

Inventory of Basic Conceptions in Physics (IBC-P04)

<i>Mechanics Taxonomy (Items 1-15)</i>	<i>Test Items*</i>
<p>1. <i>Law of Inertia (Newton's 1st law)</i> The state of inertia of physical bodies is characterized with a constant velocity (that is not necessarily zero) in Galilean reference systems. No external cause, and more specifically no interaction, is needed to maintain such a state.</p>	(3, 4, 5), 10
<p>2. <i>Interaction and Force</i> No physical body can act on itself. No force (impetus) can develop as a consequence of motion. An interaction takes place between at least two bodies, an « agent » (acting body) and an « object » (body acted upon). A force of particular characteristics is associated with a particular kind of interaction.</p>	5, 8, (10)
<p>3. <i>Law of Interaction (Newton's 3rd law)</i> 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.</p>	14, 15
<p>4. <i>Law of Cause and Effect (Newton's 2nd law)</i> A constant force exerted on an object of a given mass causes the object to move with constant acceleration. Acceleration and not velocity (or displacement time) of object is proportional to the exerted force and inversely proportional to the object mass.</p>	11, 12, 13
<p>5. <i>State Laws</i> 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. 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. The velocity of a uniformly accelerating object changes in proportion to the duration of motion and not to the distance traveled. 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 takes place all along with the same acceleration. Whatever their motion in a given reference system, equal values of a particular kinematical concept do not necessarily imply equal values of all other concepts. For example, two objects that occupy the same position at a given time do not necessarily have the same speed at this time.</p>	1, 2 3, 4 6 7, 9

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

<i>DC Circuits Taxonomy (Items 16-30)</i>	<i>Test Items</i>
<p><i>1. Interaction and Electric Potential Difference</i></p> <p>A generator does not interact with an electrical load unless the two constitute, or are part of, a closed circuit.</p> <p>In a steady state, the role of a DC battery is to maintain a constant epd U between its ends, not a constant potential V.</p>	<p>16</p> <p>22</p>
<p><i>2. Causal Law: Ohm's law</i></p> <p>A constant epd U, and not a constant potential V, between two points of a closed circuit causes the flow of a constant electric current I between these two points. The current I is proportional to the epd U and inversely proportional to the resistance R of any load connected between these two points.</p>	<p>18, 19</p>
<p><i>3. Composition / Conservation Laws (for simple series and parallel circuits)</i></p> <p>Kirchhoff's loop rule (Conservation of Energy): The algebraic sum of epds across all elements of a circuit loop is zero.</p> <p>Kirchhoff's node rule (Conservation of Charge): The algebraic sum of all currents at a given node (or junction) in a circuit is zero</p>	<p>27</p> <p>28</p>
<p><i>4. State Laws</i></p> <p>The resistance of a conducting wire depends of the material it is made of, its length and its cross-sectional area.</p> <p>A number of electrical loads are said to be connected in series with a generator when the epd across all loads, which may not be necessarily the same across each, add up to the epd between the generator terminals. In a steady state, the same electric current flows in all loads in series, and this irrespective of the apparent topology or order of the loads in the circuit. However, the bigger the number of electrical loads in the circuit, the smaller the current.</p> <p>A number of loads are said to be connected in parallel with a generator when the same epd, equal to the epd between the generator terminals, exists between the ends of each load. In a steady state, the same epd, but not necessarily the same current, is maintained between the ends of all loads in parallel, and this irrespective of the apparent topology, number or order of the loads in the circuit.</p> <p>If one of the loads breaks down and results in an open circuit, all other loads in series with it will be shut off, whereas those in parallel stay operational.</p>	<p>17</p> <p>20, 23, 25</p> <p>21, 24, 26</p> <p>29, 30</p>

<i>Light and Sound (Items 31-41)</i>	<i>Test Items</i>
<p><i>1. Image Formation</i></p> <p>The image of an object formed by reflection on a flat mirror is symmetric to the object with respect to the mirror.</p> <p>The position of the image of an object formed by refraction across two media depends on the composition and topology of the two media.</p> <p>An observer may detect the image of an object given by an optical system only when the observer is located in the appropriate field of vision.</p>	<p>31</p> <p>32, 33, 35</p> <p>34</p>
<p><i>2. Comparative State Laws for Light and Sound Propagation</i></p> <p>Light can travel in vacuum whereas sound requires physical media for propagation.</p> <p>The speed of light and sound depends on the medium of propagation and not on the source of either type of wave. More specifically, the wavelength and not the frequency of either wave is affected by the physical nature of the medium.</p> <p>Light travels faster than sound, irrespective of the medium of propagation. However, the denser the medium the slower light travels but the faster sound does.</p>	<p>39, 40</p> <p>36, 37</p> <p>38, 41</p>

<i>Matter Conservation and Archimedes Principle (Items 42-46)</i>	
<p><i>1. Matter Conservation</i></p> <p>Mass and volume of a liquid are conserved when a given quantity of the liquid is poured from one container into another under the same environmental conditions.</p> <p>The height that the liquid reaches in a given container of regular shape is inversely proportional to the cross sectional area of the container.</p>	<p>42, 43,</p> <p>44</p>
<p><i>2. Archimedes Principle</i></p> <p>A solid may float, remain at equilibrium or sink in a given fluid depending on whether the density of the solid is respectively smaller, equal or greater than the density of the fluid.</p>	<p>45, 46</p>