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Indoor Rockets

Inquiry Approaches - Math

Initial Inquiry

Why is it useful to build mathematical models to describe real world phenomena?

Mathematical models allow us to make predictions about events in the real world based on the information provided by the model. For example, models allow doctors to predict the concentration, and therefore effectiveness, of a drug in the body after it has been administered. Biologists use mathematical models based on exponential functions to predict the growth of populations.

If an object is thrown off the top of a building, what factors would determine how far away from the building the object will land?

The height of the building and the initial vertical velocity of the object will affect how long the object will stay in the air, and how much time it will have to travel horizontally. The horizontal velocity that the object is thrown with will affect how far the object is able to travel in this time. The shape of the object and the presence or absence of wind will also play a role.

Experimental Procedure Inquiry

What happened to the trajectory of the rocket when you changed the angle? What launch angle launches the rocket the furthest horizontal distance? The furthest vertical distance?

The trajectory changed as the angle was changed. The rocket launches the furthest horizontal distance when angled at 45 degrees. It launches the furthest vertical distance when angled at 90 degrees.

Were you able to get the rocket to land in the same spot three times in a row? What obstacles might have prevented you from doing so? How could you improve the activity procedure to get the rocket to land in the same spot?

For the rocket to land in the same spot three times, it is easiest to launch it from the same spot and the same angle. If the base or the clip shifts between launches, the rocket will land in a different spot. The same amount of force needs to be exerted on the bellow pump each time; if the same force is not exerted, then the rocket will land in a different spot. To ensure the rocket follows the same trajectory each time, the base, clip and bellow pump could be secured in place so they do not shift between launches. To control the amount of force exerted, an object could be dropped on the pump to launch the rocket, or a pump with a gauge could be used.

If you derived the time-height model, in what ways could the experimental setup be improved so that your calculated value of a is close to the theoretical value of -4.9?

The biggest challenge in deriving this model is obtaining an accurate value for the maximum height of the rocket. If you could observe the rocket flight slowly, perhaps by filming it, then the height could be measured more accurately. Additionally, because of the effect of air resistance, the rocket will not fly a perfectly parabolic path. You would need to perform the experiment in a vacuum chamber in order to derive a model that perfectly matches the theory.

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In-Depth Inquiry

Can you think of other systems that can be described using quadratics?

The stopping distance of a vehicle can be modelled using a quadratic function. Leonhard Euler, a prominent Swiss mathematician, discovered how to describe the movement of a pendulum using a simple quadratic function. In finance, quadratic functions are used to model investments.