Skid distance

Introduction

A friction force converts kinetic energy to heat as something slides on a road or a floor. If the friction force *f* is constant (independent of velocity), the work done by friction can be calculated as *f.D* where *D* is the skid distance.

We can write … $f.D = \frac{1}{2} mu^2$ … where *u* is the initial velocity

Demonstration

Use coins, blocks, toy cars with locked wheels etc. launch the objects by pivoting a straight-edge (metre rule) about one end.

The distance objects move when in contact with the launcher is Δy. The launch time is Δt. Δy is proportional to *x* on the horizontal axis through the pivot, and Δt is the same for all objects. It follows that the launch velocity $\Delta y/\Delta t$ is proportional to *x*.

Insert a *photograph* (*with photo analysis*) into Logger Pro. Click positions.

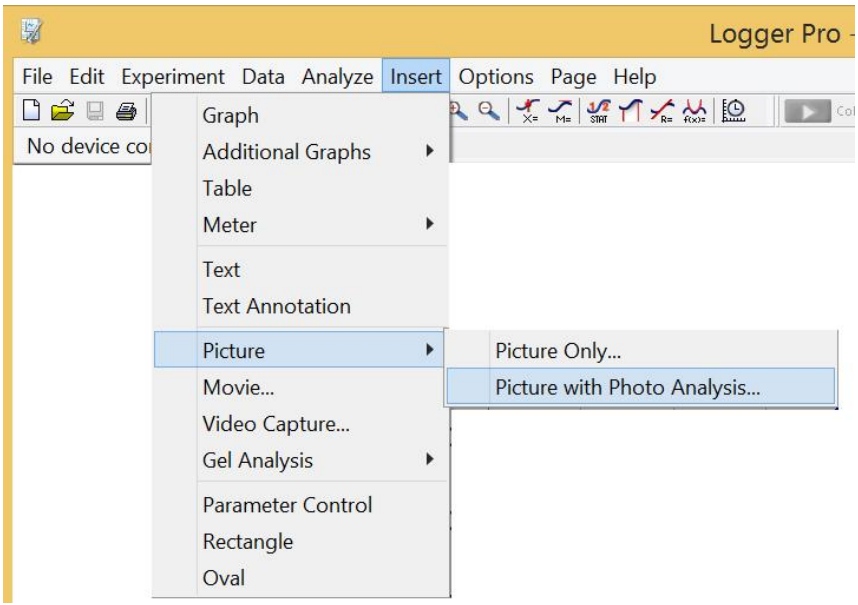


Fig 1 – inserting a picture.

The coins in figure 2 below were sliding on A3 paper. They came to rest on a curve.

Note: *some launch practice is required and a uniform surface must be found.*

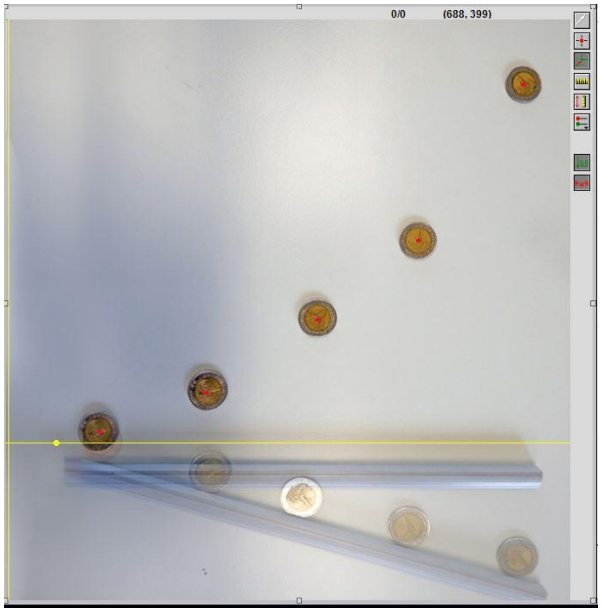
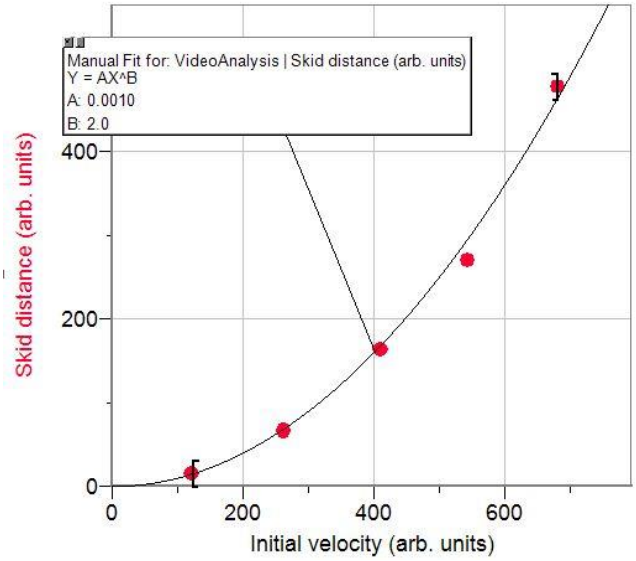


Fig 2 – a composite picture imported to Logger pro (with photo analysis).

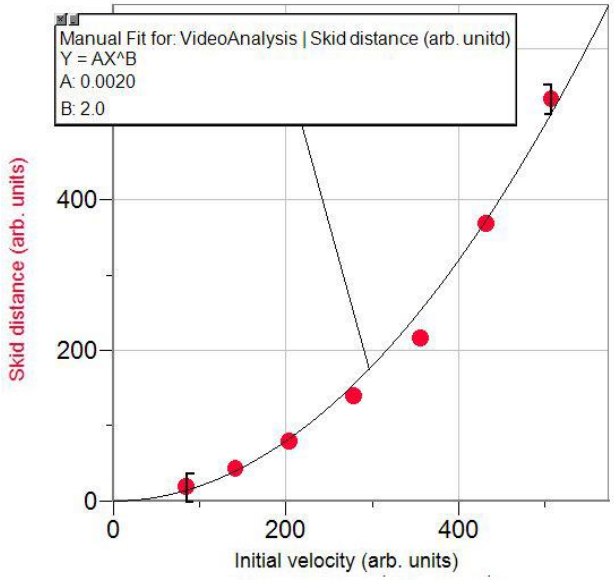
Trapezoidal blocks sliding on a polished concrete floor came to test on a curve. The blocks each had a different mass and the areas in contact with the floor were also different.

Fig 3 – axes and position dots have been entered in Logger pro.

The curve fits below (Graphs 1 and 2) show that (within errors due to launch and surface variations) the skid distance curve is a parabola ($y = Ax^2$).



Graph 1 – five coins slide on A3 paper. Skid distance is proportional to the initial velocity squared within errors.



Graph 2 – seven blocks of different mass and area slide on a floor. Skid distance is proportional to initial velocity squared within errors.

Mass, and areas in contact make no difference. This finding has immediate consequences ...

1 A fully loaded truck (with brakes in good order) can be stopped in the same distance as a car. It is not more dangerous to travel at speed in front of a truck.

2 A car can be stopped in the same distance empty (driver only) and when fully loaded. It is not correct to assume that because you are by yourself it is safe to travel faster.

3 Skid distance depends on velocity squared. Traveling twice as fast lengthens the potential skid by **four** times.

4 The length of skid-marks (for known road conditions) indicates the initial speed of a vehicle before an accident. Skid length alone (rubber on the road) is enough to charge a driver with dangerous driving.

5 Putting fat tires on a truck does not reduce skid distances.

Surfaces	μ_K
Rubber on concrete (dry)	0.68
Rubber on concrete (wet)	0.58
Rubber on asphalt (dry)	0.67
Rubber on asphalt (wet)	0.53
Rubber on ice	0.15
Waxed ski on snow	0.05
Wood on wood	0.30
Steel on steel	0.57
Copper on steel	0.36
Teflon on Teflon	0.04

Coefficients of sliding friction

6 Water on a road lowers the coefficient of friction. That is why you may see flashing 40 km/h signs on Bangkok motorways during thunderstorms.

7 This stone on Death Valley California was forced to move by high winds when rain reduced the coefficient of friction to near zero.

Image https://commons.wikimedia.org/wiki/File:2006_1205_135618-DVNP-RACETRACK.jpg