chem 3331

99

Final Exam

Name (PRINT)_____
Last, First

Chemistry 3331

Signature _____

December 5, 2001

SS# _____

Please circle the name of your professor and class time where appropriate.

Dr. Bean (T/Th 10 AM) **Dr. Cai**

Dr. Bean (T/Th 5:30 PM)

Page #	Score	
1. 12 pts.		
2. 11 pts		
3. 7 pts.		
4. 12 pts.		
5. 16 pts.		
6. 12 pts.		
7. 10 pts.		
8. 10 pts.		
9. 4 pts.		
10. 6 pts.		

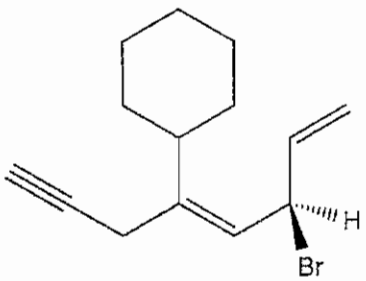
TOTAL_____

Note: Present your student ID when you return the exam booklet

I. NOMENCLATURE (12 pts; 3 pts each)

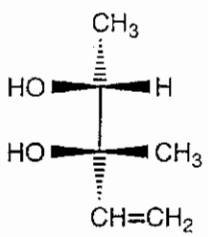
Give an acceptable IUPAC name for each of the following compounds. Be sure to indicate the **stereochemical designations** where appropriate.

1)

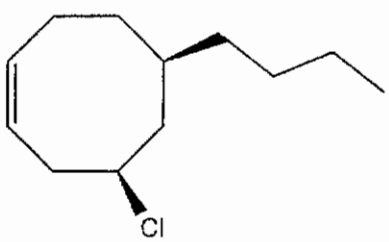


2)

3)



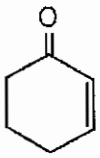
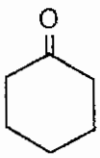
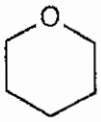
4)



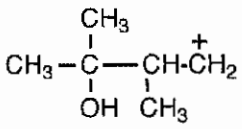
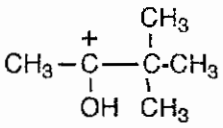
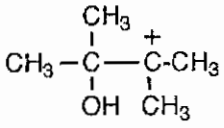
FE

II. FACTS: Total = 18 points

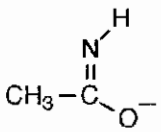
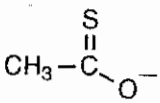
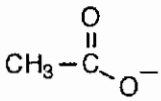
1. Place the following compounds in order of increasing frequency of the carbon - oxygen bond stretching vibration. (1 = lowest frequency, 3 = highest frequency) (3 pts.)

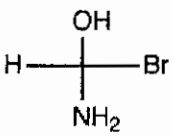
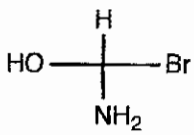
2. Place the following carbocations in order of increasing stability (1=least stable, 3=most stable). (3 pts.)

3. Place the following anions in order of increasing basicity. (1 = weakest, 3 = strongest base) (3 pts.)

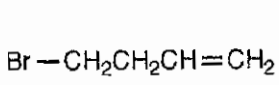




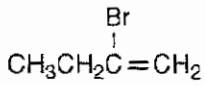
4. Label the pair of molecules as identical, enantiomers, diastereomers, or structural isomers. (2 pts.)

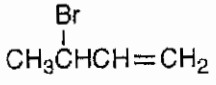



FE 2

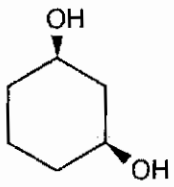
5. Place the following halides in order of their increasing reactivity in the S_N1 process (1=least reactive, 3=most reactive). (3 pts.)

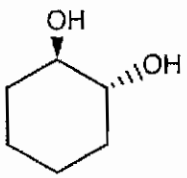


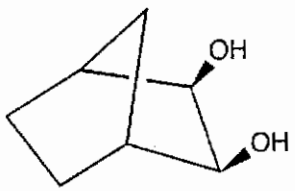


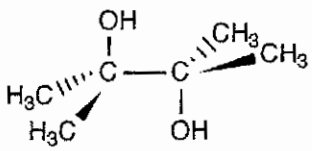


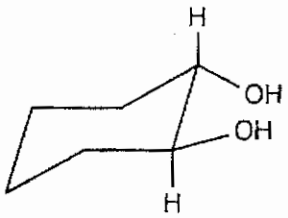
6. Circle the alcohol(s) that could be cleaved by periodic acid (HIO_4). (2 pts.)



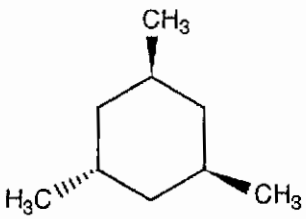








7. Draw the most stable conformation of the compound below in the box provided. (2 pts.)

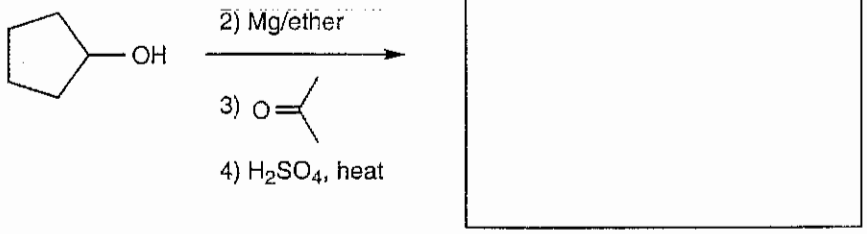


FE 3

III. REACTIONS (40 pts; 4 pts each)

For each of the following multiple step reactions, draw the **Final Major Organic** product, or **necessary reagents**, or **starting material** in the box provided. Be sure to indicate the **Stereochemistry** where this is pertinent. You may place intermediate products below the reaction for partial cerdit.

1)



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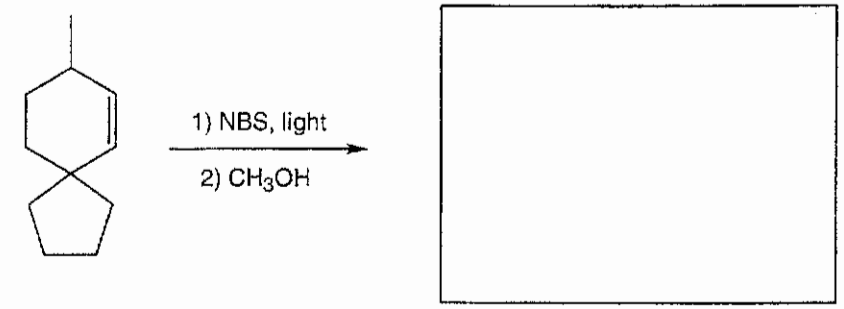

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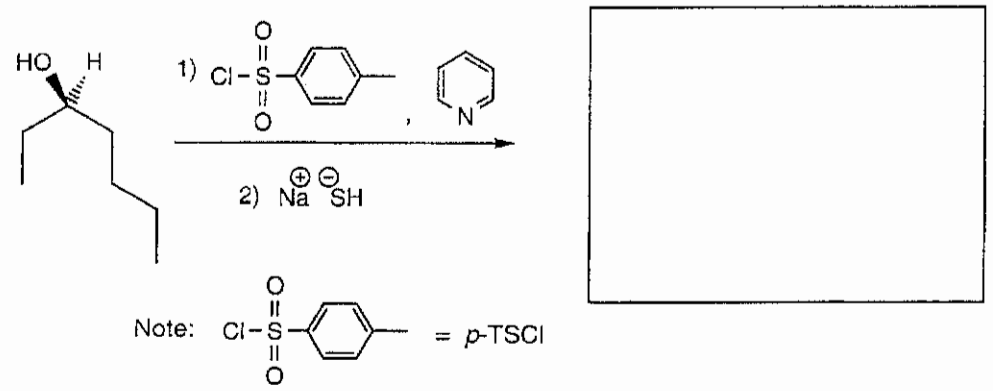
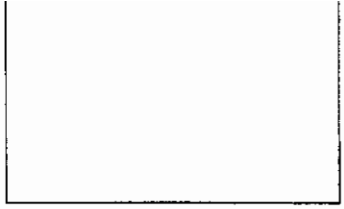


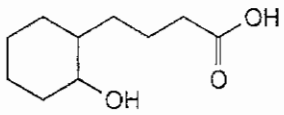
Note: = *p*-TSCl

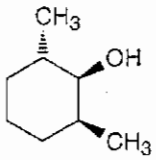
FE 4

4) 

1) $KMnO_4/HCl/warm$

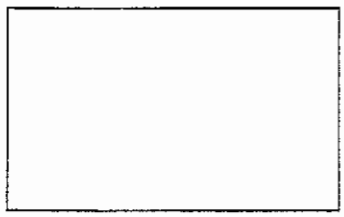
2) $NaBH_4/CH_3OH$

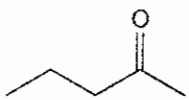


5) 

1) PBr_3

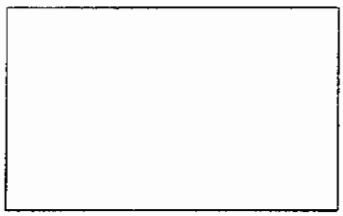
2) $(CH_3)_3CO^{\ominus}K^{\oplus}$

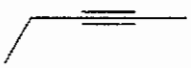


6) 

1) $H-C\equiv C^{\ominus}\ Na^{\oplus}$

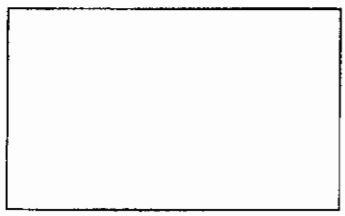
2) $HgSO_4/H_2SO_4/H_2O$

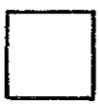


7) 

1) Na/NH_3

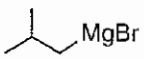
2) Br_2/H_2O

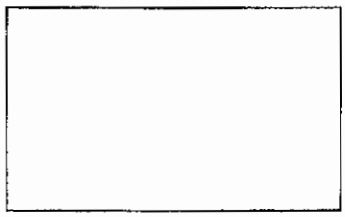




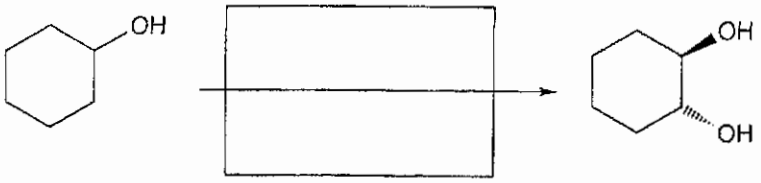
FE 5

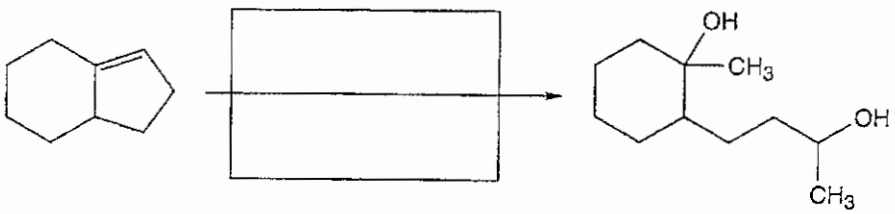
8) 

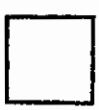
1) BH_3/THF
2) H_2O_2/NaOH/H_2O
3) CrO_3·pyridine·HCl
4) 
5) H_3O^+



Note: CrO_3·pyridine·HCl = PCC

9) 

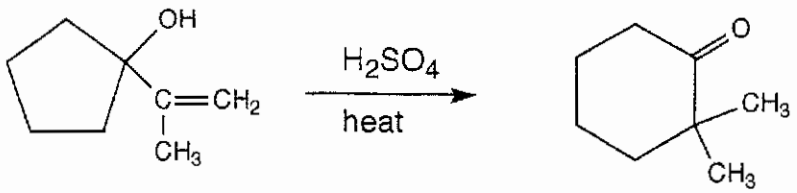
10) 



FE 6

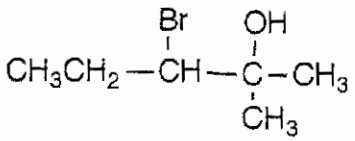
IV. Mechanism: 10 points

For the following reaction, propose a detailed, step by step mechanism to explain the formation of the product. Show all intermediates and formal charges, and use curved arrows to indicate electron flow.



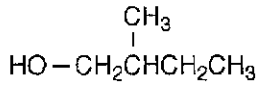
v. Synthesis: 10 Points

From alkanes, alkenes, or alcohols of **two** carbons or less, any oxidizing or reducing agents, and any inorganic reagents, synthesize the compound below.

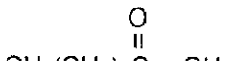


VI. Spectroscopy: 10 points

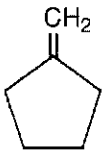
Carefully examine the five infrared spectra and the seven compounds below. Place the letter of the compound in the box beside its spectrum.



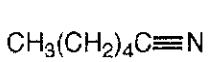
A



B



C



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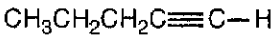

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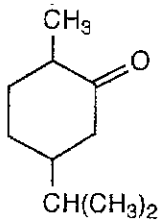
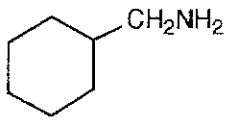
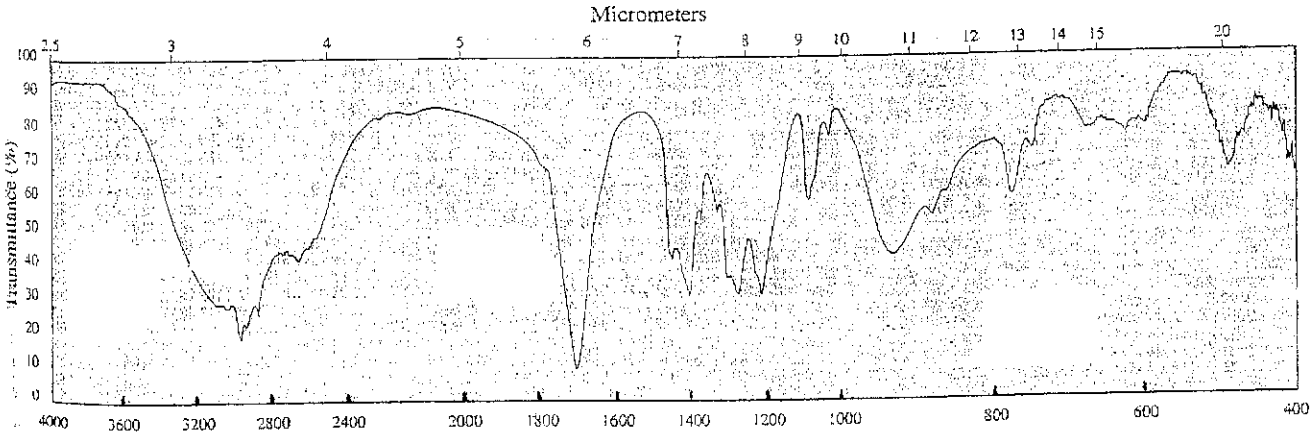


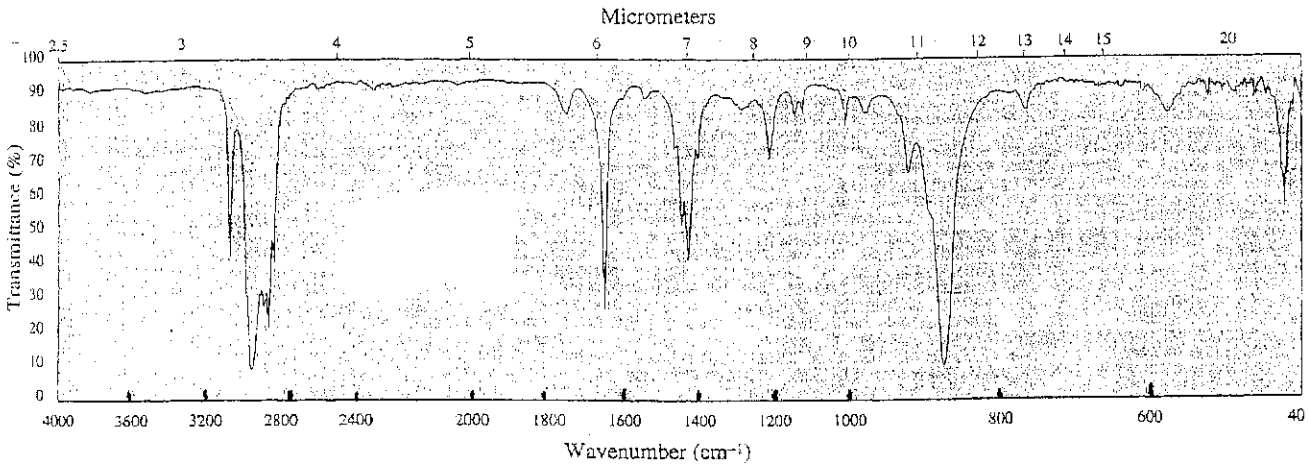
F



G

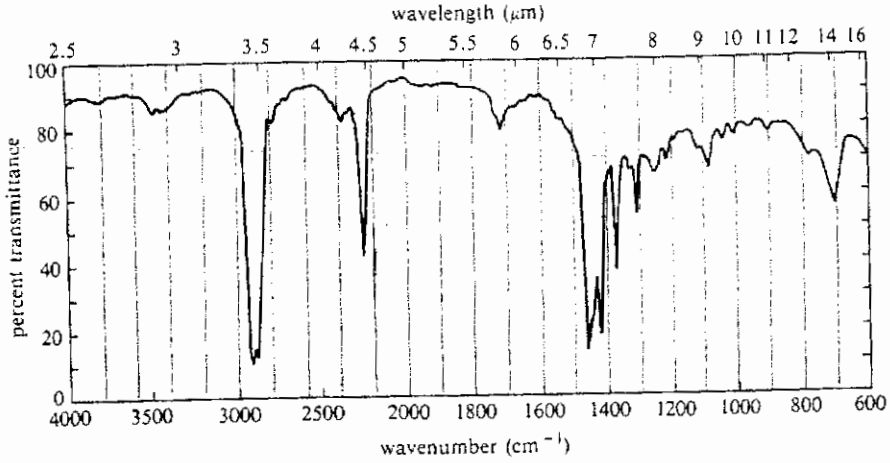


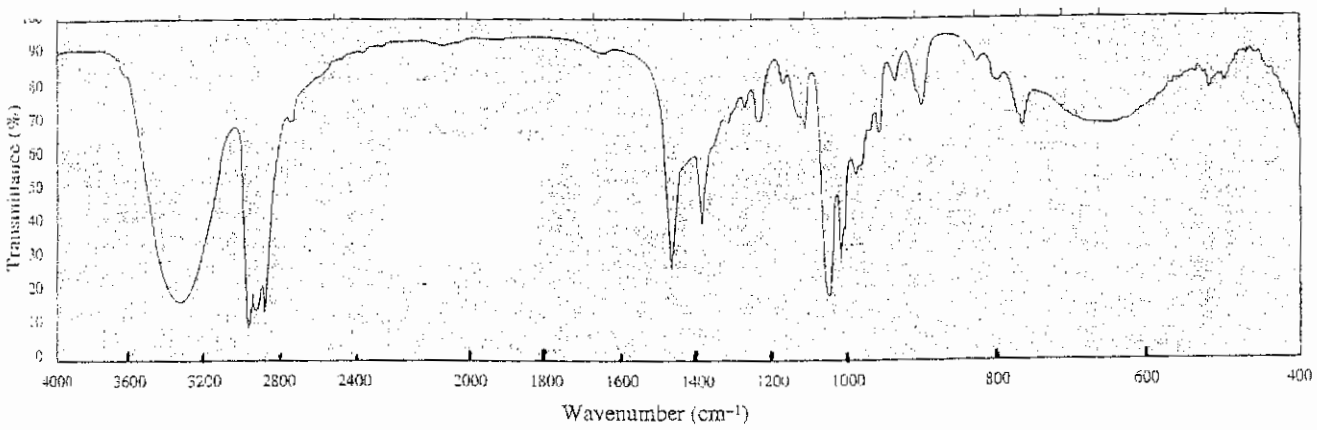
1.

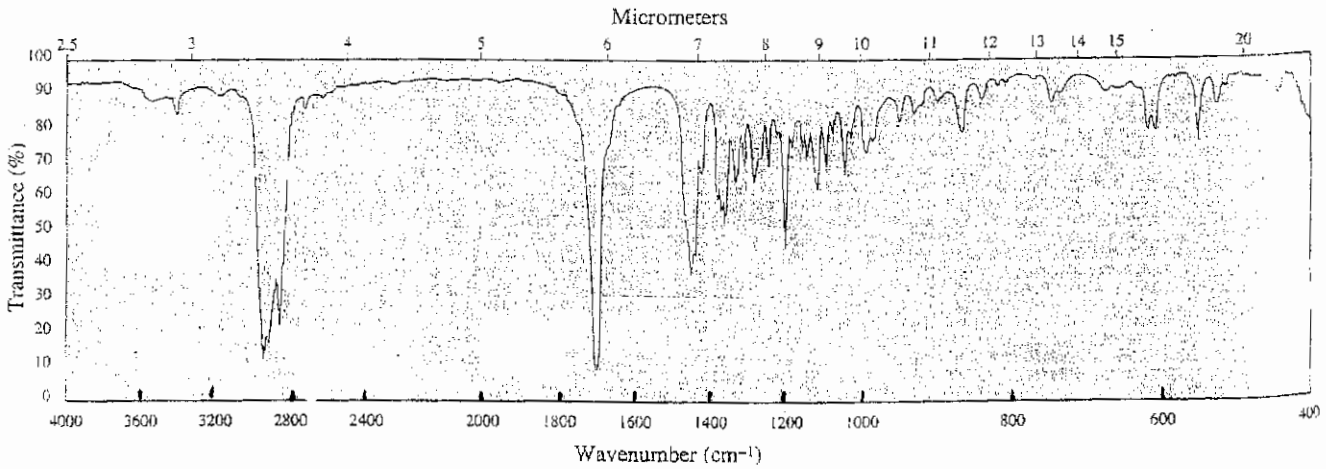


2

FE 9


wavelength (μm)
2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 8 9 10 11 12 14 16
percent transmittance
100 80 60 40 20 0
4000 3500 3000 2500 2000 1800 1600 1400 1200 1000 800 600
wavenumber (cm⁻¹)


Transmittance (%)
4000 3600 3200 2800 2400 2000 1800 1600 1400 1200 1000 800 600 400
Wavenumber (cm⁻¹)


Micrometers
2.5 3 4 5 6 7 8 9 10 11 12 13 14 15 20
Transmittance (%)
100 90 80 70 60 50 40 30 20 10 0
4000 3600 3200 2800 2400 2000 1800 1600 1400 1200 1000 800 600 400
Wavenumber (cm⁻¹)

FE 10

A. Alkyl			
C—H (stretching)		2853–2962	(m–s)
Isopropyl, $-CH(CH_3)_2$		1380–1385	(s)
	and	1365–1370	(s)
tert-Butyl, $-C(CH_3)_3$		1385–1395	(m)
	and	~1365	(s)
B. Alkenyl			
C—H (stretching)		3010–3095	(m)
C=C (stretching)		1620–1680	(v)
$R-CH=CH_2$ (out-of-plane C—H bendings)		985–1000	(s)
	and	905–920	(s)
$R_2C=CH_2$ (out-of-plane C—H bendings)		880–900	(s)
cis-RCH=CHR (out-of-plane C—H bendings)		675–730	(s)
trans-RCH=CHR (out-of-plane C—H bendings)		960–975	(s)
C. Alkynyl			
≡C—H (stretching)		~3300	(s)
C≡C (stretching)		2100–2260	(v)
D. Aromatic			
Ar—H (stretching)		~3030	(v)
Aromatic substitution type (C—H out-of-plane bendings)			
Monosubstituted		690–710	(very s)
	and	730–770	(very s)
o Disubstituted		735–770	(s)
m Disubstituted		680–725	(s)
	and	750–810	(very s)
p Disubstituted		800–860	(very s)
E. Alcohols, Phenols, and Carboxylic Acids			
O—H (stretching)			
Alcohols, phenols (dilute solutions)		3590–3650	(sharp, v)
Alcohols, phenols (hydrogen bonded)		3200–3550	(broad, s)
Carboxylic acids (hydrogen bonded)		2500–3000	(broad, v)
F. Aldehydes, Ketones, Esters, and Carboxylic Acids			
C=O (stretching)		1630–1780	(s)
Aldehydes		1690–1740	(s)
Ketones		1680–1750	(s)
Esters		1735–1750	(s)
Carboxylic acids		1710–1780	(s)
Amides		1630–1690	(s)
G. Amines			
N—H		3300–3500	(m)
H. Nitriles			
C≡N		2220–2260	(m)

[a] Abbreviations: s = strong, m = medium, w = weak, v = variable, ~ = approximately.

FISHER SCIENTIFIC / PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	NOBLE GASES
1 H 1.0079†																1 H 1.0079†	2 He 4.00260
3 Li 6.941†	4 Be 9.01218											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994†	9 F 18.99840	10 Ne 20.179†
11 Na 22.98977	12 Mg 24.305											13 Al 26.98154	14 Si 28.086†	15 P 30.97376	16 S 32.06	17 Cl 35.453	18 Ar 39.948†
19 K 39.098†	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.90†	23 V 50.9414†	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847†	27 Co 58.9332	28 Ni 58.71†	29 Cu 63.546†	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59†	33 As 74.9216	34 Se 78.96†	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678†	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94†	43 Tc 98.9062	44 Ru 101.07†	45 Rh 102.9055	46 Pd 106.4	47 Ag 107.868	48 Cd 112.40	49 In 114.82	50 Sn 118.69†	51 Sb 121.75†	52 Te 127.60†	53 I 126.9045	54 Xe 131.30
55 Cs 132.9054	56 Ba 137.34†	57 *La 138.9055†	72 Hf 178.49†	73 Ta 180.9479†	74 W 183.85†	75 Re 186.2	76 Os 190.2	77 Ir 192.22†	78 Pt 195.09†	79 Au 196.9665	80 Hg 200.59†	81 Tl 204.37†	82 Pb 207.2	83 Bi 208.9804	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0254	89 †Ac (227)	104 § (260)	105 § (260)													

* Lanthanoid Series

58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24†	61 Pm (147)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25†	65 Tb 158.9254	66 Dy 162.50†	67 Ho 164.9304	68 Er 167.26†	69 Tm 168.9342	70 Yb 173.04†	71 Lu 174.97

† Actinoid Series

90 Th 232.0381	91 Pa 231.0359	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (255)	103 Lr (256)

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§ The International Union for Pure and Applied Chemistry has not adopted official names or symbols for these elements.

† These weights are considered reliable to ±3 in the last place. Other weights are reliable to ±1 in the last place.

Atomic weights corrected to conform to the 1971 values of the Commission on Atomic Weights.