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A MINI-REVIEW AS APPLIED TO EULER'S CONVEX POLYHEDRA FORMULA AND TWO OTHERS

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Abstract: We show the correspondence between Euler-Gibbs-DNA Polyhedra equations. It is possible to relate these three equations.

Leonhard Euler	$V = 2 + E – F$	(convex polyhedra)
Josiah Willard Gibbs	$F = 2 + C – P$	(phase rule)
DNA Polyhedra	$s = 2 + c – \mu$	(biology)

The sources are presented which have the proofs for the three equations and the details for the correspondence. There is a corresponding states between them as math bridges geometry, chemistry and biology.

Key Words:"convex polyhedra""Gibbs phase rule""DNA polyhedra" "corresponding states"

I. Introduction

There is a pattern between mathematics, chemistry and biology and it follows Euler's convex polyhedra formula. Euler's formula relates V vertices, E edges and F faces of the polyhedron, the most simple being the convex one. See Fig. 1 for an equilateral prism and a cube being deformed while V, E and F are invariant.

Then, for the Gibbs phase rule in chemistry, the vertices V correspond to the degrees of freedom F because the convex vertices can have some movement in (x, y, z) space as shown in Fig. 1. Another parallel construct is that of DNA Polyhedra with s Siefert circles that are analogous to V vertices, as they appear to be able to move in (x, y, z) space.

II. Results

The proof for Euler's theorem is in the literature [1] and the proof for the Gibbs phase rule is in [2] pages 211-216. Hu, et al [3] have the proof for the DNA Polyhedra formula.

Now, it remains to set up the correspondence as in the Abstract. Fig. 1 outlines how V in Euler corresponds with F in Gibbs. Then, think of the phases as pools bounded by components, so P coresponds with F. One can think of the faces as having edges and the phases as having components.

Thus, Euler and Gibbs are mathematically parallel. In Hu, et al [3] the correspondence is laid out in equations (4) – (11).

III. Discussion

One thing to examine is to understand why the three equations in the Abstract corespond. It is like the principal of corresponding states [4], of which the van der Waals equation of state [5] page 168 is a prime example.

Hu, et al [3] notes that, by October 2011, for DNA Polyhedra there is: cube, tetrahedron, octahedron, dodecahedron, icosahedrons and buckyball. What I have outlined in the Abstract is the simple case. Euler noted there is another formula for non-convex polyhedra, but that is out of the scope of this article.

IV. Conclusion

The author should mention an article that is included in his efforts in physical chemistry [6], which is the theory for the Bubble Nucleation in Polymer Solutions data. The author has an interest in mathematics and is fascinated by Eulers formula applying to convex polyhedra.

V. Acknowledgments

The Second Coming will save all the living on earth. Paula Campbell is a faithful friend of mine since January 1987.

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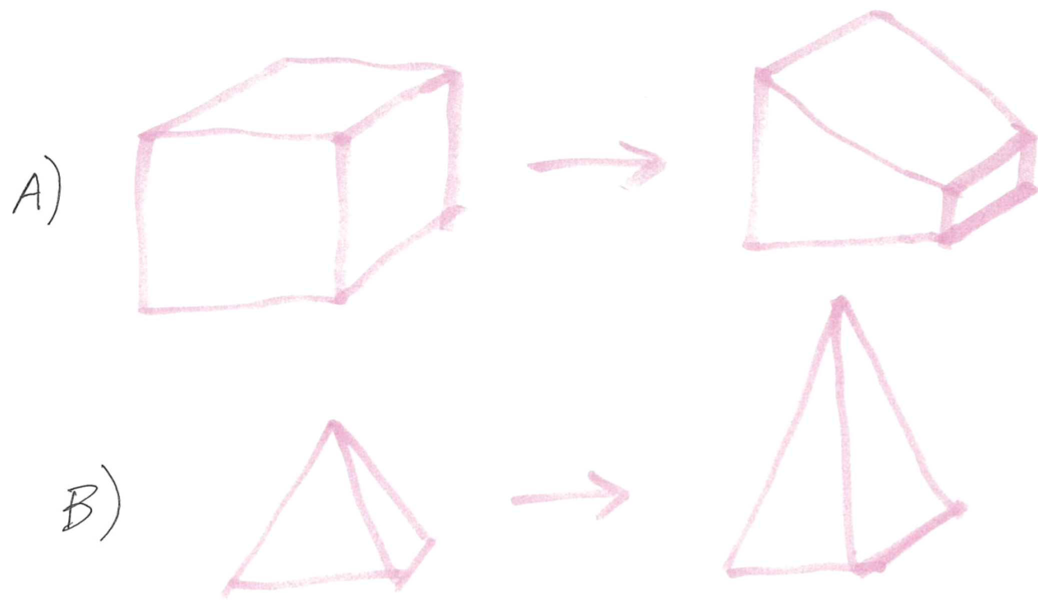

Fig. 1 A) V, E and F are invariant by deformation of cube
B) same as A) for equilateral pyramid
Meaning: V (vertices) are likened to F (degrees of freedom). Thus, V in Euler corresponds to F in Gibbs.
Vertices have some movement in (x, y, z) space.