Chapter Assessment

Physics You Learned

This section is a useful resource that helps students to revise and recall prior learning. Important concepts that students investigated in *Physics in Action* are briefly summarized and related equations are listed across the summary. Students could use the *Physics You Learned* table throughout their reading of the chapter for a quick reference to an essential concept that they investigated earlier in a previous section.

To help students review all the equations and concepts, once they have reached the end of the chapter, consider posting a visual display of important equations on the walls of your classroom. Divide students into groups and ask them to take turns to make up a list of five questions relating to the concepts they have learned and have each team member answer those questions. This strategy is useful in having students evaluate their knowledge of the physics concepts they have learned in the chapter. A key function of this section is that it gives students an opportunity to review for their *Physics Practice Test*.

Physics You Learned

Physics Concepts	Is There an Equation?
When an object is moving, it will continue to move at constant speed in a straight line unless there is an unbalanced force to change its motion. If the object is at rest, it stays at rest unless there is an unbalanced force. This is known as **Newton's first law.**	
The tendency of an object to resist changing its motion is called **inertia.** Inertia is measured in the same units as mass.	
A **frame of reference** is the specific point of view from which a particular measurement is made. Different frames of reference yield different measurements.	
The acceleration is defined as the change in velocity with respect to time.	$a = \frac{\Delta v}{\Delta t}$
A **force** is measured in the SI unit newtons.	
The acceleration of an object (a)is directly proportional to the net force applied (F_{net}), and inversely proportional to the object's mass (m). This is known as **Newton's second law.**	$a = \frac{F_{net}}{m}$
The weight (F_g)of an object is equal to an object's mass (m)multiplied by the strength of Earth's gravitational field (g). Weight is the force of Earth's gravity acting on an object.	$F_g = mg$
Using significant figures ensures that any calculations made do not indicate a level of precision greater than the measurements.	
Active Physics Plus The net force (F_{net})on an object in equilibrium is zero. When an object is in equilibrium (either at rest or traveling with constant velocity) the vector sum of all the forces acting on the object equals zero.	$F_{net} = 0$
Active Physics Plus When forces act at right angles on the same body, the net force is determined by using the **Pythagorean theorem.**	$F_{net} = \sqrt{(F_1^2 + F_2^2)}$
The shape of a projectile's path is a **parabola** if there is no air resistance.	
Active Physics Plus The vertical velocity and the horizontal velocity of an object are independent of one another, and can be used separately to determine aspects of a projectile's flight. The total velocity can be calculated from the horizontal and vertical components using the Pythagorean theorem.	$v = \sqrt{(v_y^2 + v_x^2)}$
The horizontal distance traveled by a projectile (d_{horiz}) equals the projectile's horizontal speed (v_{horiz}) multiplied by the time of flight. The vertical distance covered by a projectile (d_{vert}) depends upon the acceleration due to gravity (a_g) and the time the object is in flight (t) squared. The horizontal and vertical motions of a projectile are independent of each other.	$d_{horiz} = (v_{horiz})t$ $d_{vert} = \frac{1}{2} a_g t^2$

CHAPTER 2

	The maximum range of a projectile returning to the same height as the launch point occurs when it is launched at 45° degrees to the horizontal.	
Active Physics Plus	When an object is projected at an angle to the horizontal, the motion may be analyzed after the velocity is broken into vertical and horizontal components.	
	Forces come in pairs. Whenever a force is exerted on a mass *b* $(F_{a \text{ on } b})$, the mass *b* exerts an equal force in the opposite direction on the mass *a* $(-F_{b \text{ on } a})$. This is known as **Newton's third law.**	$(F_{a \text{ on } b} = -F_{b \text{ on } a})$
	The normal force is a force that acts perpendicular to a surface.	
	A **free-body diagram** is a sketch of all the forces acting on an object.	
	The force of friction (F_f) equals the coefficient of friction (μ) multiplied by the normal force (F_N). Friction is a force acting between two bodies in contact that resists the relative motion of those bodies. It always acts parallel to the surfaces in contact.	$F_f = \mu F_N$
	The coefficient of friction (μ) is a dimensionless constant.	
Active Physics Plus	The coefficient of static friction (μ_s) on an inclined plane equals the tangent of the angle the plane makes with the horizontal $(\tan\theta)$.	$\mu_s = \tan\theta$
	An object's **kinetic energy** (KE) is proportional to the object's mass (m) multiplied by its velocity squared (v^2). Kinetic energy is an object's energy of motion.	$KE = \frac{1}{2}mv^2$
	Gravitational potential energy (GPE) is proportional to an object's mass (m) multiplied by its vertical height above Earth (Δh) and the acceleration due to gravity (g). Gravitational potential energy is energy due to an object's vertical position above Earth's surface.	$GPE = mg\Delta h$
	Elastic potential energy (EPE) is proportional to the spring constant of the material (k) multiplied by the material's change in length (x) squared. Elastic potential energy is energy stored in a material due to its compression or stretch.	$EPE = \frac{1}{2}kx^2$
Active Physics Plus	Work (W) done on an object can increase its kinetic energy (ΔKE). When work is done on an object moving on a horizontal surface, the kinetic energy of the object increases.	$W = \Delta KE$ $= \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right)$
	Work (W) is the product of the force exerted on an object (F), and the displacement in the direction of the force (d). Work done on an object increases its energy and may change an object's kinetic or potential energy.	$W = Fd$
	The **law of conservation of energy** states that energy may change its forms, but not its amount. The total amount of energy remains the same during any changes in form.	$Energy_{before} = Energy_{after}$