CHEM 2311
E1 practice-ii (answers provided)

1. (32 points) Circle the letter *on the right* which corresponds to the answer to each question. There is only one correct answer for each question.

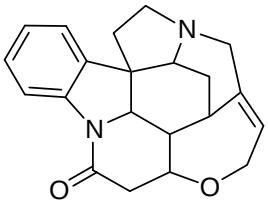
(i) Credit for the first synthesis of an organic compound from an inorganic precursor is usually given to:

A. Berzelius **B.** Lewis **C.** Wöhler **D.** Arrhenius

A
B
C
D

(ii) Which functional groups and structural features are present in the following molecule (strychnine)?

i. 2° amine ii. amide iii. ether iv. alkene
v. ester vi. *sp* carbon vii. carbonyl viii. ketone



E. i, ii and iv only **F.** ii, v and vii only
G. ii, iii, iv, and vii only **H.** i, ii, iv and viii only

E
F
G
H

(iii) How many 2° *alcohols* with the molecular formula $C_6H_{14}O$ are possible?

I. five **J.** six **K.** seven **L.** eight

I
J
K
L

(iv) Which of the following matches of functional groups and molecules are correct?

a. Acid b. Aldehyde i. CH_3COCH_3 ii. CH_3CN
c. Ester d. Ketone iii. $CH_3CH_2CO_2CH_3$ iv. CH_3CO_2H

M. a-iv and d-iii. **N.** c-iii and d-iv. **O.** b-ii and d-i. **P.** c-iii and d-i.

M
N
O
P

(v) Which principle(s) or rule must be used to determine the correct electronic configuration for carbon in its ground state?

i. Aufbau Principle ii. Hund's Rule iii. Pauli Exclusion Principle

Q. i and ii **R.** i and iii **S.** ii and iii **T.** I, ii and iii

Q
R
S
T

(vi) What is the ground state electron configuration of silicon?

U. $1s^2 2s^2 2p^6 3s^2 3p^4$ **V.** $1s^2 2s^2 2p^6 3s^1 3p^3$ **W.** $1s^2 2s^2 2p^6 3s^2 3p^1$ **X.** $1s^2 2s^2 2p^6 3s^2 3p^2$

U
V
W
X

(vii) Which of the following compounds contains an sp^2 carbon atom?

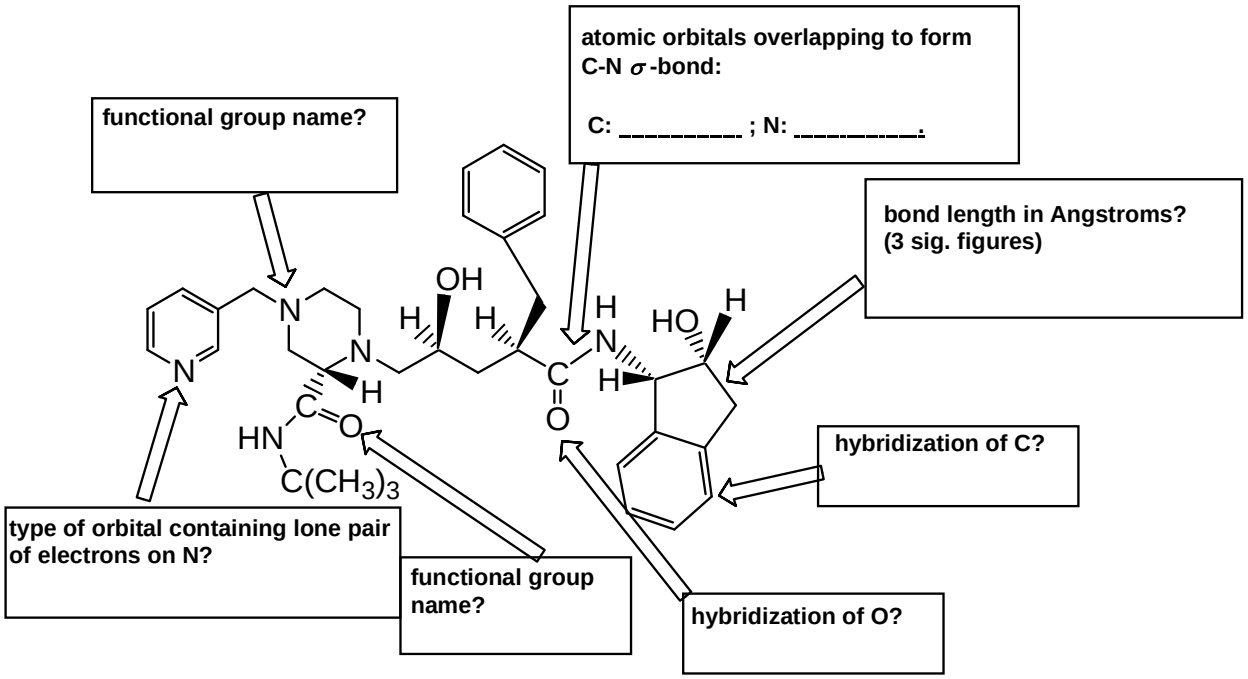
Y. alcohol **Z.** alkyne **AA.** ester **BB.** bromoalkane

Y
Z
AA
BB

(viii) What is the shape of the orbital of nitrogen in $H_2C{=}NH$ which overlaps with the *s* orbital on hydrogen to form a σ-bond?

CC
DD
EE
FF

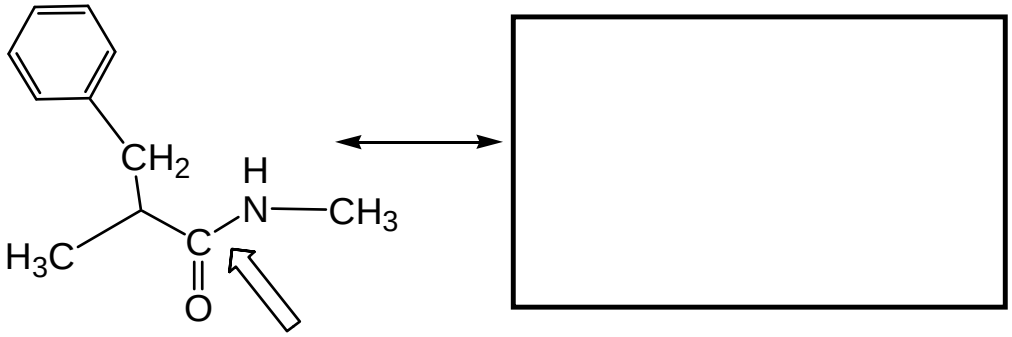
2. (a) (16 pts)The structure of Crixivan (an HIV protease inhibitor) is shown below. Provide appropriate descriptions of the molecular features in the boxes



(b) (4pts) How many lone pairs of non-bonding valance shell electrons does Crixivan possess? (these are omitted from the structure shown above)

(c) (4pts) What is the molecular formula of Crixivan?

(d) (6 pts) The C-N bond (see arrow below) is slightly *shorter* than the C-N bond of a simple amine. Draw a resonance structure of this fragment that explains this observation.



(e) (8pts) Write a Lewis structure for each of the following compounds. Show all nonbonding electrons and any formal charges.

i) HNO_3

ii) $POCl_3$

3. Give answers for each part of the question in the spaces provided.

(a) (9 pts) Draw bond-line structures for the three constitutional isomeric ketones with the formula $C_5H_{10}O$.

(b) (6 pts) Draw bond-line structures for two constitutional isomeric tertiary amines with formula $C_5H_{13}N$. (There are more than two structures possible.)

(c) (9 pts) Write structures for three constitutional isomers with the molecular formula C_4H_8O that do no contain a carbonyl bond. (There are more than three structures possible.)

(d) (6 pts) There are four amides with the formula (C_3H_7NO). One of these amides has a melting point and boiling point that are substantially lower than those of the other three. Draw its structure and explain why its mp and bp are substantially lower than the other three amides.