Review Comments

Our train problem gave us practice working out a mathematical solution to a one-dimensional problem. It was more difficult than most problems, because we did not know if it had a final answer. We first had to see if the trains collided. (They did.)

Once we did this, then we could tell how long it took (20 m/s) and how far away it occurred (400 m) from the starting point.

Train, train, go away.
Come again another

High School Physics

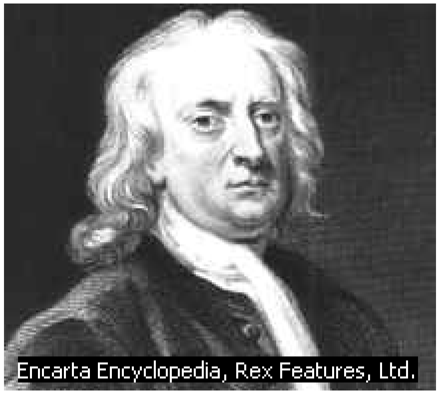
Sponsored by Newton's Laws

Study Hard:
The Mind Is a Terrible Thing to Waste

All photos are from Microsoft Clip Art and Microsoft Encarta.

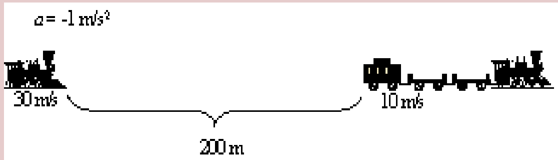
Physics Is Our Business

The Great Train Crash



Isaac Newton's work represents one of the greatest contributions to science ever made by an individual. Most notably, Newton derived the law of universal gravitation, invented the branch of mathematics called calculus, and performed experiments investigating the nature of light and color.

Avoiding Disaster



Two Trains on the Same Track

The engineer of a passenger train traveling at 30 m/s sights a freight train whose caboose is 200 m ahead on the same track. The freight train is traveling in the same direction as the passenger train with a velocity of 10 m/s. The engineer of the passenger train immediately applies the brakes, causing a constant acceleration of -1 m/s^2, while the freight train continues with constant speed. If there is a collision, where and when will it take place?

Equations

The basic equation we used was:

$$x = v_0 t + \tfrac{1}{2} a t^2$$

We chose the passenger train as our reference point because the engineer is the one that applied the brakes. The equation describing the motion of the freight train was:

$$x = (30\tfrac{m}{s})t + \tfrac{1}{2}(-1\tfrac{m}{s^2})t^2$$

The freight train moved at a constant velocity, but it was 200 meters away from the engineer. The equation describing its motion was:

$$x - 200m = (10\tfrac{m}{s})t + \tfrac{1}{2}(0\tfrac{m}{s^2})t^2$$

Because both of these motions were happening simultaneously in the same direction, they were set equal to each other to see if they could be solved.

$$x = (30\tfrac{m}{s})t + (-0.5\tfrac{m}{s^2})t^2 = (10\tfrac{m}{s})t + 200m$$

Rearranging and putting like terms together gave:

$$(0.5\tfrac{m}{s^2})t^2 - (20\tfrac{m}{s})t + 200m = 0$$

Using the quadratic equation we substituted to give:

$$t = \frac{20 \pm \sqrt{(-20)^2 - 4(0.5)(200)}}{2(0.5)}$$

Substituting into:

$$x = (10\tfrac{m}{s})(20s) + 200m$$
$$x = 400m$$

Graph of Motion