Chemistry 2541
Fall 2010; Final Exam

This exam has 8 problems on 10 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) Key

Scores:

Problem 1. 17

Problem 2. 19

Problem 3. 22

Problem 4. 40

Problem 5. 20

Problem 6. 26

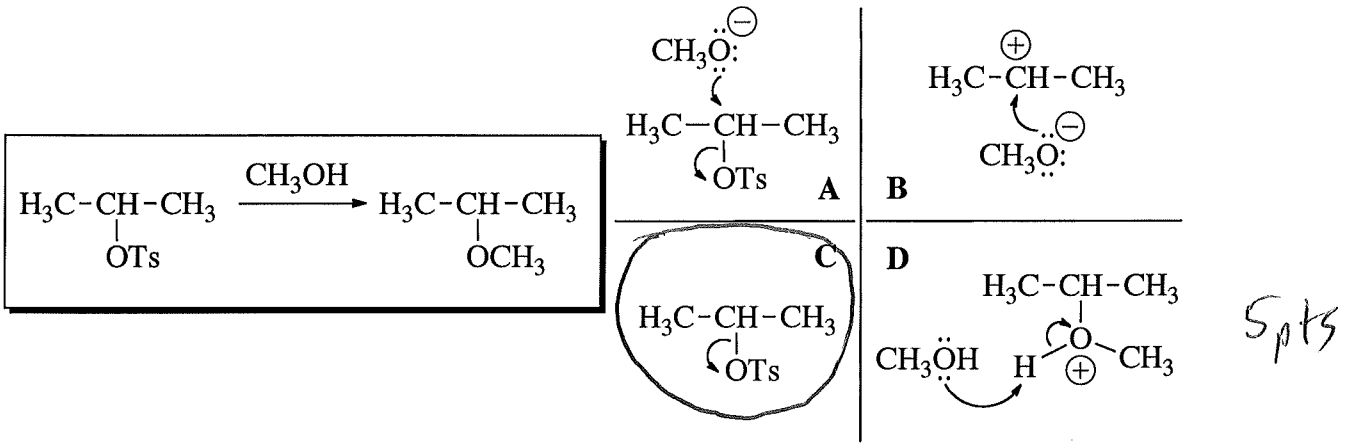
Problem 7. 28

Problem 8. 28

Total: 200

1. (17 pts) Answer the questions on mechanisms of the following reactions:

(a) Which one of the following four schemes (**A-D**) gives the best representation of the **rate-limiting step** of the reaction in the box (circle the correct answer; **5 pts**):



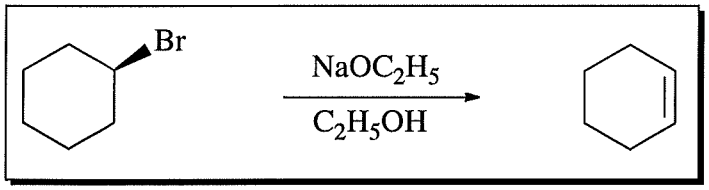
• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

3pts

(S_N1) S_N2 E1 E2 Electrophilic addition Radical substitution

---

(b) Answer questions on the mechanism of the reaction in the box:



• Circle the correct **rate equation** for this reaction (**3 pts**):

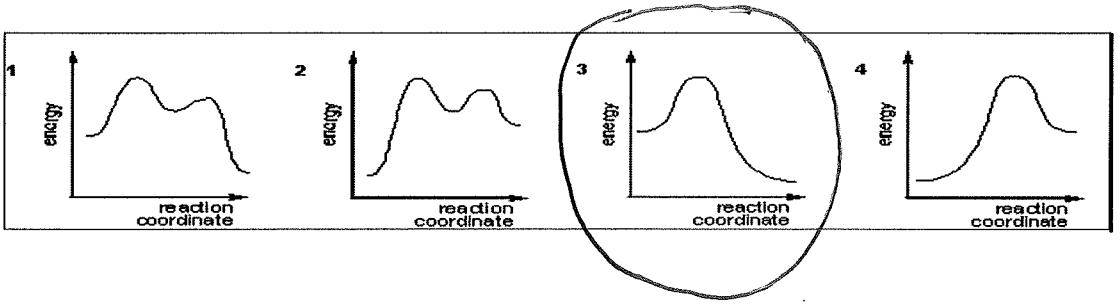
3pts

Rate = k [RBr] (Rate = k [RBr] [C_2H_5ONa]) Rate = k [C_2H_5ONa] Rate = k [C_2H_5ONa] [Br^-]

• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

S_N1 S_N2 E1 (E2) Electrophilic addition Radical substitution 3pts

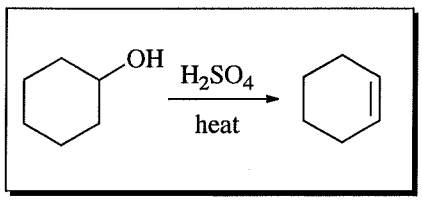
• Circle the correct energy diagram for this reaction (**3 pts**):

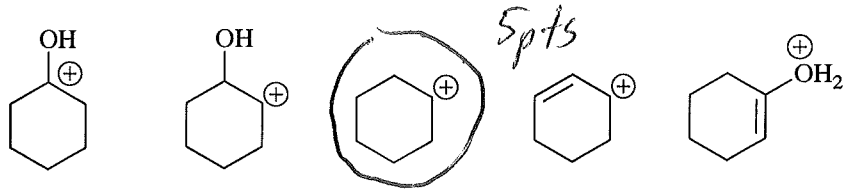


3pts

17pts

2. (**19** pts) **(a)** Circle the structure of an **intermediate** in the reaction shown in the box (**5 pts**):





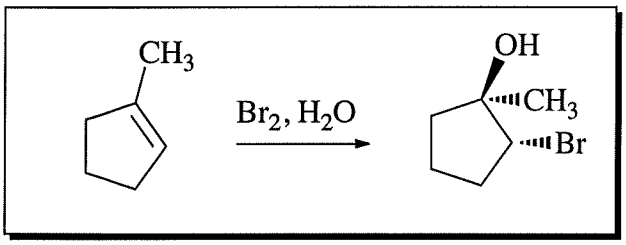
5 pts

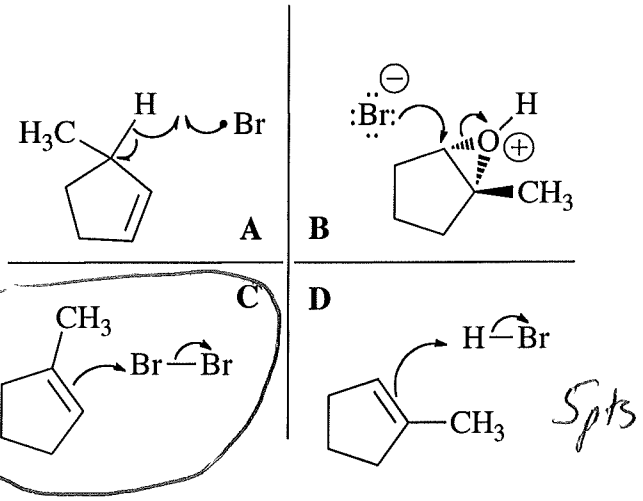
• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

3 pts

S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

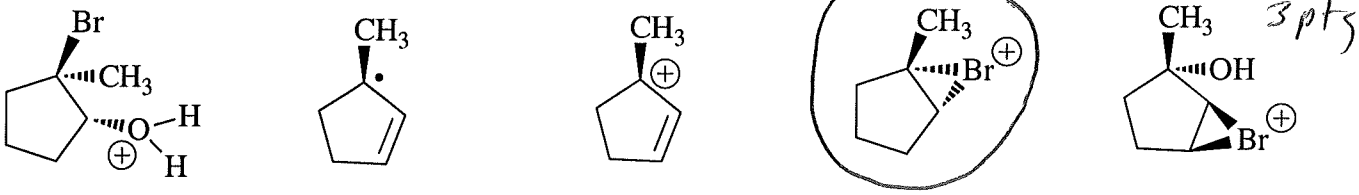
(b) Which one of the following four schemes (**A-D**) gives the best representation of the ***initial step*** of the reaction in the box (circle the correct answer; **5 pts**):





5 pts

• Circle the structure of the key **intermediate** of this reaction (**3 pts**).



3 pts

• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

3 pts

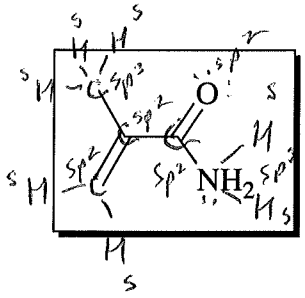
S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

19 pts

3. (**22** pts) Answer the following questions on the structure of the molecules shown in the boxes below.

a) (12 pts) Answer the questions about types of bonds that are present in the following molecule (2 pts each correct answer):

2 pts each



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

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

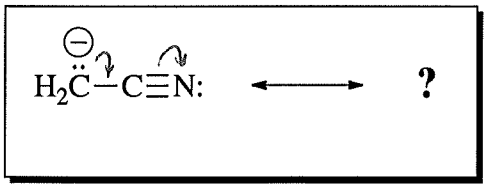
Number of σ bonds formed by overlap of *s* and sp^3 orbitals: 5

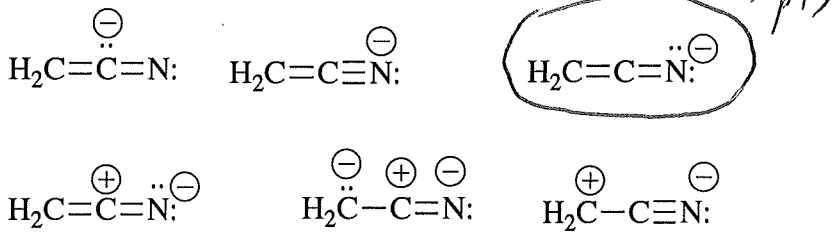
Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals: 2

Total number of σ bonds: 12

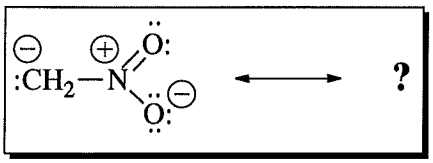
Total number of π bonds: 2

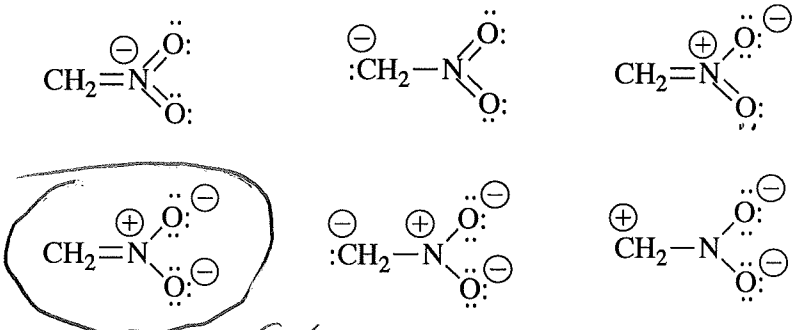
b) (10 pts) Circle the structure of the most important resonance contributors of the molecules in the boxes (5 pts each):





5 pts

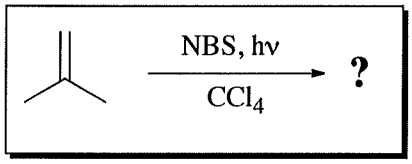




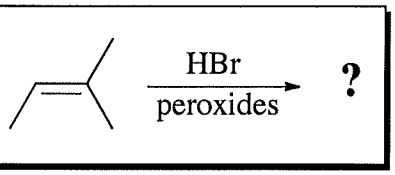
5 pts

22 pts

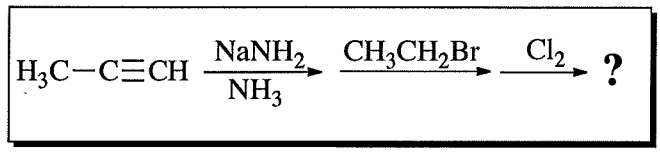
4. (**40**, 5 pts each) Circle the name of the **major product** in each of the following reactions: 5 pts



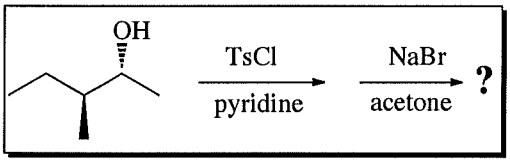
(*E*)-1-bromopropene 2-bromo-2-methylpropane (*E*)-1,2-dibromopropene
(*Z*)-1-bromo-2-methyl-1-propene 1,2-dibromo-2-methylpropane
(*E*)-1-bromo-2-methyl-1-propene 3-bromo-2-methyl-1-propene



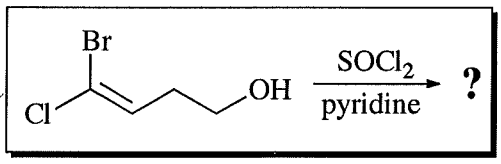
1-bromo-3-methyl-2-butene 1-bromo-2-methylbutane
(*E*)-1-bromo-2-methyl-2-butene 2-bromo-2-methylbutane
2-bromo-3-methylbutane 1-bromo-2-methyl-2-butene 5 pts



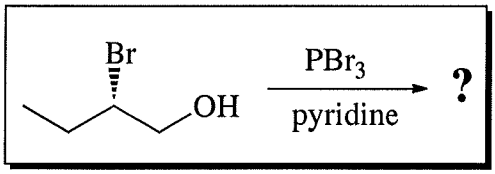
(*E*)-2-pentene (*E*)-2,3-dichloro-2-pentene
(*Z*)-2,3-dichloro-2-pentene (*E*)-1,2-dichloro-2-pentene
(*Z*)-1,2-dichloro-2-pentene 1-chloro-2-pentyne 5 pts



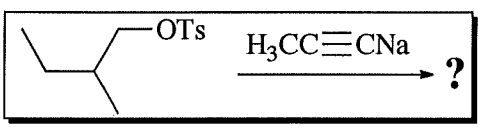
(*S*)-2-bromo-3-methylpentane (*R*)-2-bromo-3-methylpentane
(2*R*,3*S*)-2-bromo-3-methylpentane (2*S*,3*R*)-2-bromo-3-methylpentane
(2*S*,3*S*)-2-bromo-3-methylpentane (2*R*,3*R*)-2-bromo-3-methylpentane 5 pts



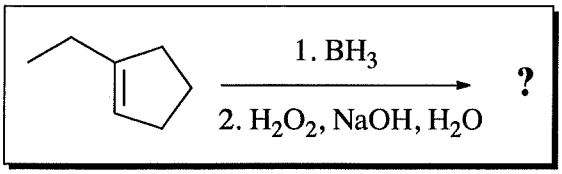
(*E*)-1-bromo-1,4-dichloro-1-butene 4,4-dichloro-3-buten-1-ol
(*E*)-1-bromo-1,4-dichloro-2-butene 4,4-dichloro-3-buten-2-ol 5 pts
(*Z*)-1-bromo-1,4-dichloro-1-butene 4,4-dibromo-3-buten-1-ol



(2*S*,3*S*)-2,3-dibromobutane (2*R*,3*S*)-2,3-dibromobutane
(*S*)-1,2-dibromobutane (*R*)-1,2-dibromobutane
(2*R*,3*S*)-2,3-dibromobutane (2*R*,3*R*)-2,3-dibromobutane 5 pts



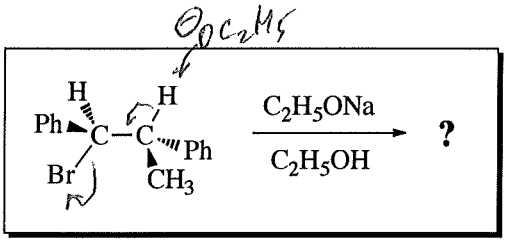
2-methyl-2-butene 4-methyl-2-hexyne isopropylmethylacetylene
5-methyl-1-hexyne 5-methyl-2-heptyne isopropylacetylene 5 pts

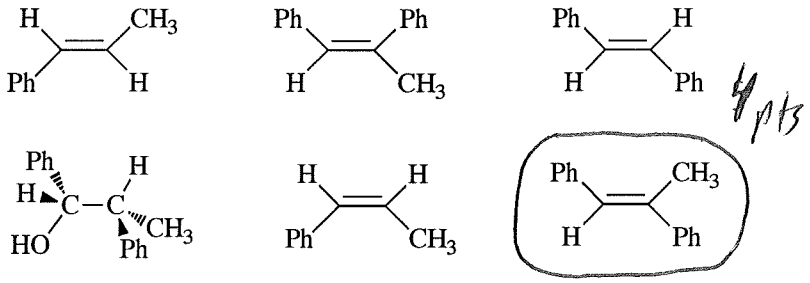


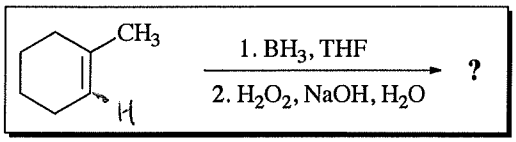
trans-2-ethylcyclopentanol *cis*-2-ethylcyclopentanol 5 pts
1-ethylcyclopentanol 2-ethylcyclopentan-1,2-diol
1-ethyl-1,2-cyclopentanediol 3-ethylcyclopentanol

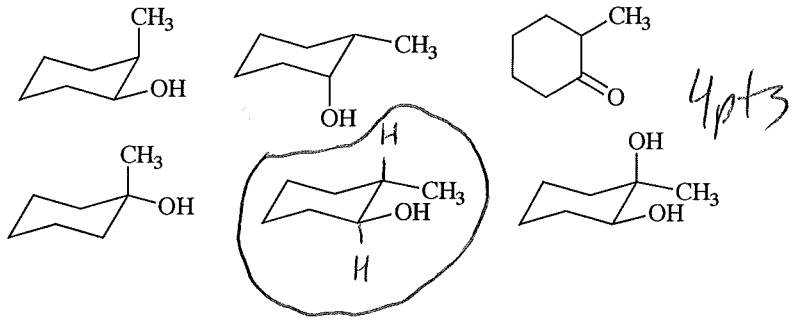
40

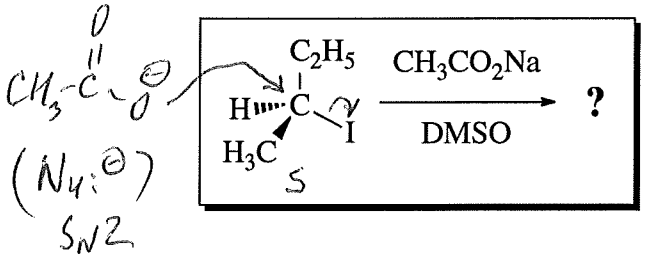
5. (**20**, 4 pts each) Circle the structure of the **major product** in each of the following reactions:

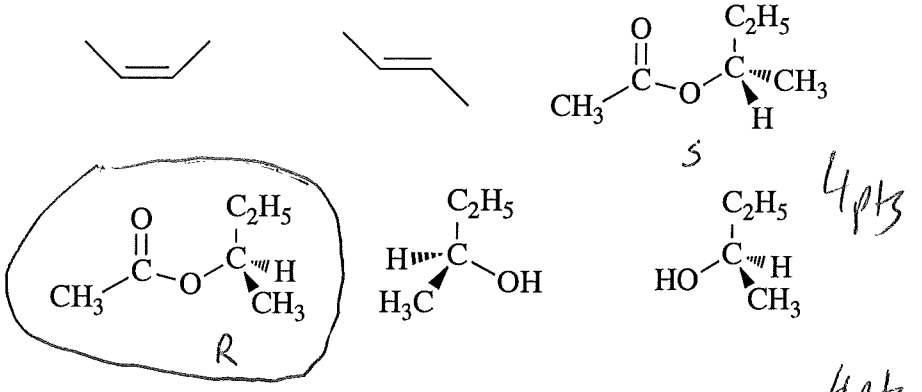


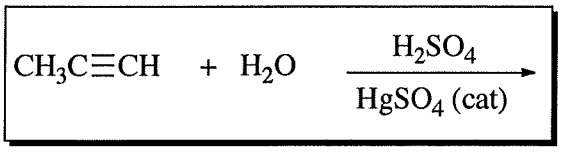


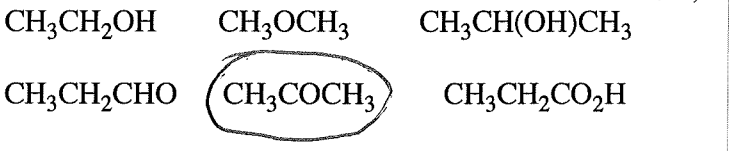


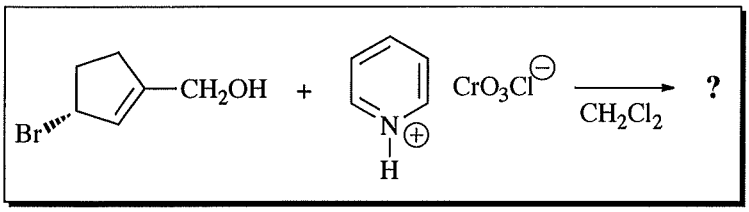


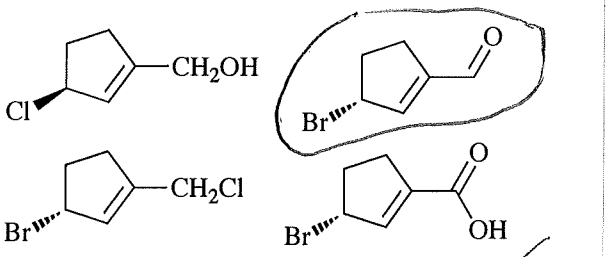






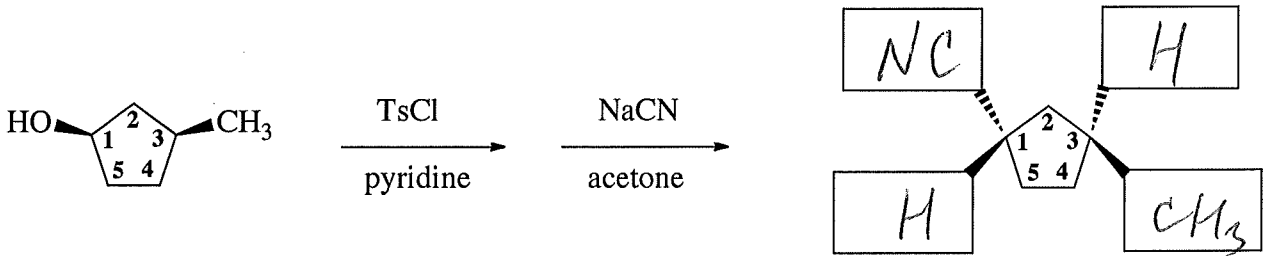


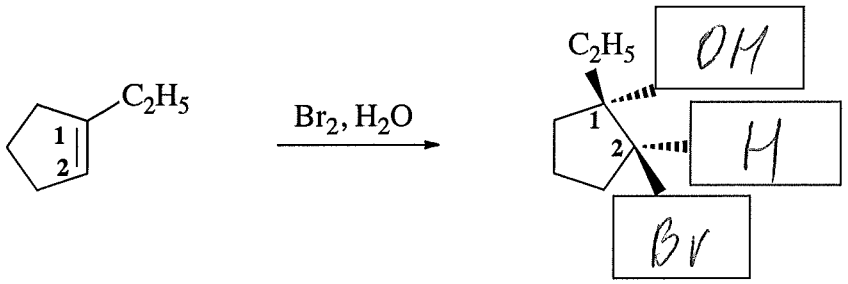




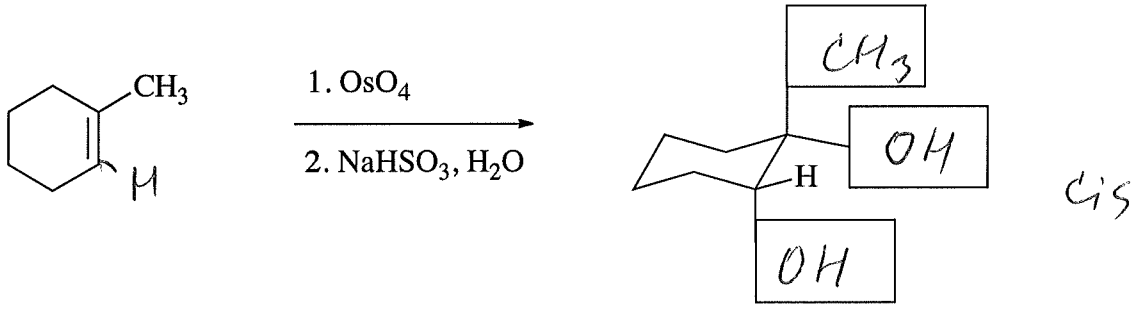
20pts

6. (**26** pts) Finish drawing the structures of the products in these reactions by placing appropriate substituents (including H) in the boxes on the bonds (2 pt each missing part).

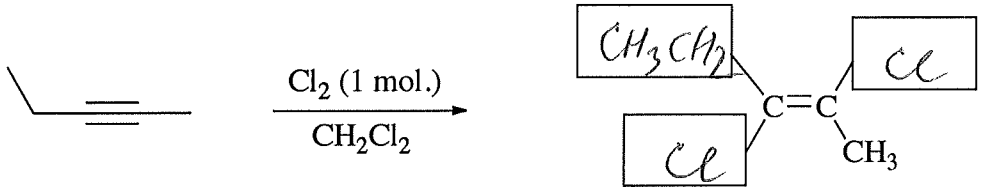




2pts each

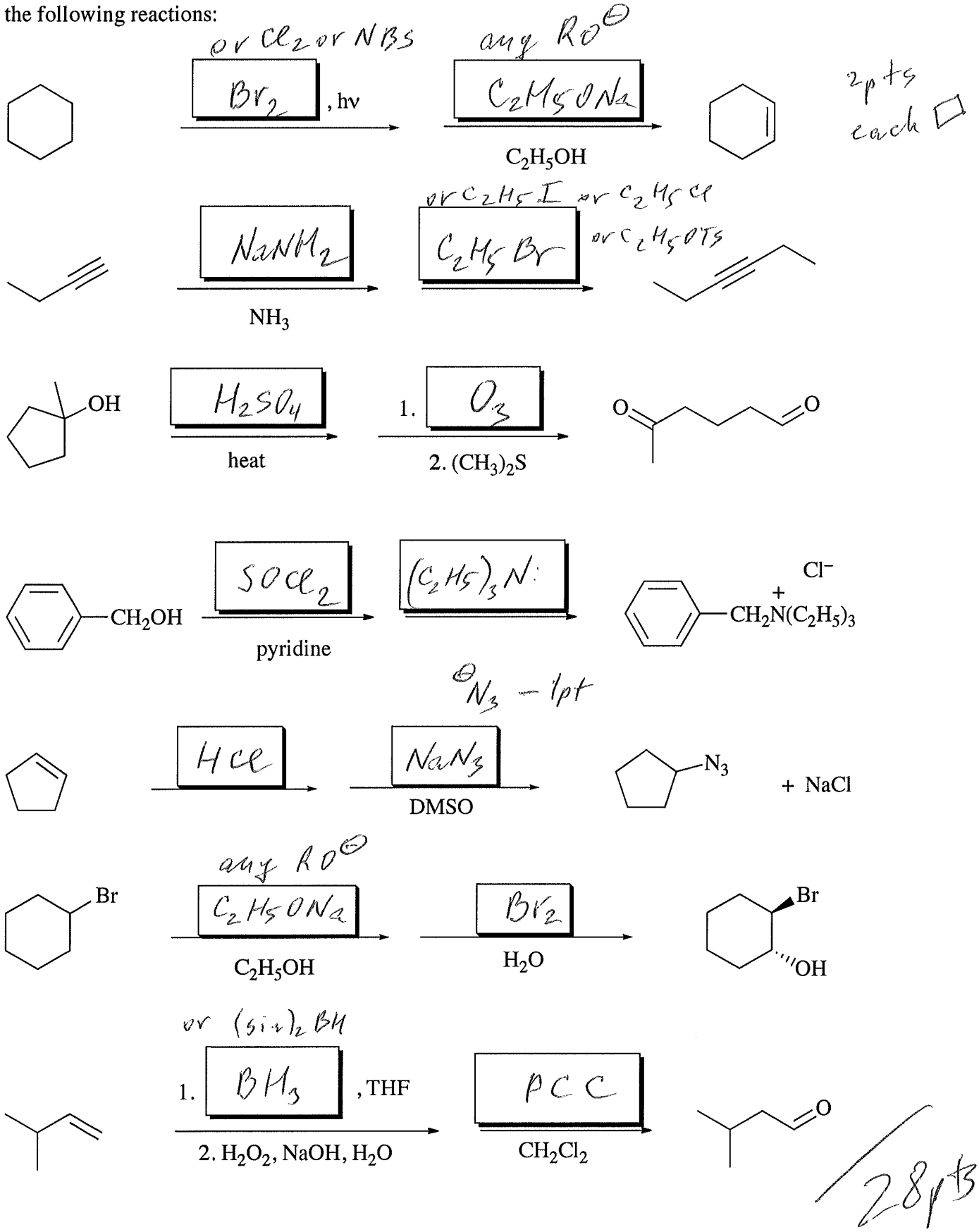


cis



26 pts

7. (**28**, 2 pts each box) Place in each box the molecule of a reagent that is required to perform each of the following reactions:



8. (**28**, 4 pts each) For each of the following questions (a)-(g) **circle** the item that is the correct answer.

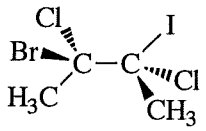
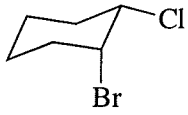
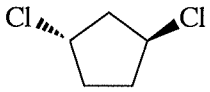
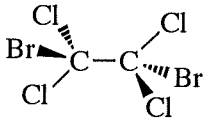
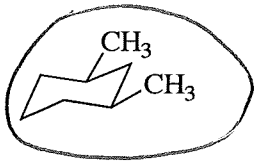
(**a**) Which one of the following compounds is the **strongest base**?

CH_3OH CH_3NH_2 $KOCH_2CH_3$ *t*-BuOK KOH CH_3CH_3

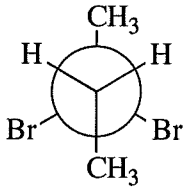
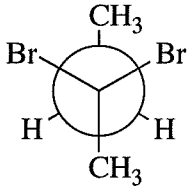
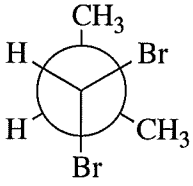
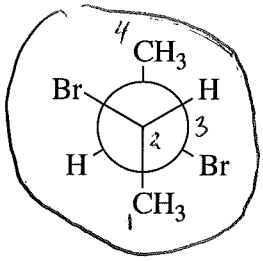
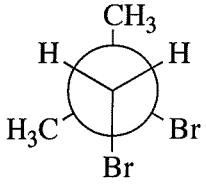
(**b**) Which one of the following compounds has the most **acidic C–H bonds**?

2-butyne *trans*-2-butene 1-butene *cis*-2-butene 2-methylbutane 1-butyne

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

(**d**) Which of the following Newman projections represents **2,3-dibromobutane**?

(**e**) Which one of the following compounds will have the **highest** boiling point?

propane 2-propene-1-ol 2-chloropropane 1-fluoropropane propene propyne

(**f**) Which of the following compounds is the **most reactive** in the S_N2 reactions?

1-iodohexane 2-iodohexane 3-iodohexane 5-iodo-1-hexene 2-iodo-2-methylhexane

(**g**) Which of the following compounds is the **most reactive** in the S_N1 reactions?

1-chlorohexane 1-iodo-2-methylhexane 1-iodo-2-methylcyclohexane 3-iodohexane

iodocyclohexane 4-iodocyclohexene 1-iodo-1-methylcyclohexane