Phun With Physics!

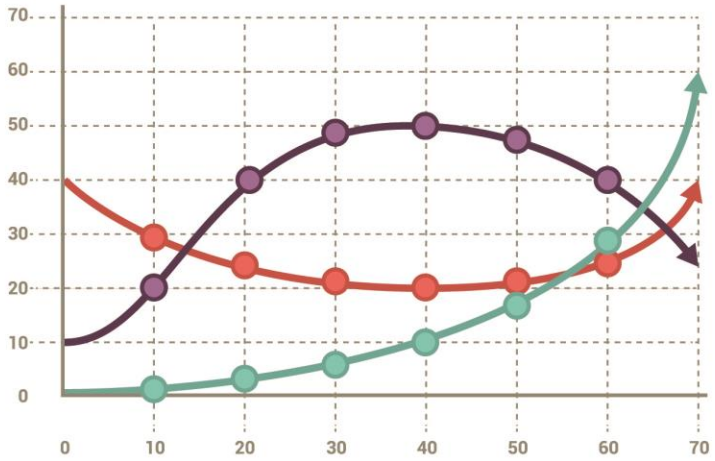
Graphing Motion with Toy Cars (EE02)

Presentation by David Warner

POSITION

VELOCITY

ACCELERATION



1. Match Graph
2. Velocity of a Toy Car
3. Constant Velocity
4. Constant Acceleration

Motion Sensor

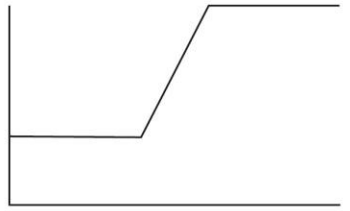
PASCO

$85

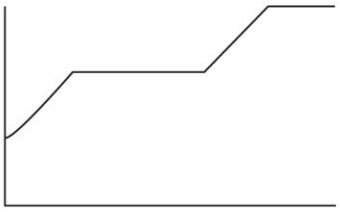
- Knowing the speed of sound (342 m/s) and measuring the time it takes for a sound wave to reflect off an object, the position can be calculated at any point in time.
- The default pulse frequency is 20 Hz, but can be increased up to 50 Hz.
- However, the maximum position is limited by the round trip time it takes for the sound wave to return before the next pulse is emitted.
- The minimum position is about 15 cm.

1 Match Graph

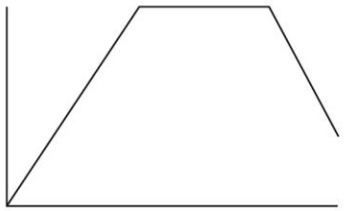
Use your body with the Motion Sensor to match the 4 Position vs Time Graphs.



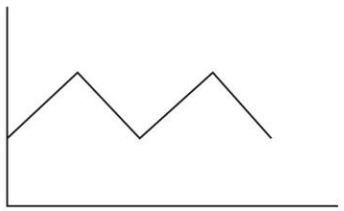
1 Score (_____)



2 Score (_____)



3 Score (_____)



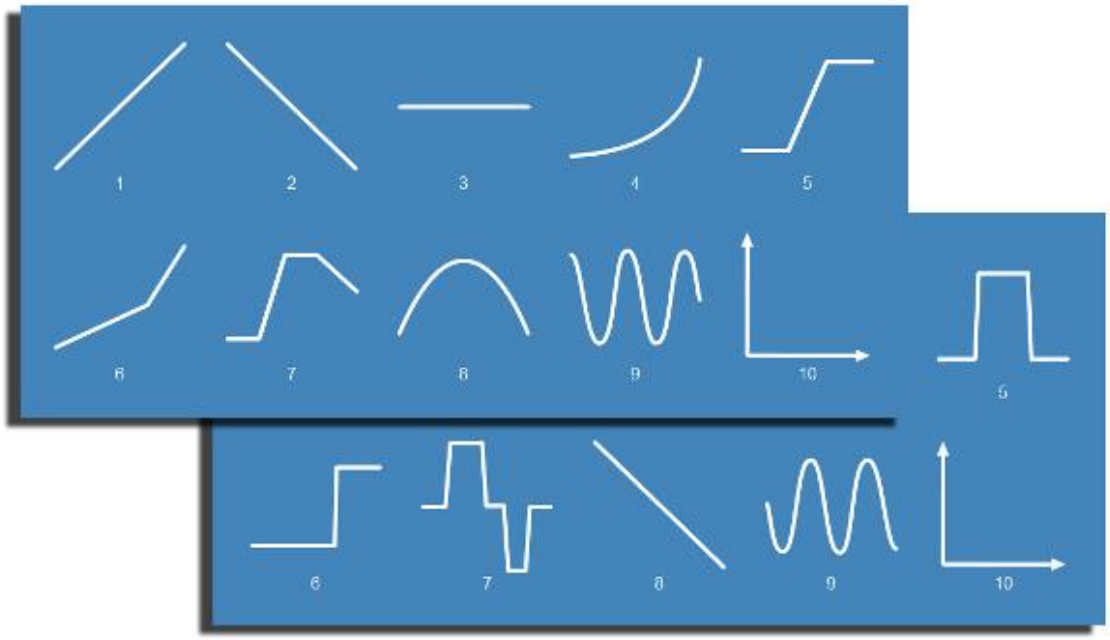
4 Score (_____)

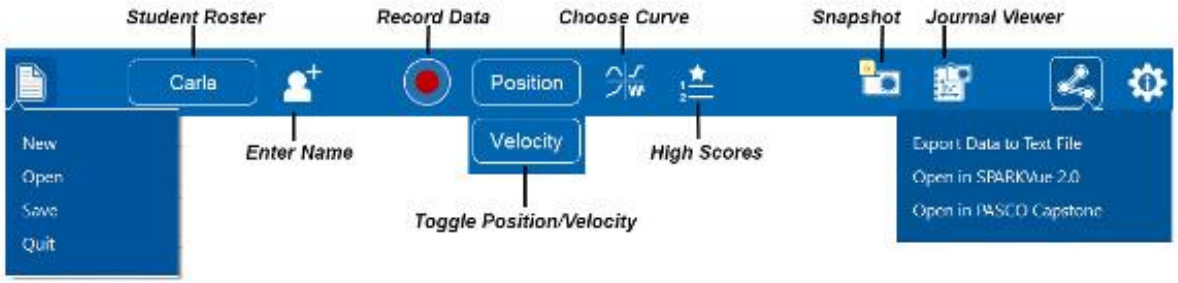
Match Graph Kit

PASCO - $145

- Software
- Motion Sensor
- Air Link

[VIDEO]





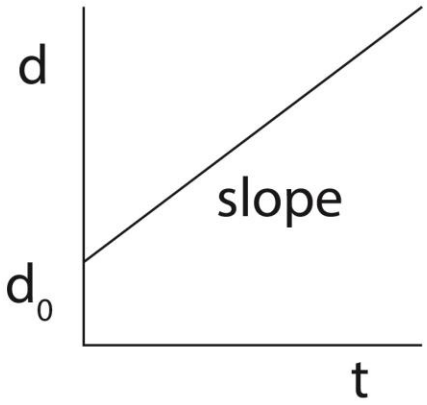
2 Velocity of a Toy Car

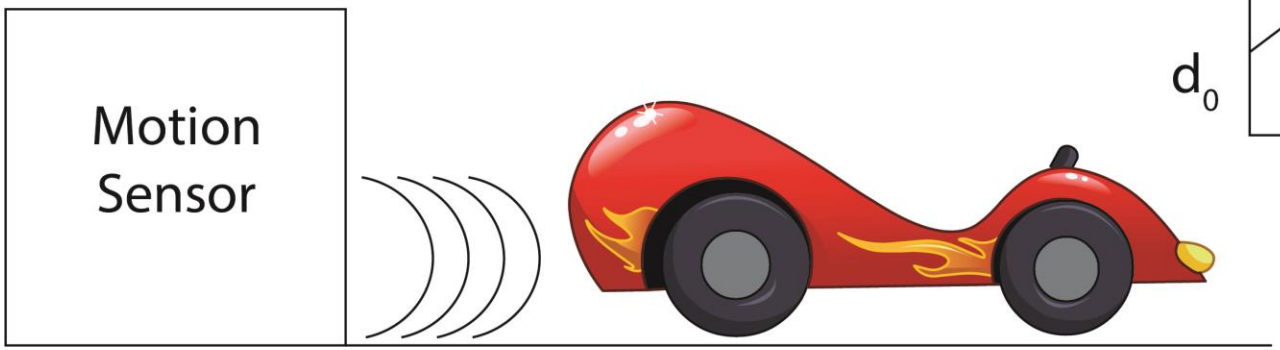
Using a toy car, create a Position vs Time Graph.
Do a linear curve fit to measure the velocity.

Slope(m)= _____m/s (velocity)

y intercept(b)=_____m (initial position)

$y=mx+b$ $d=vt+d_0$





The slope is the speed of the car!

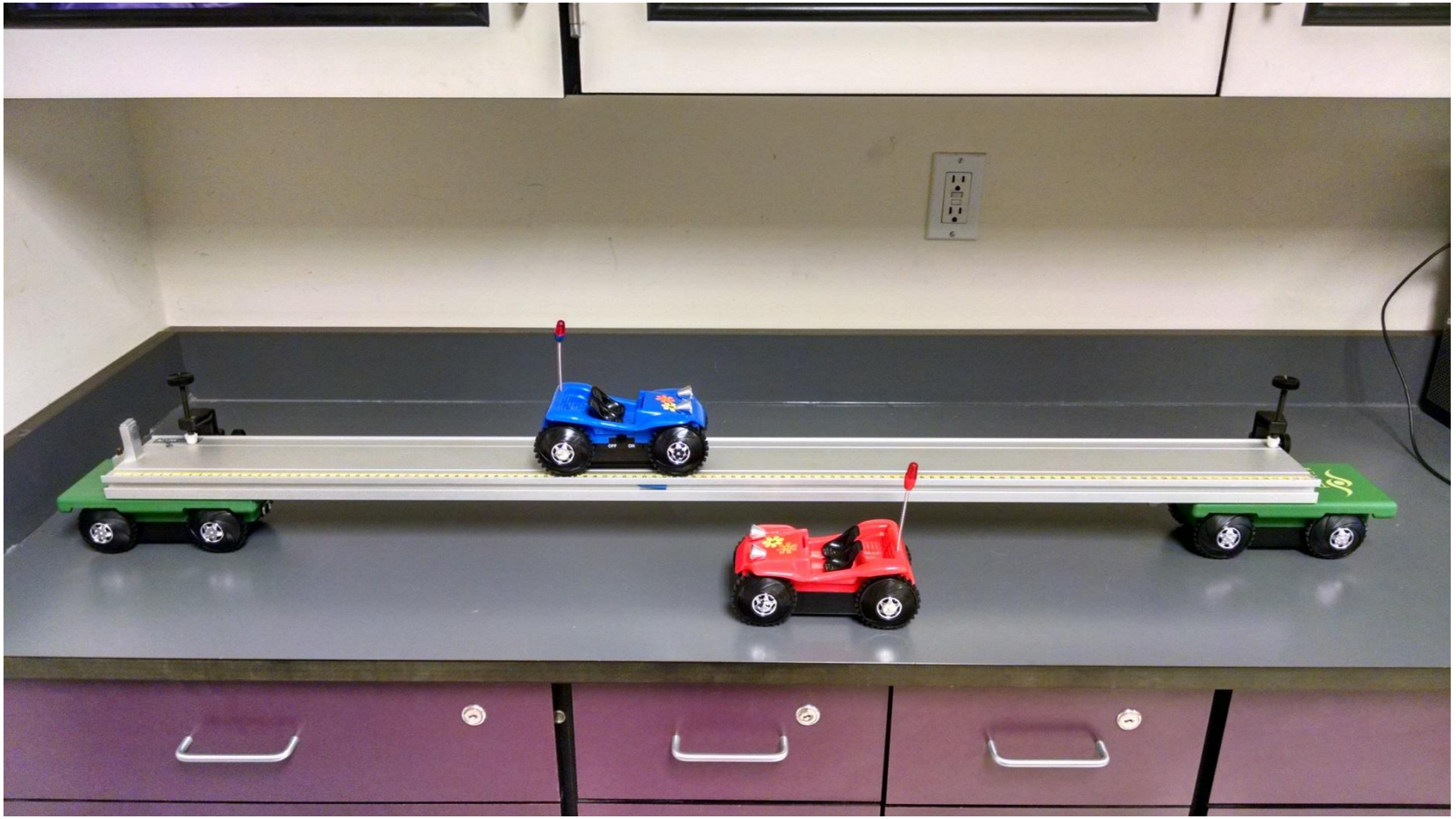
Toy Car

Arbor Scientific

$8.50

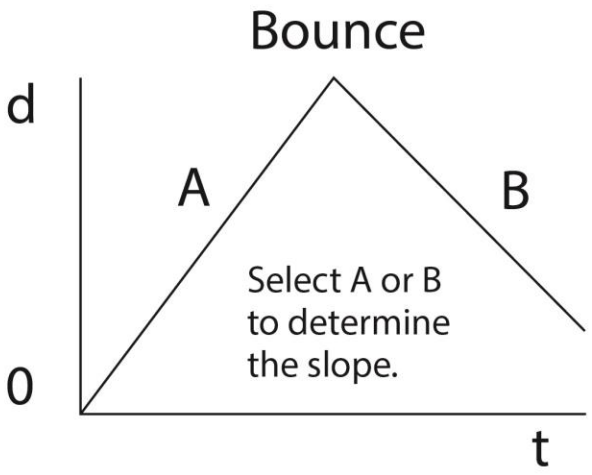
- Powered by 4-C batteries
- On-off switch at front
- All wheel drive

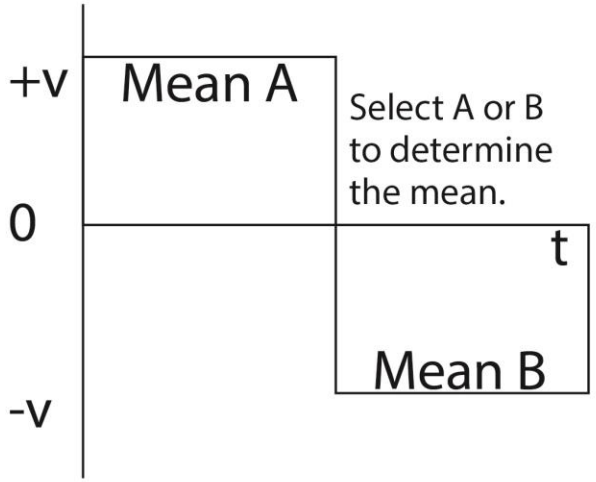
Cars can operate on a table or on a track.



3 Constant Velocity

Using a motion sensor and PASSCAR on a flat track, produce a Position vs Time and Velocity vs Time Graph as the car bounces off the end of the track.





Slope A _____m/s (positive)

Slope B _____m/s (negative)

Mean A_____m (positive)

Mean B_____m (negative)

The mean velocity should equal the slopes above.

PASCO SCIENTIFIC

1.2m Aluminum Track

$100

Pass Track

$80

PASCar

2 for $100

GOCar

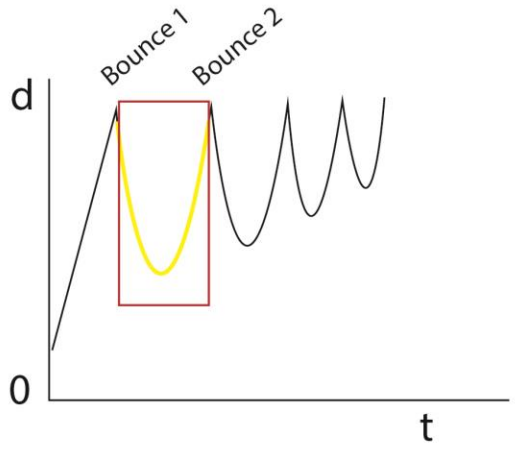
$39

No magnets

No plunger

4 Constant Acceleration

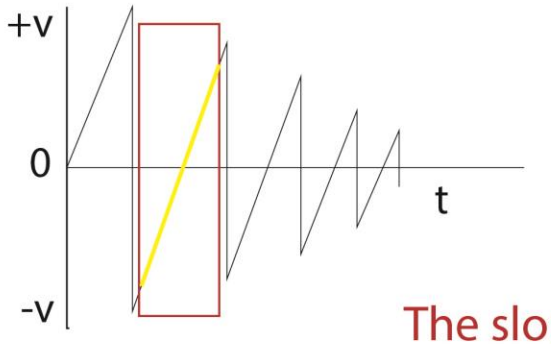
Using a motion sensor and a PASSCAR on an inclined track, produce a Position vs Time and Velocity vs Time Graph for a car bouncing on the track.



$y = Ax^2 + Bx + C$ $d = (1/2\ a)\ t^2 + v_0 t + d_0$

Select the region between Bounce 1 and Bounce 2 and do a quadratic fit on the **Position vs Time Graph.**

A=_____ m/s^2 2A=_____ m/s^2



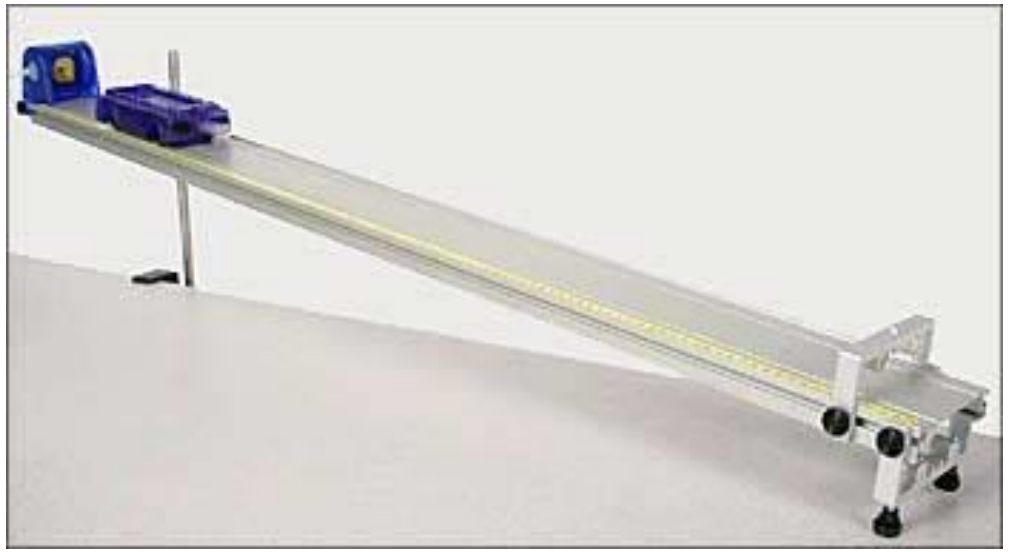
$y = mx + B$ $v = at + v_0$

Select the region between Bounce 1 and Bounce 2 and do a linear fit on the **Velocity vs Time Graph.**

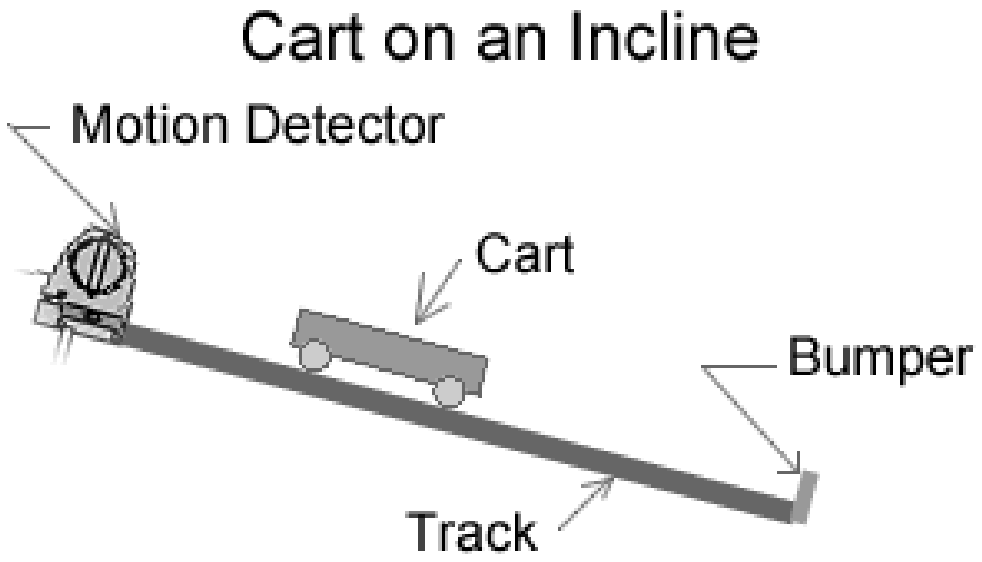
Slope=_____ m/s^2

The slope of each line is the acceleration down the track!

Incline Track
End Stop
Motion Sensor
PASCar



VIDEO



Thank you for attending !!!