Massachusetts Institute of Technology
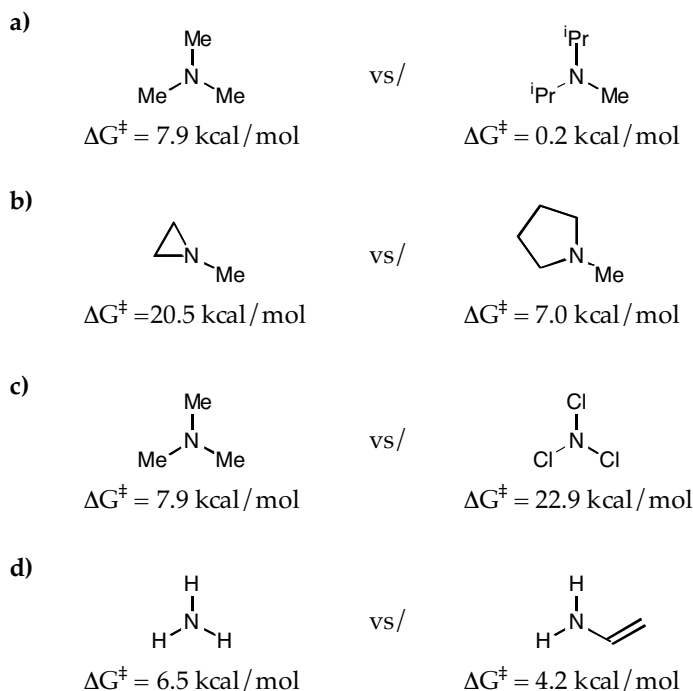
## Problem Set 4
Due: Thursday, 10/30/03 at 4 PM

1. Several factors (sterics, electronics, orbital interactions, etc.) can affect the inversion barrier of an amine. For each of the following pairs, provide an explanation for the relative magnitude of the given inversion barriers.
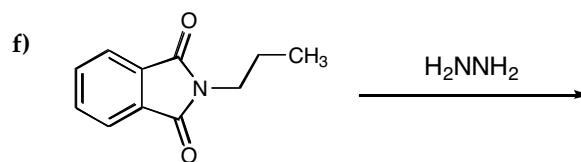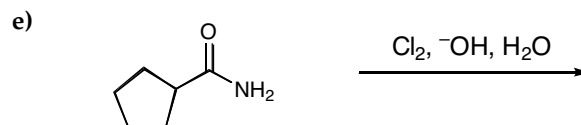
a)

vs/

$\Delta G^{\ddagger} = 7.9 \text{ kcal/mol}$ $\Delta G^{\ddagger} = 0.2 \text{ kcal/mol}$

b)

vs/

$\Delta G^{\ddagger} = 20.5 \text{ kcal/mol}$ $\Delta G^{\ddagger} = 7.0 \text{ kcal/mol}$

c)

vs/

$\Delta G^{\ddagger} = 7.9 \text{ kcal/mol}$ $\Delta G^{\ddagger} = 22.9 \text{ kcal/mol}$

d)

vs/

$\Delta G^{\ddagger} = 6.5 \text{ kcal/mol}$ $\Delta G^{\ddagger} = 4.2 \text{ kcal/mol}$
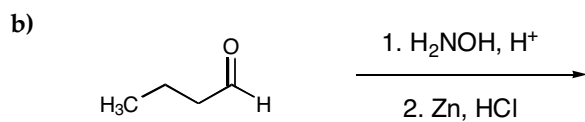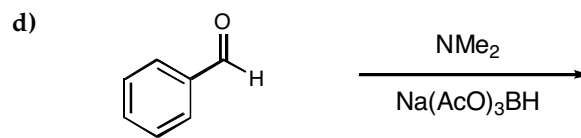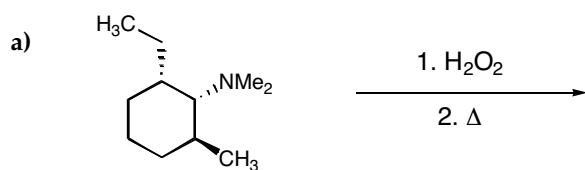
2. Provide a mechanism for each of the following transformations. Your mechanisms must account for the observed selectivity.
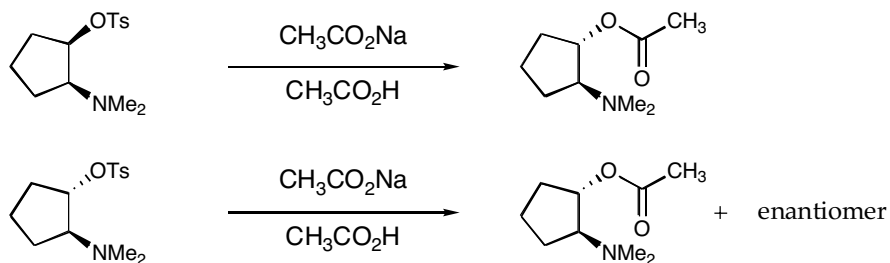
3. Provide **two syntheses** of the following primary amine from *(R)*-2-pentanol. Both methods must avoid over-alkylation.
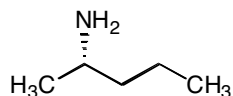
4. Predict the products of the following reactions. Assume the appropriate work-up is included.

a)

H₃C, NMe₂, CH₃ (substituted cyclohexane)

1. H_2O_2
2. Δ

d)

(benzaldehyde)

NMe_2

$Na(AcO)_3BH$

b)

H₃C — CHO

1. H_2NOH, H^+
2. Zn, HCl

e)

(cyclopentane carboxamide) NH_2

Cl_2, ^-OH, H_2O

c)

(cyclohexanone)

1. HCN, KCN
2. $LiAlH_4$

f)

(phthalimide-N-CH₂CH₂CH₃) CH₃

H_2NNH_2

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5. Provide syntheses for each of the following molecules from the given starting material. Show all synthetic intermediates. Your syntheses must avoid over-alkylation.

a)

H_2N, CH₃, H₃C (amine)   from   OH, CH₃, H₃C (alcohol)

b)

(benzyl-NH-CH₂CH₂CH₃)   from   H₃C — CHO

c)

H₃C, CH₃, H₃C, NH₂   from   H₃C, CH₃, O, H₃C, Cl

d)

H₃C, CH₃, N (cyclohexyl), CH₃, CH₃, CH₃   from   NH₂ (cyclohexylamine)

e)

CH₃ (butenyl)   from   NMe₂, CH₃, H₃C