Lesson 1 Introduction to Momentum

Momentum is a quantity possessed by masses in motion. To calculate momentum we use this equation:

Momentum = Mass x Velocity

Its units are therefore kg m/s

In symbols, p is used for momentum, m for mass and v for velocity so it becomes:

$$p = mv$$

Moving objects can have high momentum if they have large mass, large velocity or both - for example:

- A truck rolling slowly to a stop has a large momentum because of its large mass.
- A speeding bullet has a large momentum because of its high velocity.
- The International Space Station has large mass and high velocity so it would be a very difficult object to stop moving.

Training to use the Tracker app (15mins)

In this topic, you will be able to do some practical work, safely at home especially through using the Tracker video analysis software. To learn the basics of how to use this watch this video and then download your own copy of Tracker:

https://youtu.be/sDk0fsb13Ms Video (11:13)

https://physlets.org/tracker/ Download

Open Tracker and load this video file:

TennisBall.mp4

Set up Tracker to track the ball as in the training video - in summary, remember these three steps BUT read 4 and 5 before you start tracking:

1. Create a 0.3m measuring stick along the length of the blue ruler (SHIFT CLICK)
2. Create a set of axes centred on the ball in the first frame
3. Create a POINT MASS (CTRL-SHIFT-CLICK) centred on the ball and drag out a large search window

This time you will use Tracker to plot the momentum of the ball in the x-direction so there are two extra steps:

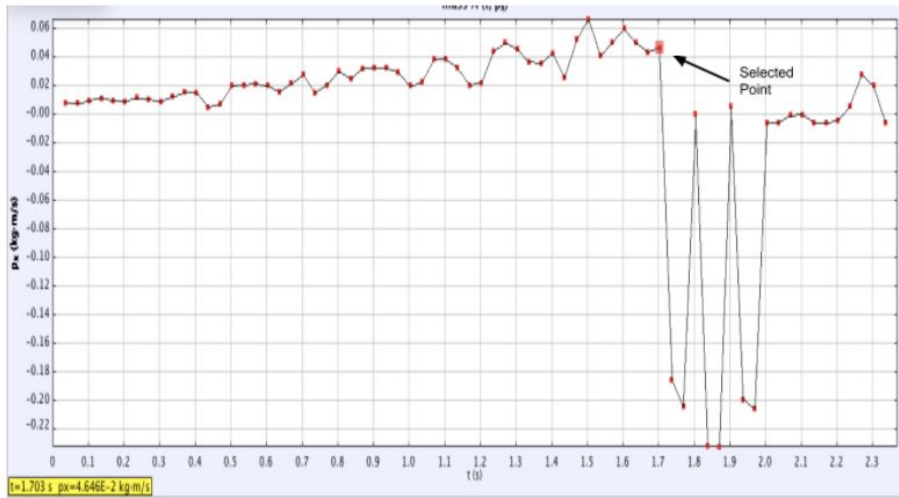1. Enter the mass of the tennis ball, which is 0.059kg (or 59g) in the window at top left:
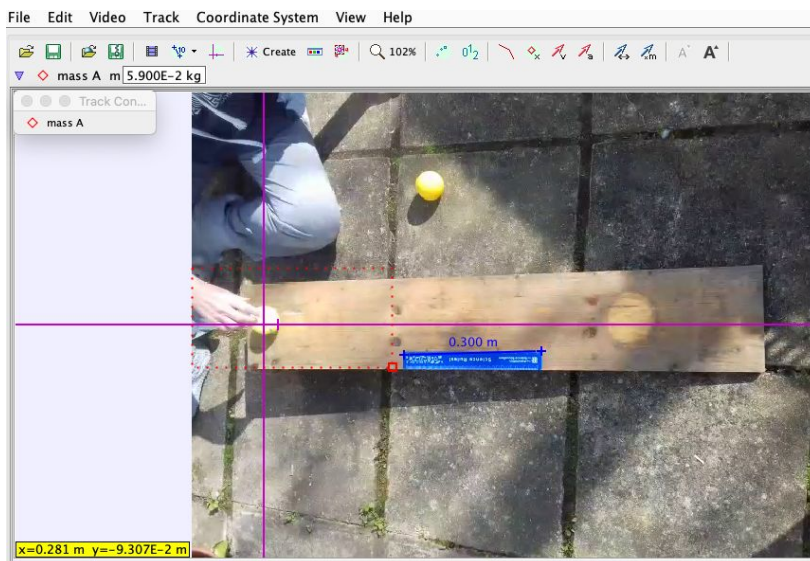
2. Change the graph x-axis to px(kg m/s) where p stands for momentum (in the x-direction) - hover the mouse over the label and choose from the list:
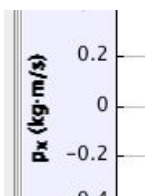
Now Track!

Expand your final graph of momentum vs time - click on the last sensible looking data point before tracking was lost, as in this example:

Cut and paste a copy of YOUR graph into your Physics notes and write down the value of px for the selected data point - in the example, the value to write down can be seen in the yellow box bottom left:

px = 4.646E-2 kg m/s (or 0.0464 kg m/s)

Finally, as the mass of the tennis ball was 0.059kg, rearrange the equation for momentum

p=mv

And use it to calculate a value for v, the velocity of the ball, from your recorded value of px.(in the example the calculation and answer would be v = 0.0464/0.059 = 0.79 m/s)

Summary (5mins)

Please add the following to your Physics notes:

- In physics, momentum is a quantity possessed by any mass which is moving
- Momentum is a measure of how difficult it is to stop a mass from moving
- The equation for momentum, with units, is….(look this up!)