

Zeroth law of thermodynamics is an implication and not an equivalency

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See: en.wikipedia.org/wiki/Zeroth_law_of_thermodynamics#cite_note-Buchdahl-7

Assuming the apparatus and method of Meth8/VL4, let p q r: A B C.

[T]hermal equilibrium as a transitive relationship is:

If p is in thermal equilibrium with q, and if q is in thermal equilibrium with r,
then p is in thermal equilibrium with r. (3.1.1)

$$((p=q) \& (q=r)) \supset (p=r) ; \quad \text{TTTT TTTT TTTT TTTT} \quad (3.1.2)$$

Eq. 3.1.2 is tautologous. This means the zeroth law of thermodynamics as an implication is confirmed.

A reflexive, transitive relationship does not guarantee an equivalence relationship. (3.2.1)

$$((p=q) \& (q=r)) = (p=r) ; \quad \text{TTFT TFTT TTFT TTFT} \quad (3.2.2)$$

Eq. 3.2.2 is *not* tautologous. This means the zeroth law of thermodynamics is not an equivalency.

However, equivalence in Eq. 3.2.2 is supposed to be forced into tautology with both reflexivity and symmetry as follows.

Reflexivity is defined as:

If r is in thermal equilibrium with p and q,
then p and q are in thermal equilibrium with one another. (1.1)

$$(r=(p \& q)) \supset (p=q) ; \quad \text{TFFT TTTT TFFT TTTT} \quad (1.2)$$

Symmetry is defined as:

If p is in thermal equilibrium with q, then q is in thermal equilibrium with p. (2.1)

$$(p=q) \supset (q=p) ; \quad \text{TTTT TTTT TTTT TTTT} \quad (2.2)$$

In order for Eq. 3.2.2 to be tautologous, both Eqs. 1.2 and 2.2 must imply Eq. 3.2.2.

$$(((r=(p \& q)) \supset (p=q)) \& ((p=q) \supset (q=p))) \supset (((p=q) \& (q=r)) = (p=r)) ; \quad \text{TTTT TTFT TTTT TTFT} \quad (4.2)$$

Eq. 4.2 is *not* tautologous. This means that reflexivity and symmetry cannot force the zeroth law of thermodynamics into an equivalency.

Because the zeroth law of thermodynamics is an implication, which cannot be coerced into equivalency, subsequent laws of thermodynamics as based on the zeroth law become implications and not equivalencies. This serves to weaken assertions based on the laws of thermodynamics as equivalencies as reduced to implications.