Chemistry 2541, Fall 2017
Final Exam

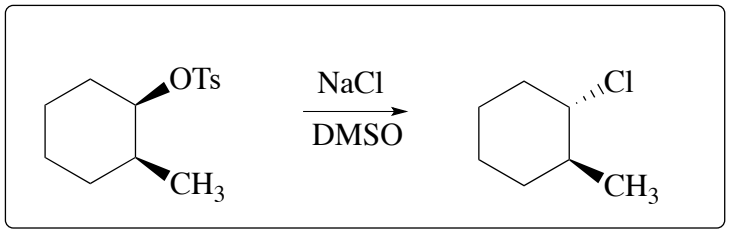
(200 points)

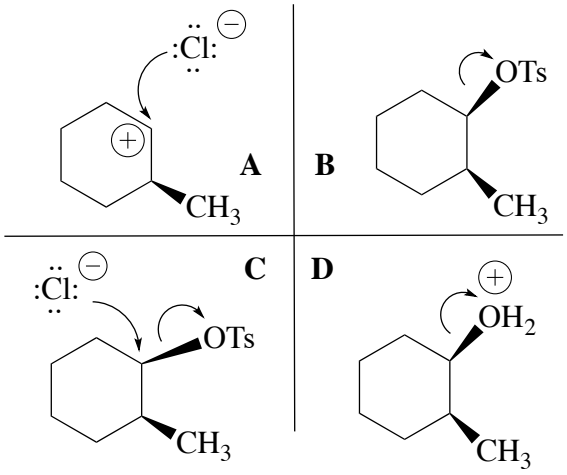
Important notes:

- Please use the provided Scantron form for your answers; you can keep the sheet with the questions and can use it as scratch paper
- Do not forget to write your name on the Scantron form
- You will not receive credit for unmarked answers or for more than one mark on answer line
- Your scores will be posted on eGradebook; graded Scantron forms will not be returned to students.

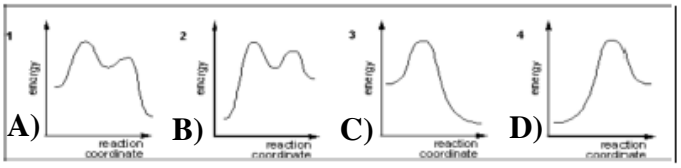
Questions 1-50 (150 pts): Please mark the appropriate box on the front of the Scantron form (3 pts each).

1. Which one of the following four schemes (**A-D**) represents a **step** in the **mechanism** of the reaction in the box?





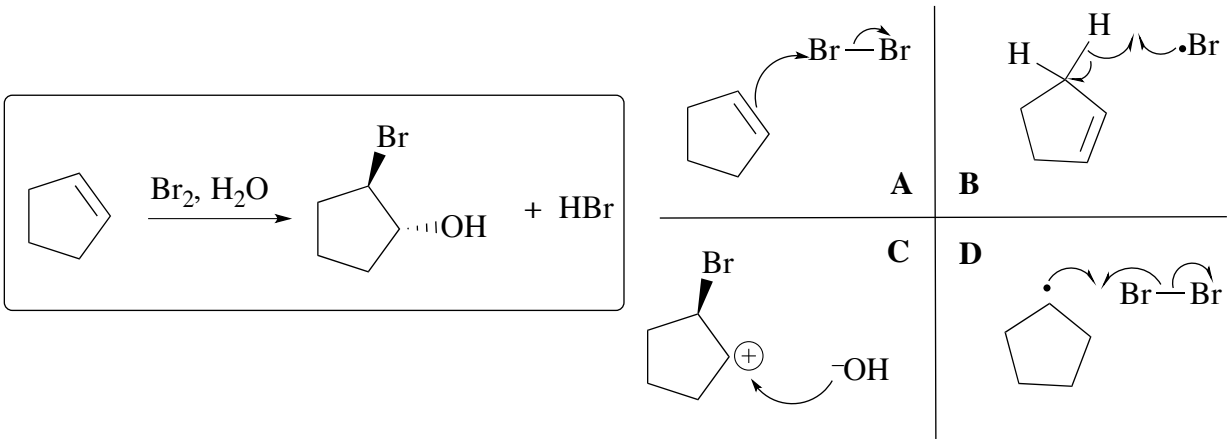
2. What is the **energy diagram** for the reaction shown above in **Question 1**?



3. What type of **mechanism** the reaction shown in **Question 1** has?

A) S_N1 B) S_N2 C) E1 D) E2

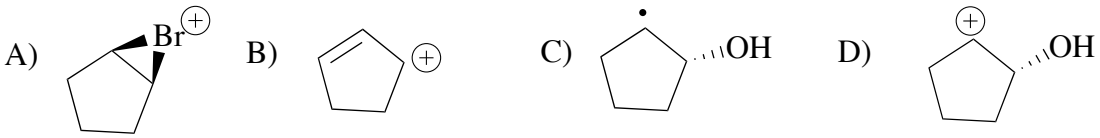
4. Which one of the following four schemes (**A-D**) represents a **step** in the **mechanism** of the reaction in the box?



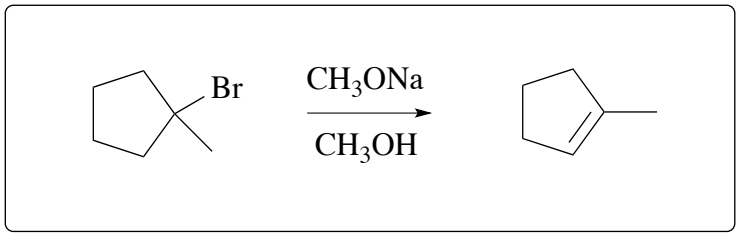
5. What type of **mechanism** the reaction shown in **Question 4** has?

A) Radical substitution B) Radical addition C) Electrophilic addition D) S_N1

6. What is the structure of an **intermediate** in the reaction shown in **Question 4**?



7. What is the **rate equation** for the reaction in the box?



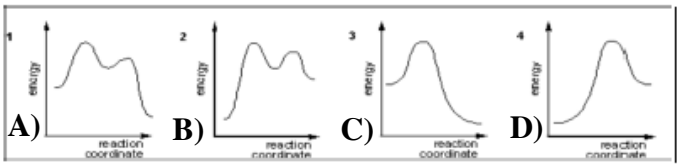
A) Rate = k [CH_3OH]

B) Rate = k [RBr]

C) Rate = k [RBr][CH_3OH]

D) Rate = k [RBr][CH_3ONa]

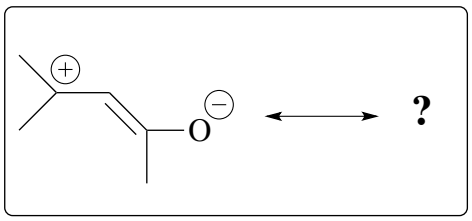
8. What is the **energy diagram** for the reaction shown above in **Question 7**?

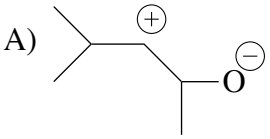


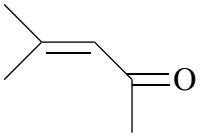
9. What type of **mechanism** the reaction shown in **Question 7** has?

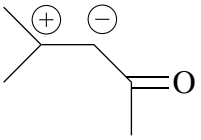
A) E1 B) S_N1 C) E2 D) S_N2

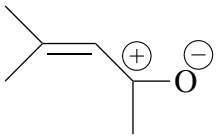
10. Which of the following structures represents the **major** resonance contributor of molecule in the box?



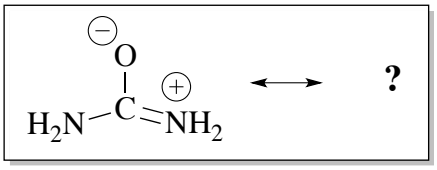
A) 

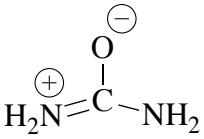
B) 

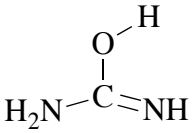
C) 

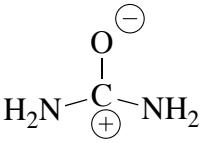
D) 

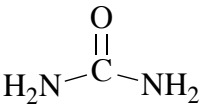
11. Which of the following structures represents the **major** resonance contributor of molecule in the box?



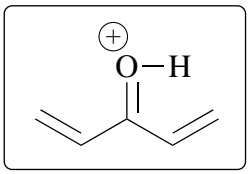
A) 

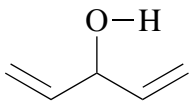
B) 

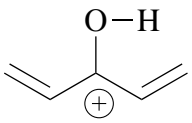
C) 

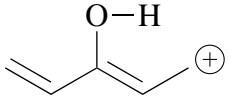
D) 

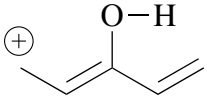
12. Which of the following is **NOT a resonance structure** of the molecule shown in the box?



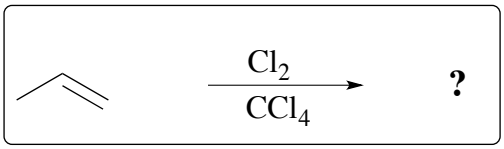
A) 

B) 

C) 

D) 

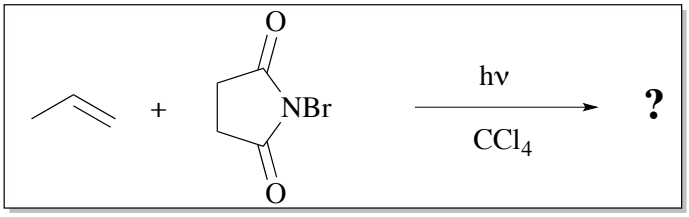
13. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) (*E*)-1-chloropropene B) 2-chloropropane

C) 1,2-dichloropropane D) 3-chloropropene

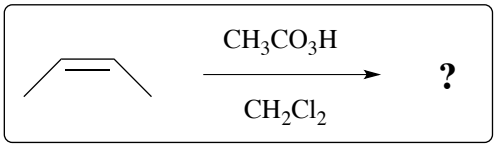
14. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) (*E*)-1-bromopropene B) 2-bromopropane

C) 1,2-dibromopropane D) 3-bromopropene

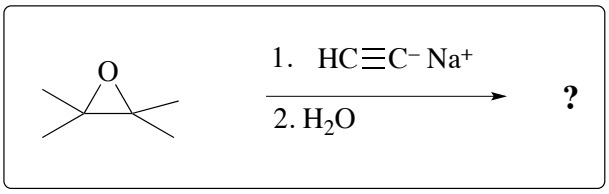
15. What is the **IUPAC** name of the major **product** for the reaction shown in the box?

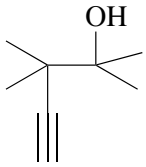


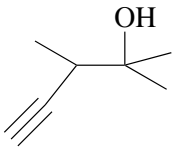
A) *cis*-3,4-dimethylepoxide B) *trans*-2,3-dimethyloxirane

C) *trans*-2,3-dimethylepoxide D) *cis*-2,3-dimethyloxirane

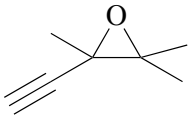
16. What is the main **product** of the reaction shown in the box?



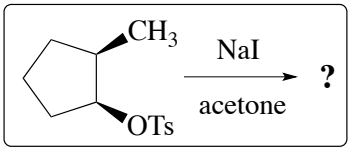
A) 

B) 

C) $HC\equiv CC(CH_2)_2CH_2OH$

C) 

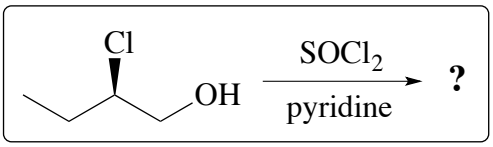
17. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) (1*S*,2*S*)-1-iodo-2-methylcyclopentane B) (1*R*,2*R*)-1-iodo-2-methylcyclopentane

C) (1*S*,2*R*)-1-iodo-2-methylcyclopentane D) (1*R*,2*S*)-1-iodo-2-methylcyclopentane

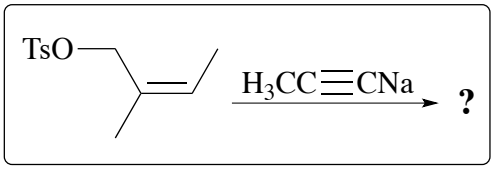
18. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) (2*S*,3*S*)-2,3-dichlorobutane B) (2*R*,3*S*)-2,3-dichlorobutane

C) (*R*)-1,2-dichlorobutane D) (*S*)-1,2-dichlorobutane

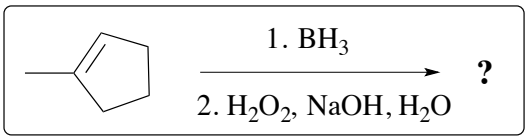
19. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) (*Z*)-3-methyl-2-hepten-5-yne B) (*E*)-3-methyl-2-hepten-5-yne

C) (*Z*)-3-methyl-2-octen-6-yne D) (*E*)-3-methyl-2-octen-6-yne

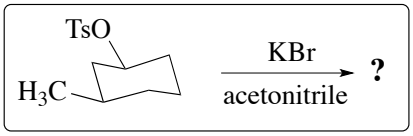
20. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) *cis*-2-methylcyclopentanol B) *trans*-2-methylcyclopentanol

C) 1-methylcyclopentanol D) 1-methylcyclopentene

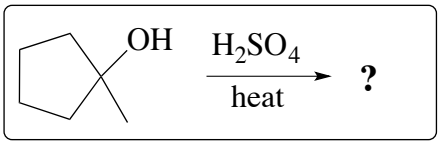
21. What is the IUPAC name of the major **product** for the reaction shown in the box?



A) *cis*-1-bromo-4-methylcyclohexane B) *cis*-1-bromo-3-methylcyclohexane

C) *trans*-1-bromo-4-methylcyclohexane D) *trans*-1-bromo-3-methylcyclohexane

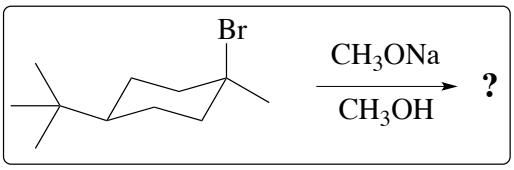
22. What is the IUPAC name of the major **product** for the reaction shown in the box?

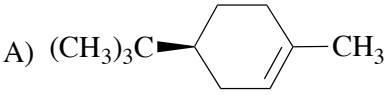


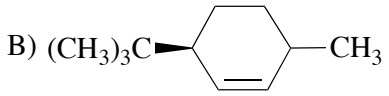
A) methylenecyclopentane B) 3-methylcyclopentene

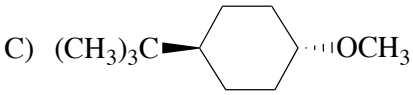
C) 4-methylcyclopentene D) 1-methylcyclopentene

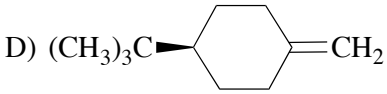
23. What is the main **product** of the reaction shown in the box?



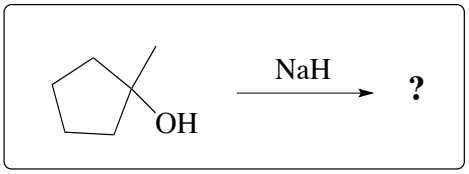
A) 

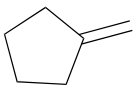
B) 

C) 

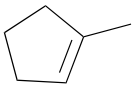
D) 

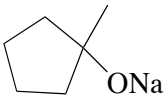
24. What is the main **product** of the reaction shown in the box?



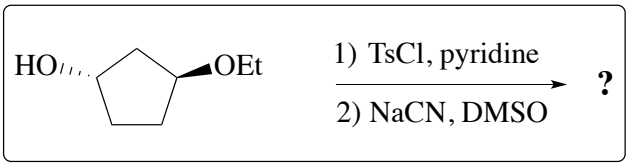
A) 

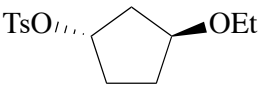
B) 

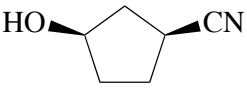
C) 

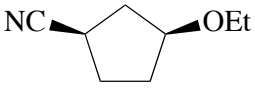
D) 

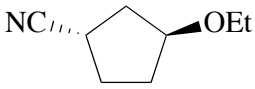
25. What is the main **product** of the reaction shown in the box?



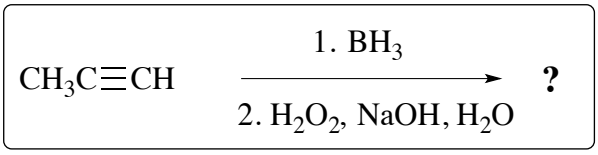
A) 

B) 

C) 

D) 

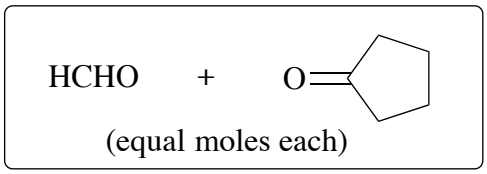
26. What is the main **product** of the reaction shown in the box?



A) $CH_3CH_2CH_2OH$ B) $CH_3CH(OH)CH_3$

C) CH_3COCH_3 D) CH_3CH_2CHO

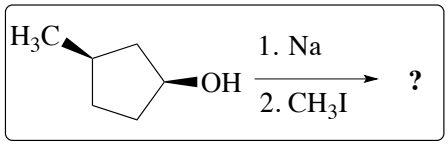
27. What **alkene** when treated with **ozone** and then with $(CH_3)_2S$ gives the products shown in the box?



A) methylenecyclopentane B) vinylcyclopentane

C) allylcyclopentane D) 1-methylcyclopentene

28. What is the IUPAC name of the major **product** for the reaction shown in the box?



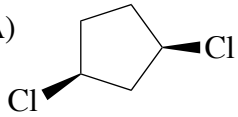
A) *trans*-1-methoxy-3-methylcyclopentane B) *cis*-3-methoxycyclopentanol

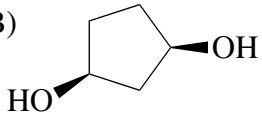
C) *cis*-1-methoxy-3-methylcyclopentane D) 3-methylcyclopentene

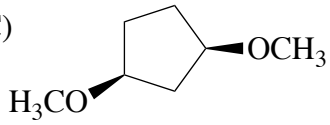
29. Which one of the following compounds is the **strongest acid**?

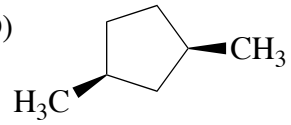
A) *t*-BuOH B) CH_3CH_2Br C) CH_3NH_2 D) CH_3CO_2H

30. Which one of the following compounds has the highest **solubility in water**?

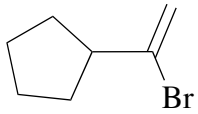
A) 

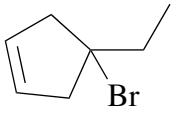
B) 

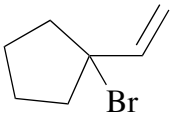
C) 

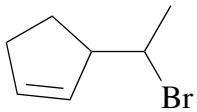
D) 

31. Which molecule is the best substrate for $\mathbf{S_N1}$ reaction?

A) 

B) 

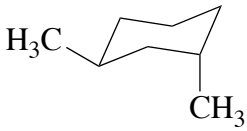
C) 

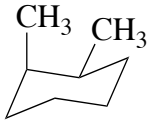
D) 

32. Which one of the following molecules is a **meso** compound?

A) 

B) 

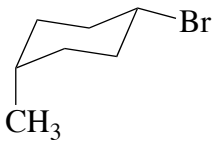
C) 

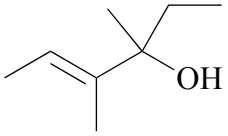
D) 

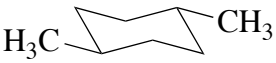
33. Which of the following compounds is the **strongest base**?

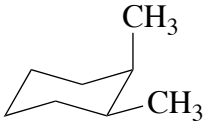
A) $NaN(CH_3)_2$ B) NaF C) NaOEt D) NaI

34. Which one of the following molecules is **chiral**?

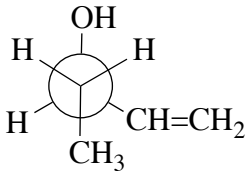
A) 

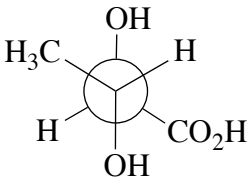
B) 

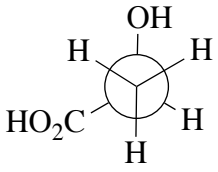
C) 

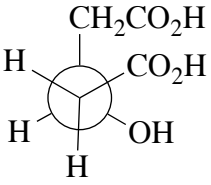
D) 

35. Which of the following molecules contains **two chiral centers**?

A) 

B) 

C) 

D) 

36. Consider the following **orders of priority** (highest to lowest). Which order is incorrect?

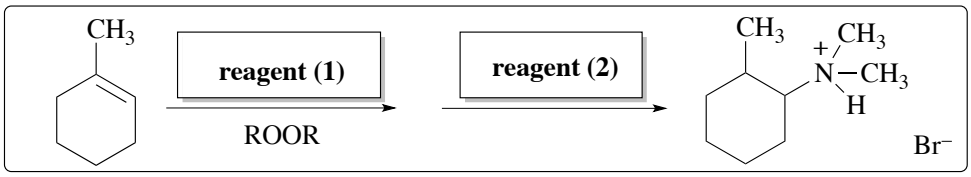
A) Cl > CH_2CH_3 > CH_3 > H

B) Cl > $CH{=}CH_2$ > $C(CH_3)_3$ > H

C) OH > CHO > CH_2CH_2OH > CH_3

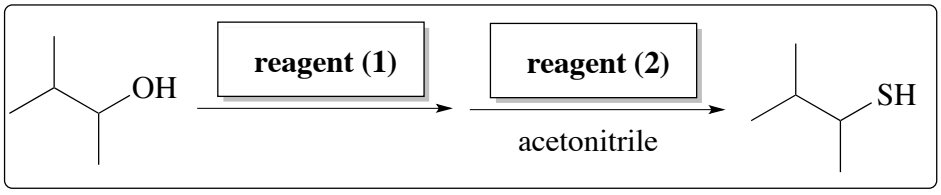
D) NH_2 > CH_2SH > CH_2OH > CH_3

37. Which sequence of **reagents** can be used for the reaction shown in the box?



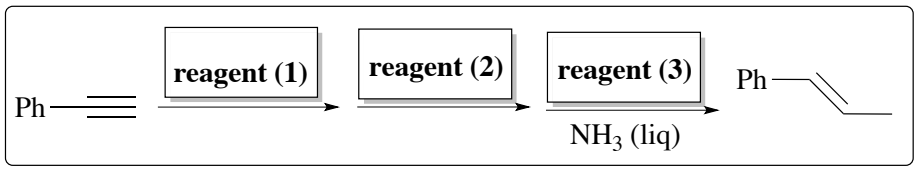
A) (**1**) NBS, (**2**) $NaN(CH_3)_2$
B) (**1**) HBr, (**2**) $(CH_3)_2NH$
C) (**1**) Br_2, (**2**) $(CH_3)_2NH$
D) (**1**) HBr, (**2**) $NaNH_2$

38. Which sequence of **reagents** can be used for the reaction shown in the box?



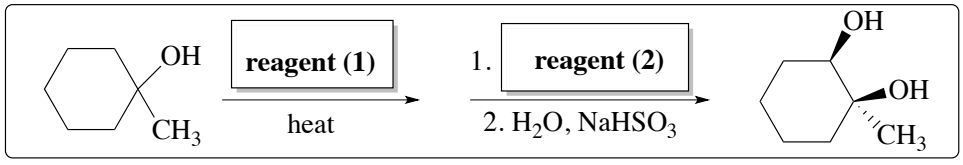
A) (**1**) HBr, (**2**) $NaSCH_3$
B) (**1**) NBS, (**2**) $NaSCH_3$
C) (**1**) Br_2, (**2**) NaSH
D) (**1**) PBr_3, (**2**) NaSH

39. Which sequence of **reagents** can be used for the reaction shown in the box?



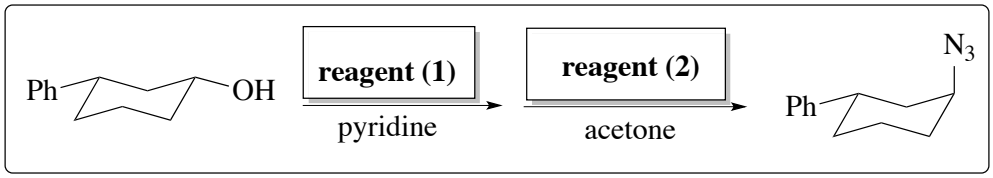
A) (**1**) Br_2, (**2**) $NaNH_2$, (**3**) Na
B) (**1**) CH_3Br, (**2**) NH_3, (**3**) Na
C) (**1**) CH_3Br, (**2**) $NaNH_2$, (**3**) H_2
D) (**1**) $NaNH_2$, (**2**) CH_3Br, (**3**) Na

40. Which sequence of **reagents** can be used for the reaction shown in the box?



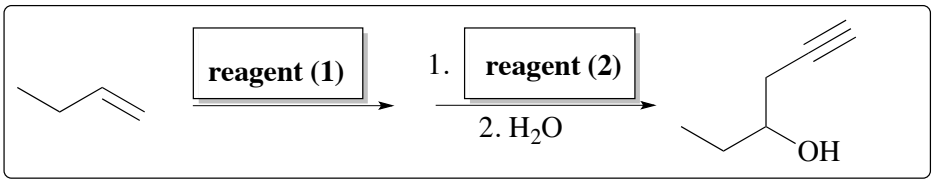
A) (**1**) H_3PO_4, (**2**) O_3
B) (**1**) H_2SO_4, (**2**) OsO_4
C) (**1**) CH_3CH_2ONa, (**2**) OsO_4
D) (**1**) PCC, (**2**) H_2SO_4

41. Which sequence of **reagents** can be used for the reaction shown in the box?



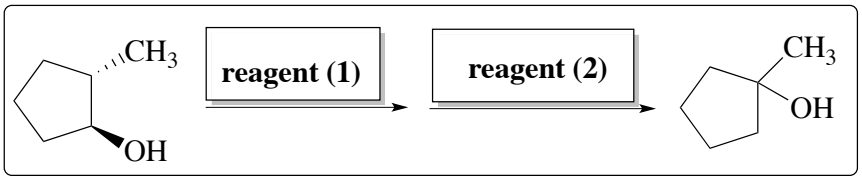
A) (**1**) TsCl, (**2**) NaN_3
B) (**1**) $SOCl_2$, (**2**) NaCN
C) (**1**) TsCl, (**2**) NH_3
D) (**1**) PCC, (**2**) NaN_3

42. Which sequence of **reagents** can be used for the reaction shown in the box?



A) (**1**) Br_2, (**2**) NaCN
B) (**1**) HBr, (**2**) NaCN
C) (**1**) RCO_3H, (**2**) NaN_3
D) (**1**) RCO_3H, (**2**) $HC\equiv C^- Na^+$

43. Which sequence of **reagents** can be used for the reaction shown in the box?



A) (**1**) CH_3CH_2ONa, (**2**) NaOH, H_2O
B) (**1**) H_2SO_4, heat, (**2**) H_2SO_4, H_2O
C) (**1**) IBX, (**2**) NaOH, H_2O
D) (**1**) PCC, (**2**) H_2SO_4, H_2O

44. Which is the **least stable** alkene?

A) 2-methyl-2-pentene **B)** *trans*-2-pentene **C)** 1-pentene **D)** 2,3-dimethyl-2-pentene

45. Arrange the compounds in the box in order of **decreasing boiling point**.

I) butane II) 2-chloropropane III) isopropanol

A) (highest) I > II > III **B)** (highest) III > II > I **C)** (highest) II > III > I **D)** (highest) II > I > III

46. Which of the following represents the order of increasing **acidity** for compounds the box?

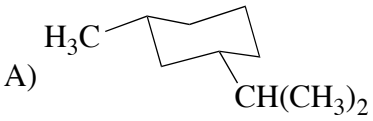
(**1**) CH_3Br (**2**) CH_3CO_2H (**3**) CH_3CH_2OH (**4**) FCH_2CO_2H (**5**) HI

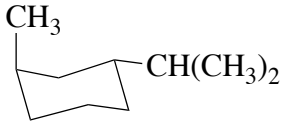
A) 1 (strongest) > 2 > 4 > 3 > 5 (weakest) **B)** 5 (strongest) > 4 > 2 > 3 > 1 (weakest)
C) 4 (strongest) > 1 > 2 > 3 > 5 (weakest) **D)** 5 (strongest) > 1 > 4 > 2 > 3 (weakest)

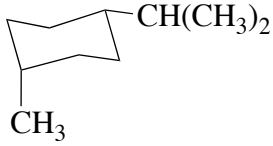
47. Which species is **NOT a Lewis acid**?

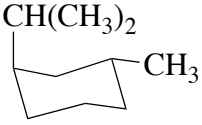
A) $B(CH_2CH_3)_3$ **B)** BH_3 **C)** AlH_4^- **D)** $AlBr_3$

48. Which one of the following structures has the lowest **diaxial interactions**?

A) 

B) 

C) 

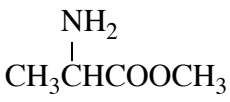
D) 

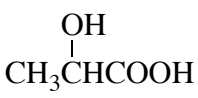
49. Which of the following is a **tertiary alcohol**?

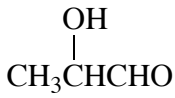
A) 3-buten-1-ol B) (*R*)-2-methyl-1-butanol
C) (*R*)-3-buten-2-ol D) 2-methyl-3-buten-2-ol

50. Which of the following molecules contains both an **acid** AND an **alcohol** functional group?

A) 

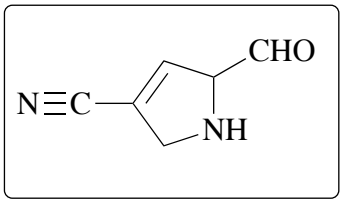
B) 

C) 

D) 

PLEASE MARK YOUR ANSWERS IN THE APPROPRIATE BOX ON THE BACK OF THE SCANTRON FORM (50 points total):

Question 51 (30 pts): Consider the molecule shown below and answers the following questions. Indicate your answers by marking the appropriate number in **boxes 51-60** on the back of the Scantron form (3 pts each).

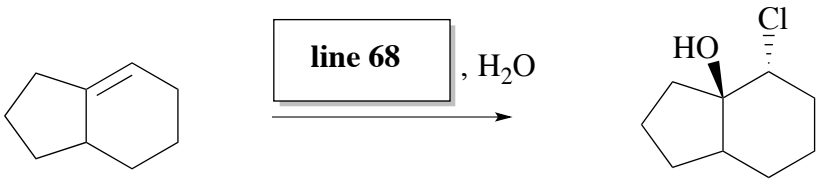


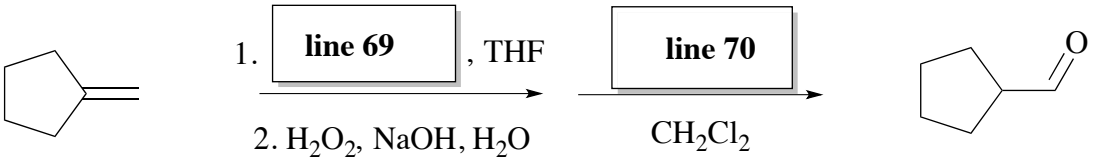
Box 51: Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals
Box 52: Number of π bonds formed by overlap of *sp* and *sp* orbitals
Box 53: Number of σ bonds formed by overlap of sp^2 and *sp* orbitals
Box 54: Number of σ bonds formed by overlap of *s* and sp^3 orbitals
Box 55: Number of σ bonds formed by overlap of sp^3 and sp^3 orbitals
Box 56: Number of π bonds formed by overlap of sp^2 and sp^2 orbitals
Box 57: Number of σ bonds formed by overlap of sp^2 and sp^2 orbitals
Box 58: Total number of σ bonds
Box 59: Total number of π bonds
Box 60: Total number of non-bonding electrons in this molecule

(Continued on the next page)

Question 52 (20 pts): Please write your answers in **boxes 66-70** on the back of the Scantron form. Provide the **reagents** that give indicated products in high yield (4 pts each):


line 66
peroxides
line 67
NH2
CH3
Br


line 68
, H2O
HO
Cl


1.
line 69
, THF
2. H2O2, NaOH, H2O
line 70
CH2Cl2
O