Tennessee Science

Physics I

Motion and Stability: Forces and Interactions PHYS1.PS2

1. Investigate and evaluate the graphical and mathematical relationship (using either manual graphing or computers) of one-dimensional kinematic parameters (distance, displacement, speed, velocity, acceleration) with respect to an object's position, direction of motion, and time. PHYS1.PS2.1
2. Algebraically solve problems involving constant velocity and constant acceleration in one dimension. PHYS1.PS2.2
3. Algebraically solve problems involving arc length, angular velocity, and angular acceleration. Relate quantities to tangential magnitudes of translational motion. PHYS1.PS2.3
4. Use free-body diagrams to illustrate the contact and non-contact forces acting on an object. Use the diagrams in combination with graphical or component-based vector analysis and with Newton's first and second laws to predict the position of the object on which the forces act in a constant net force scenario. PHYS1.PS2.4
5. Gather evidence to defend the claim of Newton's first law of motion by explaining the effect that balanced forces have upon objects that are stationary or are moving at constant velocity. PHYS1.PS2.5
6. Using experimental evidence and investigations, determine that Newton's second law of motion defines force as a change in momentum, F = Δp/Δt. PHYS1.PS2.6
7. Plan, conduct, and analyze the results of a controlled investigation to explore the validity of Newton's second law of motion in a system subject to a net unbalanced force, Fnet = ma or Fnet = Δp/Δt. PHYS1.PS2.7
8. Use examples of forces between pairs of objects involving gravitation, electrostatic, friction, and normal forces to explain Newton's third law. PHYS1.PS2.8
9. Use Newton's law of universal gravitation, $F = G m1m2 r 2$, to calculate the gravitational forces, mass, or distance separating two objects with mass, given the information about the other quantities. PHYS1.PS2.9
10. Develop and apply the impulse-momentum theorem along with scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on an object during a collision (e.g., helmet, seatbelt, parachute). PHYS1.PS2.10

11 **Use experimental evidence to demonstrate that air resistance is a velocity dependent drag force that leads to terminal velocity.** PHYS1.PS2.11

12 **Develop a model to predict the range of a two-dimensional projectile based upon its starting height, initial velocity, and angle at which it was launched.** PHYS1.PS2.12

13 **Plan and conduct an investigation to provide evidence that a constant force perpendicular to an object's motion is required for uniform circular motion (F = m v2 / r).** PHYS1.PS2.13

Energy PHYS1.PS3

1 **Investigate conduction, convection, and radiation as a mechanism for the transfer of thermal energy.** PHYS1.PS3.1

2 **Use the principle of energy conservation and mathematical representations to quantify the change in energy of one component of a system when the energy that flows in and out of the system and the change in energy of the other components is known.** PHYS1.PS3.2

3 **Assess the validity of the law of conservation of linear momentum (p=mv) by planning and constructing a controlled scientific investigation involving two objects moving in one-dimension.** PHYS1.PS3.3

4 **Construct an argument based on qualitative and quantitative evidence that relates the change in temperature of a substance to its mass and heat energy added or removed from a system.** PHYS1.PS3.4

5 **Define power and solve problems involving the rate of energy production or consumption (P = ΔE/Δt). Explain and predict changes in power consumption based on changes in energy demand or elapsed time. Investigate power consumption and power production systems in common use.** PHYS1.PS3.5

6 **Recognize and communicate information about energy efficiency and/or inefficiency of machines used in everyday life.** PHYS1.PS3.6

7 **Compare and contrast the process, design, and performance of numerous next-generation energy sources (hydropower, wind power, solar power, geothermal power, biomass power, etc.).** PHYS1.PS3.7