

# The Theoretical Minimum

## Classical Mechanics - Solutions

L01E01

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M. Bivert

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**Exercise 1.** *Since the notion is so important to theoretical physics, think about what a closed system is, and speculate on whether closed systems can actually exist. What assumptions are implicit in establishing a closed system? What is an open system?*

The book defines a closed system as "a collection of objects [...] that is either the entire universe (1) or is so isolated from everything else that it behaves as if nothing else exists (2)". From everyday experience, we *know* there's a lot going on we're not aware of. Thus, we know we can't even hope to *truly* consider the entire universe, but in an abstract sense, at best.

Furthermore, to establish with absolute certainty (2), it is necessary to have a full understanding of everything that exists. For, even were we to build a system isolated from everything we know that could affect it, by the previous assumption, there may be some elements, unknown to us, affecting the system in various ways.

Hence, as for a lot of things in physics, a closed system is but a conceptual tool, a (very) convenient approximation of some aspects of what we think we experience of reality.

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To establish our closed system, we must generally assume that it is closed *relatively* to what we are trying to measure/observe. That is, there will be no external factors noticeably/unexpectedly affecting the result of a given observation/consideration.

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As we can only define a closed system as an approximation, we won't bother trying to define an *open system* in absolute terms either. A *opened system*, is by contrast with a closed system, a collection of objects that isn't neither the entire Universe, nor so isolated from everything else that it behaves as if nothing else exists. More simply, it's a collection of objects affected by its environment.