01 The Pyramid Periodic Table

The Janet Periodic Table (first printed 1928) is also known as the Left Step Table. This table may be re-organized as four square matrices. Each matrix is a different size.

If the cells of each matrix are represented as a cube, then the matrices may be stacked to form a stepped pyramid with four “levels”. Each level is a matrix. If each cell represents a chemical element, then the stepped pyramid becomes a 3D Table of Elements. It may be named as the “Pyramid Periodic Table”. It is also possible to view vertical sections cut through the pyramid to reveal “vertical relationships” of the elements.

Each element is associated with a cube which has a “location” within the pyramid. Quantum numbers are used to locate any element within the pyramid. The atomic number is related to the quantum numbers of the most significant electron.

**The Four Matrices:**

The Janet table may be re-arranged as a set of four matrices. Each matrix is a different size. If the cells are represented as cubes, then the matrices may stack vertically with the four core cells in alignment. The result appears as a stepped pyramid. Each cell represents a chemical element identified by the atomic number (Z) shown as the upper number in each cell. Each matrix is identified by a “matrix number” (M) which is also a “level number” in the pyramid structure. The “orbital id” (eg; 1s, 2p, 3d, 4f) of the most significant electron is shown as the lower symbol in each cell. A “Madelung number” (M₁) identifies each half matrix.

**Top Level, Matrix; M = 1**  \( (M₁ \text{ upper} = 1, M₁ \text{ lower} = 2) \)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s</td>
<td>1s</td>
<td>1s</td>
</tr>
<tr>
<td>2s</td>
<td>4</td>
<td>2s</td>
</tr>
</tbody>
</table>

**Matrix; M = 2**  \( (M₁ \text{ upper} = 3, M₁ \text{ lower} = 4) \)

<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>2p</td>
<td>2p</td>
<td>2p</td>
<td>2p</td>
<td>2p</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>12</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2p</td>
<td>3s</td>
<td>3s</td>
<td>2p</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>19</td>
<td>20</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>3p</td>
<td>4s</td>
<td>4s</td>
<td>3p</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>3p</td>
<td>3p</td>
<td>3p</td>
<td>3p</td>
<td></td>
</tr>
</tbody>
</table>
Orbitals are grouped to form concentric “half square rings” in each matrix. Each orbital is contained within one half of a matrix (upper or lower half) and may be shown shaded. All cells on the upper half matrix have the same Madelung number. All cells on the lower half matrix have the same Madelung number.
The Quantum Numbers;

The four quantum numbers \((n, L, m_L, m_s)\) are well defined in the literature;

- \(n\) is associated with electron distance from the nucleus; \(n = \text{range;1}...8\)
- \(L\) is angular momentum; \(L = \text{range;0}...((n-1))\)
- \(m_L\) is magnetic moment associated with angular momentum; \(m_L = \text{range;}-L...0...+L\)
- \(m_s\) is magnetic moment associated with spin; \(m_s = \pm\frac{1}{2}\) (spin up, spin down)

A fifth quantum number \((s)\) represents the spin momentum of an electron; \(s = \frac{1}{2}\)

This number is usually omitted because it has the same value for all leptons (including electrons).

Madelung Number;

A “Madelung number” \((M_1)\) is a sum of quantum numbers; \(M_1 = n + L\)

All cells in the same half matrix (upper or lower) have the same Madelung number.

If; \(M_1\) is an odd number, then; the upper half matrix is represented; \(M_{1\text{Upper}} = 1, 3, 5, 7\)

If; \(M_1\) is an even number, then; the lower half matrix is represented; \(M_{1\text{Lower}} = 2, 4, 6, 8\)

Magnetic Dipole;

The rotation of an electron may set up a magnetic dipole. If a magnetic dipole exists then the magnetic moment \((m_n)\) has two possible values;

\[ m_n = \pm\frac{1}{2} \]

Where; \(m_n = -\frac{1}{2}\) represents “dipole north” (upper half of a matrix)
\(m_n = +\frac{1}{2}\) represents “dipole south” (lower half of a matrix)

Matrix Number;

The pyramid table is a re-arrangement of the Janet Periodic Table into four square matrices. A matrix number \((M)\) can be calculated from the Madelung numbers;

\[ M = \frac{1}{2}M_{1\text{Lower}} = \frac{1}{2}(M_{1\text{Upper}}+1) \]

Or; \[ M = \frac{1}{2}(n+L+s-m_n) \]
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**Total Momentum;**

Orbital momentum \((L)\) and spin momentum \((s)\) may be combined as “total momentum” \((M_2)\);

\[
M_2 = L + s
\]

**The Elemental Matrix;**

The quantum numbers are associated with physical properties of the most significant electron. The five quantum numbers and the derived numbers \((m_n, M, M_1, M_2)\) may represent any element, and may be grouped as an “elemental matrix”;

<table>
<thead>
<tr>
<th>(n)</th>
<th>(m_L)</th>
<th>(m_n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(M_1)</td>
<td>(L)</td>
<td>(m_n)</td>
</tr>
<tr>
<td>(M)</td>
<td>(M_2)</td>
<td>(s)</td>
</tr>
</tbody>
</table>

**Location;**

Quantum numbers also define the location of any “element cube” within the pyramid. Location is identified by; half level, square ring, and displacement.

**Half Matrix (Upper, Lower);**

All cells within one half (upper or lower) of each matrix have the same Madelung number;

- If; \(M = 1\) then; \(M_1\) Upper = 1 \(M_{1}\) Lower = 2
- If; \(M = 2\) then; \(M_1\) Upper = 3 \(M_{1}\) Lower = 4
- If; \(M = 3\) then; \(M_1\) Upper = 5 \(M_{1}\) Lower = 6
- If; \(M = 4\) then; \(M_1\) Upper = 7 \(M_{1}\) Lower = 8

**Half Matrix (Left, Right);** \(m_s\) gives the left or right half of any matrix

- \(m_s = +\frac{1}{2}\) is the right half of a matrix
- \(m_s = -\frac{1}{2}\) is the left half of a matrix

**Square Rings;** Quantum number ‘\(L\)’ gives the ring number

A matrix is composed of a 2x2 “core” surrounded by concentric “square rings”. The core and each ring are identified by the ring number (\(L\));

\[
L = 0, 1, 2, 3 = s, p, d, f
\]

The core is; \(L = 0\)
**Displacement:** Quantum number ‘m_l’ gives the displacement (clockwise or ccw) within any ring from the diagonal (from the nearest corner cube). Each cell is identified by a “displacement number” \( m_L \);

\[ m_{L_{\text{min}}} = -L, \quad m_{L_{\text{max}}} = +L \]

If the cube lies on a major diagonal then; \( m_L = 0 \)

**Level:** \( M \) gives the level number (matrix number)

\[ M = \frac{1}{2} M_{\text{Lower}} = \frac{1}{2}(M_{\text{Upper}} + 1) \]

\( M \) values are; \( 1,2,3,4 \)

\( M = 1 \) represents the top level (smallest matrix) \( (M_1 = 1,2) \)

\( M = 4 \) represents the bottom level (largest matrix) \( (M_1 = 7,8) \)

**The Atomic Number:**

An atomic number \( Z \) can be calculated from the quantum numbers. An atomic number is the sum of three “atomic functions” \( (Z_1, Z_2, Z_3) \);

\[ Z = Z_1 + Z_2 + Z_3 \]

Where;

\[ Z_1 = f(M_1, M) \quad \text{associated with electric force} \]

\[ Z_2 = f(M_2, m_L) \quad \text{associated with electro-magnetic (orbital) force} \]

\[ Z_3 = f(M_2, m_s) \quad \text{associated with electro-magnetic (spin) force} \]

Atomic functions are defined as;

\[ Z_1 = \frac{1}{2}M(M+1)(2M+1) + 2M^2(M_1 - 2M) \]

\[ Z_2 = m_L - 2M_s^2 \]

\[ Z_3 = 2m_sM_2 \]

Each element may be represented by an atomic number. The element is located within the pyramid by the quantum numbers associated with the most significant electron. The atomic number must be related to the quantum numbers (and to the location of the associated element).
Location Calculations:

The following examples are calculations for various elements (oxygen, copper, lead).

**Oxygen; Z = 8**

Elemental matrix:

\[
\begin{array}{ccc}
  n & m_l & m_n \\
  M_1 & L & m_s \\
  M & M_2 & s \\
\end{array}
\]

Populated matrix:

\[
\begin{array}{ccc}
  2 & -1 & -\frac{1}{2} \\
  3 & 1 & +\frac{1}{2} \\
  2 & 1\frac{1}{2} & \frac{1}{2} \\
\end{array}
\]

Matrix:

\[M = \frac{1}{2}(M_1 + 1) = \frac{1}{2}(3 + 1) = 2\]

Location:

- Upper half of Level 2; \(M_1 = 3\)
- Outermost ring; \(L = n - 1 = 1\)
- Displacement; one cell left of diagonal \((m_l = -1)\)
- Right half of matrix \((m_s = +\frac{1}{2})\)

Atomic functions:

\[Z_1 = \frac{1}{2}M(M+1)(2M+1) + 2M^2(M_1 - 2M)\]
\[Z_1 = \frac{1}{2}(2)(3)(5) + 2(4)(3-4) = 20 - 8 = 12\]
\[Z_2 = m_l - 2M_s^2\]
\[Z_2 = (-1) - (2)(9/4) = -5\frac{1}{2}\]
\[Z_3 = 2m_sM_2\]
\[Z_3 = 2(+\frac{1}{2})(3/2) = 1\frac{1}{2}\]
\[Z = Z_1 + Z_2 + Z_3 = 12 - 5\frac{1}{2} + 1\frac{1}{2} = 8 \text{ (oxygen)}\]
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**Copper;**  \( Z = 29 \)

Elemental matrix;

\[
\begin{array}{ccc}
3 & +1 & -\frac{1}{2} \\
5 & 2 & +\frac{3}{2} \\
3 & 2\frac{1}{2} & \frac{1}{2}
\end{array}
\]

Matrix;  \( M = \frac{1}{2}(M_1+1) = \frac{1}{2}(5+1) = 3 \)

Location;  Upper half of Level 3 \( (M_1 = 5) \)

Outermost ring \( (L = 2) \)

Displacement; one right of diagonal \( (m_L = +1) \)

Right half of matrix 3 \( (m_s = +\frac{1}{2}) \)

Atomic functions;

\[
Z_1 = \frac{1}{3}M(M+1)(2M+1) + 2M^2(M_1 - 2M)
\]

\[
Z_1 = \frac{1}{3}(3)(4)(7) + 2(9)(5-6) = 56 - 18 = 38
\]

\[
Z_2 = m_L - 2M^2
\]

\[
Z_2 = (1) - (2)(2\frac{1}{2})^2 = -11\frac{1}{2}
\]

\[
Z_3 = 2m_sM_2
\]

\[
Z_3 = 2(+\frac{1}{2})(2\frac{1}{2}) = 2\frac{1}{2}
\]

\[
Z = Z_1 + Z_2 + Z_3
\]

\[
Z = 38 - 11\frac{1}{2} + 2\frac{1}{2} = 29 \quad \text{(copper)}
\]

**Lead;**  \( Z = 82 \)

Elemental matrix;

\[
\begin{array}{ccc}
6 & 0 & -\frac{1}{2} \\
7 & 1 & -\frac{1}{2} \\
4 & 1\frac{1}{2} & \frac{1}{2}
\end{array}
\]

Matrix;  \( M = \frac{1}{2}(M_1+1) = \frac{1}{2}(7+1) = 4 \)

Location;  Upper half of Level 4; \( M_1 = 7 \)

Ring;  \( L = 1 \)
Displacement; on diagonal \((m_L = 0)\)

Left half of matrix \((m_s = -\frac{1}{2})\)

Atomic functions:

\[
Z_1 = \frac{7}{3}M(M+1)(2M+1) + 2M^2(M_1 - 2M)
\]

\[
Z_1 = \frac{7}{3}(4)(5)(9) + 2(16)(7-8) = 120 - 32 = 88
\]

\[
Z_2 = m_L - 2M^2
\]

\[
Z_2 = (0) - (2)(1\frac{1}{2})^2 = -4\frac{1}{2}
\]

\[
Z_3 = 2m_sM_2
\]

\[
Z_3 = 2(-\frac{1}{2})(1\frac{1}{2}) = -1\frac{1}{2}
\]

\[
Z = Z_1 + Z_2 + Z_3
\]

\[
Z = 88 - 4\frac{1}{2} - 1\frac{1}{2} = 82 \quad \text{(Lead)}
\]

**Slicing:**

A 3D periodic table may be created if each cell of a matrix is represented as a cube, and the matrices are stacked vertically. Matrix01 \((M=1)\) is the top level and Matrix04 \((M=4)\) is the base. The resulting 3D table resembles a stepped pyramid.

Vertical slices through the structure reveal vertical relationships between the elements. Major slicing reveals all four “levels” of the structure. Minor slicing does not account for all levels and also reveals vertical relationships. Two major slices are shown below;

**Major Slice (“North” View):**

<table>
<thead>
<tr>
<th></th>
<th>1s</th>
<th>1s</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2p</td>
<td>3s</td>
<td>3s</td>
</tr>
<tr>
<td>3d</td>
<td>31</td>
<td>37</td>
</tr>
<tr>
<td>4p</td>
<td>5s</td>
<td>38</td>
</tr>
<tr>
<td>5s</td>
<td>4p</td>
<td>4p</td>
</tr>
<tr>
<td>6p</td>
<td>7s</td>
<td>86</td>
</tr>
<tr>
<td>7s</td>
<td>88</td>
<td>80</td>
</tr>
<tr>
<td>5d</td>
<td>81</td>
<td>70</td>
</tr>
<tr>
<td>6p</td>
<td>87</td>
<td>4f</td>
</tr>
<tr>
<td>4f</td>
<td>71</td>
<td>5d</td>
</tr>
</tbody>
</table>
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Major Diagonal Slice ("North-West" View);

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>3s</td>
<td>2p</td>
<td>1s</td>
</tr>
<tr>
<td>14</td>
<td>19</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>41</td>
<td>50</td>
<td>55</td>
<td>38</td>
</tr>
<tr>
<td>6d</td>
<td>5f</td>
<td>6s</td>
<td>5s</td>
</tr>
<tr>
<td>88</td>
<td>85</td>
<td>78</td>
<td>67</td>
</tr>
</tbody>
</table>

Janet (Left Step) Periodic Table;

The Janet PT is displayed below in two parts (A,B). Each cell represents a chemical element represented by the atomic number (Z), shown as the lower number. A cell also contains the "orbital" (nL) of the most significant electron, shown as the upper number.

Janet Periodic Table (Part A);

<table>
<thead>
<tr>
<th></th>
<th>1s</th>
<th>1s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2s</td>
<td>2s</td>
</tr>
<tr>
<td></td>
<td>3p</td>
<td>3p</td>
</tr>
<tr>
<td></td>
<td>4p</td>
<td>4p</td>
</tr>
<tr>
<td></td>
<td>5p</td>
<td>5p</td>
</tr>
<tr>
<td></td>
<td>6s</td>
<td>6s</td>
</tr>
<tr>
<td>1s</td>
<td>7s</td>
<td>7s</td>
</tr>
<tr>
<td>2s</td>
<td>8s</td>
<td>8s</td>
</tr>
</tbody>
</table>

Each row has a common sum (n+L) of quantum numbers.

Where; L = 0,1,2,3 = s,p,d,f

n = 1......8

Janet Periodic Table (Part B);

<table>
<thead>
<tr>
<th></th>
<th>4f</th>
<th>4f</th>
<th>4f</th>
<th>4f</th>
<th>4f</th>
<th>4f</th>
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<th>4f</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
<td>65</td>
</tr>
<tr>
<td>5f</td>
<td>5f</td>
<td>5f</td>
<td>5f</td>
<td>5f</td>
<td>5f</td>
<td>5f</td>
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<td>5f</td>
</tr>
<tr>
<td>89</td>
<td>90</td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>95</td>
<td>96</td>
<td>97</td>
</tr>
</tbody>
</table>

March 5, 2019
Conclusion;

The Periodic Table may be represented in 3D as a stepped pyramid having four levels. This is a series of four square matrices. The matrices have different sizes. Each element is precisely located by quantum numbers of the most significant electron. Relationships of the elements may also be revealed by vertical slicing.