

Newton's Third Law

1. What is Newton's Third Law? (*Words*)

For every action, There is an equal and opposite reaction.
This means if A pushes B to the right, then B pushes A to the left.

2. What is another way of saying Newton's Third Law? (*Equation*)

$$F_{AB} = - F_{BA}$$

3. According to Newton's Third Law, forces are interactions between two objects and that forces always come in pairs.

4. In Newton's Third Law, the action/reaction forces are always equal and opposite. Why don't they simply cancel each other out?

Because the forces are acting on different objects!

5. How does Newton's Third Law apply to a hammer hitting a nail?

Hammer pushes nail (making nail go in wood)
Nail pushes back on hammer (stopping the hammer)

6. How does Newton's Third Law apply to a propeller on a plane?

Propeller pushes air backwards,
so air pushes propeller forwards

7. How does Newton's Third Law apply to a person trying to walk?

You push the ground backwards, so
the ground pushes you forwards

8. If you are leaning and pushing against a wall, what is the reaction force?

The wall pushing back on you.

9. If you pull a heavy bag to the right, what is the reaction force?

The heavy bag pulling you to the left.

10. Even though the ACTION and REACTION forces are always equal and opposite, the effect of each force can be quite different, depending on the _____ of each object.

MASS

Newton's Third Law

11. If two objects exert forces on each other (and there are no other forces) which object will have a greater acceleration?

The smaller mass has a bigger acceleration.

Just because two forces are equal and opposite does not mean they are part of a Newton's Third Law action / reaction pair. Here is a tricky example of that:

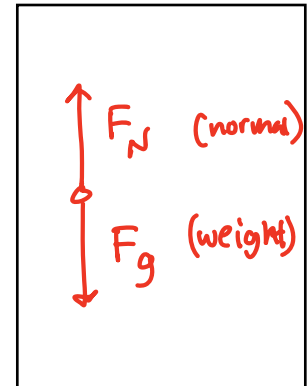
12. A backpack that weighs 50 N is at rest on a table.
a. In the box to the right, draw and label a force diagram showing the two forces that are acting on the backpack.

- b. Are those two forces equal and opposite? How do you know?

Yes. The backpack is @ rest, so they cancel out and the net force is zero.

- c. Hopefully, you said one of the forces on the backpack was its *weight*. Remember that the term *weight* is just a faster way of saying the *force of gravity*, which is faster way of saying:

force of gravity on the backpack => the earth pulling down on the backpack



- d. So what is the reaction to the weight of the backpack?

The backpack pulling up on the earth

- e. Hopefully, you said the other force on the backpack was the *normal force*. Remember that the term *normal force* is just a faster way of saying:

normal force on the backpack => the ground pushing up on the backpack

- f. So what is the reaction to the normal force on the backpack?

The backpack pushing down on the ground.

13. In general, what is the reaction to the weight of an object?

The object pulling up on the earth.

14. A bug collides with a car on the highway.

- a. Who experiences the greater impact force? Explain.

The same! That is Newton's 3rd Law!

- b. Who experiences the greater acceleration? Explain.

The bug! The bug has a much smaller mass so it has a much greater acceleration.