Inventory of Basic Conceptions in Mechanics

Taxonomy Themes	*Test Item**
1. Law of Inertia (Newton's 1st law)	
The state of inertia of physical bodies is characterized with a constant velocity (that is not necessarily zero) in Galilean reference systems.	(10, 11, 20, 25,
No external cause, and more specifically no interaction, is needed to maintain such a state.	31)
2. Interaction and Force	
No physical body can act on itself. An interaction takes place between at least two bodies, an « agent » (acting body) and an « object » (body acted upon) whose kinematical and/or dynamical state is being investigated.	25
The concept of force represents agent-object interaction. A force of particular characteristics is associated with a particular kind of interaction. These characteristics are not affected by the kinematical state of the object (current or past), or by the object interaction with other agents. In particular, motion does not imply force (impetus), and the force exerted by a given agent on an object does not build up or get used up because of the motion of the object.	2, 11, 14, (31)
The force acting on an object lasts as long as the interaction with the respective agent is taking place. It vanishes at the instant the interaction is brought to an end. The same goes for the force effect on the object.	(2, 19, 25, 33)
3. Law of Interaction (Newton's 3rd law)	
Agent and object exert simultaneous forces on one another. The two exchanged forces are equal and opposite, irrespective of the physical or kinematical properties of either body.	22 23, 24
4. Law of Cause and Effect (Newton's 2nd law)	
An object must interact with at least one agent in order to change its state of inertia, and more specifically to change the direction or the magnitude of its velocity.	(26, 27, 32)
The concept of acceleration represents the effect of interaction between agent and object. Acceleration and not velocity of object is proportional to the exerted force and inversely proportional to the object mass, and this irrespective of the nature of interaction.	28, 29, 30, 32
5. Law of Composition (Newton's 4th law) / Superposition Principle	
Many forces can be composed only if exerted simultaneously on the same object.	19
Simultaneous interaction of a given object with many agents is identical in cause and effect: (a) to the absence of any interaction when the sum of all forces acting on the object is zero, or, otherwise, (b) to its interaction with a single agent that exerts on it a force equal to the vectorial sum of all forces exerted by the original agents.	20, 21, 31 17, (32)
The kinematical state of the object may be determined by the superposition of motions that it would have undergone, during the same period, under each dynamical state separately.	12, 16, (18, 26)
6. State Laws	
The kinematical state of a given object, from a particular moment onward, depends on the velocity of the object at this moment and its interaction with all influential agents. This state is independent of prior motion of either object or agents.	9, 10
Under the action of a constant force, an object maintains a uniformly accelerated motion following: (a) a linear trajectory when its initial velocity (at the time the force starts acting) is either zero or pointing in the (same or opposite) direction of the force, or (b) a parabolic trajectory when this is not the case with the velocity.	15, 27, 33 18, (12), 13, 26
The velocity of a uniformly accelerating object changes in proportion to the duration of motion and not to the distance traveled. For a given acceleration, duration of motion and velocity change are independent of the object mass. When the object slows down until a point where it turns around in the opposite direction, the object does not stop at this point; motion in both directions is symmetric and it takes place all along with the same acceleration.	1 5,6 3 4
Whatever their motion in a given reference system, two objects that occupy the same position at a given time do not have necessarily the same speed at this time. However, two objects may have the same acceleration when they move with different velocities.	7 8

* *Items between parentheses are shared with another theme to which they are more crucial.*

