GCE AS/A LEVEL

2410U10-1A

TUESDAY, 14 MAY 2024 – MORNING

CHEMISTRY – AS unit 1

DATA BOOKLET

Avogadro constant	N_A	=	$6.02 \times 10^{23}\ \text{mol}^{-1}$
molar gas constant	R	=	$8.31\ \text{J mol}^{-1}\ \text{K}^{-1}$
molar gas volume at 273 K and 1 atm	V_m	=	$22.4\ \text{dm}^3\ \text{mol}^{-1}$
molar gas volume at 298 K and 1 atm	V_m	=	$24.5\ \text{dm}^3\ \text{mol}^{-1}$
Planck constant	h	=	$6.63 \times 10^{-34}\ \text{J s}$
speed of light	c	=	$3.00 \times 10^{8}\ \text{m s}^{-1}$
density of water	d	=	$1.00\ \text{g cm}^{-3}$
specific heat capacity of water	c	=	$4.18\ \text{J g}^{-1}\ \text{K}^{-1}$
ionic product of water at 298 K	K_w	=	$1.00 \times 10^{-14}\ \text{mol}^2\ \text{dm}^{-6}$
fundamental electronic charge	e	=	$1.60 \times 10^{-19}\ \text{C}$

temperature (K) = temperature (°C) + 273

$1\ \text{dm}^3 = 1000\ \text{cm}^3$

$1\ \text{m}^3 = 1000\ \text{dm}^3$

1 tonne = 1000 kg

$1\ \text{atm} = 1.01 \times 10^5\ \text{Pa}$

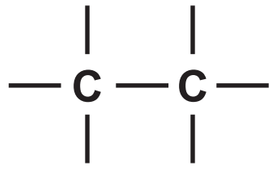
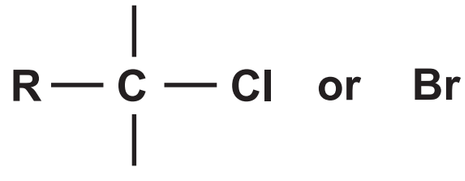
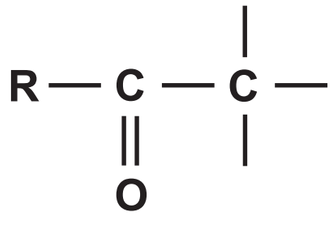
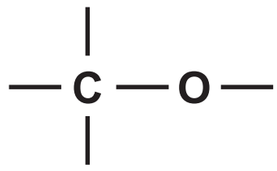
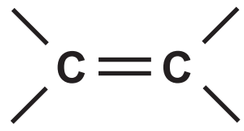
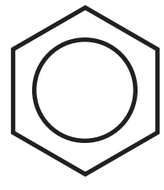
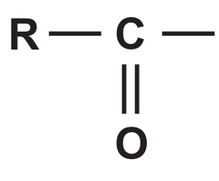
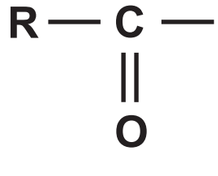
Multiple	Prefix	Symbol
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m

Multiple	Prefix	Symbol
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G

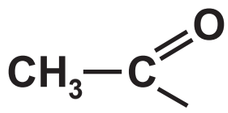
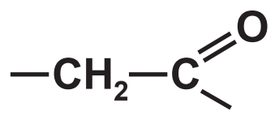
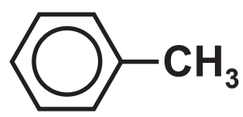
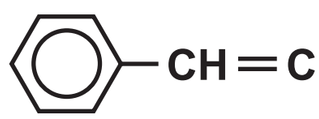
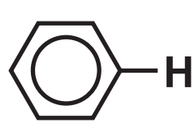
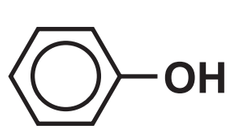
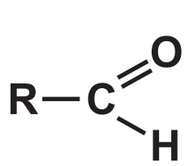
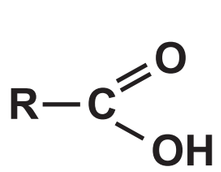
INFRARED ABSORPTION VALUES

BOND	WAVENUMBER / cm^{-1}
C — Br	500 to 600
C — Cl	650 to 800
C — O	1000 to 1300
C ═ C	1620 to 1670
C ═ O	1650 to 1750
C ≡ N	2100 to 2250
C — H	2800 to 3100
O — H (carboxylic acid)	2500 to 3200 (very broad)
O — H (alcohol / phenol)	3200 to 3550 (broad)
N — H	3300 to 3500

^{13}C NMR CHEMICAL SHIFTS RELATIVE TO TMS = 0

TYPE OF CARBON	CHEMICAL SHIFT, δ (ppm)
	5 to 40
	10 to 70
	20 to 50
	25 to 60
	50 to 90
	90 to 150
	110 to 125
	110 to 160
 (carboxylic acid / ester)	160 to 185
 (aldehyde / ketone)	190 to 220

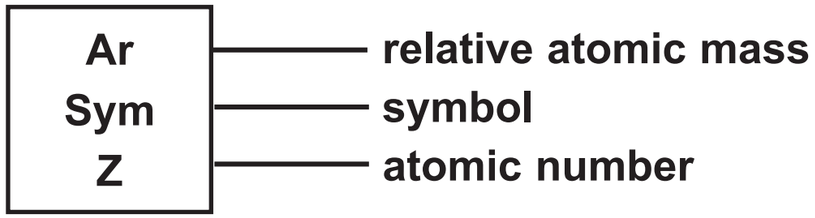
^{1}H NMR CHEMICAL SHIFTS RELATIVE TO TMS = 0

TYPE OF PROTON	CHEMICAL SHIFT, δ (ppm)
$-CH_3$	0.1 to 2.0
$R-CH_3$	0.9
$R-CH_2-R$	1.3
$CH_3-C\equiv N$	2.0
	2.0 to 2.5
	2.0 to 3.0
	2.2 to 2.3
HC—Cl or HC—Br	3.1 to 4.3
HC—O	3.3 to 4.3
R—OH	4.5 *
$-C=CH$	4.5 to 6.3
$-C=CH-CO$	5.8 to 6.5
	6.5 to 7.5
	6.5 to 8.0
	7.0 *
	9.8 *
	11.0 *

*variable figure dependent on concentration and solvent

THE PERIODIC TABLE OF ELEMENTS

KEY



1	2	GROUP	3	4	5	6	7	0
		1 H 1						4 He 2
7 Li 3	9 Be 4		11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12		27 Al 13	28 Si 14	31 P 15	32 S 16	35·5 Cl 17	40 Ar 18
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63·5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
86 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

THE PERIODIC TABLE – KEY

ATOMIC NUMBER – SYMBOL – NAME

1 H - Hydrogen	38 Sr - Strontium	75 Re - Rhenium
2 He - Helium	39 Y - Yttrium	76 Os - Osmium
3 Li - Lithium	40 Zr - Zirconium	77 Ir - Iridium
4 Be - Beryllium	41 Nb - Niobium	78 Pt - Platinum
5 B - Boron	42 Mo - Molybdenum	79 Au - Gold
6 C - Carbon	43 Tc - Technetium	80 Hg - Mercury
7 N - Nitrogen	44 Ru - Ruthenium	81 Tl - Thallium
8 O - Oxygen	45 Rh - Rhodium	82 Pb - Lead
9 F - Fluorine	46 Pd - Palladium	83 Bi - Bismuth
10 Ne - Neon	47 Ag - Silver	84 Po - Polonium
11 Na - Sodium	48 Cd - Cadmium	85 At - Astatine
12 Mg - Magnesium	49 In - Indium	86 Rn - Radon
13 Al - Aluminium	50 Sn - Tin	87 Fr - Francium
14 Si - Silicon	51 Sb - Antimony	88 Ra - Radium
15 P - Phosphorus	52 Te - Tellurium	89 Ac - Actinium
16 S - Sulfur	53 I - Iodine	90 Th - Thorium
17 Cl - Chlorine	54 Xe - Xenon	91 Pa - Protactinium
18 Ar - Argon	55 Cs - Caesium	92 U - Uranium
19 K - Potassium	56 Ba - Barium	93 Np - Neptunium
20 Ca - Calcium	57 La - Lanthanum	94 Pu - Plutonium
21 Sc - Scandium	58 Ce - Cerium	95 Am - Americium
22 Ti - Titanium	59 Pr - Praseodymium	96 Cm - Curium
23 V - Vanadium	60 Nd - Neodymium	97 Bk - Berkelium
24 Cr - Chromium	61 Pm - Promethium	98 Cf - Californium
25 Mn - Manganese	62 Sm - Samarium	99 Es - Einsteinium
26 Fe - Iron	63 Eu - Europium	100 Fm - Fermium
27 Co - Cobalt	64 Gd - Gadolinium	101 Md - Mendelevium
28 Ni - Nickel	65 Tb - Terbium	102 No - Nobelium
29 Cu - Copper	66 Dy - Dysprosium	103 Lr - Lawrencium
30 Zn - Zinc	67 Ho - Holmium	
31 Ga - Gallium	68 Er - Erbium	
32 Ge - Germanium	69 Tm - Thulium	
33 As - Arsenic	70 Yb - Ytterbium	
34 Se - Selenium	71 Lu - Lutetium	
35 Br - Bromine	72 Hf - Hafnium	
36 Kr - Krypton	73 Ta - Tantalum	
37 Rb - Rubidium	74 W - Tungsten	