

Chapter 6 Newton's Third Law of Motion

The Law of Action - Reaction

Pre-Test - Post-Test

1. Two people pull on a rope in a tug-of-war. Each pulls with 400 N of force. What is the tension in the rope?

A) Zero	C) 800 N
B) 400 N	D) none of the above.

2. As a ball falls, the action force is the pull of the Earth's mass on the ball. The reaction force is the _____.
 - A) air resistance acting against the falling ball.
 - B) the acceleration of the ball towards the Earth.
 - C) the pull of the ball's mass on the Earth.
 - D) none of these.

3. The attraction of a person's body to the Earth is called weight. The reaction to this force is _____.
 - A) the persons body pushing against the Earth's surface.
 - B) the Earth's surface pushing against the person's body.
 - C) the person's body pulling on the Earth.
 - D) none of these.

4. The force exerted on the tires of a car to accelerate it along the road is exerted by

A) the engine.	C) the road.
B) the tires.	D) not enough information.

5. An unfortunate bug splatters against the windshield of a moving car. Compared to the force of the car on the bug, the force of the bug on the car is _____.

A) smaller.	C) the same.
B) larger.	D) not enough information.

6. A Mack truck and a Volkswagen traveling at the same speed have a head-on collision. The vehicle to undergo the greater change in velocity will be the _____.

A) volkswagen.	C) same for both.
B) mack truck.	D) not enough information.

7. If a horse pulls on a wagon at rest, the wagon pulls back equally as much on the horse. Will the wagon be set into motion?
 - A) Yes, because there is a time delay between action and reaction.
 - B) Yes, because there is a net force acting on the wagon.
 - C) Yes - The horse's pull on the wagon is larger than the wagon's pull on the horse.
 - D) No, because the forces cancel each other.

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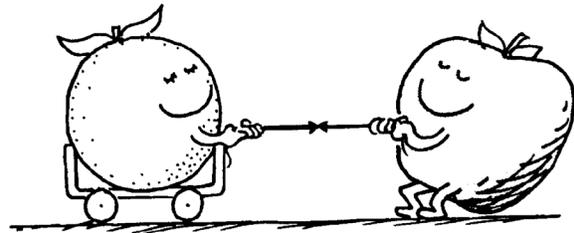
Newton's Third Law of Motion

Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.

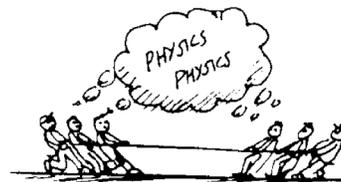
Forces and Interactions

1. Two blocks of different masses are attached by a stretched rubber band. After they are released, which block pulls harder on the other?
2. Newton's third law of motion redefines the meaning of a force, explain.
3. What happens when an object exerts a force on another object?
4. Give a situation in which a force can be applied to an object without the object applying a force back.

7. Why is it easier to walk on a carpeted floor than on a smooth polished floor?
8. How do you win in a game of tug-of-war?

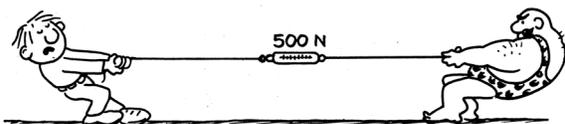


9. In a game of tug-of-war on a smooth floor where the boys team wears socks and the girls team wears rubber soled shoes, who would most likely win regardless of who can pull harder?

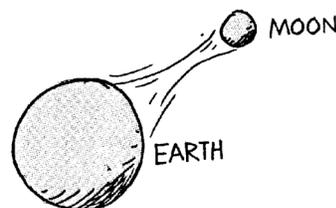


Tug-of-War

5. In a game of tug-of-war who pulls harder, the winning side or the losing side?



10. Who wins when you play tug-of-war on ice?
11. Does the Earth pull on the moon, or does the moon pull on the earth? Which pulls harder?



6. Explain walking in terms of Newton's third law.

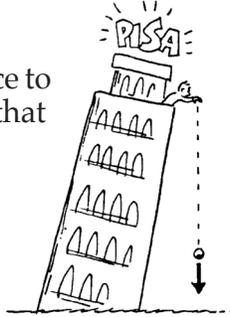
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Gravity

12. What is the reaction force to the gravitational force that acts on a falling object?



13. Your weight is the result of a gravitational force of the earth on your body. What is the corresponding reaction force?

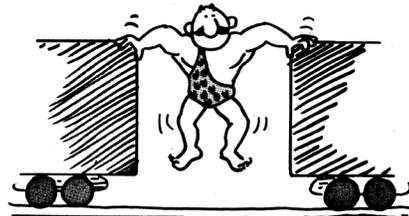


17. Would you care to fire a gun that has a bullet ten times as massive as the gun? Explain.

18. Explain how a rocket works.

19. Give two ways to improve the performance of a rocket.

20. The strong man pushes two initially stationary freight cars of equal mass apart before he himself drops to the ground. Is it possible for him to give either of the cars a greater speed than the other? Explain

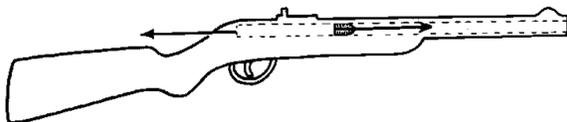


Force, Mass, and Acceleration

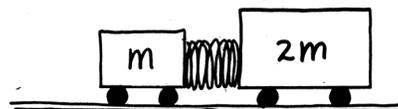
14. When you jump up, the world really does recoil downward. Why can't this motion of the world be noticed?

15. If all forces have an equal and opposite reaction force how is it possible that anything can move?

16. If the forces that act on a bullet and the recoiling gun from which it is fired are equal in magnitude, why do the bullet and gun have very different accelerations? Explain



21. Suppose two carts, one twice as massive as the other, fly apart when a compressed spring is released.



a) On which cart is the force greater?

b) How will the speed of cart 2m compare to the speed of car m?

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22. Two people of equal mass attempt to play tug-of-war on ice. When they pull on the rope they each slide towards one another.

a) How do their accelerations compare?

b) Suppose one person has twice the mass as the other, how far do they each slide before they meet?

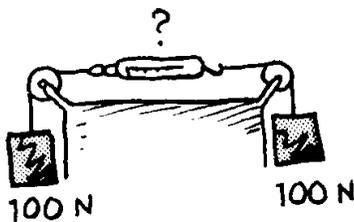
23. If a big truck and small car have a head-on collision.



a) Upon which vehicle is the impact force greater?

b) Which vehicle undergoes the greater change in its motion? Explain your answers.

24. Two 100-N weights are attached to a spring scale as shown. Does the scale read 0, 100, or 200 N, or give some other reading?



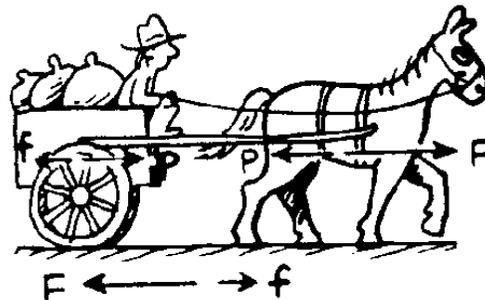
25. Can a dog wag its tail without the tail in turn "wagging the dog"? (Consider a dog with a relatively massive tail.)

26. Why can't a boxer hit a piece of paper in the air with a force of 50 N?

27. Two blocks of different masses are attached by a stretched rubber band. After they are released, which block pulls harder on the other?

The Horse-Cart Problem

28. A horse is urged to pull a milk wagon. The horse refuses to try, citing Newton's third law as his defense: "The pull of the horse on the wagon is opposite and equal to the pull of the wagon on the horse. If I can never exert a force on the wagon greater than it exerts on me, how can I ever start the wagon moving?" asks the horse. How would you reply, knowing that you must deliver the milk or lose your job?



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