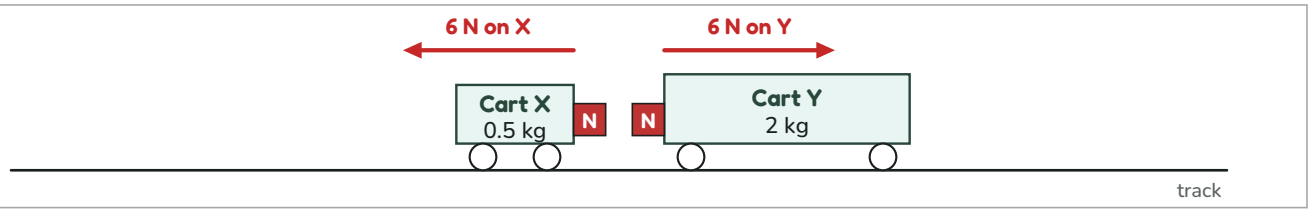
Newton's Third Law: Find the Partner Force

Grades 6-8

Name _____ Date _____

Directions: Forces come two at a time. If object A pushes or pulls object B, then B pushes or pulls A just as hard the other way. For items 1 to 4, name the partner force: both objects, then the way it points.



For item 6: two carts on a level track, let go at the same moment. Their magnets repel. Ignore friction.

1. A motorboat propeller shoves water backward, toward the stern. Partner force: _____ pushes on _____, direction: _____

2. A bowling ball rolling east strikes a pin and pushes it east. Partner force: _____ pushes on _____, direction: _____

3. A basketball lands on a gym floor and presses down on the boards. Partner force: _____ pushes on _____, direction: _____

4. Gravity pairs work without touching. Earth pulls a falling hailstone downward. Partner force: _____ pulls on _____, direction: _____

5. A lantern hangs still from a hook. Gravity pulls the lantern down and the hook pulls it up with equal strength. Kira calls these two an action-reaction pair. Explain why she is wrong, and name the real partner of the hook's pull.

6. Use the diagram. The magnets push both carts for the same short time. (a) Mass of cart Y ÷ mass of cart X: _____ (b) Which cart gains more speed during the push? _____ (c) The forces match, so why does one cart speed up more than the other?

7. A spring launcher is bolted to the deck of a toy boat floating at rest in a tub. It fires a steel marble toward the east. Describe what the boat does, name the two forces in the pair, and tell which object ends up moving faster.

8. Design item. A loaded ferry sometimes bumps a concrete pier while docking. A stop that takes longer needs less force. Describe one thing to add to the pier that stretches out the stop, and explain how it protects BOTH ferry and pier.

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Answer key

Items 1 to 4: two points each, one for naming both objects in the right order and one for the direction. Item 5: two points, one for the reason and one for the partner of the hook's pull. Item 6: three points, one for each part. Items 7 and 8: three points each.

1. **The water pushes on the propeller, forward (toward the bow).**
   Exchange the two names and flip the direction. The forward push of the water on the propeller is what drives the boat.

2. **The pin pushes on the bowling ball, west.**
   Same size as the push of the ball on the pin, even though the pin is the one that goes flying.

3. **The floor (the boards) pushes on the basketball, up.**
   The upward push of the floor on the ball is the force that makes the ball bounce.

4. **The hailstone pulls on Earth, upward (toward the hailstone).**
   Equal in size to the pull of Earth on the hailstone. Earth has so much mass that its motion does not change in any way we could notice.

5. **Both of those forces act on the lantern, and a pair always acts on two different objects. The partner of "hook pulls up on lantern" is "lantern pulls down on hook".**
   Not asked for, but also true: gravity's pull on the lantern has its own partner, the lantern pulling up on Earth. Two equal forces on one object are balanced forces, not a third-law pair.

6. **(a) 2 ÷ 0.5 = 4. (b) Cart X. (c) The mass of cart X is smaller, so an equal 6 N push changes its motion more.**
   The mass of cart Y is 4 times that of cart X, so the same force acting for the same time gives cart Y one quarter of the speed that cart X gains. Equal forces do not mean equal changes in motion.

7. **The boat drifts west. The launcher (boat) pushes the marble east, and the marble pushes the launcher (boat) west equally hard. The marble ends up faster because it has far less mass than the boat.**
   Full credit needs the direction of the boat, both forces with their objects, and mass as the reason for the different speeds.

8. **Sample: hang thick rubber fenders (old tires, rope bundles or air-filled bumpers) along the pier. They squash as the ferry presses in, so the ferry stops over a longer time and the force on its hull is smaller.**
   The pier is protected too: the ferry pushes on the pier exactly as hard as the pier pushes on the ferry, so making one push smaller makes the other smaller. Accept any soft or springy layer with the longer-time reason.