

CHEM 2 ELECTRON CONFIGURATION

Relationship to position on the Periodic Table; formation of cations and anions.

Bohr planetary (particle) model

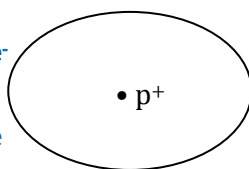
Energy of electron in orbit $E_n = -R / n^2$ n = principal quantum number

Maximum number of electrons per shell = $2.n^2$, so for $n=1$, $2e^-$ $n=2$, $8e^-$ $n=3$, $18e^-$ etc.

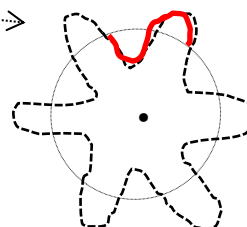
Schrodinger's wave mechanical model

Electron behaving as a wave. (wave functions, Ψ) -such that a stable energy state is only established when an integral number of wavelengths are "quantized" into the orbital to produce a "stationary state", a confined e^- wave.

Bohr e^-
as a
particle



Schrodinger
 e^- as a wave



The four quantum numbers:

n = principal quantum number, $n = 1, 2, 3, \dots$;

Gives the ENERGY of the electron shell via, $E_n = -R/n^2$

ℓ = orbital quantum number, $\ell = 0, 1, 2, \dots (n-1)$;

Gives the SHAPE of the sub-shell electron cloud (orbital shape)

$\ell = 0$ = s-orbital, spherical; $\ell = 1$ = p-orbital, dumbbell shape, $\ell = 2$ = d-orbital

See next page for the shapes of s- p- and d-atomic orbitals.

m_ℓ = magnetic quantum number, $m_\ell = 0, \pm 1, \pm 2, \dots, \pm \ell$;

Gives the NUMBER OF ORBITALS in the sub-shell and their orientation in space

$m_\ell = 0$, ONE s-orbital, $m_\ell = 0, \pm 1$, THREE p-orbitals $m_\ell = 0, \pm 1, \pm 2$, FIVE d-orbitals

Eg. If $n = 2$, then $\ell = 0$ or 1, and for $\ell = 0$, $m_\ell = 0$; and for $\ell = 1$, $m_\ell = 0, +1, -1$,

For $\ell = 0$, $m_\ell = 0$ only : this defines **one** orbital – in this case the **2s-orbital**.

For $\ell = 1$, $m_\ell = 0, +1$ or -1 only; this defines **3 separate** orbitals – in this case the three **2p-orbitals**.

m_s = SPIN quantum number, $m_s = +\frac{1}{2}$ or $-\frac{1}{2}$, often represented as \uparrow or \downarrow , to indicate spin up or down.

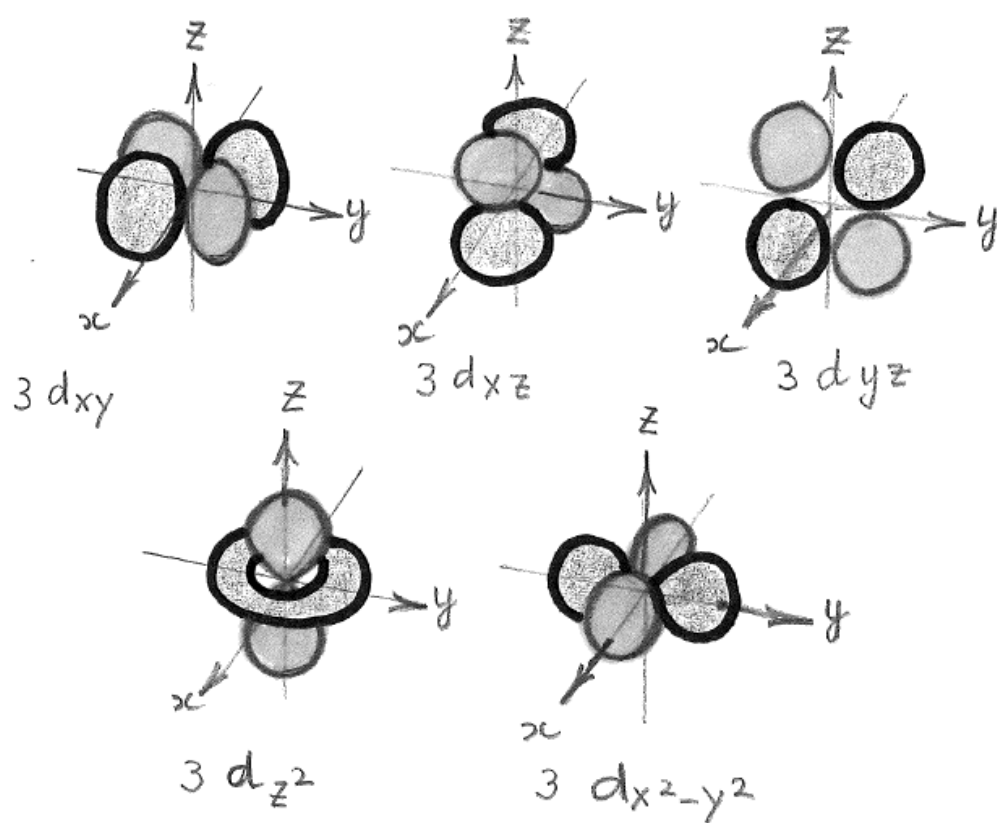
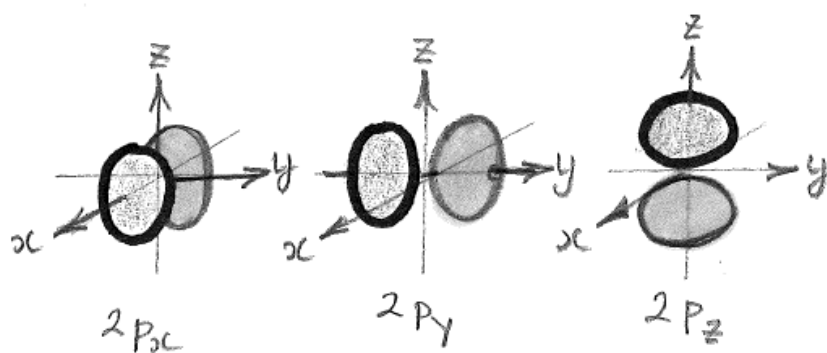
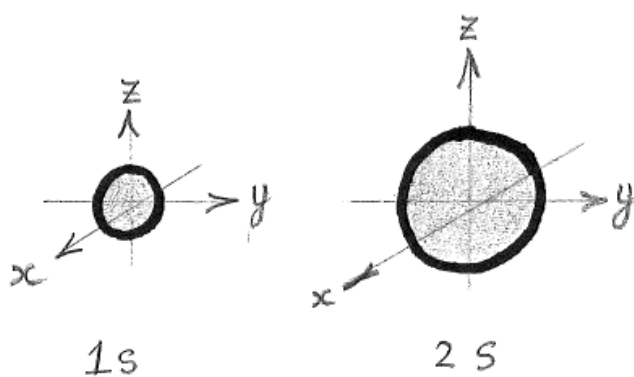
Electrons are often designated as arrows in orbital "boxes", eg



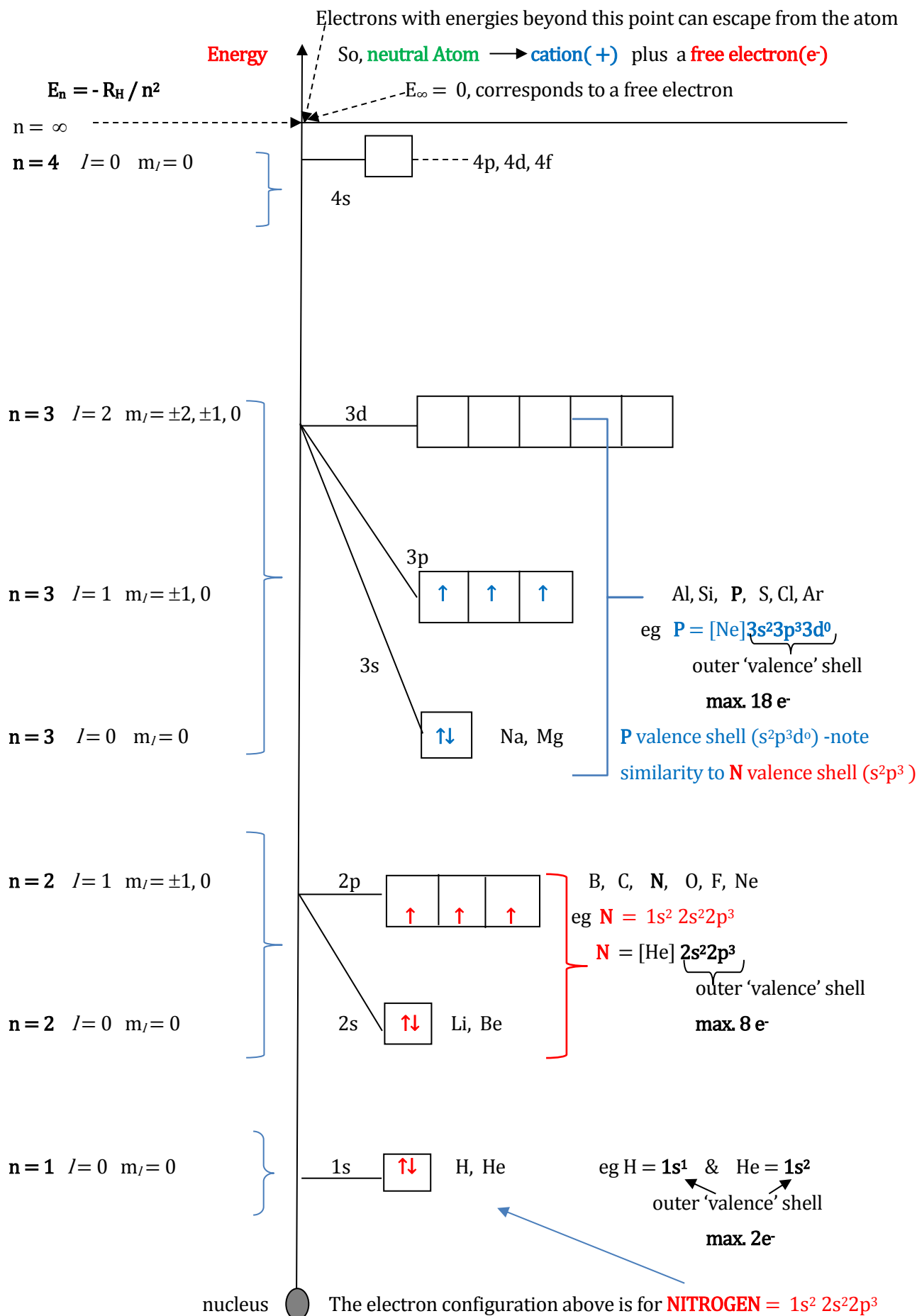
or



SHAPES OF ATOMIC ORBITALS



FOR A MULTI-ELECTRON ATOM, we can plot this as shown below :



Note how the filling of the orbitals gives rise to the layout of the Periodic Table shown on the next page.

Group Number = Number of outer shell electrons
The Modern Periodic Table of the Elements

VIII
18

Element name		Mercury		Atomic #	
		80			
Symbol		Hg			
		200.59		Avg. Mass	
Electronegativity		(1.9)			

The power to attract electrons

Hydrogen		Helium		Lithium		Beryllium		Sodium		Magnesium		Calcium		Potassium		Rubidium		Cesium		Francium	
1	H	2	He	3	Li	4	Be	11	Na	12	Mg	20	Ca	19	K	37	Rb	55	Ba	87	Fr
1.01		4.00		1.0	6.94	9.01		0.9	22.99	24.31		40.08	39.10	0.8	85.47	0.8	132.91	137.33	223	223	
2.1				2.1		1.5					1.2	1.0			1.0		0.7	0.9		0.7	

III		IV		V		VI		VII	
13	B	14	C	15	N	16	O	17	F
10.81	2.0	12.01	2.5	14.01	3.0	16.00	3.5	19.00	4.0

VIII		IX		X		XI		XII	
21	Sc	22	Ti	23	V	24	Cr	25	Mn
44.96	1.3	47.88	1.5	50.94	1.6	52.00	1.6	54.94	1.5

XIII		XIV		XV		XVI		XVII	
31	Ga	32	Ge	33	As	34	Se	35	Br
69.72	1.6	72.61	1.8	74.92	2.0	78.96	2.4	79.90	2.8

XVIII		XIX		XX		XXI		XXII	
49	In	50	Sn	51	Sb	52	Te	53	I
114.82	1.7	118.71	1.8	121.76	1.9	127.60	2.1	126.90	2.5

XXIII		XXIV		XXV		XXVI		XXVII	
81	Tl	82	Pb	83	Bi	84	Po	85	At
204.38	1.8	207.20	1.8	208.98	1.9	(209)	2.0	(210)	2.2

XXVIII		XXIX		XXX		XXXI		XXXII	
113	Uut	114	Uuq	115	Uup	116	Uuh	117	Uus
(284)		(289)		(288)		(292)			

XXXIII		XXXIV		XXXV		XXXVI		XXXVII	
119	Uut	120	Uuq	121	Uup	122	Uuh	123	Uus
(289)		(292)		(291)		(293)			

XXXVIII		XXXIX		XL		XLI		XLII	
125	Uut	126	Uuq	127	Uup	128	Uuh	129	Uus
(292)		(295)		(294)		(296)			

XLIII		XLIV		XLV		XLVI		XLVII	
131	Uut	132	Uuq	133	Uup	134	Uuh	135	Uus
(297)		(301)		(300)		(303)			

XLVIII		XLIX		L		LI		LII	
137	Uut	138	Uuq	139	Uup	140	Uuh	141	Uus
(303)		(307)		(306)		(309)			

LIII		LIV		LV		LVI		LVII	
143	Uut	144	Uuq	145	Uup	146	Uuh	147	Uus
(307)		(311)		(310)		(313)			

LVIII		LVIX		LX		LXI		LXII	
149	Uut	150	Uuq	151	Uup	152	Uuh	153	Uus
(311)		(315)		(314)		(317)			

LXIII		LXIV		LXV		LXVI		LXVII	
155	Uut	156	Uuq	157	Uup	158	Uuh	159	Uus
(315)		(319)		(318)		(321)			

LXVIII		LXIX		LXX		LXXI		LXXII	
161	Uut	162	Uuq	163	Uup	164	Uuh	165	Uus
(319)		(323)		(322)		(325)			

LXXIII		LXXIV		LXXV		LXXVI		LXXVII	
167	Uut	168	Uuq	169	Uup	170	Uuh	171	Uus
(323)		(327)		(326)		(329)			

LXXVIII		LXXIX		LXXX		LXXXI		LXXXII	
173	Uut	174	Uuq	175	Uup	176	Uuh	177	Uus
(327)		(331)		(330)		(333)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
179	Uut	180	Uuq	181	Uup	182	Uuh	183	Uus
(331)		(335)		(334)		(337)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
185	Uut	186	Uuq	187	Uup	188	Uuh	189	Uus
(335)		(339)		(338)		(341)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
191	Uut	192	Uuq	193	Uup	194	Uuh	195	Uus
(339)		(343)		(342)		(345)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
197	Uut	198	Uuq	199	Uup	200	Uuh	201	Uus
(343)		(347)		(346)		(349)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
203	Uut	204	Uuq	205	Uup	206	Uuh	207	Uus
(347)		(351)		(350)		(353)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
209	Uut	210	Uuq	211	Uup	212	Uuh	213	Uus
(351)		(355)		(354)		(357)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
215	Uut	216	Uuq	217	Uup	218	Uuh	219	Uus
(355)		(359)		(358)		(361)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
221	Uut	222	Uuq	223	Uup	224	Uuh	225	Uus
(359)		(363)		(362)		(365)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
227	Uut	228	Uuq	229	Uup	230	Uuh	231	Uus
(363)		(367)		(366)		(369)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
233	Uut	234	Uuq	235	Uup	236	Uuh	237	Uus
(367)		(371)		(370)		(373)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
239	Uut	240	Uuq	241	Uup	242	Uuh	243	Uus
(371)		(375)		(374)		(377)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
245	Uut	246	Uuq	247	Uup	248	Uuh	249	Uus
(375)		(379)		(378)		(381)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
251	Uut	252	Uuq	253	Uup	254	Uuh	255	Uus
(379)		(383)		(382)		(385)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
257	Uut	258	Uuq	259	Uup	260	Uuh	261	Uus
(383)		(387)		(386)		(389)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
263	Uut	264	Uuq	265	Uup	266	Uuh	267	Uus
(387)		(391)		(390)		(393)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
269	Uut	270	Uuq	271	Uup	272	Uuh	273	Uus
(391)		(395)		(394)		(397)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
275	Uut	276	Uuq	277	Uup	278	Uuh	279	Uus
(395)		(399)		(398)		(401)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
281	Uut	282	Uuq	283	Uup	284	Uuh	285	Uus
(399)		(403)		(402)		(405)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
287	Uut	288	Uuq	289	Uup	290	Uuh	291	Uus
(403)		(407)		(406)		(409)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
293	Uut	294	Uuq	295	Uup	296	Uuh	297	Uus
(407)		(411)		(410)		(413)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
299	Uut	300	Uuq	301	Uup	302	Uuh	303	Uus
(411)		(415)		(414)		(417)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
305	Uut	306	Uuq	307	Uup	308	Uuh	309	Uus
(415)		(419)		(418)		(421)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
311	Uut	312	Uuq	313	Uup	314	Uuh	315	Uus
(419)		(423)		(422)		(425)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
317	Uut	318	Uuq	319	Uup	320	Uuh	321	Uus
(423)		(427)		(426)		(429)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
323	Uut	324	Uuq	325	Uup	326	Uuh	327	Uus
(427)		(431)		(430)		(433)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
329	Uut	330	Uuq	331	Uup	332	Uuh	333	Uus
(431)		(435)		(434)		(437)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
335	Uut	336	Uuq	337	Uup	338	Uuh	339	Uus
(435)		(439)		(438)		(441)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
341	Uut	342	Uuq	343	Uup	344	Uuh	345	Uus
(439)		(443)		(442)		(445)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
347	Uut	348	Uuq	349	Uup	350	Uuh	351	Uus
(443)		(447)		(446)		(449)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
353	Uut	354	Uuq	355	Uup	356	Uuh	357	Uus
(447)		(451)		(450)		(453)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
359	Uut	360	Uuq	361	Uup	362	Uuh	363	Uus
(451)		(455)		(454)		(457)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
365	Uut	366	Uuq	367	Uup	368	Uuh	369	Uus
(455)		(459)		(458)		(461)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
371	Uut	372	Uuq	373	Uup	374	Uuh	375	Uus
(459)		(463)		(462)		(465)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
377	Uut	378	Uuq	379	Uup	380	Uuh	381	Uus
(463)		(467)		(466)		(469)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
383	Uut	384	Uuq	385	Uup	386	Uuh	387	Uus
(467)		(471)		(470)		(473)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
389	Uut	390	Uuq	391	Uup	392	Uuh	393	Uus
(471)		(475)		(474)		(477)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
395	Uut	396	Uuq	397	Uup	398	Uuh	399	Uus
(475)		(479)		(478)		(481)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
401	Uut	402	Uuq	403	Uup	404	Uuh	405	Uus
(479)		(483)		(482)		(485)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
407	Uut	408	Uuq	409	Uup	410	Uuh	411	Uus
(483)		(487)		(486)		(489)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
413	Uut	414	Uuq	415	Uup	416	Uuh	417	Uus
(487)		(491)		(490)		(493)			

LXXXIII		LXXXIV		LXXXV		LXXXVI		LXXXVII	
419	Uut	420	Uuq	421	Uup	422	Uuh	423	Uus
(491)		(495)		(494)		(497)			

LXXXVIII		LXXXIX		LXXX		LXXXI		LXXXII	
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