A MAGICAL PAIR OF 6x6 CHEMICAL SQUARES

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The two 6x6 squares below contain 72 distinct entries from the periodic table of the elements, chosen from among the 110 which have been assigned official names by the IUPAC (International Union of Pure and Applied Chemistry). Each small square displays the standard abbreviation and atomic number for its element.

H_{1}	Be_{4}	B_{5}	C_{6}	N_{7}	F_{9}
Si_{14}	Ar_{18}	K_{19}	Sc_{21}	Ge_{32}	Cd_{48}
In_{49}	Sn_{50}	Xe_{54}	Ba_{56}	Pr_{59}	Nd_{60}
Er_{68}	Tm_{69}	Lu_{71}	Ta_{73}	Re_{75}	Os_{76}
Ir_{77}	Pt_{78}	Hg_{80}	Tl_{81}	Pb_{82}	Ac_{89}
Th_{90}	Pa_{91}	Pu_{94}	Es_{99}	Sg_{106}	Hs_{108}

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Li_{3}	O_{8}	Na_{11}	Al_{13}	Cl_{17}	Cr_{24}
Fe_{26}	Cu_{29}	Ga_{31}	As_{33}	Se_{34}	Sr_{38}
Y_{39}	Nb_{41}	Pd_{46}	Sb_{51}	I_{53}	Cs_{55}
La_{57}	Pm_{61}	Sm_{62}	Gd_{64}	Tb_{65}	Dy_{66}
Yb_{70}	W_{74}	Au_{79}	At_{85}	Rn_{86}	Fr_{87}
U_{92}	Cm_{96}	No_{102}	Db_{105}	Bh_{107}	Mt_{109}

These two 6x6 squares are equal to each other in three different ways.

First Way: Put the full name of each element in its square. The resulting 6x6 square on the left is an exact anagram (transposition) of the letters in the 6x6 square on the right:

Left square:

Hydrogen	Beryllium	Boron	Carbon	Nitrogen	Fluorine
Silicon	Argon	Potassium	Scandium	Germanium	Cadmium
Indium	Tin	Xenon	Barium	Praseodymium	Neodymium
Erbium	Thulium	Lutetium	Tantalum	Rhenium	Osmium
Iridium	Platinum	Mercury	Thallium	Lead	Actinium
Thorium	Protactinium	Plutonium	Einsteinium	Seaborgium	Hassium

transposed, yields

Right square:

Lithium	Oxygen	Sodium	Aluminium	Chlorine	Chromium
Iron	Copper	Gallium	Arsenic	Selenium	Strontium
Yttrium	Niobium	Palladium	Antimony	Iodine	Caesium
Lanthanum	Promethium	Samarium	Gadolinium	Terbium	Dysprosium
Ytterbium	Tungsten	Gold	Astatine	Radon	Francium
Uranium	Curium	Nobelium	Dubnium	Bohrium	Meitnerium

It is important to note that three of the 110 elements have pairs of conflicting (but both widely used) spellings: Caesium/Cesium, Aluminium/Aluminum, and Sulphur/Sulfur. To resolve this issue we decided to use the IUPAC-preferred spellings for these elements, as given on the IUPAC

web page www.iupac.org/reports/periodic_table/index.html#names. Surprisingly, the IUPAC recommendations are somewhat inconsistent, as they prefer "Caesium" and "Aluminium" for Cs and Al but mandate the spelling "Sulfur" for S. At any rate, all names and abbreviations used here conform to IUPAC usage.

Second Way: Consider the atomic number of each element, shown as a subscript the original squares above and repeated in the arrays below. The sum of the numbers in each 6x6 square is exactly the same - 2019.

1	4	5	6	7	9		3	8	11	13	17	24	
14	18	19	21	32	48		26	29	31	33	34	38	
49	50	54	56	59	60	*summed*	39	41	46	51	53	55	(= 2019)
68	69	71	73	75	76	*equals*	57	61	62	64	65	66	
77	78	80	81	82	89		70	74	79	85	86	87	
90	91	94	99	106	108		92	96	102	105	107	109	

Third Way: This time, delete the atomic number in each square, leaving the standard abbreviation for each element:

H	Be	B	C	N	F		Li	O	Na	Al	Cl	Cr
Si	Ar	K	Sc	Ge	Cd		Fe	Cu	Ga	As	Se	Sr
In	Sn	Xe	Ba	Pr	Nd		Y	Nb	Pd	Sb	I	Cs
Er	Tm	Lu	Ta	Re	Os		La	Pm	Sm	Gd	Tb	Dy
Ir	Pt	Hg	Tl	Pb	Ac		Yb	W	Au	At	Rn	Fr
Th	Pa	Pu	Es	Sg	Hs		U	Cm	No	Db	Bh	Mt

Replace each abbreviation with its alphabetic score, using the familiar A=1, B=2, C=3 numbering scheme (ignoring case, as usual, so that, for instance, Lithium (Li) is scored L+I = 12+9 = 21). The scores in each 6x6 square sum to the same number - 737.

8	7	2	3	14	6		21	15	15	13	15	21	
28	19	11	22	12	7		11	24	8	20	24	37	
23	33	29	3	34	18	*summed*	25	16	20	21	9	22	(= 737)
23	33	33	21	23	34	*equals*	13	29	32	11	22	29	
27	36	15	32	18	4		27	23	22	21	32	24	
28	17	37	24	26	27		21	16	29	6	10	33	

The next largest pair of triply-equal squares like this would be 7x7 in size, containing a total of 98 different elements. Since there are only 110 named elements, it seems quite unlikely that 98 of them could be so arranged. If this is true then the 6x6 pair presented here is the largest possible (at least for now, until many more new chemical elements have been discovered and named).