

----- Demonstration -----

We will look at the forces of interaction when two objects collide.

Collision #1: Two equal inertia objects moving towards each other with the same speed.

Collision #2: Two equal inertia objects. Object 1 is moving. Object 2 is at rest.

Collision #3: Two equal inertia objects, both moving in the same direction. Object 1 faster.

Collision #4: Two objects with different inertias. Object 1 is more massive than object 2. The objects are moving towards each other with equal speed.

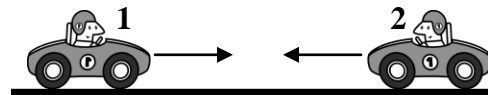
Collision #5: Two objects with different inertias. Object 1 is more massive than object 2. Object 1 is moving. Object 2 is at rest.

Collision #6: Two equal inertia objects. Object 1 is moving. Object 2 is at rest. The objects will stick together after the collision.

----- Predictions -----

Place a check next to your prediction.

Collision #1: Two equal inertia cars ($m_1 = m_2$) moving towards each other with the same speed ($V_1 = V_2$).



1. Predict the relative magnitude of the forces between car₁ and car₂ during the collision.

_____ Car₁ exerts a larger force on car₂ than car₂ exerts on car₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)

_____ Car₁ exerts the same force on car₂ as car₂ exerts on car₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)

_____ Car₂ exerts a larger force on car₁ than car₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

Collision #2: Two equal inertia cars ($m_1 = m_2$). Car₁ is moving towards car₂ while car₂ is initially at rest ($V_1 > 0$ $V_2 = 0$).



2. Predict the relative magnitude of the forces between car₁ and car₂ during the collision.

_____ Car₁ exerts a larger force on car₂ than car₂ exerts on car₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)

_____ Car₁ exerts the same force on car₂ as car₂ exerts on car₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)

_____ Car₂ exerts a larger force on car₁ than car₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

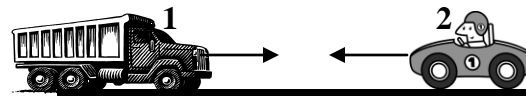
Collision #3: Two equal inertia cars ($m_1 = m_2$). Both cars are moving in the same direction. Car₁ is moving faster than car₂ ($V_1 > V_2$).



3. Predict the relative magnitude of the forces between car₁ and car₂ during the collision.

- _____ Car₁ exerts a larger force on car₂ then car₂ exerts on car₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)
- _____ Car₁ exerts the same force on car₂ as car₂ exerts on car₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)
- _____ Car₂ exerts a larger force on car₁ then car₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

Collision #4: A truck and a car of unequal inertias ($m_1 > m_2$) moving towards each other with the same speed ($V_1 = V_2$).



4. Predict the relative magnitude of the forces between truck₁ and car₂ during the collision.

- _____ Truck₁ exerts a larger force on car₂ then car₂ exerts on truck₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)
- _____ Truck₁ exerts the same force on car₂ as car₂ exerts on truck₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)
- _____ Car₂ exerts a larger force on truck₁ then truck₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

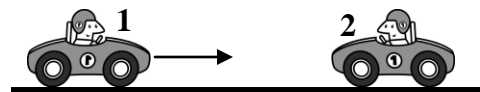
Collision #5: A truck and a car of unequal inertias ($m_1 > m_2$). Truck₁ is moving towards car₂ while car₂ is initially at rest ($V_1 > 0$ $V_2 = 0$).



5. Predict the relative magnitude of the forces between truck₁ and car₂ during the collision.

- _____ Truck₁ exerts a larger force on car₂ then car₂ exerts on truck₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)
- _____ Truck₁ exerts the same force on car₂ as car₂ exerts on truck₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)
- _____ Car₂ exerts a larger force on truck₁ then truck₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

Collision #6: Two equal inertia cars ($m_1 = m_2$). Car₁ is moving towards car₂ while car₂ is initially at rest ($V_1 > 0$ $V_2 = 0$). The cars will stick together after the collision.



6. Predict the relative magnitude of the forces between car₁ and car₂ during the collision.

- _____ Car₁ exerts a larger force on car₂ then car₂ exerts on car₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)
- _____ Car₁ exerts the same force on car₂ as car₂ exerts on car₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)
- _____ Car₂ exerts a larger force on car₁ then car₁ exerts on car₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

----- Partner Discussion -----

If you change any of your predictions do so by putting a double check to indicate your revised prediction.

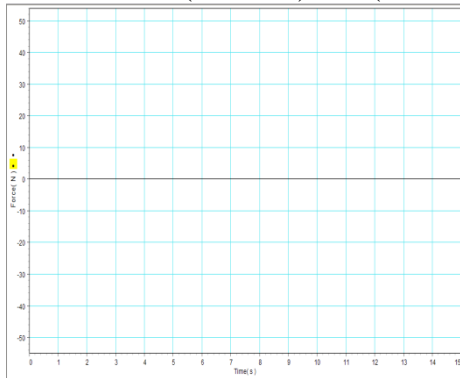
----- Class Discussion -----

Enter your predictions using the clickers to share with the class.

----- Physics Speaks -----

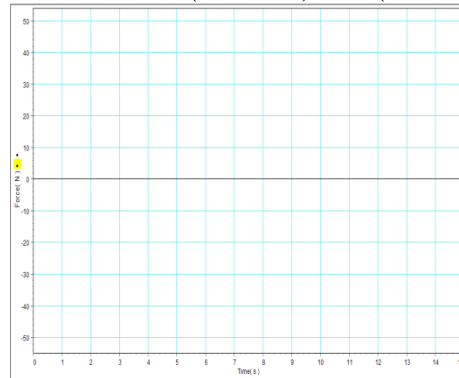
----- Results -----

Collision #1: ($m_1 = m_2$) and ($V_1 = V_2$).



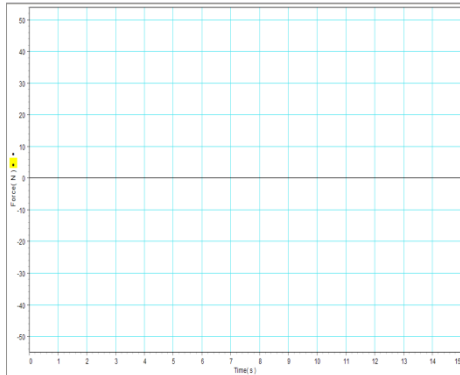
($F_{\text{on2due to 1}}$ ___ $F_{\text{on1dueto2}}$)

Collision #3: ($m_1 = m_2$) and ($V_1 > V_2$).



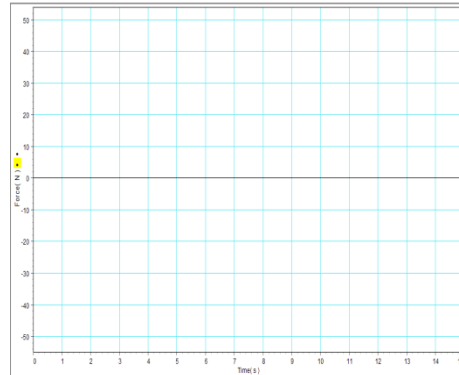
($F_{\text{on2due to 1}}$ ___ $F_{\text{on1dueto2}}$)

Collision #2: ($m_1 = m_2$) and ($V_1 > 0$ $V_2=0$).



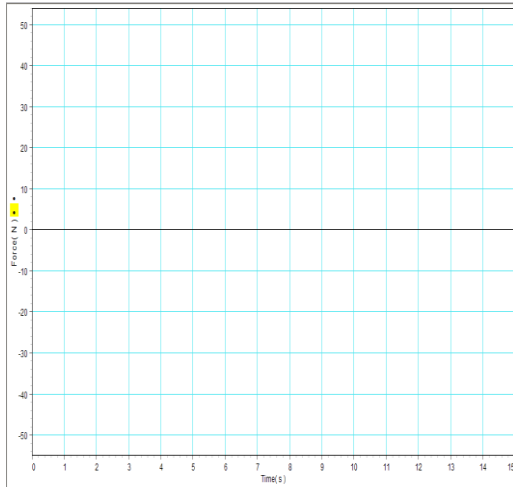
($F_{\text{on2due to 1}}$ ___ $F_{\text{on1dueto2}}$)

Collision #4: ($m_1 > m_2$) and ($V_1 = V_2$).



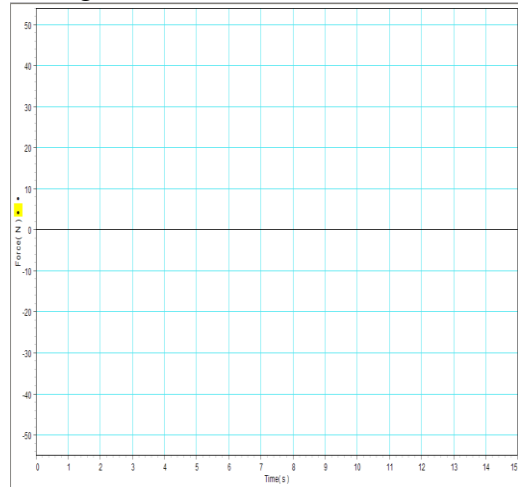
($F_{\text{on2due to 1}}$ ___ $F_{\text{on1dueto2}}$)

Collision #5: ($m_1 > m_2$) and ($V_1 > 0$ $V_2=0$).



($F_{\text{on2due to 1}}$ $F_{\text{on1dueto2}}$)

Collision #6: ($m_1 = m_2$), ($V_1 > 0$ $V_2=0$) and together after.



($F_{\text{on2due to 1}}$ $F_{\text{on1dueto2}}$)

What can you state about the force on object 1 due to object 2 and the force on object 2 due to object 1 from the evidence you have seen?

----- Extend -----

Collision #7: Car₁ moving towards an unmovable wall₂. ($V_1 > 0$ $V_2=0$).



1. Predict the relative magnitude of the forces between car₁ and wall₂ during the collision.

- _____ Car₁ exerts a larger force on wall₂ then wall₂ exerts on car₁ ($F_{\text{on2due to 1}} > F_{\text{on1dueto2}}$)
- _____ Car₁ exerts the same force on wall₂ as wall₂ exerts on car₁ ($F_{\text{on2due to 1}} = F_{\text{on1dueto2}}$)
- _____ Wall₂ exerts a larger force on car₁ then car₁ exerts on wall₂ ($F_{\text{on2due to 1}} < F_{\text{on1dueto2}}$)

What other situations could we experiment with for this demonstration?
