



A-level

CHEMISTRY

Data Booklet

7405

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Chemistry question papers.**

[Turn over]

The Periodic Table of the Elements

1	2	Key						
(1)	(2)	relative atomic mass						
		symbol						
		atomic (proton) number						
		(3)	(4)	(5)	(6)	(7)	(8)	(9)
6.9 Li 3	9.0 Be 4							
23.0 Na 11	24.3 Mg 12							
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	96.0 Mo 42	[97] Tc 43	101.1 Ru 44	102.9 Rh 45
132.9 Cs 55	137.3 Ba 56	138.9 La * 57	178.5 Hf 72	180.9 Ta 73	183.8 W 74	186.2 Re 75	190.2 Os 76	192.2 Ir 77
[223] Fr 87	[226] Ra 88	[227] Ac † 89	[267] Rf 104	[270] Db 105	[269] Sg 106	[270] Bh 107	[270] Hs 108	[278] Mt 109

1.0
H
1

* 58 – 71 Lanthanides

140.1 Ce 58	140.9 Pr 59	144.2 Nd 60	[145] Pm 61	150.4 Sm 62
232.0 Th 90	231.0 Pa 91	238.0 U 92	[237] Np 93	[244] Pu 94

† 90 – 103 Actinides

3

			3	4	5	6	7	0
			(13)	(14)	(15)	(16)	(17)	(18)
			10.8	12.0	14.0	16.0	19.0	20.2
			B	C	N	O	F	Ne
			5	6	7	8	9	10
(10)	(11)	(12)	27.0	28.1	31.0	32.1	35.5	39.9
			Al	Si	P	S	Cl	Ar
			13	14	15	16	17	18
58.7	63.5	65.4	69.7	72.6	74.9	79.0	79.9	83.8
Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
28	29	30	31	32	33	34	35	36
106.4	107.9	112.4	114.8	118.7	121.8	127.6	126.9	131.3
Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
46	47	48	49	50	51	52	53	54
195.1	197.0	200.6	204.4	207.2	209.0	[209]	[210]	[222]
Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
78	79	80	81	82	83	84	85	86
[281]	[281]	[285]	[286]	[289]	[289]	[293]	[294]	[294]
Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
110	111	112	113	114	115	116	117	118
152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0
Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
63	64	65	66	67	68	69	70	71
[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]	[262]
Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
95	96	97	98	99	100	101	102	103

[Turn over]

1	H	Hydrogen	31	Ga	Gallium
2	He	Helium	32	Ge	Germanium
3	Li	Lithium	33	As	Arsenic
4	Be	Beryllium	34	Se	Selenium
5	B	Boron	35	Br	Bromine
6	C	Carbon	36	Kr	Krypton
7	N	Nitrogen	37	Rb	Rubidium
8	O	Oxygen	38	Sr	Strontium
9	F	Fluorine	39	Y	Yttrium
10	Ne	Neon	40	Zr	Zirconium
11	Na	Sodium	41	Nb	Niobium
12	Mg	Magnesium	42	Mo	Molybdenum
13	Al	Aluminium	43	Tc	Technetium
14	Si	Silicon	44	Ru	Ruthenium
15	P	Phosphorus	45	Rh	Rhodium
16	S	Sulfur	46	Pd	Palladium
17	Cl	Chlorine	47	Ag	Silver
18	Ar	Argon	48	Cd	Cadmium
19	K	Potassium	49	In	Indium
20	Ca	Calcium	50	Sn	Tin
21	Sc	Scandium	51	Sb	Antimony
22	Ti	Titanium	52	Te	Tellurium
23	V	Vanadium	53	I	Iodine
24	Cr	Chromium	54	Xe	Xenon
25	Mn	Manganese	55	Cs	Caesium
26	Fe	Iron	56	Ba	Barium
27	Co	Cobalt	57	La	Lanthanum
28	Ni	Nickel	58	Ce	Cerium
29	Cu	Copper	59	Pr	Praseodymium
30	Zn	Zinc	60	Nd	Neodymium

61	Pm	Promethium	90	Th	Thorium
62	Sm	Samarium	91	Pa	Protactinium
63	Eu	Europium	92	U	Uranium
64	Gd	Gadolinium	93	Np	Neptunium
65	Tb	Terbium	94	Pu	Plutonium
66	Dy	Dysprosium	95	Am	Americium
67	Ho	Holmium	96	Cm	Curium
68	Er	Erbium	97	Bk	Berkelium
69	Tm	Thulium	98	Cf	Californium
70	Yb	Ytterbium	99	Es	Einsteinium
71	Lu	Lutetium	100	Fm	Fermium
72	Hf	Hafnium	101	Md	Mendelevium
73	Ta	Tantalum	102	No	Nobelium
74	W	Tungsten	103	Lr	Lawrencium
75	Re	Rhenium	104	Rf	Rutherfordium
76	Os	Osmium	105	Db	Dubnium
77	Ir	Iridium	106	Sg	Seaborgium
78	Pt	Platinum	107	Bh	Bohrium
79	Au	Gold	108	Hs	Hassium
80	Hg	Mercury	109	Mt	Meitnerium
81	Tl	Thallium	110	Ds	Darmstadtium
82	Pb	Lead	111	Rg	Roentgenium
83	Bi	Bismuth	112	Cn	Copernicium
84	Po	Polonium	113	Nh	Nihonium
85	At	Astatine	114	Fl	Flerovium
86	Rn	Radon	115	Mc	Moscovium
87	Fr	Francium	116	Lv	Livermorium
88	Ra	Radium	117	Ts	Tennessine
89	Ac	Actinium	118	Og	Oganesson

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DATA SHEET**TABLE A****Infrared absorption data**

Bond	Wavenumber /cm⁻¹
N—H (amines)	3300 – 3500
O—H (alcohols)	3230 – 3550
C—H	2850 – 3300
O—H (acids)	2500 – 3000
C≡N	2220 – 2260
C=O	1680 – 1750
C=C	1620 – 1680
C—O	1000 – 1300
C—C	750 – 1100

TABLE B


¹H NMR chemical shift data

Type of proton	δ /ppm
ROH	0.5 – 5.0
RCH ₃	0.7 – 1.2
RNH ₂	1.0 – 4.5
R ₂ CH ₂	1.2 – 1.4
R ₃ CH	1.4 – 1.6
$\begin{array}{c} \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$	2.1 – 2.6
$\begin{array}{c} \\ \text{R}-\text{O}-\text{C}- \\ \\ \text{H} \end{array}$	3.1 – 3.9
RCH ₂ Cl or Br	3.1 – 4.2
$\begin{array}{c} \\ \text{R}-\text{C}-\text{O}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$	3.7 – 4.1
$\begin{array}{c} \text{R} \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \end{array}$	4.5 – 6.0
$\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C} \\ \backslash \\ \text{H} \end{array}$	9.0 – 10.0
$\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C} \\ \backslash \\ \text{O}-\text{H} \end{array}$	10.0 – 12.0

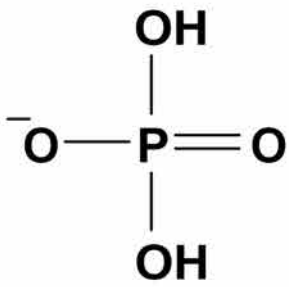
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TABLE C

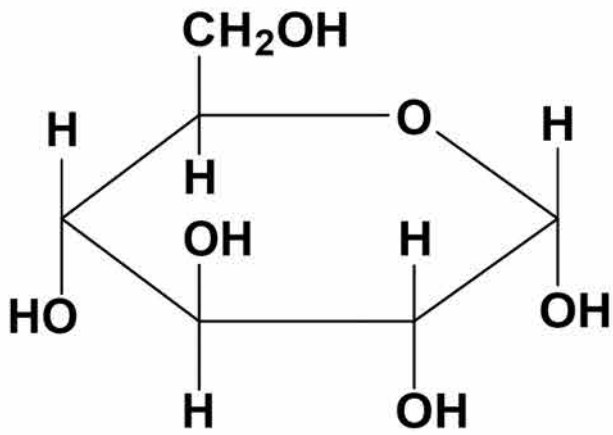
¹³C NMR chemical shift data

Type of carbon	δ /ppm
$\begin{array}{c} \quad \\ -\text{C}-\text{C}- \\ \quad \end{array}$	5 – 40
$\begin{array}{c} \\ \text{R}-\text{C}-\text{Cl or Br} \\ \end{array}$	10 – 70
$\begin{array}{c} \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \end{array}$	20 – 50
$\begin{array}{c} \\ \text{R}-\text{C}-\text{N} \\ \quad \diagup \quad \diagdown \end{array}$	25 – 60
$\begin{array}{c} \\ -\text{C}-\text{O}- \\ \end{array}$	alcohols, ethers or esters
$\begin{array}{c} \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \end{array}$	90 – 150
$\text{R}-\text{C}\equiv\text{N}$	110 – 125
	110 – 160
$\begin{array}{c} \text{R}-\text{C}- \\ \\ \text{O} \end{array}$	esters or acids
$\begin{array}{c} \text{R}-\text{C}- \\ \\ \text{O} \end{array}$	aldehydes or ketones

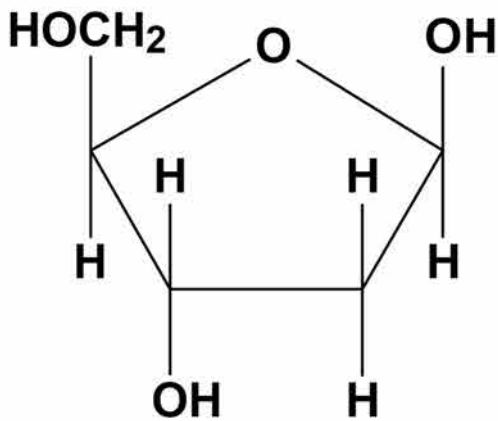
PHOSPHATE AND SUGARS



phosphate



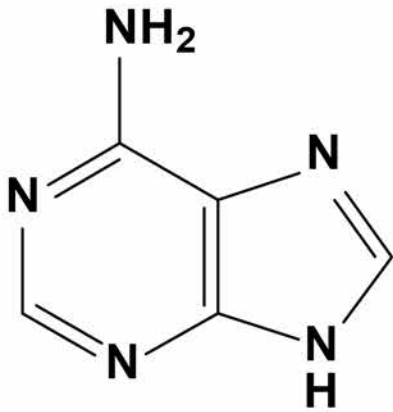
glucose



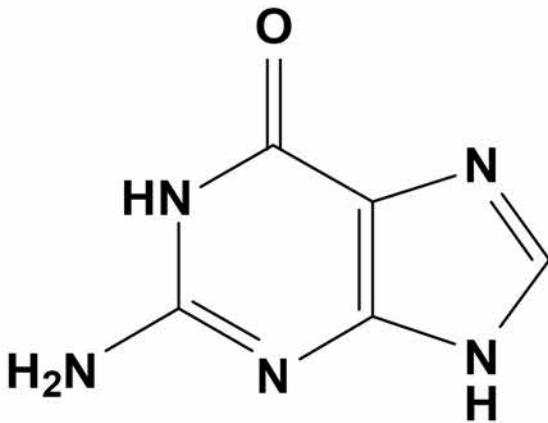
2-deoxyribose

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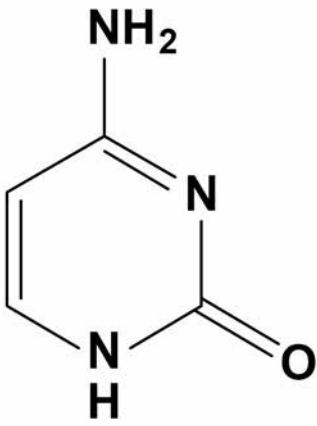
BASES



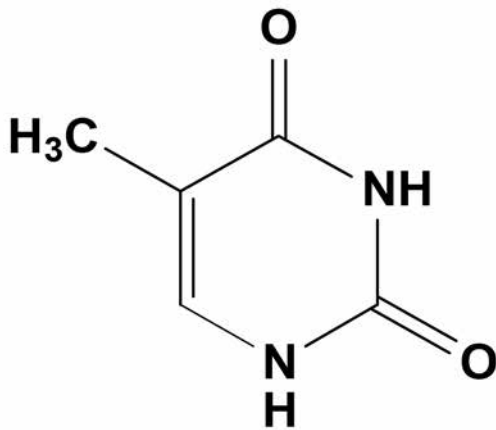
adenine



guanine



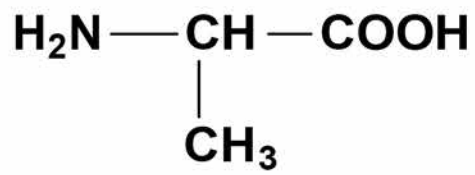
cytosine



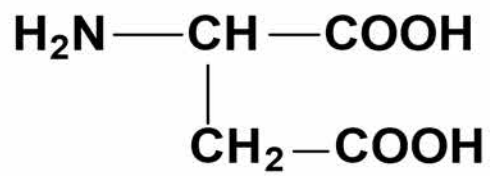
thymine

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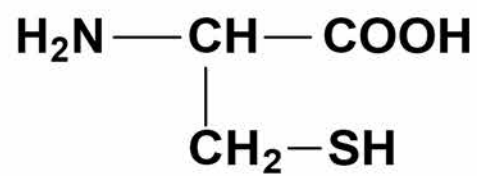
AMINO ACIDS



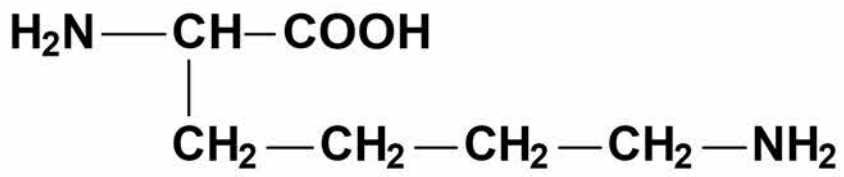
alanine



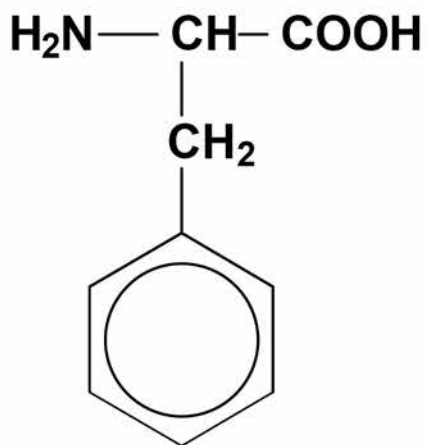
aspartic acid



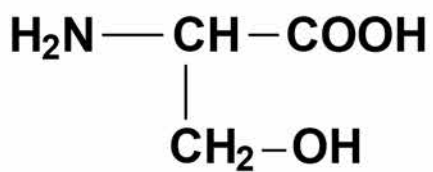
cysteine



lysine



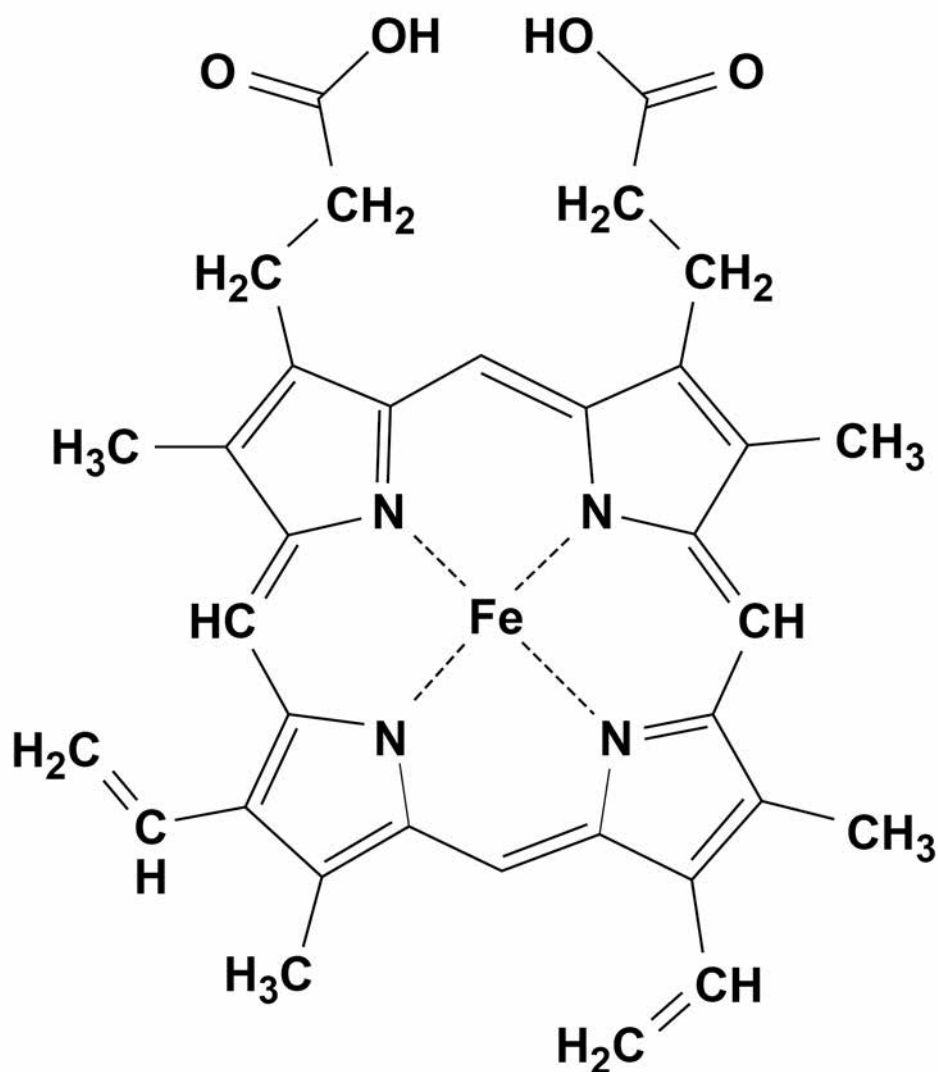
phenylalanine



serine

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HAEM B

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