Conservation of Momentum

$$\vec{P}_{total} = \vec{P}'_{total} \quad \text{(in an isolated system)}$$

Recall $\vec{p} = m\vec{v}$

$$\vec{P}_A + \vec{P}_B = \vec{P}_A' + \vec{P}_B'$$

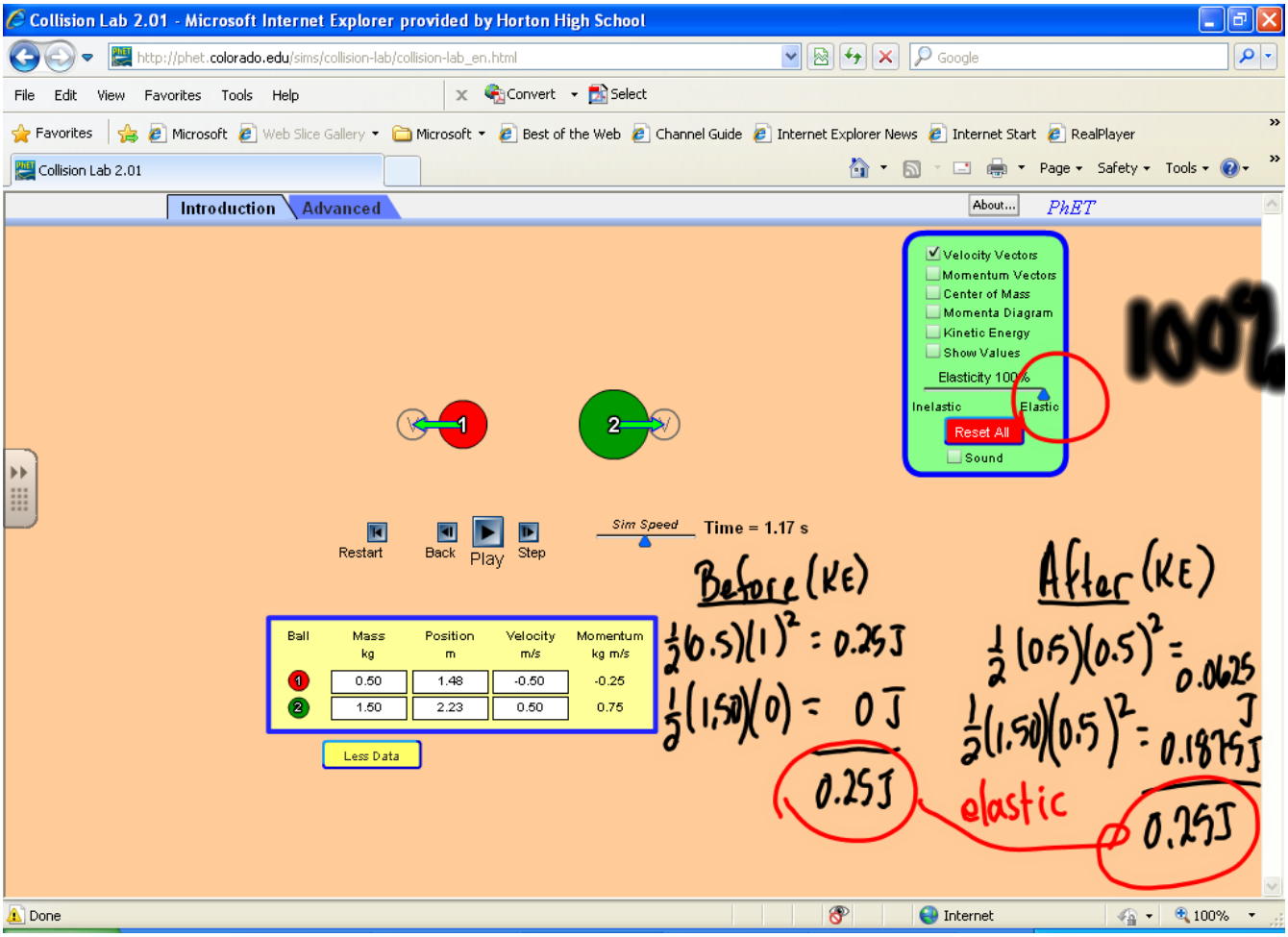
We know from the last class that momentum is conserved in any collision.

What about kinetic energy during a collision?

Elastic Collision

An elastic collision is a collision in which the total kinetic energy is the same before and after the collision.

* Only some collisions are elastic!.


Collision Lab 2.01 - Microsoft Internet Explorer provided by Horton High School
http://phet.colorado.edu/sims/collision-lab/collision-lab_en.html
Collision Lab 2.01
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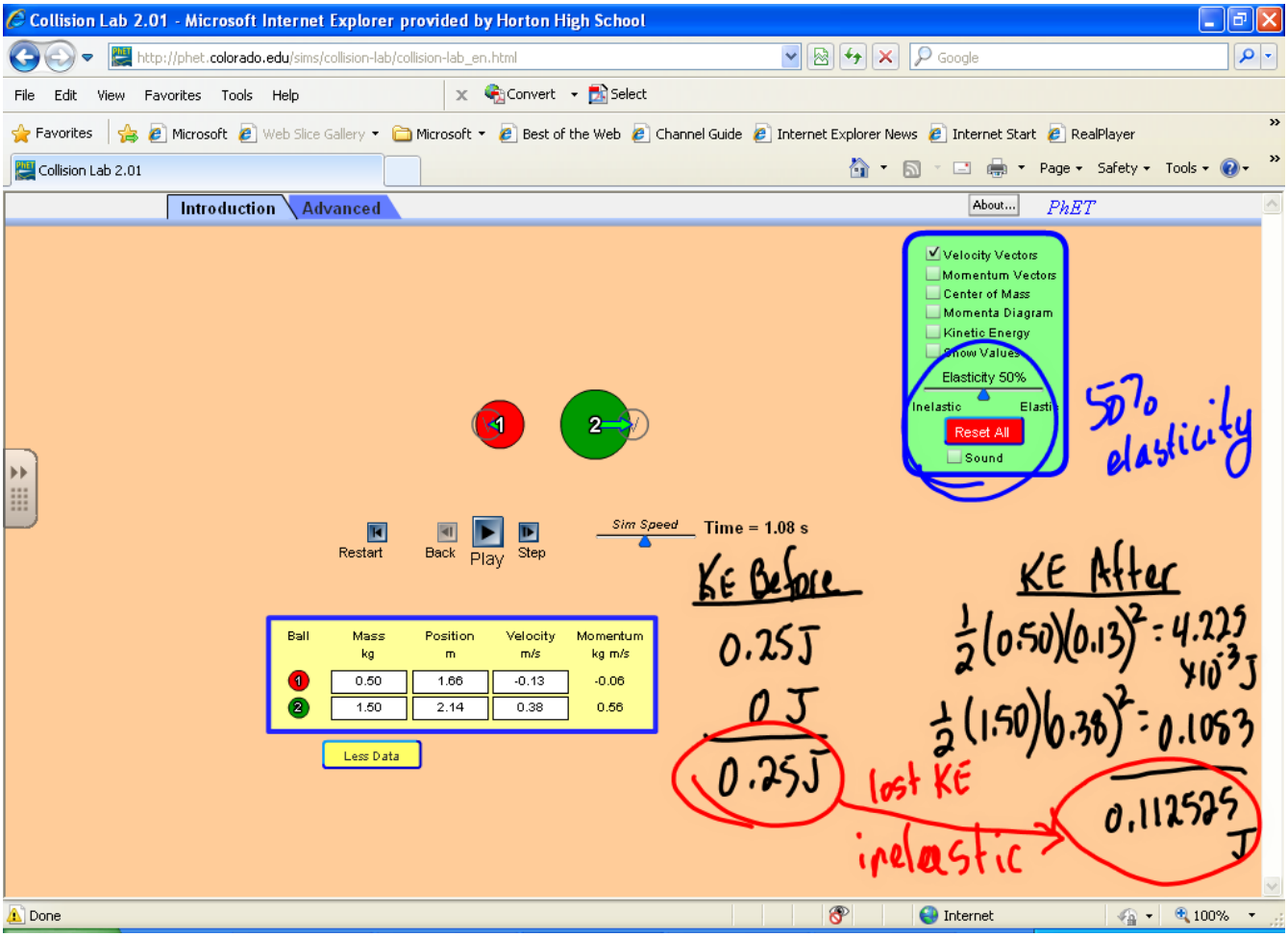
Kinetic Energy
Show Values
Elasticity 100%
Inelastic
Elastic
Reset All
Sound
100%
Restart
Back
Play
Step
Sim Speed
Time = 1.17 s
Ball
Mass kg
Position m
Velocity m/s
Momentum kg m/s
1
0.50
1.48
-0.50
-0.25
2
1.50
2.23
0.50
0.75
Less Data
Before (KE)
$\frac{1}{2}(0.5)(1)^2 = 0.25J$
$\frac{1}{2}(1.50)(0) = 0J$
0.25J
After (KE)
$\frac{1}{2}(0.5)(0.5)^2 = 0.0625J$
$\frac{1}{2}(1.50)(0.5)^2 = 0.1875J$
elastic
0.25J
Done
Internet
100%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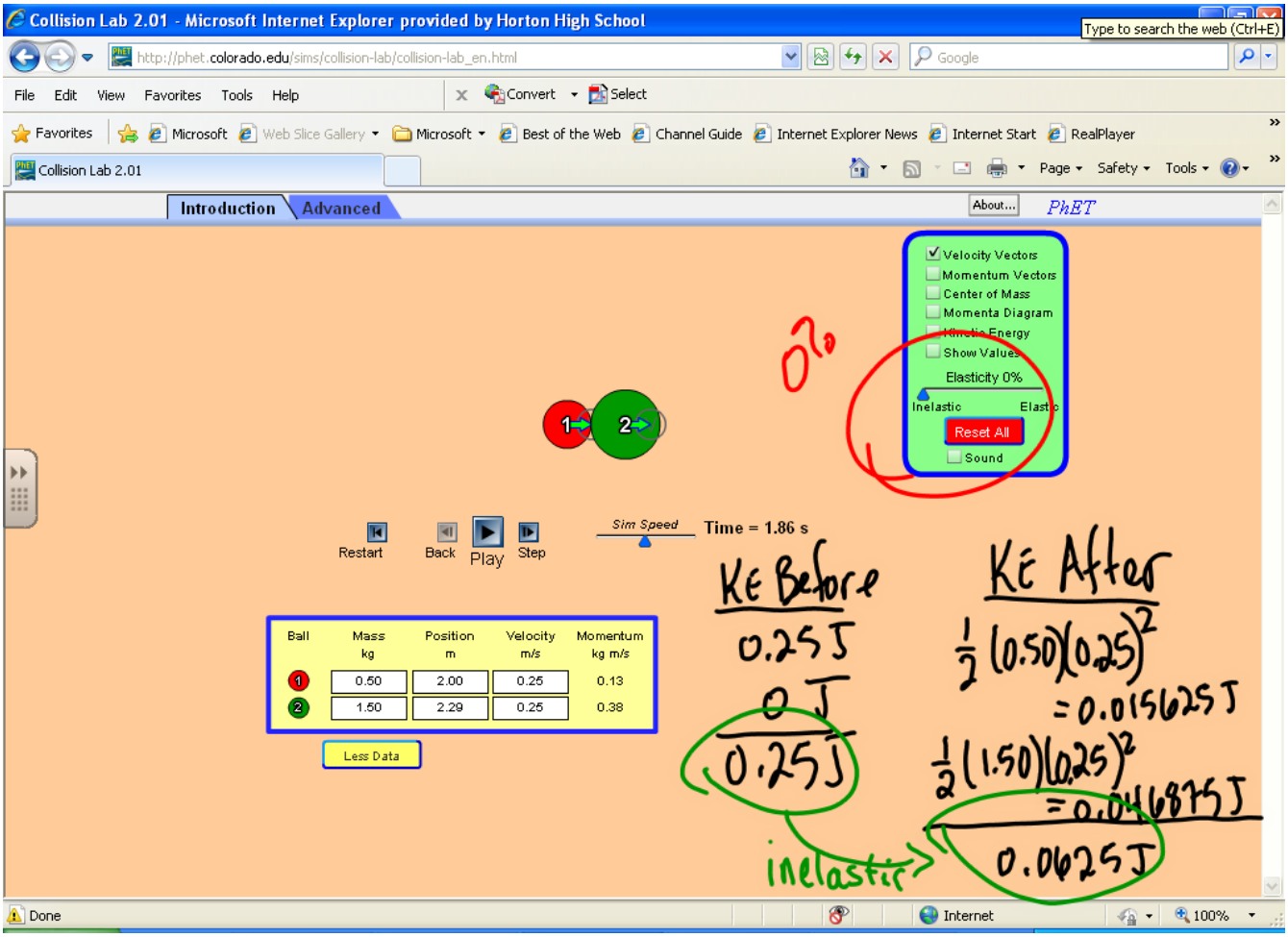
Inelastic
Reset All
Sound
50% elasticity
Restart
Back
Play
Step
Sim Speed
Time = 1.08 s
Ball
Mass kg
Position m
Velocity m/s
Momentum kg m/s
1
0.50
1.66
-0.13
-0.06
2
1.50
2.14
0.38
0.56
Less Data
KE Before
0.25J
0J
0.25J
KE After
½(0.50)(0.13)² = 4.225 x10⁻³J
½(1.50)(0.38)² = 0.1083
0.112525 J
lost KE
inelastic
Done
Internet
100%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Kinetic Energy
Show Values
Elasticity 0%
Inelastic
Elastic
Reset All
Sound
Restart
Back
Play
Step
Sim Speed
Time = 1.86 s
Ball
Mass kg
Position m
Velocity m/s
Momentum kg m/s
0.50
2.00
0.25
0.13
1.50
2.29
0.25
0.38
Less Data
KE Before
0.25 J
0 J
0.25 J
KE After
½ (0.50)(0.25)²
= 0.015625 J
½ (1.50)(0.25)²
= 0.046875 J
0.0625 J
inelastic

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First we need to know all the masses and velocities => use conservation of momentum to find out the missing velocity for the steel ball after the collision.

$$\vec{P}_{total} = \vec{P}'_{total}$$

$$\vec{P}_A + \vec{P}_B = \vec{P}'_A + \vec{P}'_B$$

($\vec{P}_B = 0$)

$$m_A\vec{v}_A = m_A\vec{v}'_A + m_B\vec{v}'_B$$

$$(0.250\,kg)(5.00\,m/s) = (0.250\,kg)(-2.62\,m/s) + (0.800\,kg)\vec{v}'_B$$

$$1.25\,kg\cdot m/s = -0.655\,kg\cdot m/s + (0.800\,kg)\vec{v}'_B$$

$$1.905\,kg\cdot m/s = (0.800\,kg)v'_B$$

$$v'_B = 2.38125\,m/s$$

$$\vec{v}_B = 2.38\,m/s\ [\text{in the original dir A hit ball}]$$

KE BEFORE

A: $\frac{1}{2}(0.250\,kg)(5.00\,m/s)^2 = 3.125\,J$

B: $0\,J$

$3.125\,J$

KE AFTER

A: $\frac{1}{2}(0.250\,kg)(2.62)^2 = 0.85805\,J$

B: $\frac{1}{2}(0.800\,kg)(2.38125)^2 = 2.26815\,J$

$3.126\,J$

Since $E_{k(total)} = E'_{k(total)}$ The collision was elastic

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