Punk Aim Trajectory

Punk Knock Down or Cat Rack is a classic carnival game. You throw balls to knock down targets ("punks") to score. The Meltec company updated it with an air-powered cannon to shoot rubber balls instead of throwing them. Making the air cannon shoot reliably and aiming it correctly both takes a little bit of physics.

Pressure and Muzzle Velocity

Balls feed into the metal pipe from below. When you presss the button a tank full of high pressure air releases behind the ball, accelerating it out of the tube. The ball must fit tightly in the tube so the air pressure is concentrated across the the ball. Balls that are too small let air escape around them, reducing the force and creating backpressure. Balls that are too tight will just get stuck. The presurized ball accelerates quickly until it bursts from the end of the tube with a sastifying pop.

High Pressure Air From Tank

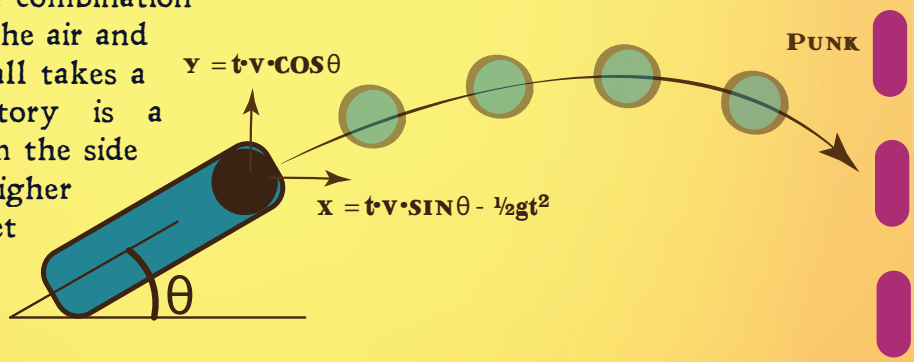
Air Tube

Ball too Small

The velocity of the ball will depend on the mass of the ball, the air pressure, the surface area of the ball, and the length of the tube.

Trajectory to the target

Once the ball flies from the tube it stops accelerating. Horizontal velocity stays about the same all the way to the target; the ball travels forward at a constant speed. Vertical velocity is a combination of the initial push up from the air and down from gravity. The ball takes a curved path. The trajectory is a parabola, watch a shot from the side to see it. You must aim higher than the center of the target in order to hit it spot on.



The Prof. Asks?

1. If you sealed the tube with a very large ball and put even more pressure on it, what might happen?
2. What happens if you aim straight up in the air?
3. How would it change your aim if the ball was twice as heavy?
4. How would it change your aim if the targets were twice as far?

Wackenhammer's Arcade & Carousel

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