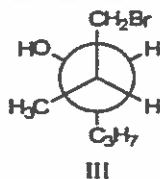
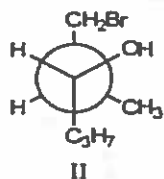
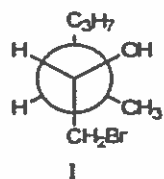
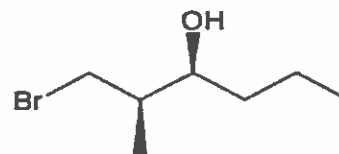
23. Which of the Fischer projections below correctly represent the molecule to the right?



(e) none of these

24.

Which staggered Newman projection(s), looking down the C2—C3 bond (C2 in front and C3 in back), illustrates the compound to the right?



(a) I

(b) II

(c) III, IV and V

(d) IV and V

(e) V

25

How many compounds, including stereoisomers, could be referred to as dichlorocyclopropane?

(a) 6

(b) 5

(c) 4

(d) 3

(e) none of these

26.

How many stereogenic centers does the molecule to the right have?

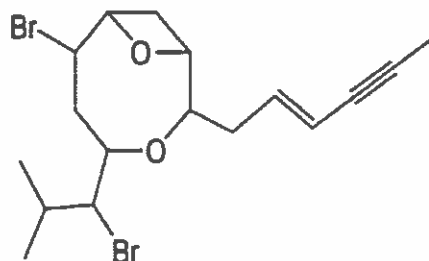
(a) 6

(b) 7

(c) 8

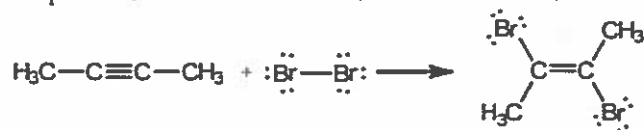
(d) 9

(e) none of these



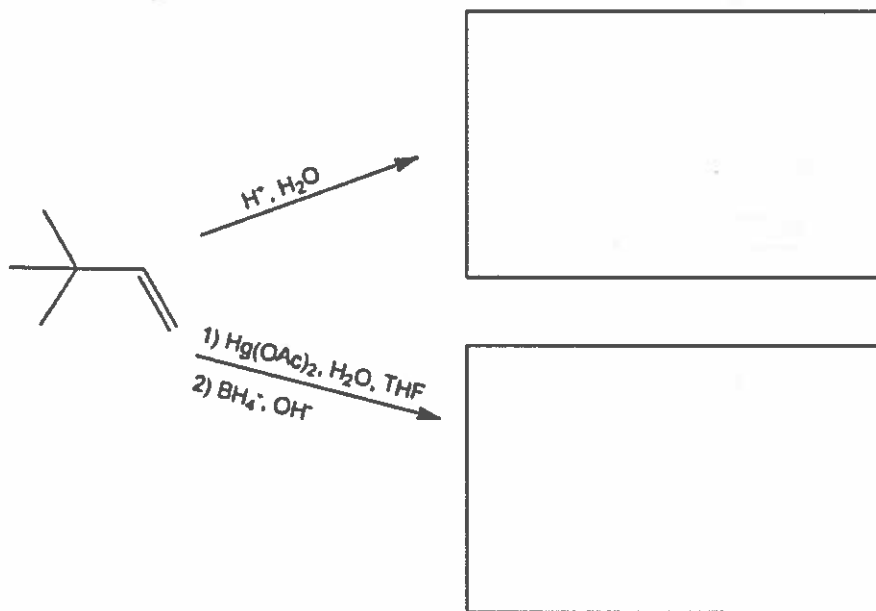
27.

(9 pts) Write a mechanism for the following reaction that accounts for the stereochemistry of the product. Use curved arrows to show movement of electron pairs.



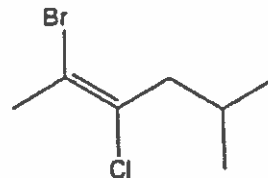
28.

(8 pts) Draw the structure of the major alcohol product expected from each of the following reactions. Be careful to take into account regioselectivity and possible rearrangements of intermediates.

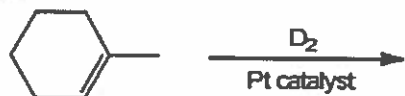


29. (4 pts) The correct IUPAC name for to the right is?

- a) (*E*)-2-bromo-3-chloro-5,5-dimethyl-2-pentene
- b) (*E*)-2-bromo-3-chloro-5-methyl-2-hexene
- c) (*Z*)-2-bromo-3-chloro-5,5-dimethyl-2-pentene
- d) (*Z*)-2-bromo-3-chloro-5-methyl-2-hexene
- e) (*E*)-5-bromo-4-chloro-2-methyl-4-hexene

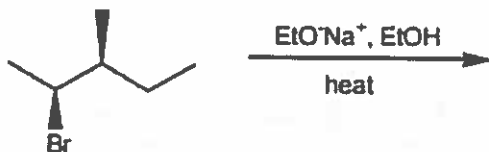


30. (4 pts) The major product from the following catalytic hydrogenation reaction is?



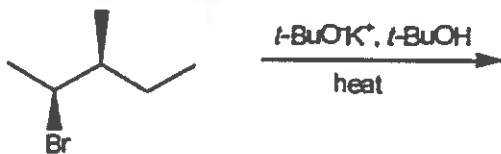
- a)
- b)
- c)
- d)
- e)

31. (4 pts) The major product from the following reaction is?



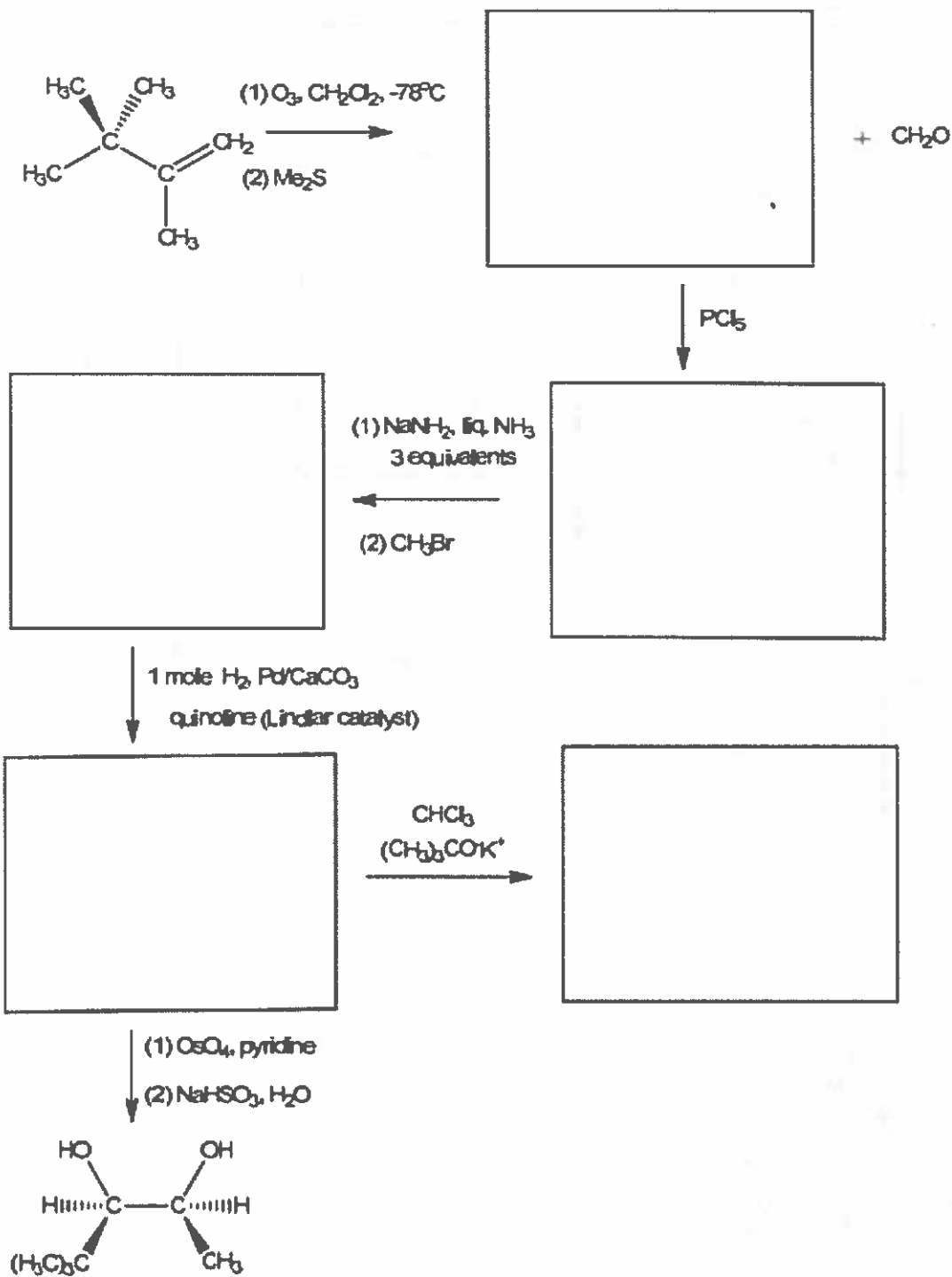
- a)
- b)
- c)
- d)
- e)

32. (4 pts) The major product from the following reaction is?

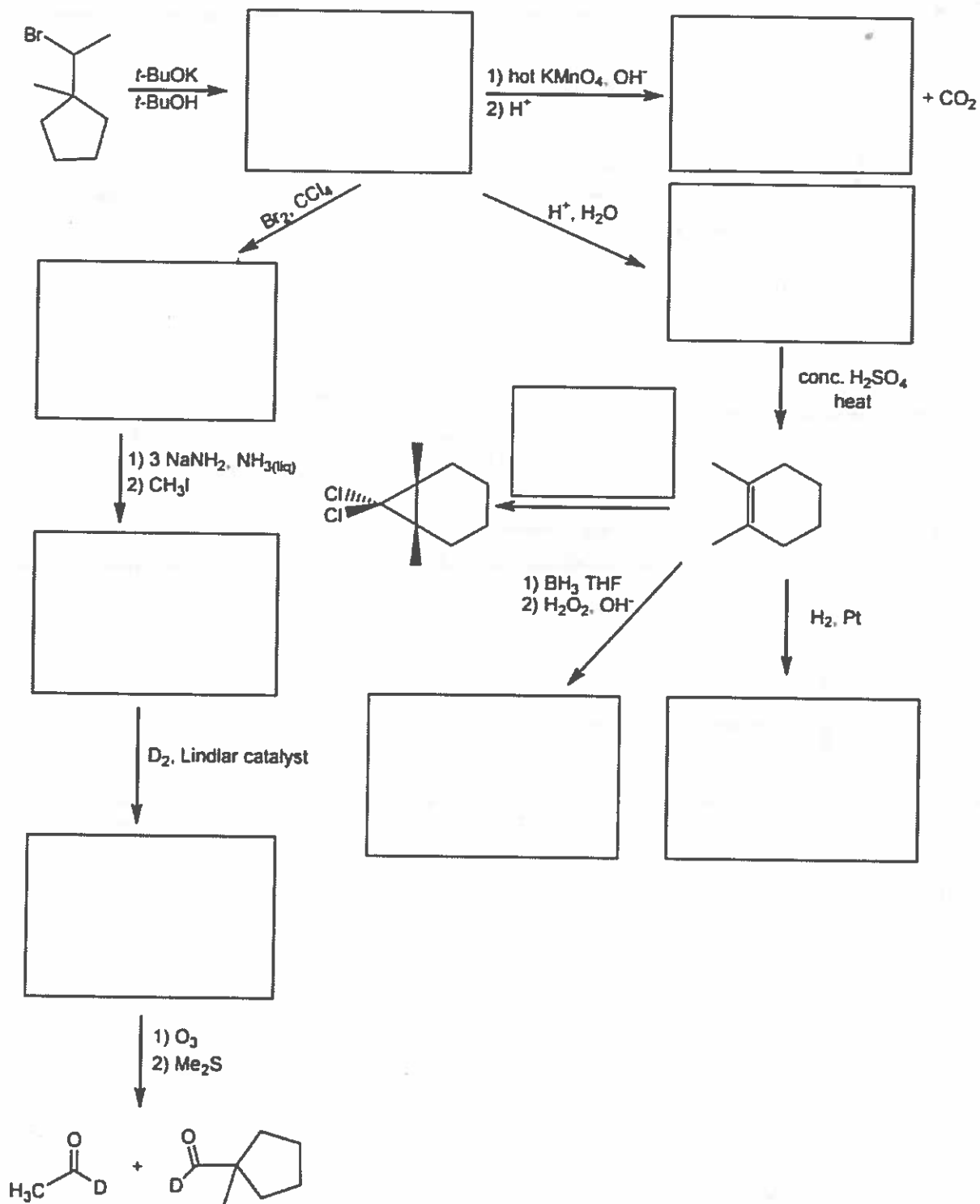


- a)
- b)
- c)
- d)
- e)

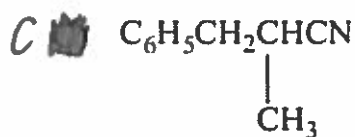
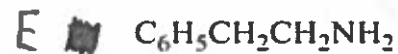
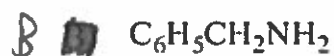
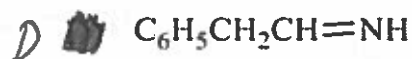
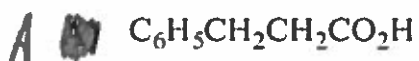
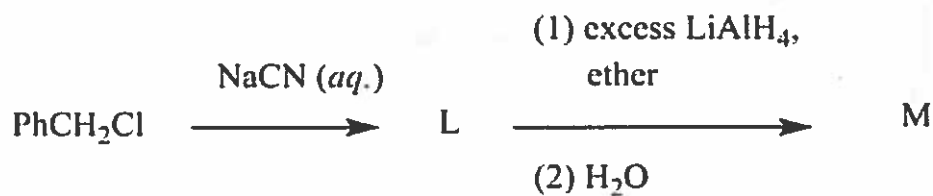
33. (20 pts) Draw the structure of the organic product for each of the reactions in the following sequence.



34. (36 pts) Fill in the boxes with the proper bond-line structure or reagent(s) as appropriate.

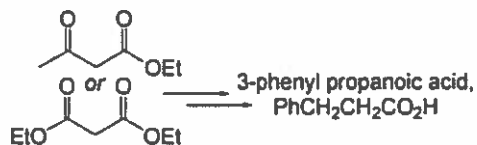
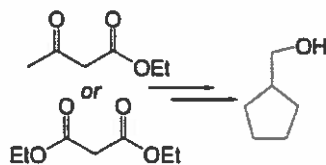


35. What would be the final organic product (M) of the following reaction?

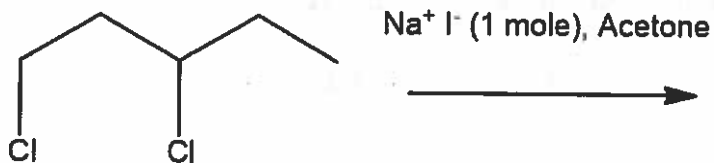


36.

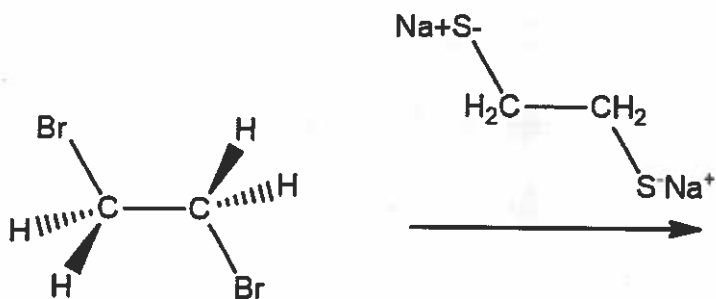
(30 points) Provide a sequence of reactions to perform the following transformations, showing the reagents and structures of all isolated synthetic intermediates. The synthesis must use the given starting materials; you may also use benzene and any other starting materials with 3 or fewer carbon atoms. You may use any reagents. Do not show mechanisms or the structures of reactive intermediates. Shorter, more efficient syntheses are preferred; overly long or inefficient sequences will lose some credit.



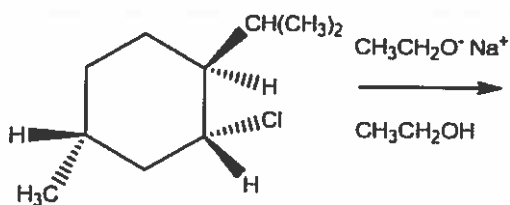
37.



38.



39.



40. Draw bond-line structures for all alkenes, including stereoisomers, that could be hydrogenated to give $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$. Hint: there are 7, not 3!