Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| \_\_\_\_\_/50  Fong | \_\_\_\_\_/50  Rugg | \_\_\_\_\_/100  Total |

1. Write the likely major mechanism (E1, E2, SN1 , SN2 or none) in the box below the arrow and write down the likely final product(s) that could occur for the proposed reactions below: (3 pts each)

**Likely product(s) (if any)**

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

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1. Order the reactions below in order from fastest to slowest for SN2 substitution. (3 pts)

\_\_\_\_\_>\_\_\_\_\_>\_\_\_\_\_>\_\_\_\_\_>\_\_\_\_\_

**reaction Substrate solvent nucleophile**

A 2-fluoro-2-methylpropane Methanol Cl-

B 1-iodopropane ethanol methoxide (CH3O-)

C 2-iodo-2-methylpropane Methanol Cl-

D bromoethane CH3CN I-

E bromomethane DMF I-

1. Order the reactions below in order from fastest to slowest for SN1 substitution. (3 pts)

\_\_\_\_\_>\_\_\_\_\_>\_\_\_\_\_>\_\_\_\_\_

**Reaction Substrate solvent**

A t-butyl-iodide methanol

B ethyl iodide DMF

C t-butyl-fluoride methanol

D 2-iodopropane ethanol

1. Given that the reaction below runs SN1 , write out the mechanism (curved arrow notation)

and indicated major and minor products. (4 pts)



1. Draw the activated complex expected when CH3I undergoes an SN2 reaction with CH3S-. (2 pts)

\_\_\_\_\_/12

1. Which will run faster? (circle your choice) (4 pts)

a) CH3I with OH\_ in methanol CH3I with OH- in CH3CN

b) t-butyl chloride with I‑ in methanol t-butyl chloride with I- in acetone

c) t-butyl fluoride with H2O t-butyl fluoride with I-

d) 1-chloropropane with I‑ in acetone 1-chloro-2,2-dimethylpropane with I- in acetone

1. Circle the feature that doesn’t apply in each line below for SN2. (3 pts)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) | inversion occurs | favors 1o and 0o α carbons | features intermediate | likes aprotic polar solvents |
| b) | best leaving group’s source acid has pKa<0 | works best with low steric hindrance | has 5-coordinated transition state | rate independent of nucleophile |
| c) | I->Br->Cl->F- as Nuc in aprotic polar solvent | favors 1o and 2o β carbons | CH3CN favored over CH3OH as solvent | strong base is often a good Nuc- for SN2 |

1. Circle the feature below that doesn’t apply in each line below for SN1. (3 pts)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) | racemization occurs | runs best with aprotic, polar solvents | rate independent of Nuc\_ | has intermediate |
| b) | solvolysis happens if no Nuc\_ | rate limit is formation of carbocation | favors 3o α carbons | I- faster than F- as Nuc- |
| c) | rearrangement possible | works best in polar, protic solvents | retention of configuration | best leaving group’s source acid’s pKa<0 |

\_\_\_\_/10

Laboratory Questions (4 pts)

1. Once upon a time, Joe Chemist was asked by his incessantly cackling and height-challenged professor to run several reactions. The first was a substitution to convert n-butanol to 1-bromobutane. Which of the possible, initial steps makes the most sense? (circle your answer)
   1. *mixing KOH and ether*
   2. *Adding NaBr to an 80% sulfuric acid solution*
   3. *adding a small sliver of I2  to the butanol*
   4. *mixing NaBr with with acetone*
2. After wiping drool from his professor off his lab coat, Joe got the reagents for the above reaction into a 50 mL round-bottom flask. His next step to make 1-bromobutane is:
3. *solvent extracting the mixture after 20 minutes of standing*
4. *adding sodium carbonate to neutralize the solution*
5. *refluxing the mixture vigorously for 40 minutes*
6. *chilling the flask and the adding KOH in ethanol*
7. Just as Joe finishes his substitution, the obviously drugged-out gnome of an instructor begins ranting and giggling about carrying out an elimination on 1-bromocylohexane. The initial steps of this synthesis should be:

*a) refluxing in ethanol with KOH followed by distillation*

*b) slow distillation in the presence of concentrated sulfuric acid*

*c) vigorous refluxing followed by solvent extraction in water*

*d) adding a sliver of I2 along with Mg to the 1-bromocyclohexane*

1. The final product is a mixture of 1-bromocyclohexane (mp: -57 oC, bp: 166 oC) and cyclohex-1-ene (mp -104 oC, bp 83 oC). Which of the following is NOT a method to determine the purity for these compounds?
2. *Refractive index*
3. *Melting point*
4. *TLC*
5. *GC*

\_\_\_\_\_/4

1. Name the following compounds. (4 pts)

|  |
| --- |
| \_\_\_\_\_/50  Rugg |



1. Identify the stability of the following alkenes as most, least, and middle. (3 pts)



1. Can the trans version of the following alkene exist? (1 pt)  Yes No
2. Indicate whether you would use sodium ethoxide (NaOEt) or potassium tert-butoxide (KOtBu) to achieve each of the following transformations. Explain your choice. (4 pts)



1. Below are two stereoisomers of 1-bromo-4-tert-butylcyclohexane, undergoing E2 reactions. The cis conformation quickly eliminates to the alkene, while the trans conformer is very slow at the elimination. Explain using chairs or Newman projections. (6 pts)



\_\_\_\_/18

1. Draw a detailed mechanism for the following reaction. (5 pts)



1. Fill in the boxes. The boxes above the arrows are for the reagents, which are listed in the box on the right. For the products, indicate stereochemistry using wedges and hashes if needed. (2 pts for products, 1 pt for reagent, total of 7 pts)

**Possible Reagents**

|  |  |
| --- | --- |
| A | 1. BH3 2. H2O2, NaOH |
| B | Br2 |
| C | Br2, H2O |
| D | HBr |
| E | HBr, HOOH |
| F | 1. CH3CO3H 2. H+, H2O |
| G | H2, Pt |
| H | H2O, dil. H2SO4 |
| I | 1. Hg(OAc)2, H2O 2. NaBH4 |
| J | 1. KMnO4, 2. NaOH |
| K | 1. O3 2. SMe2 |
| L | 1. OsO4 2. NaHSO3/H2O |

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

\_\_\_\_\_/12

1. Draw the mechanism and predict the products for the following reactions. Be sure to account for regiochemistry, stereochemistry, and rearrangement. Use wedges and hashes to indicate stereochemistry (don’t just say anti or syn). (5 pts each)

|  |  |
| --- | --- |
| a) |  |
| b) |  |
| c) |  |
| d) |  |

\_\_\_\_\_/20