

PRACTICE PROBLEMS – UNIT 13 KEY

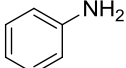
13A.1 a) $1 \times 10^{-8}\text{m}$ b) $1 \times 10^8\text{ Hz}$ c) blue light d) ultraviolet light

13A.2 a) 253 nm b) $9 \times 10^{-19}\text{ J}$ c) visible light

13A.3 vibrational states with energy difference of 25 kJ/mol

13A.4 b) directly proportional to frequency

13A.5 d) X-rays

13B.1 a)  b)  c) 

13B.2. In UV spectroscopy, more conjugation leads to compounds absorbing **longer** wavelengths of **lower** energy due to a **decreased** gap between the HOMO and the LUMO.

13B.3 a) C b) B c) C

13B.4 a) C b) C c) A d) C

13B.5 a) C b) B c) C

13C.1. a) neither b) bromine

13C.2 a) 98 b) no

13C.3 a) 87 b) 88

13C.4 a) 70 b) 42

13C.5 c) one bromine atom

13C.6 d) the peak with the greatest relative intensity.

13C.7 c) bromine has two major isotopes

13C.8 No, it cannot distinguish between compounds with the same formula ($\text{C}_2\text{H}_6\text{O}$).

13C.9. a) the molar mass of the compound b) M^+

13C.10 Organic compounds contain carbon and 1% of all carbons are ^{13}C isotopes leading to an ion with a mass that is greater by 1.

13D.1 a) ketone b) alkene c) alcohol d) alcohol e) alkene f) carboxylic acid g) alkene
h) ketone i) alcohol j) carboxylic acid k) alkyne l) amine m) alkane n) ketone
o) amine

13D.2 a) The alkene C-H stretch at $3150\text{-}3000\text{ cm}^{-1}$ and the C=C stretch at 1650 cm^{-1} would disappear.
b) The OH stretch at $3600\text{-}3200\text{ cm}^{-1}$ would disappear.

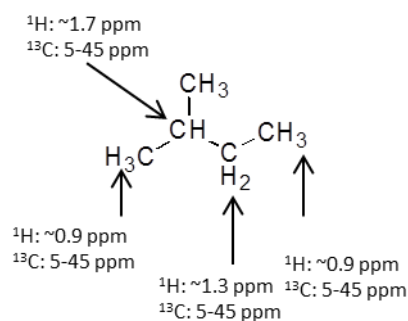
- c) Alkyne C-H absorption at 3300 cm^{-1} and triple bond stretch at 2250 cm^{-1} would disappear and the alkene C-H stretch at $3150\text{--}3000\text{ cm}^{-1}$ and the C=C stretch at 1650 cm^{-1} would appear in the spectrum.
- d) The OH stretch at $3600\text{--}3200\text{ cm}^{-1}$ would disappear and the carbonyl stretch at $1800\text{--}1650\text{ cm}^{-1}$ would appear.
- e) The Alkyne C-H absorption at 3300 cm^{-1} would disappear.

13E.1

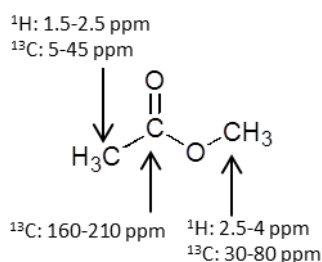
	a)	b)	c)	d)	e)	f)	g)	h)	i)	j)	k)
^1H	5	4	2	5	3	3	2	3	4	3	5
^{13}C	6	5	4	5	5	4	3	4	5	3	5

	l)	m)	n)	o)	p)	q)	r)	s)	t)	u)	v)
^1H	2	2	4	5	2	4	6	6	4	3	3
^{13}C	2	4	4	5	4	3	6	7	5	6	4

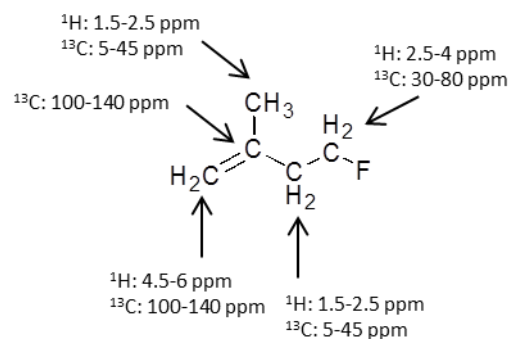
13F.1 a)



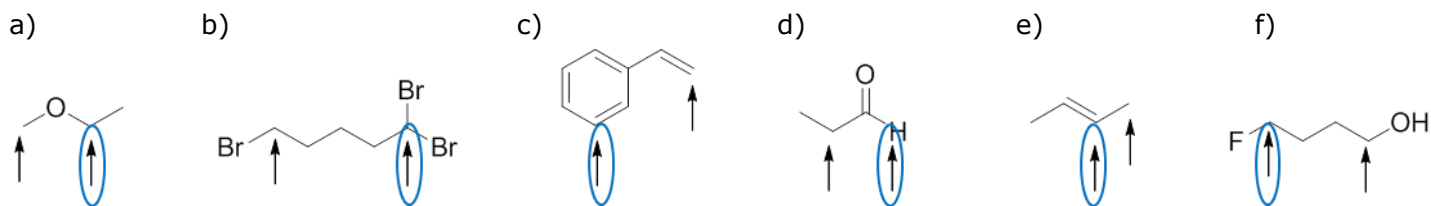
b)



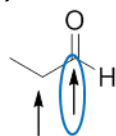
c)



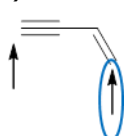
13F.2



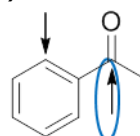
13F.3 a)



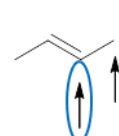
b)



c)

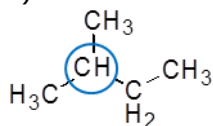


d)

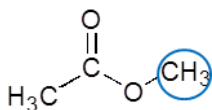


13F.4

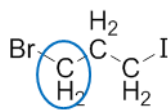
a)



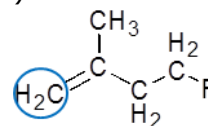
b)



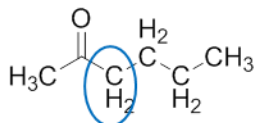
c)



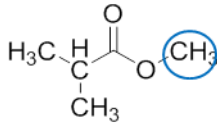
d)



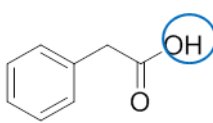
e)



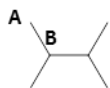
f)



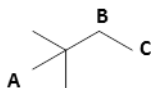
g)



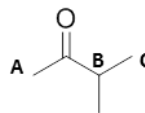
13G.1 a) A:B 12:2 (6:1)



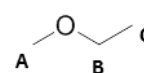
b) A:B:C 9:2:3



c) A:B:C 3:1:6



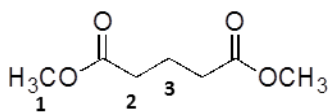
d) A:B:C 3:2:3



13H.1 Arrows going from left to right. a) doublet, triplet b) quintet, triplet c) quintet, triplet d) singlet, singlet e) quartet, triplet f) quintet, triplet g) doublet, triplet h) quintet, singlet i) quartet (top), doublet (bottom) j) doublet, septet k) triplet, triplet l) doublet, singlet m) triplet, quartet n) singlet, singlet

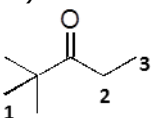
13I.1

a)



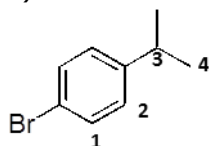
Peak number	Approx. ppm	integration	splitting
1	2.5-4	6 (3)	singlet
2	1.5-2.5	4 (2)	triplet
3	~1.3	2 (1)	quintet

b)



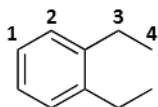
Peak number	Approx. ppm	integration	splitting
1	~0.9	9	singlet
2	1.5-2.5	2	quartet
3	~0.9	3	triplet

c)



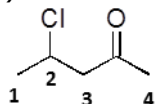
Peak number	Approx. ppm	integration	splitting
1	6.5-8	2	doublet
2	6.5-8	2	doublet
3	1.5-2.5	1	septet
4	~0.9	6	doublet

d)



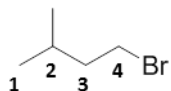
Peak number	Approx. ppm	integration	splitting
1	6.5-8	2 (1)	doublet
2	6.5-8	2 (1)	doublet
3	1.5-2.5	4 (2)	quartet
4	~0.9	6 (3)	triplet

e)



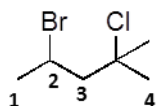
Peak number	Approx. ppm	integration	splitting
1	~0.9	3	doublet
2	2.5-4	1	sextet
3	1.5-2.5	2	doublet
4	1.5-2.5	3	singlet

f)



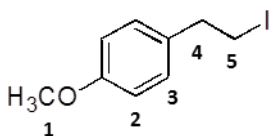
Peak number	Approx. ppm	integration	splitting
1	~0.9	6	doublet
2	~1.7	1	multiplet
3	~1.3	2	quartet
4	2.5-4	2	triplet

g)



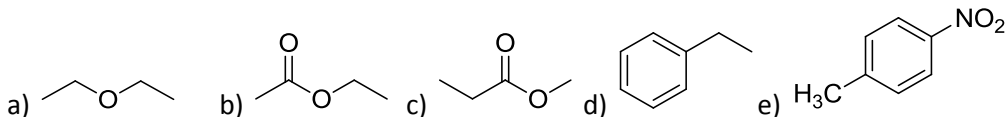
Peak number	Approx. ppm	integration	splitting
1	~0.9	3	doublet
2	2.5-4	1	sextet
3	~1.2	2	doublet
4	~0.9	6	singlet

h)



Peak number	Approx. ppm	integration	splitting
1	2.5-4	3	singlet
2	6.5-8	2	doublet
3	6.5-8	2	doublet
4	1.5-2.5	2	triplet
5	2.5-4	2	triplet

13I.2



13I.3 Compound B

13I.4. Compound C

13I.5 Compound C

13I.6. a) E b) D c) A

13I.7. a) E b) C c) A

13I.8 . a) E b) D c) C d) A

13J.1 a) GC MS

- 13J.2 b) radio waves
- 13J.3. a) the molar mass
- 13J.4. a) vibrational
- 13J.5. a) Stretching and bending
- 13J.6 b) UV-Vis
- 13J.7 d) functional groups.
- 13J.8 d) NMR
- 13J.9 c) both the charge and the mass of the ion