

# TAURANGA GIRLS’ COLLEGE

# NCEA LEVEL 3 CHEMISTRY

RESOURCE BOOKLET

## AS 91388 Demonstrate understanding of spectroscopic data in chemistry 3 credits

#### Version 1

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**IR absorptions for representative functional groups**

|  |  |  |  |
| --- | --- | --- | --- |
| **Molecular Motion** | **Wavenumber (cm−1)** | **Molecular Motion** | **Wavenumber (cm−1)** |
| N–H stretch (1 per N–H bond) | 3500–3300 | C═O stretch | 1750–1700 |
| O–H stretch | 3600–3300 | C═O stretch (amide) | 1680–1630 |
| O–H stretch (carboxylic acid) | 3400–2400 | C═C stretch  | 1690–1630 |
| ═C–H stretch | 3100–3010 | N–H bend | 1640–1500 |
| C–H stretch | 2950–2800 | C–O stretch | 1320–1210 |
| C–H aldehyde stretch | ~2850 and ~2750 | C–Cl stretch | 785–540 |
| C═O stretch (acyl chlorides) | 1810–1775 | C–Br | 650–510 |

**13C NMR chemical shift (ppm) Fragments in Mass Spectrum**

|  |  |
| --- | --- |
| **Relative mass** | **Molecular ion, M+** |
| 15 | CH3+ |
| 17 | OH+ |
| 27 | C2H3+ |
| 29 | C2H5+ or CHO+ |
| 31 | OCH3+ or CH2OH+ |
| 35 & 37 | Cl+ |
| 41 | C3H5+  |
| 43 | C3H7+  |
| 45 | COOH+ |
| 59 | CH2COOH+ or COOCH3+ |
| 62 & 64 | CCH2Cl+ |
| 63 & 65 | CHCH2Cl+ |
| 79 & 81 | Br+ |

|  |  |
| --- | --- |
| **Carbon environment** | **Chemical shift (ppm)** |
| C=O (in ketones) | 200–230 |
| C=O (in aldehydes) | 190–220 |
| C=O (in acids and esters) | 150–185 |
| C=C (in alkenes) | 115–140 |
| RCO2CH2R’ (esters) | 60–80 |
| RCH2OH | 50–65 |
| RCH2Cl | 40–45 |
| RCH2Br | 30–40 |
| RCH2NH2 | 37–45 |
| R3CH | 25–35 |
| CH3CO– | 20–30 |
| R2CH2 | 16–25 |
| RCH3 | 10–15 |

**PERIODIC TABLE OF ELEMENTS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 18 |
| 1 | 2 |  | Atomic Number |  |  | 1**H**1·0 | Relative atomic mass |  |  |  |  | 13 | 14 | 15 | 16 | 17 | 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**63·5 | 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**(209) | 85**At**210 | 86**Rn**(222) |
| 87**Fr**223 | 88**Ra**226 | 103**Lr**(260) | 104**Rf**(261) | 105**Db**(262) | 106**Sg**(263) | 107**Bh**(264) | 108**Hs**(265) | 109**Mt**(266) | 110**Ds**(271) | 111**Rg**(272) | 112**Cn**(277) |  | 114(289) |  | 116(289) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 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**(244) | 95**Am**(243) | 96**Cm**(247) | 97**Bk**(247) | 98**Cf**(251) | 99**Es**(252) | 100**Fm**(257) | 101**Md**(258) | 102**No**(259) |