

Warm-up:

The Thrill of Conservation!

Roller coasters are an excellent example of the conservation of energy. Work is done to raise the cars to the top of the first hill and then gravity transforms the energy back and forth between potential and kinetic for the rest of the ride.

Cedar Point Amusement Park in Sandusky, Ohio is the self-proclaimed roller coaster capital of the world. One of its 14 coasters is the Magnum XL-200. It stands out above the horizon with an incredible drop of 59.3 meters on the first hill! Disregarding any loss of energy to friction, calculate the speed of the cars at the bottom of that first hill.

Hint: $ME = mgh + \frac{1}{2}mv^2$

$$PE_{\max} = KE_{\max}$$

$$mgh = \frac{1}{2}mv^2$$

$$2 \cdot 9.8 \frac{m}{s^2} \cdot 59.3 m = \frac{1}{2} \cdot v^2 \cdot 2$$

$$\sqrt{\frac{1162.28 m^2}{s^2}} = v$$

$$v = 34.1 m/s$$

Fast!

Slight Review:

- Aristotle: different masses fall at different rates
- Galileo: objects fall at $9.8 m/s^2$
- Newton: free fall due to gravity
- Einstein: tied mass & forces to Energy

$$\begin{array}{l} \rightarrow E = mc^2 \\ \text{Energy} \quad \text{mass} \quad \text{speed of light} \end{array} \quad [3.0 \cdot 10^8 m/s]$$

- Laws of Conservation: mass/energy cannot be created/destroyed only converted to other forms

- Work-Energy theorem: work is equal to the change in energy of a system

$$\rightarrow W = \Delta E$$