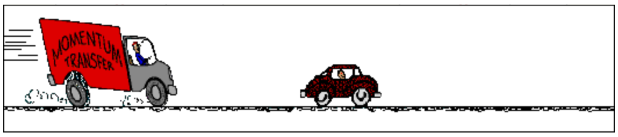
PRACTICE	LABS	TESTS
Practice problems (1-13)	• Exploding Carts Interactive • Collisions Interactive • Roller Coaster Lab	Unit 11 Test Thursday 2/28

Inelastic Collisions

LEARNING TARGET	DESCRIPTION
11.2	I can define, interpret, and solve problems involving the Law of Conservation of Momentum.
11.3	I can define, analyze, and solve problems involving two particle collision.



Review Momentum and Impulse

Momentum

$$p = m v$$

Impulse-Momentum Theorem

$$F \Delta t = \Delta p = p_f - p_i$$

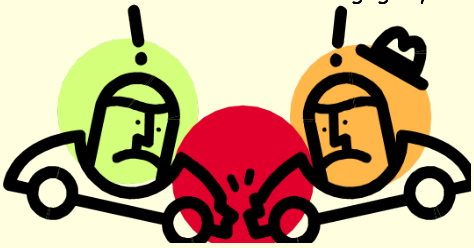
Conservation of Momentum

If the net force acting on an object is zero, its momentum is conserved.

$$p_i = p_f$$

Two-Partical Collisions

A **collision** is a situation in which two objects strike one another and in which the net external force is either zero or negligibly small.



2 Types of Collisions

Inelastic collisions are when objects stick together on impact.

m	m

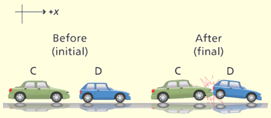
Momentum Tables

In analyzing collisions and explosions, a momentum table can be a powerful tool for problem solving. To create a momentum table, follow these basic steps:

1. Identify all objects in the system. List them vertically down the left-hand column.
2. Determine the momenta of the objects before the event. Use variables for any unknowns.
3. Determine the momenta of the objects after the event. Use variables for any unknowns.
4. Add up all the momenta from before the event, and set them equal to the momenta after the event.
5. Solve your resulting equation for any unknowns.

Inelastic Collision

A 1875-kg car going 23 m/s rear-ends a 1025-kg compact car going 17 m/s on ice in the same direction. The two cars stick together. How fast do the two cars move together immediately after the collision?



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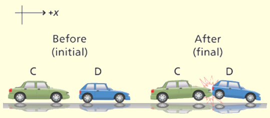

OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C		
CAR D		
TOTAL		

Inelastic Collision

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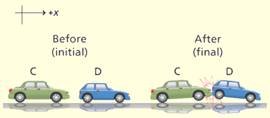

OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C	(1875 kg)(23 m/s) = 43,125 kg·m/s	
CAR D	(1025 kg)(17 m/s) = 17,425 kg·m/s	
TOTAL	60,550 kg·m/s	

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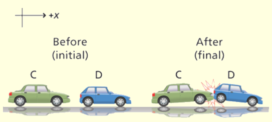
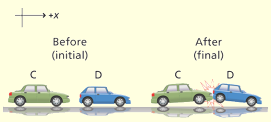


OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C	(1875 kg)(23 m/s) = 43,125 kg·m/s	(2900 kg) v_f
CAR D	(1025 kg)(17 m/s) = 17,425 kg·m/s	
TOTAL	60,550 kg·m/s	60,550 kg·m/s

Inelastic Collision

A 1875-kg car going 23 m/s rear-ends a 1025-kg compact car going 17 m/s on ice in the same direction. The two cars stick together. How fast do the two cars move together immediately after the collision?



OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C	(1875 kg)(23 m/s) = 43,125 kg·m/s	(2900 kg) v_f
CAR D	(1025 kg)(17 m/s) = 17,425 kg·m/s	
TOTAL	60,550 kg·m/s	60,550 kg·m/s

$(2900\ \text{kg})\ v_f = 60{,}550\ \text{kg·m/s}$

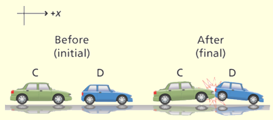
$v_f = 21\ \text{m/s}$

Inelastic Collision

The law of conservation of momentum states that, in the absence of an external force, the momentum of a system remains unchanged.

What about energy?

Inelastic Collision



OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C	(1875 kg)(23 m/s) = 43,125 kg·m/s	(2900 kg) (21 m/s)
CAR D	(1025 kg)(17 m/s) = 17,425 kg·m/s	
TOTAL	60,550 kg·m/s	60,550 kg·m/s

K_i

$\frac{1}{2}m_C v_C^2 + \frac{1}{2}m_D v_D^2$

495,938 J + 148,112 J = 644,050 J

K_f

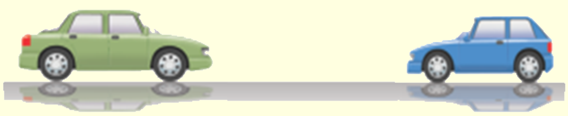
$\frac{1}{2}(m_C + m_D) v_f^2$

639,450 J

ΔK = - 4600J

Car Collision

3. A 1875-kg car going 23 m/s and a 1025-kg compact car going 17 m/s collide head on. The two cars stick together. How fast do the two cars move together immediately after the collision?
   a) How fast do the two cars move together immediately after the collision?
   b) What is the change in kinetic energy immediately after the collision?



Car Collision

What if the same two cars collided in a head on collision? What is the magnitude and direction of the two cars after the collision?

OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CAR C	(1875 kg)(23 m/s) = 43,125 kg·m/s	(2900 kg) v_f
CAR D	(1025 kg)(-17 m/s) = -17,425 kg·m/s	
TOTAL	25,700 kg·m/s	25,700 kg·m/s

$\Delta K = K_f - K_i$

$\Delta K = -5.3 \times 10^5$ J

(2900 kg) v_f = 25,700 kg·m/s

v_f = 8.9 m/s

PROBLEMS

(14 & 16)