

Solution to Plato's elements challenge

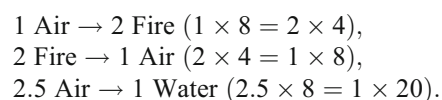
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Of all the writings of Plato, arguably none has less engaged the attention of modern scholars than *Timaeus*. However, one interesting aspect of this dialogue to chemists is the way that Plato's elements can be transformed by rearranging the primordial triangles, which might be regarded as an early quasi-molecular theory of matter. More importantly, in *Timaeus*, we find the first documented example of stoichiometric equations for the transformation of matter. Such transformations are subject to a constraint that the number of equilateral triangular faces involved remains constant. According to Plato, a particle of water (icosahedron) has 20 faces, a particle of air (octahedron) has 8, and a particle of fire (tetrahedron) has 4 faces. Thus, the stoichiometry for the transformation of water into fire and air (for example) is



because $1 \times 20 = 1 \times 4 + 2 \times 8$. Likewise, the stoichiometries for the remaining reactions discussed in *Timaeus* 56 d are as follows:



The stoichiometries of the four equations stated above, as inferred from seven translations of *Timaeus* [1–9], are summarized in Table 1.

It is clear that translations [2] and [4] err in regards to reaction 1, whereas translation [6] gives the incorrect stoichiometry for reaction 4.

Table 1 Stoichiometries for the transformations of Plato's elements as inferred from seven translations of *Timaeus* 56 d

Translation	Reaction 1	Reaction 2	Reaction 3	Reaction 4
[1]	1 Water → 1 Fire + 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water
[2]	1 Water → 1 Fire, or 1 Water → 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water
[3]	1 Water → 1 Fire + 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water
[4]	1 Water → 1 Fire, or 1 Water → 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water
[5]	1 Water → 1 Fire + 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water
[6]	1 Water → 1 Fire + 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Water → 1 Air
[7]	1 Water → 1 Fire + 2 Air	1 Air → 2 Fire	2 Fire → 1 Air	2.5 Air → 1 Water

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