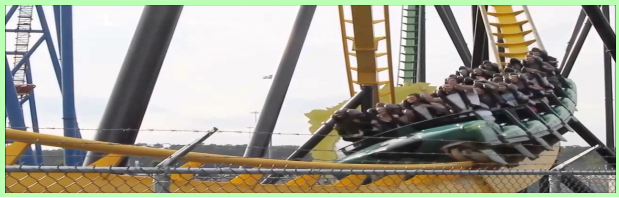
Work Done By Nonconservative Forces

Learning Target	Description
10.3	I can analyze and solve problems involving the Law of Conservation of Energy and the work done by nonconservative forces.



ADVANCED PLACEMENT PHYSICS 1 EQUATIONS

$$\Delta U_g = mg\Delta y$$

$$U_s = \frac{1}{2}kx^2$$

k = spring constant
m = mass
U = potential energy
x = position
y = height

Working Relationships

$W_{total} = W_c + W_{nc}$

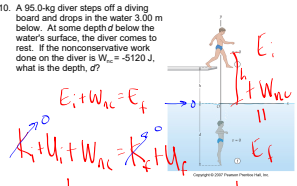
$W_{total} - W_c = W_{nc}$

$W_{total} = \Delta K$ $\quad$ $W_c = -\Delta U$

$\Delta K + \Delta U = W_{nc} = \Delta E$

Work Done by Nonconservative Forces

10. A 95.0-kg diver steps off a diving board and drops in the water 3.00 m below. At some depth d below the water's surface, the diver comes to rest. If the nonconservative work done on the diver is W_{nc} = -5120 J, what is the depth, d?



$E_i + W_{nc} = E_f$

$K_i + U_i + W_{nc} = K_f + U_f$

$mgh_i + W_{nc} = mgh_f$

$mgh + W_{nc} = mg(-d)$

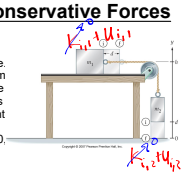
$-mg \qquad +mg$

$\frac{(95)(9.8)(3) + -5120\,J}{-(95)(9.8)} = d$

$d = 2.50\,m$

Work Done by Nonconservative Forces

11. A block of mass m_1 = 2.40 kg is connected to a second block of mass m_2 = 1.80 kg, as shown here. When the blocks are released from rest, they move through a distance d = 0.500 m, at which point m_2 hits the floor. Given that the coefficient of kinetic friction between m_1 and the horizontal surface is μ_k = 0.450, find the speed of the block just before m_2 lands.



$E_i + W_{nc} = E_f$

$K_{1,i} + U_{i,2} + W_{f,1} = K_{1,f} + U_{nc} + K_{2,f}$

$m_2gd + fd\cos 180 = \frac{1}{2}m_1v_f^2 + \frac{1}{2}m_2v_f^2$

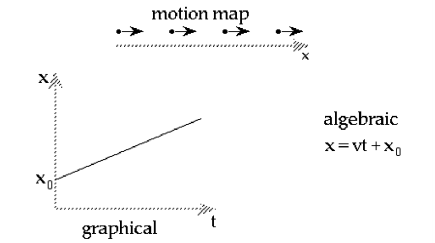
$m_2gd - \mu m_1gd = v_f^2\left(\frac{1}{2}m_1 + \frac{1}{2}m_2\right)$

$v_f = 1.30\,m/s$

Modeling a Solution

1. Draw a diagram (labeled)
2. Create a graph
3. Mathematically solve
4. Write a solution statement(s)

Multiple Representations
a particle moving at constant velocity



with explicit statements describing relationships

MODEL A SOLUTION

12. A 1.50-kg block is at rest on a ramp of height *h*. When the block is released, it slides without friction to the bottom of the ramp, and then continues across a surface that is frictionless except for a rough patch of width 10.0 cm that has a coefficient of kinetic friction μ_k = 0.640. Find *h* such that the block's speed after crossing the rough patch is 3.50 m/s.

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