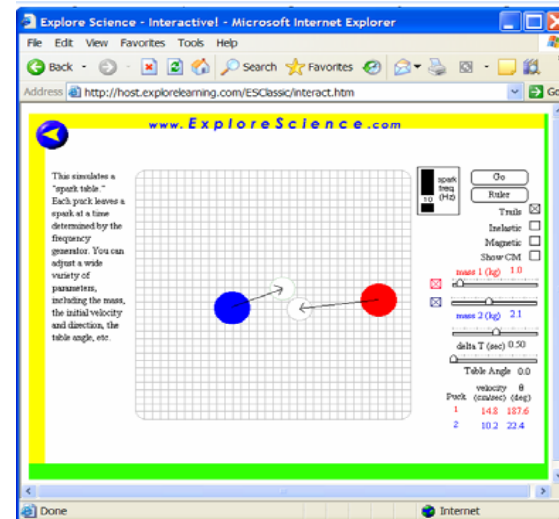


Two-Dimensional Collisions

Every type of collision can be classified according to its elasticity. A **perfectly elastic collision** is one in which none of the initial momentum or kinetic energy is lost during the collision. An inelastic collision is one in which no momentum is lost, but some of the kinetic energy is converted to other forms of energy. A **perfectly inelastic collision** is one in which the maximum kinetic energy as is possible to lose is converted to other forms of energy while keeping momentum conserved.

When objects collide elastically in two dimensions, momentum and kinetic energy are conserved in each dimension (usually designated vertical and horizontal). When the collision is inelastic, only momentum is conserved.



Go to the simulation web site at <http://host.explorelearning.com/ESClassic/interact.htm>, click on the “mechanics” icon and go to the “2D Collisions” simulation. Run various trials in order to verify that momentum in each dimension is conserved in both elastic and inelastic collisions. You can read the initial speed and angles on the simulation screen, but will need to use the “ruler” function in order to determine the speeds and angles after the collision.

For each trial:

Table 1

- Multiply the speed by the cosine of the angle to get the horizontal component of the velocity, v_x .
- Multiply the speed by the sine of the angle to get the vertical component of the velocity, v_y .
- Multiply these velocity components by the mass of the puck to obtain the components of its momentum.
- Sum the x and y components of each puck's initial and final momenta.

Table 2

- Apply the Pythagorean Theorem to the velocity components in order to obtain the magnitude of the final and initial speeds. Then use these speeds to calculate each puck's initial and final kinetic energies.
- Sum these to see if kinetic energy was conserved in the collision.

Trial 1

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 2

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 3

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 4

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 5

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 6

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 7

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 8

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 9

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.

Trial 10

puck	collision	mass, kg	initial values (before collision)						final values (after collision)					
			speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s	speed, cm/s	angle, °	v _x , cm/s	v _y , cm/s	p _x , kg•cm/s	p _y , kg•cm/s
1														
2														
			sums						sums					

puck	mass, kg	initial values (before collision)		final values (after collision)	
		speed, m/s	kinetic energy, J	speed, m/s	kinetic energy, J
1					
2					
		sum =		sum =	

Make a statement describing momentum and/or energy conservation in this trial.