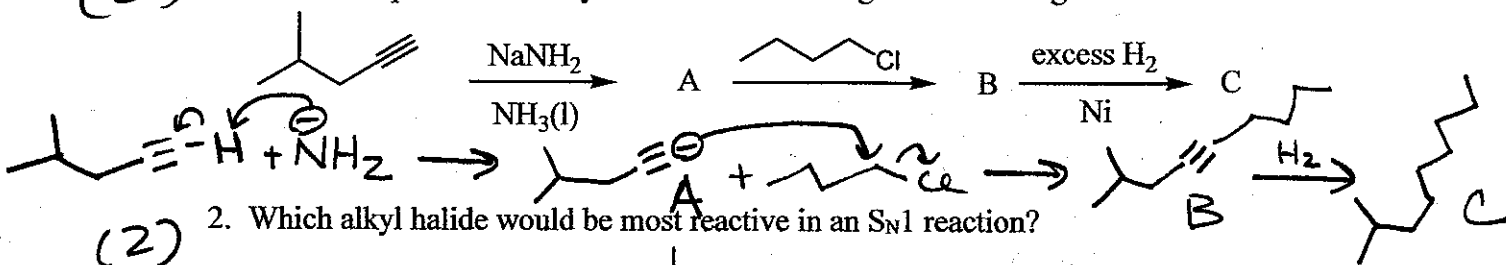


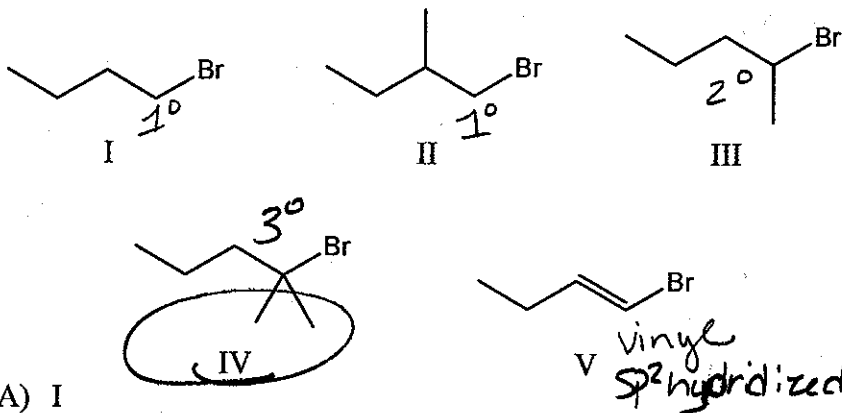
Name: Key Date: _____

60 total points + 5 points possible bonus

(5) 1. What final product is likely to be obtained through the following series of reactions?



(2) 2. Which alkyl halide would be most reactive in an $\text{S}_{\text{N}}1$ reaction?



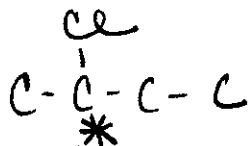
most imp. factor in $\text{S}_{\text{N}}1$ reaction is stability of carbocation generated.
 $3^\circ > 2^\circ > 1^\circ > \text{methyl}$

- A) I
- B) II
- C) III
- D) IV**
- E) V

(2) 3. Which statement concerning the "Chirality at Work" story published in C&ENG News is false?

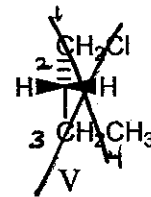
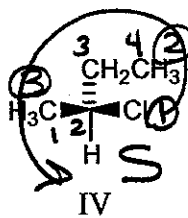
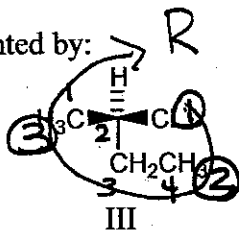
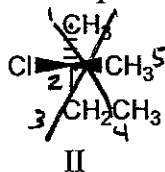
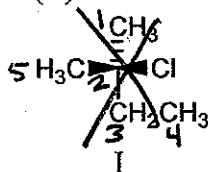
- A) An R enantiomer of a racemic drug mix may be metabolized differently by the body than the S enantiomer.
- B) Single enantiomers are now dominating racemic mixtures in drug development.
- C) Since the individual enantiomers of a racemic drug mixture always have the same biological effect, an understanding of their relative stereochemistry and pharmacokinetics is not required.**
- D) Awareness of the stereoselectivity of drug action has intensified since the thalidomide tragedies of the 1960s.
- E) None, all of these statements are true

(2) 4. The substitution mechanism whose rate depends primarily on the degree of steric hindrance around the leaving group is the $\text{S}_{\text{N}}2$ Reaction



(2)

5. (R)-2-Chlorobutane is represented by:



- A) I
B) II
C) III
D) IV
E) V

I and II and V are not 2-chlorobutane
only III has correct stereochem

① First check to make sure the structure is 2-chlorobutane
② check to see if correct stereogenic center is shown & assign stereochem

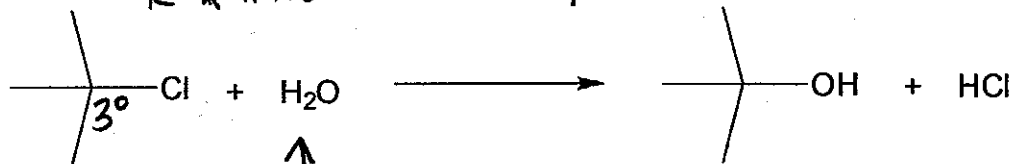
(5)

6. Question 6.16 from homework: Which S_N1 reaction (Reaction 1 or Reaction 2) would you expect to take place more rapidly? Explain your answer.

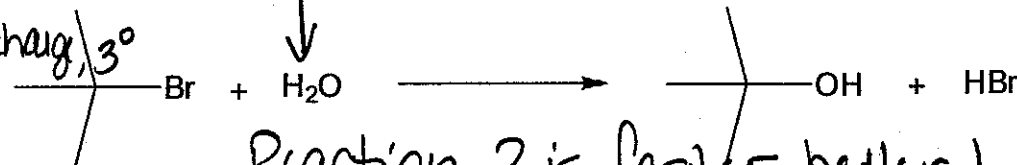
Reaction 1.

First step of S_N1 reaction is ionization of R-X into R^+ and X^- , both are 3° carbocations

only leaving group is different, Br^- is better L.G., more able to stab. \ominus charge & weaker base



nucleophile is same



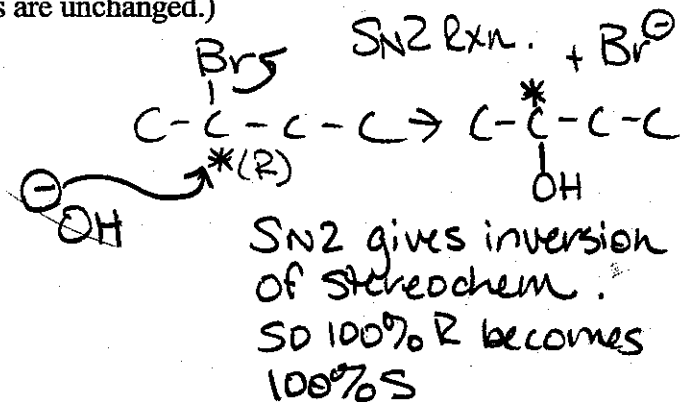
Reaction 2 is faster, better L.G.

(2)

7. Which of the following statements is (are) true of an S_N2 reaction of (R)-2-bromobutane with hydroxide ion?

- (A) The major product would be (S)-2-butanol.
 (B) Doubling the concentration of (R)-2-bromobutane would double the rate of the reaction. (Assume that all other experimental conditions are unchanged.)
 (C) Doubling the hydroxide ion concentration would double the rate of the reaction. (Assume that all other experimental conditions are unchanged.)
 (D) All of the above
 (E) Two of the above

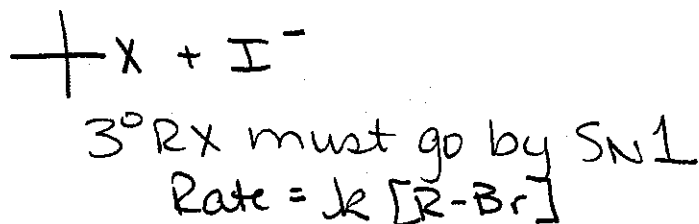
$$\text{Rate} = k [\text{OH}^-] [\text{R-X}]$$



(9)

(2) 8. The rate equation for a nucleophilic substitution reaction of a tertiary alkyl bromide (R-Br) with I⁻ ion would be:

- A) Rate = k [RBr]²[I⁻]
- B) Rate = k [RBr]**
- C) Rate = k [I⁻]
- D) Rate = k [RBr][I⁻]²
- E) Rate = k [RBr][I⁻]



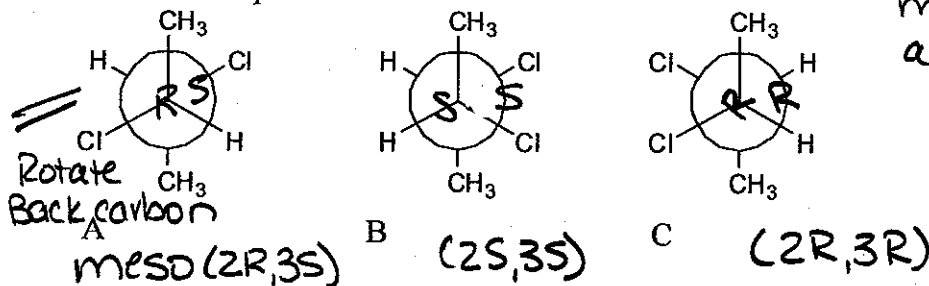
(5) 9. What is the percent composition of a mixture of (S)-(+)-2-butanol, $[\alpha]_D^{25} = +13.52^\circ$, and (R)-(-)-2-butanol, $[\alpha]_D^{25} = -13.52^\circ$, with a specific rotation $[\alpha]_D^{25} = +6.76^\circ$? Hint: calculate the ee of the dominant enantiomer and then consider the composition of the mixture.

- A) 25%(R) 75%(S)**
- ~~B) 50%(R) 50%(S)~~
- ~~C) 22%(R) 78%(S)~~
- ~~D) 75%(R) 25%(S)~~
- ~~E) 67%(R) 33%(S)~~

$$ee = \frac{+6.76}{+13.52} \times 100 = 50\% ee$$
 so there is 50% more of the (S) enantiomer
 50% excess of (S) in mixture

(2) 10. A reaction in which the nucleophile is a molecule of the solvent is referred to as a solvolysis reaction.

(5) 11. Question 5.33 from homework: Shown below are Newman projection formulas for (R,R)-, (S,S)-, and (R,S)-2,3-dichlorobutane. (a) Which is which? (b) Which formula is a meso compound?

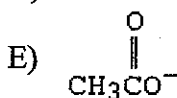


meso compound has a plane of symmetry.

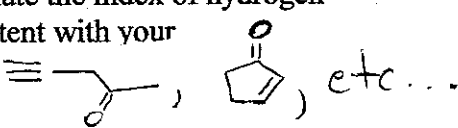
(2) 12. Which is the strongest nucleophile?

- A) CH₃CH₂OH
- B) OH⁻
- C) CH₃CH₂O⁻**
- D) H₂O

in general, strongest base = strongest nucleophile

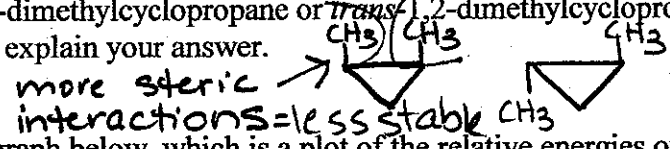


16)

13. Bonus question: using the following molecular formula, calculate the index of hydrogen deficiency and provide a reasonable line-bond structure consistent with your calculations: C_5H_6O lots of structures possible \equiv , etc...
 $2 \times 5 = 10 + 2 = 12$ if completely saturated; $12 - 6 = 6 / 2 = 3$ multiple bonds or rings

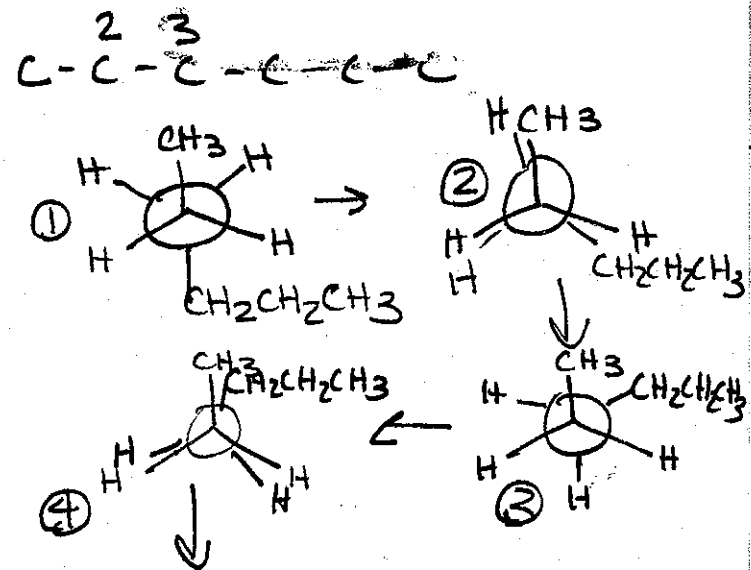
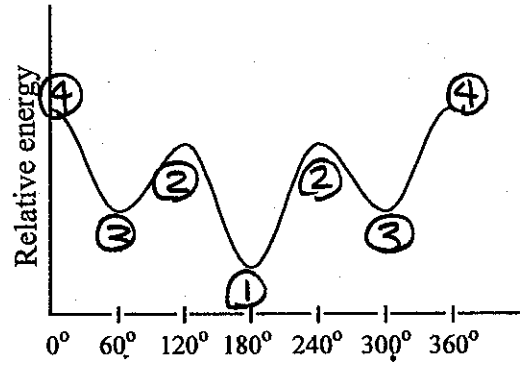
14. Question 4:41 from homework: Which compound would you expect to be the more stable: *cis*-1,2-dimethylcyclopropane or *trans*-1,2-dimethylcyclopropane? Draw structures and explain your answer.

(2)



15. Consider the graph below, which is a plot of the relative energies of the various conformations of hexane, viewed through the C2-C3 bond. The conformations corresponding to the 60° and 300° are:

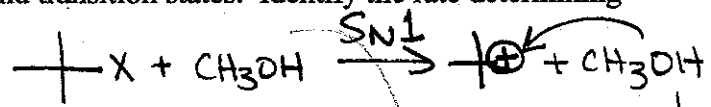
(2)



- ~~A) More stable than the conformation at 180°~~
- ~~B) Staggered and *anti*~~
- ~~C) Eclipsed~~
- D) Staggered, and *gauche***
- E) None of the above

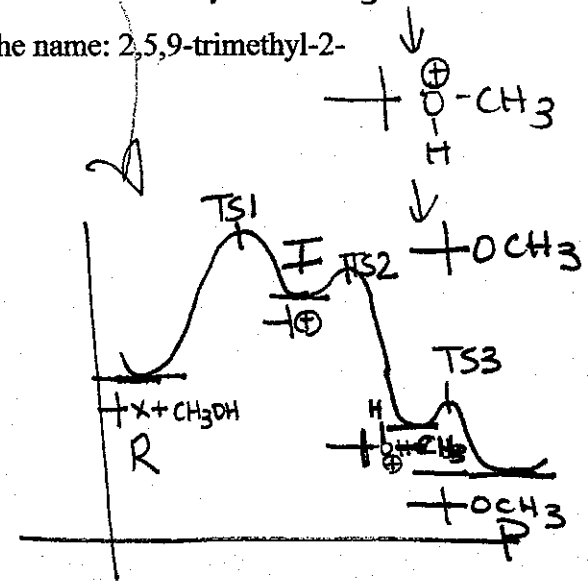
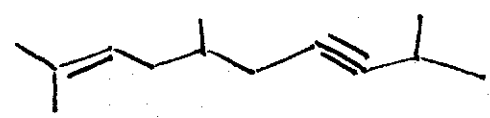
16. Draw the potential energy diagram that represents an exothermic (exergonic) reaction between a tertiary alkyl halide and methanol. Briefly explain your rationale. Label the reactants, products, intermediates, and transition states. Identify the rate determining step and label the activation energy.

(10)



17. Draw the bond-line structural formula corresponding to the name: 2,5,9-trimethyl-2-decen-7-yne

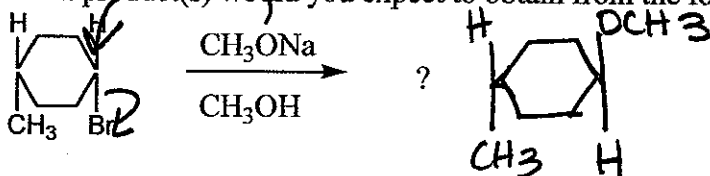
(2)



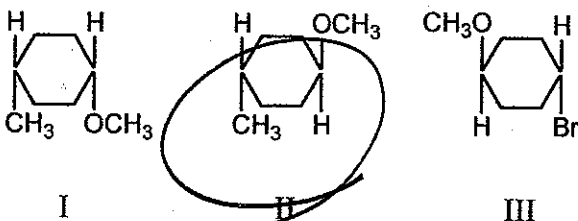
16

18. What product(s) would you expect to obtain from the following S_N2 reaction?

(2)



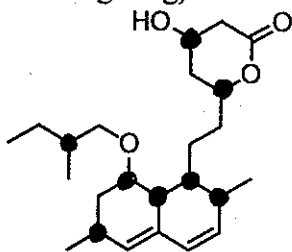
S_N2 gives inversion of configuration



- A) I
 B) II
 C) An equimolar mixture of I and II.
 D) III
 E) None of these

19. How many stereogenic centers are there in Lovastatin (Mevacor® : a cholesterol-lowering drug)?

(2)



(Lovastatin)

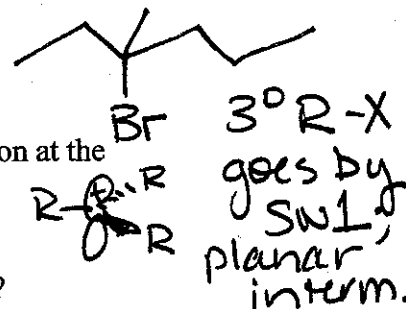
- A) 4
 B) 5
 C) 6
 D) 7
 E) 8

(4)

20. Consider the substitution reaction that takes place when (R)-3-bromo-3-methylhexane is treated with methanol. Which of the following would be true?

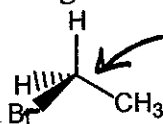
(2)

- A) The reaction would take place only with retention of configuration at the stereogenic center.
- B) No reaction would take place.
- C) ~~The alkyl halide does not possess a stereogenic center.~~
- D) The reaction would take place with racemization.
- E) The reaction would take place only with inversion of configuration at the stereogenic center.

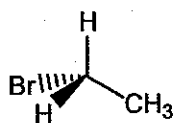


21. Which of the following is the enantiomer of the following substance?

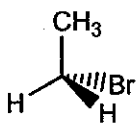
(2)



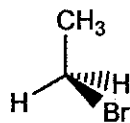
sp³ hybridized carbon, but has 2 same groups H's, not a stereogenic center



I



II



III

- A) I
- B) II
- C) III

- D) It does not have a non-superposable enantiomer.
- E) Both II and III

(4)