

Names of all students (please print) _____

Answer Key

CHEM 243 Organic Chemistry I

Points _____ (10 max)

Worksheet #16: October 22, 2021. Complete the following worksheet by collaborating with a group of 3-4 students. You can use a text book or your lecture video notes. You must work together, with the names of all students included on **ONE** sheet and turned in for a group grade.

From now on you can expect to see “**think outside the box**” types of worksheet problems, that require you to use your problem-solving skills, and information from earlier in the course. **A course notebook will be essential!** Remember, my worksheets are designed with the assumption that you have: (1) watched the videos, (2) taken notes, and (3) have your notebook open on your bench.

(1) Comparing SN2 & SN1 Reactions. Are the following terms best associated with an SN2 or SN1 reaction? **One answer each.**

SN2 minimum one step mechanism

SN2 stereospecific reaction

SN2 concerted mechanism

SN2 crowded transition state

SN1 carbocation intermediate

SN2 best nucleophile = small, strong base

SN2 steric hindrance in transition state

SN1 minimum 2-step mechanism

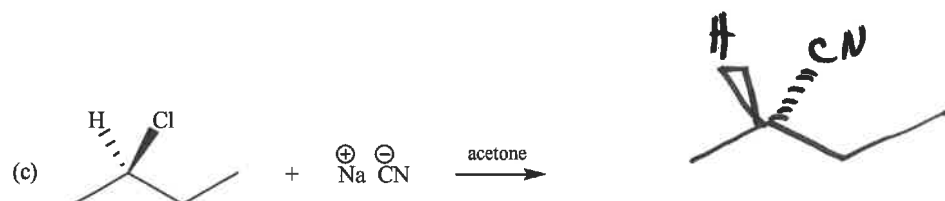
SN1 not a stereospecific reaction

SN1 prefers poor nucleophiles (water, alcohols)

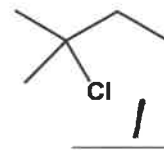
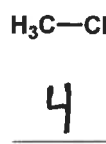
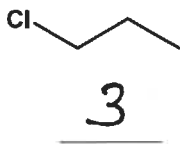
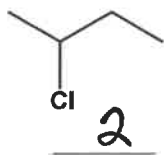
SN2 substrate reactivity: methyl > 1° > 2° >>> 3°

SN1 substrate reactivity: methyl <<< 1° << 2° < 3°

(2) (Review) SN2 Reactions – Predicting Reaction Products. Complete the reactions shown below by drawing the structure of the substitution product. It is not necessary to balance these equations. Draw the proper product **stereochemistry**, if relevant. If you believe that “no reaction” occurs, write NR.



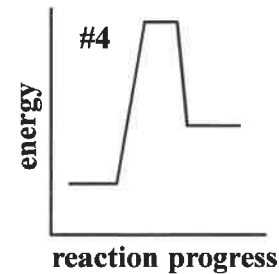
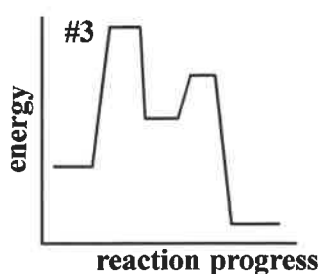
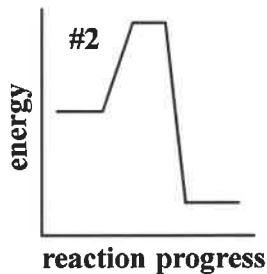
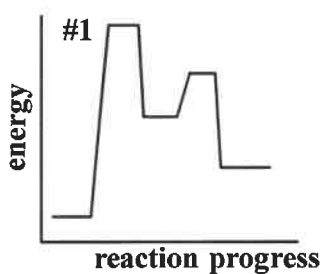
(3) **SN1 Reactions – Substrate (alkyl halide) Reactivity.** Rank the following substrates in order of their reactivity in an SN1 reaction, (1 = most reactive.....4 = least reactive).



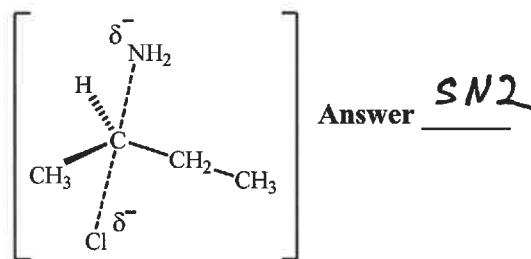
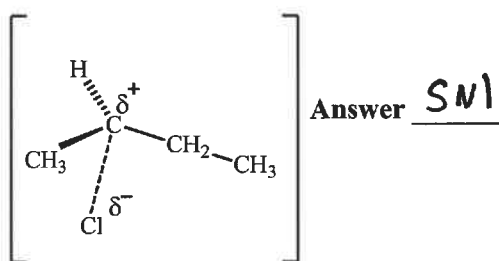
(4) **Energy Diagrams.** Of the four potential energy diagrams shown below (1-4), which of these are most consistent with an:

Exothermic SN1 reaction #3

Exothermic SN2 reaction #2



(5) **Transition States.** Of the two transition state shown below, identify if they are best associated with an SN1 or SN2 reaction:



(5) **SN1 Two-Step Mechanism.** The mechanism for the following **balanced SN1 net reaction** requires TWO steps. In Step #1 the Lg leaves, forming a carbocation intermediate. In Step #2 the nucleophile adds to the carbocation forming the neutral organic product. If you add together your Step-1 and Step-2, you must get the balanced net reaction.



(a) What is the nucleophile Cl[⊖]

(b) What is the leaving group I[⊖]

Continued.....

(c) Write a complete mechanism that explains the formation of all products in the balanced net SN1 reaction shown below. Your mechanism must consist of a series of balanced chemical equations, and curved arrows to show electron pair movement.



Step #1 (leaving group leaves to form the carbocation intermediate):



Step #2 (nucleophile adds to the carbocation forming the neutral organic product):



(d) Now, draw and label the **Energy Diagram** for this exothermic reaction, and also draw the structure for the **transition state** of the Rate-Limiting Step from your mechanism.

