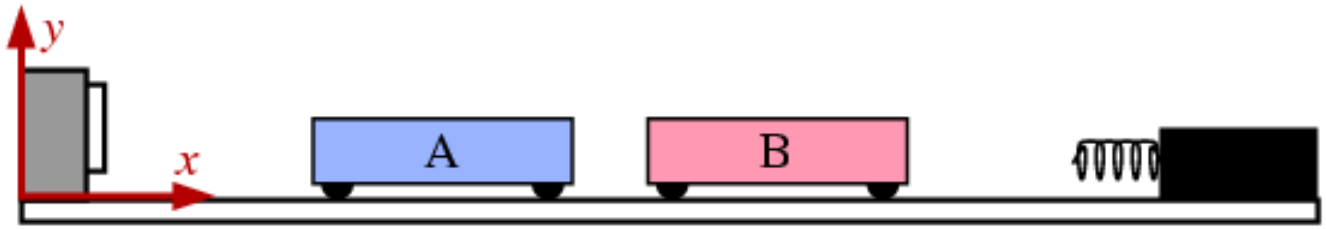
MIT

8.01T Physics I

Experiment 7: Momentum

Set Up :



Use the lighter spring on the force sensor.
Clip the motion sensor to end of the track.
Level the track.

Target cart (B) at rest about 10cm from the spring.
Incident cart (A) about 16-20cm from motion sensor.
Velcro facing = inelastic, magnets facing = elastic.
Roll incident cart just hard enough to come back to its starting point.

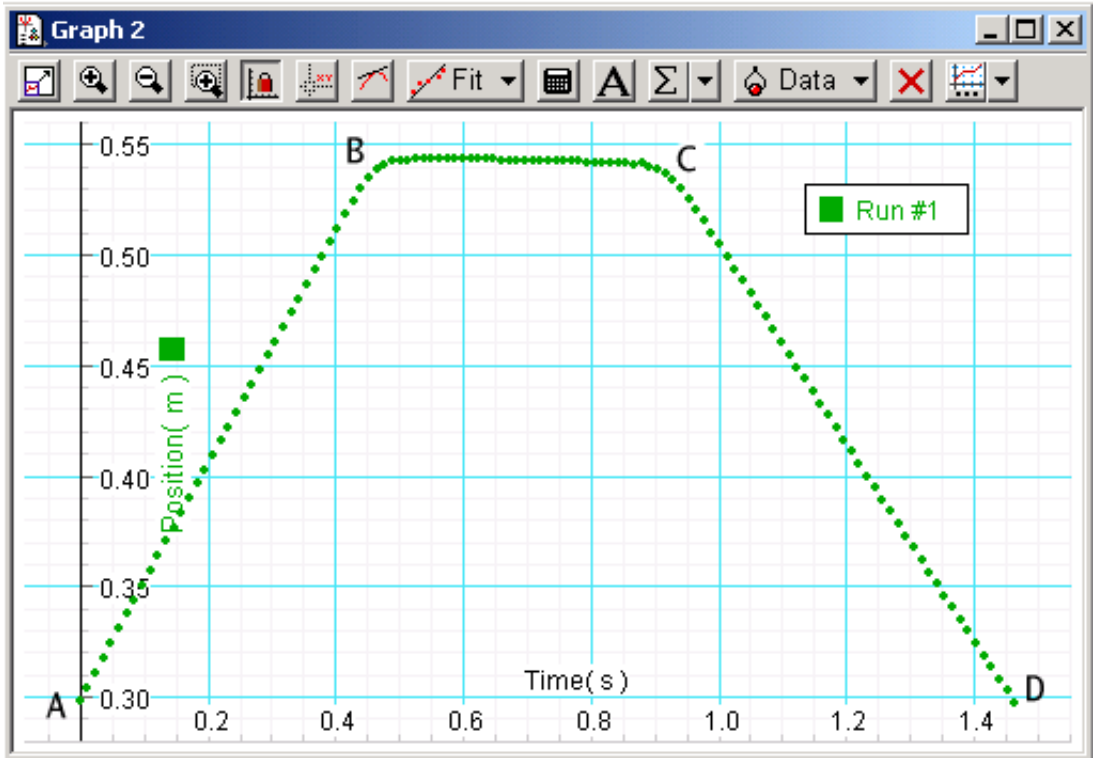
Goal

To investigate the conservation of momentum in elastic and inelastic collisions.
To investigate the amount of kinetic energy available for non-conservative work in an inelastic collision.

The next three slides are graphs typical of those you will make during your experiment. Your instructor will discuss some of their features.

Graph 1:

Two equal mass carts A and B collide.
This is X_A vs. time.



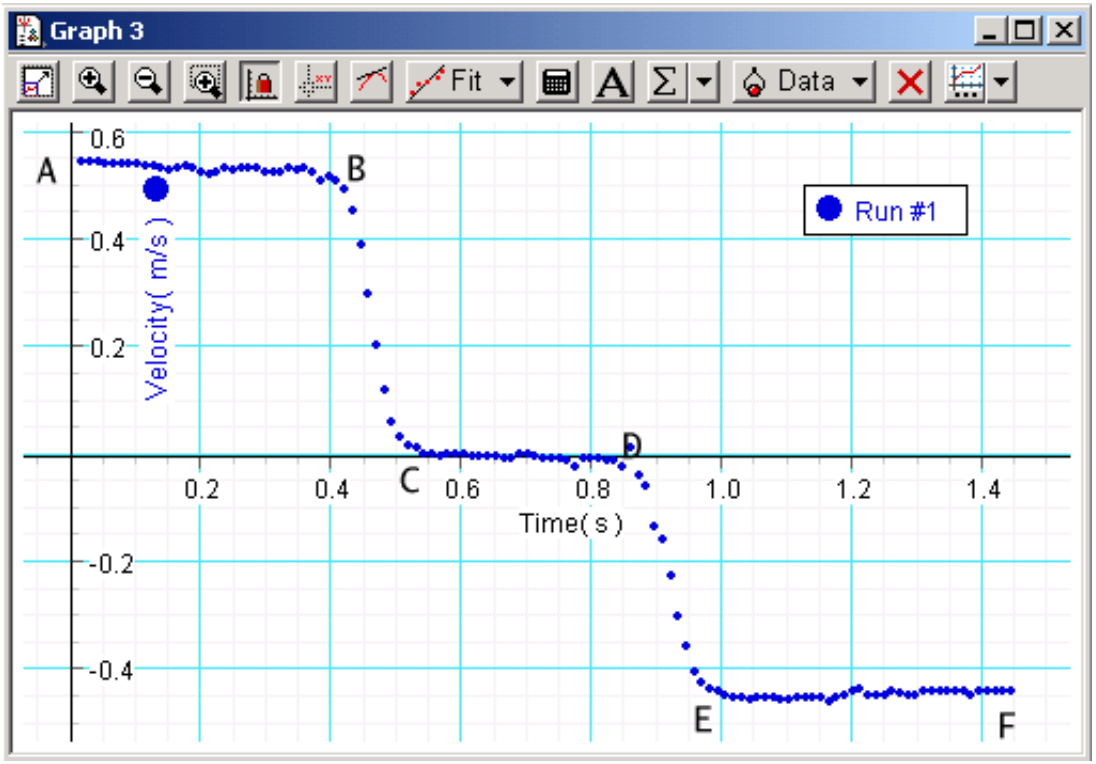
What is happening:

1. Along line AB?
2. At point B?
3. Along line BC?
4. At point C?
5. Along line CD?

Approximately what time does cart B hit the spring?

Graph 2:

Two equal mass carts A and B collide.
This is V_A vs. time.



What is happening:

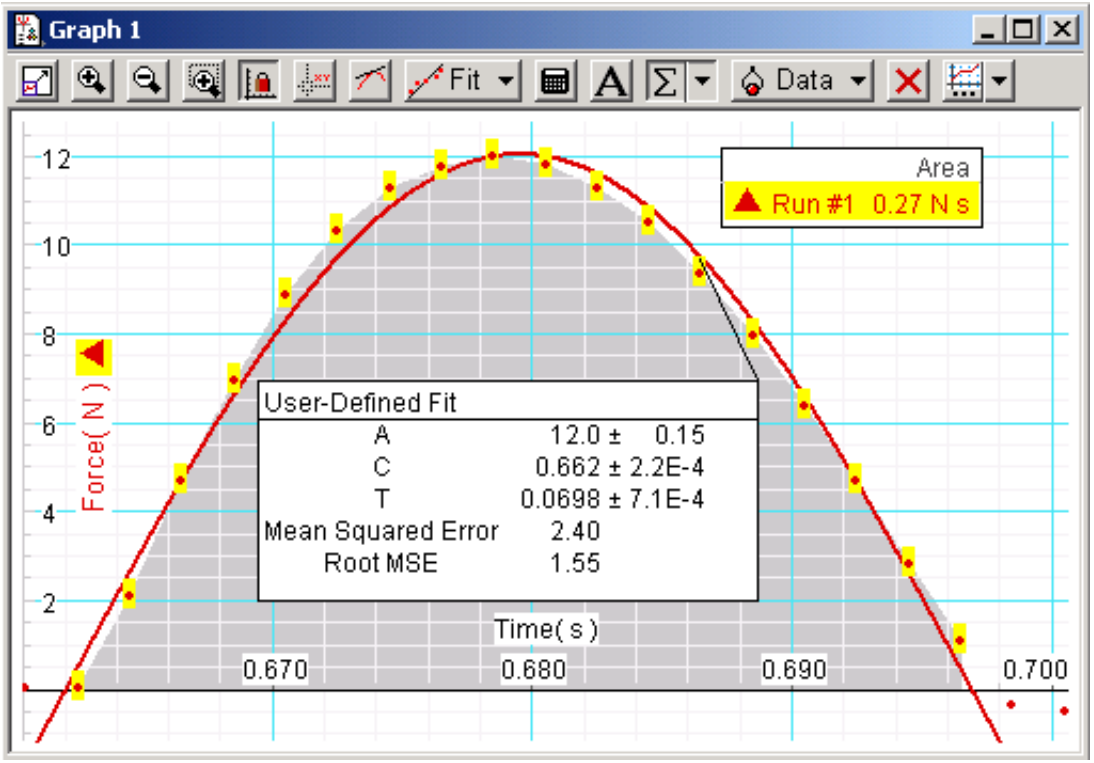
1. Along line AB?
2. Along line BC?
3. Along line CD?
4. Along line DE?
5. Along line EF?

What is V_B when cart A is half way along line BC?

Graph 3:

A cart of mass 0.25kg collides with a spring on the force sensor. Here is the force during the collision. The fit is to:

$A*\sin(2\pi(x-C)/T)$

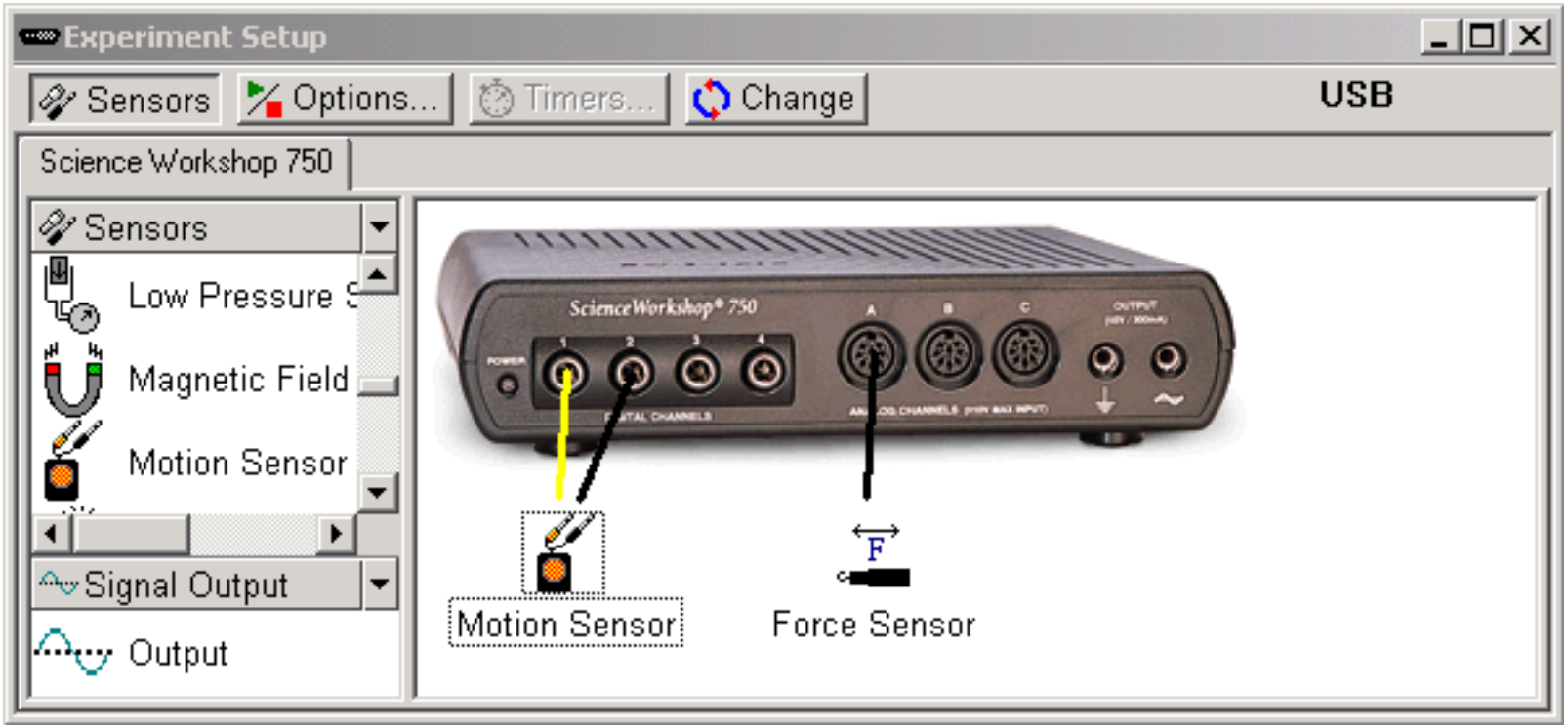


What does the area under the curve tell you?

What can you learn from the parameter T?

Starting *DataStudio*:

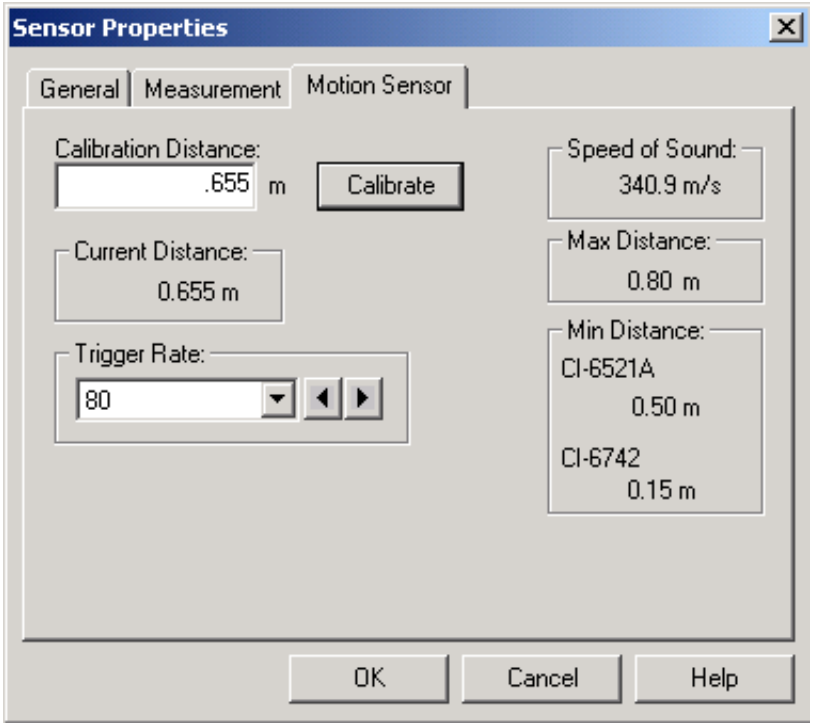
Create a new experiment. Plug force and motion sensors into the 750 and drag their icons to inputs in the Setup window.



Double-click the Force Sensor icon.

Sensors:

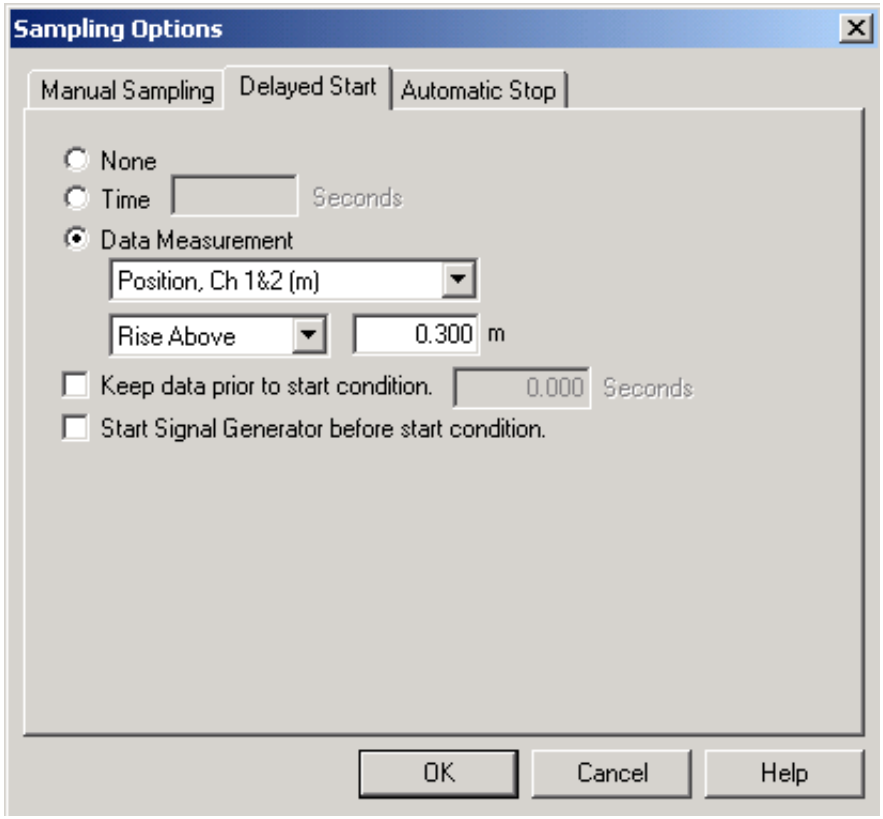
Set force sensor for 500 samples/s & low sensitivity.

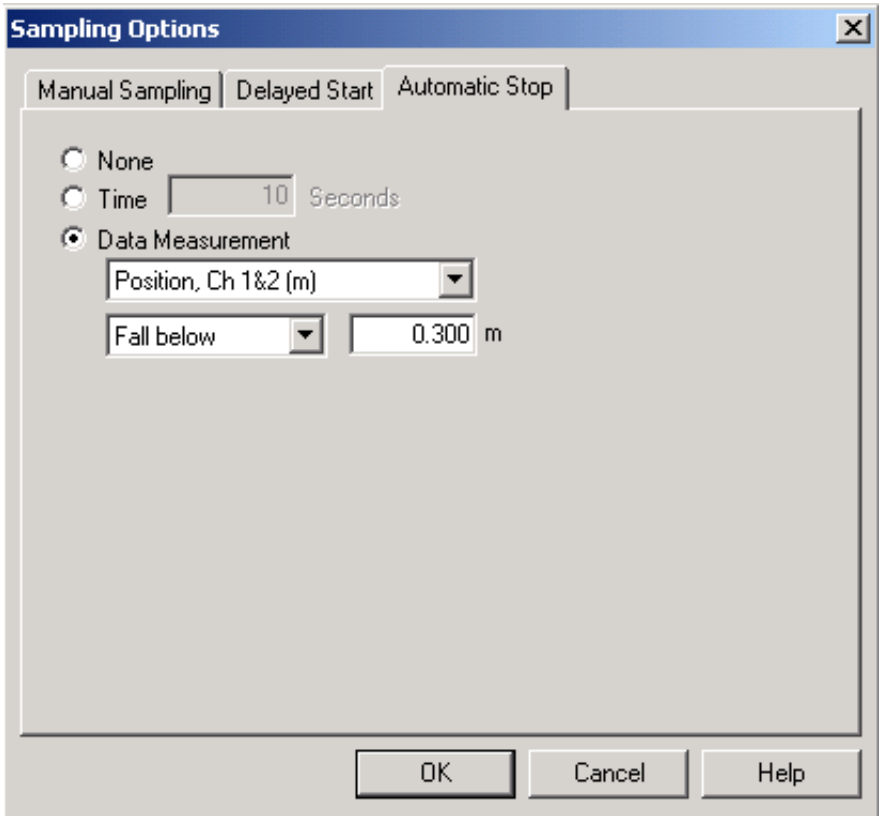


Calibrate motion sensor, set trigger rate to 80.

Click 

Sampling Options:



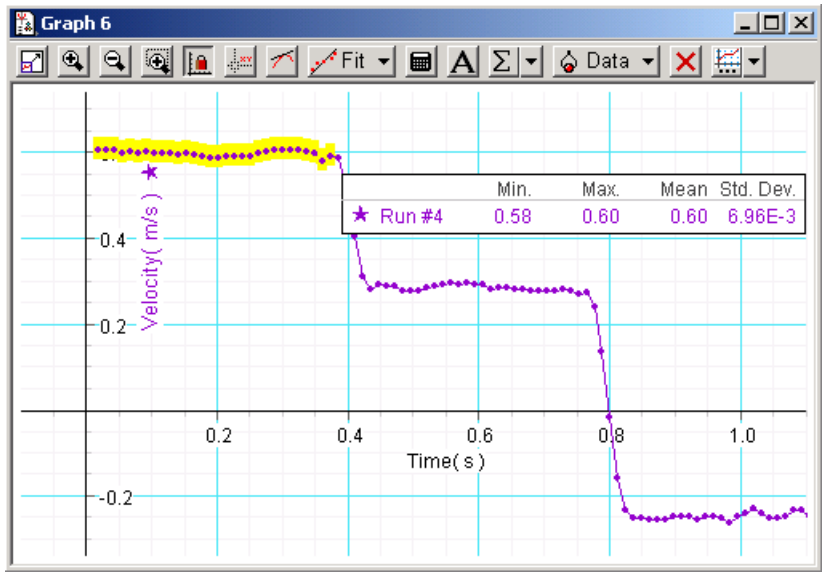


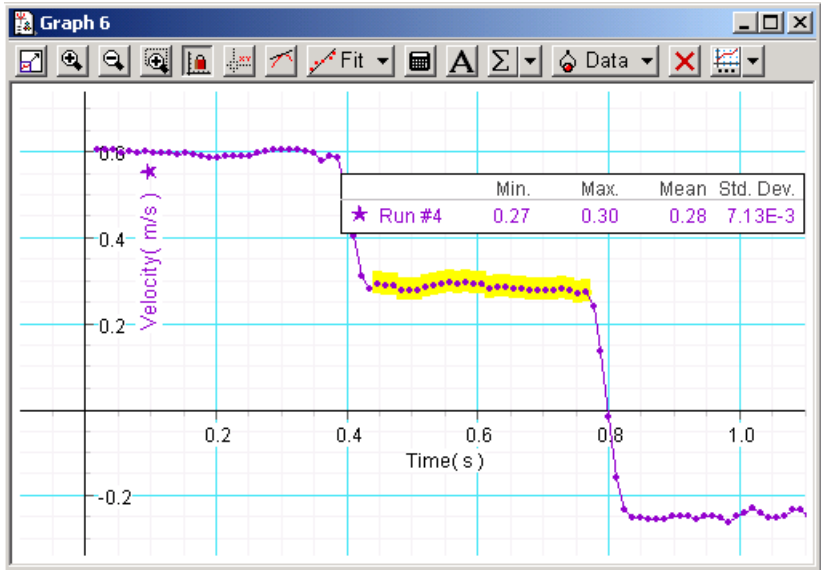
Position rises above 0.3m.

Position falls below 0.3m.

Measure and plot position, velocity and force.

Inelastic Collisions:





Use Statistics Tool (Σ) to measure velocities $v_{A,1}$ and v_2, before and after the collisions. Complete the table.

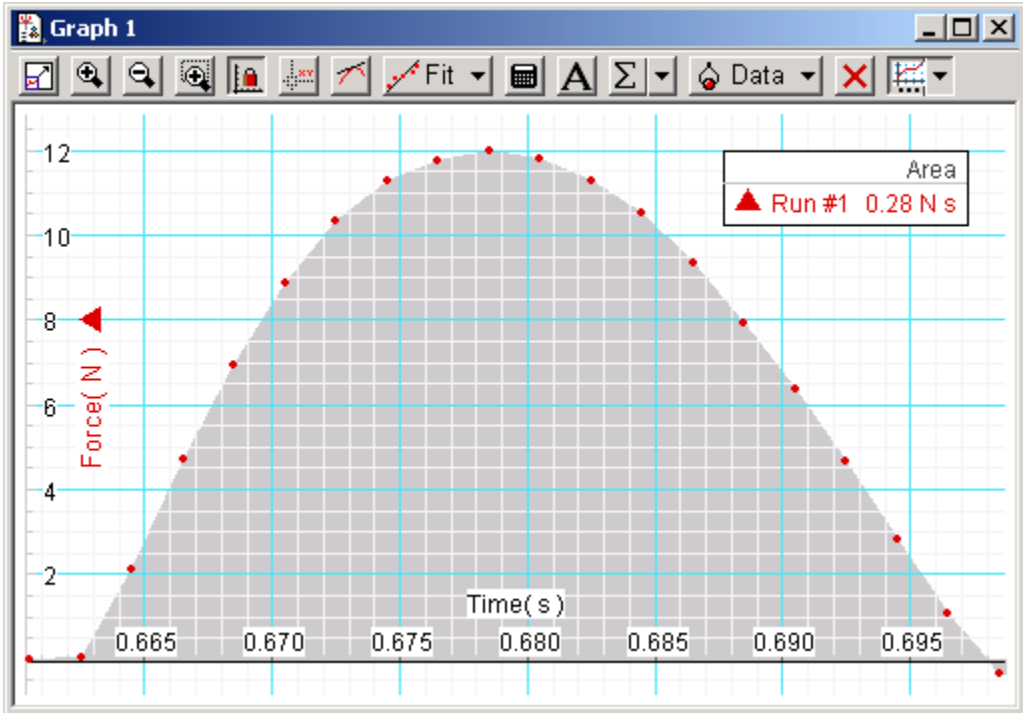
m_A	m_B	$v_{A,1}$	v_2
0.25 kg	0.25kg		
0.25 kg	0.50 kg		
0.50 kg	0.25 kg		

Elastic Collisions:

Measure $v_{A,1}$ $v_{A,2}$ as before.

Determine the spring impulse J. (Σ tool)

Find $v_{B,2}$ from J.



m_A	m_B	$v_{A,1}$	$v_{A,2}$	J
0.25 kg	0.25kg			
0.25 kg	0.75 kg			
0.75 kg	0.25 kg			

Inelastic Analysis (homework):

m_A	m_B	$v_{A,1}$	v_{CM}	K_1	K_{CMCS}	v_2	K_2	W_{NC}
0.25kg	0.25kg							
0.25kg	0.50kg							
0.50kg	0.25kg							

$$v_{\mathrm{CM}} = \frac{m_A v_{A,1}}{m_A + m_B} \qquad K_{\mathrm{CMCS}} = \tfrac{1}{2} m_A (v_{A,1} - v_{\mathrm{CM}})^2 + \tfrac{1}{2} m_B v_{\mathrm{CM}}^2$$

$$K_1 = \tfrac{1}{2} m_A {v_{A,1}}^2, \qquad K_2 + \tfrac{1}{2}(m_A + m_B) v_2^2 = K_1 - W_{\mathrm{NC}}$$

Fill in the table.

Elastic Analysis (homework):

m_A	m_B	$v_{A,1}$	v_{CM}	K_1	$v_{A,2}$	J	$v_{B,2}$	K_2
0.25kg	0.25kg							
0.25kg	0.75kg							
0.75kg	0.25kg							

Fill in the table. Part of Problem Set 9.