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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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Scholarship 2022
Chemistry

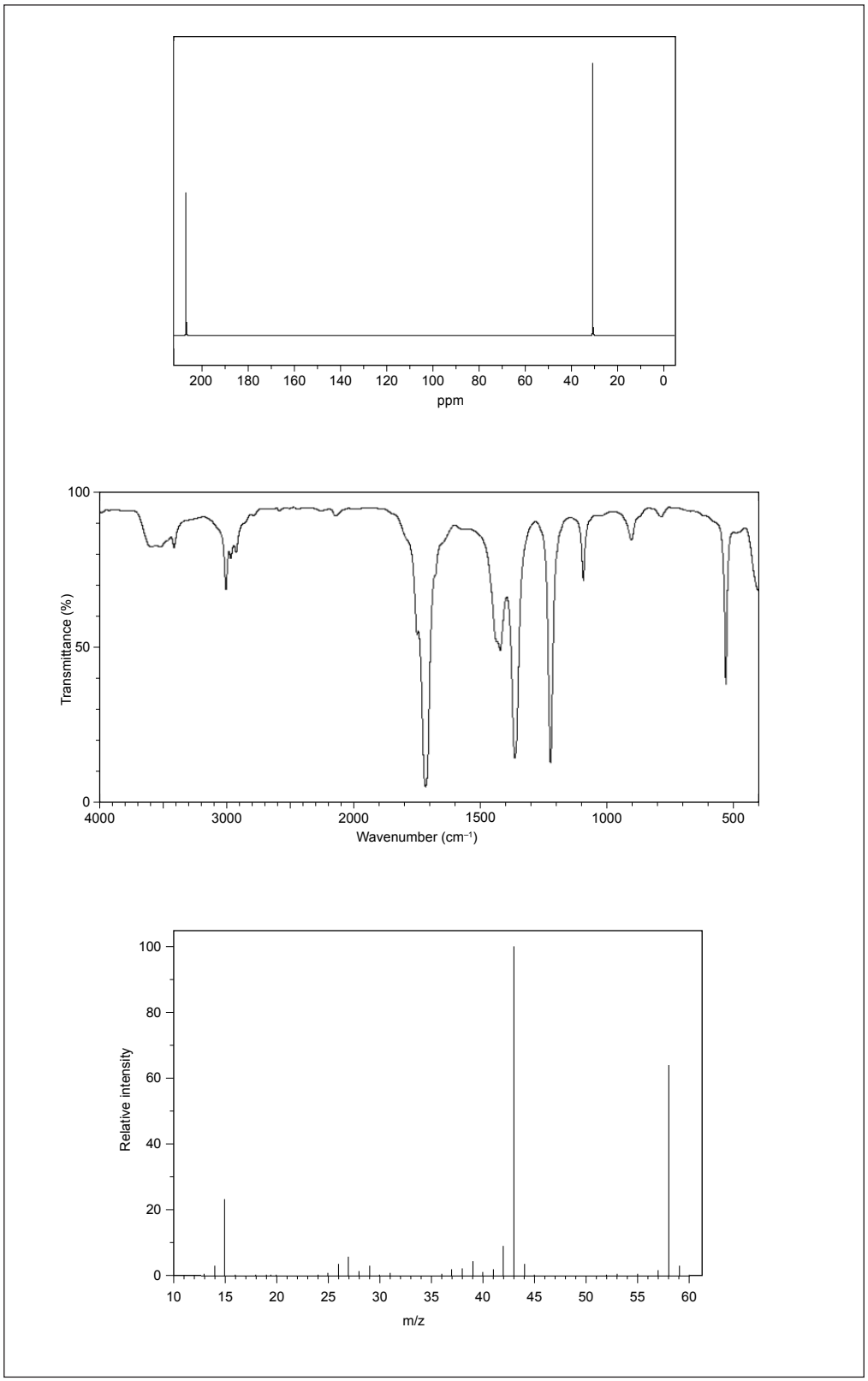
RESOURCE BOOKLET

Refer to this booklet to answer the questions for Scholarship Chemistry.

Check that this booklet has pages 2–4 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

^{13}C NMR, MS, AND IR SPECTRA FOR QUESTION FOUR (a)



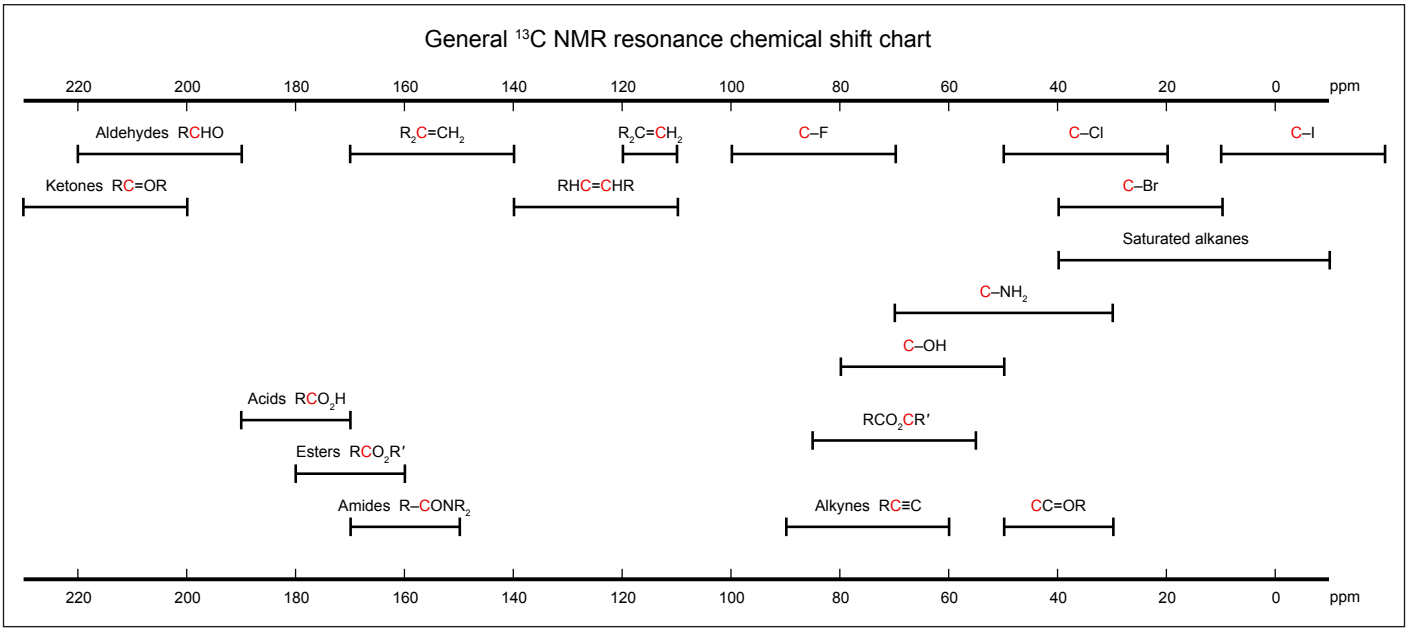
SPECTROSCOPY DATA SHEET

INFRARED SPECTROSCOPY

Functional group	Vibration	Wavenumber / cm^{-1}
Alkane	C–H stretch	2950 – 2800 (s)
Alkene	C=C–H stretch	3100 – 3010 (s)
	C=C stretch	1690 – 1630 (m)
Alkyl halide	C–F stretch	1400 – 1000 (s)
	C–Cl stretch	785 – 540 (m-w)
	C–Br stretch	650 – 510 (s-m)
	C–I stretch	600 – 485 (s-m)
Alcohol	O–H stretch	3600 – 3300 (s)
	C–O stretch	1260 – 1000 (s)
Amine	N–H stretch (1 per bond)	3500 – 3300 (s-w)
	N–H bend	1640 – 1500 (s)
	C–N stretch	1200 – 1025 (s)

Functional group	Vibration	Wavenumber / cm^{-1}
Aldehyde	C=O stretch	1725 (s)
Ketone	C=O stretch	1715 (s)
Carboxylic acid	O–H stretch	3400 (s)
	C=O stretch	1730 – 1700 (s)
	C–O stretch	1320 – 1210 (s)
Acid chloride	C=O stretch	1810 – 1775 (s)
	C–Cl stretch	730 – 550 (s-m)
Ester	C=O stretch	1750 – 1735 (s)
	C–O stretch	1260 – 1160 (s)
Amide	N–H stretch	3500 – 3200 (s)
	C=O stretch	1680 – 1630 (s)

^{13}C NMR RESONANCE SHIFTS



PERIODIC TABLE OF THE ELEMENTS

Atomic number

H Relative atomic mass 1.0

1	*2*											*13*	*14*	*15*	*16*	*17*	*18*
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.9	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.6	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** 98.9	44 **Ru** 101	45 **Rh** 103	46 **Pd** 106	47 **Ag** 108	48 **Cd** 112	49 **In** 115	50 **Sn** 119	51 **Sb** 122	52 **Te** 128	53 **I** 127	54 **Xe** 131
55 **Cs** 133	56 **Ba** 137	71 **Lu** 175	72 **Hf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 **Tl** 204	82 **Pb** 207	83 **Bi** 209	84 **Po** 210	85 **At** 210	86 **Rn** 222
87 **Fr** 223	88 **Ra** 226	103 **Lr** 262	104 **Rf** 261	105 **Db** 262	106 **Sg** 263	107 **Bh** 264	108 **Hs** 265	109 **Mt** 268	110 **Ds** 271	111 **Rg** 272	112 **Cn** 277	113 **Nh**	114 **Fl**	115 **Mc**	116 **Lv**	117 **Ts**	118 **Og**

Lanthanide Series	57 **La** 139	58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm** 147	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173
Actinide Series	89 **Ac** 227	90 **Th** 232	91 **Pa** 231	92 **U** 238	93 **Np** 237	94 **Pu** 239	95 **Am** 241	96 **Cm** 244	97 **Bk** 249	98 **Cf** 251	99 **Es** 252	100 **Fm** 257	101 **Md** 258	102 **No** 259