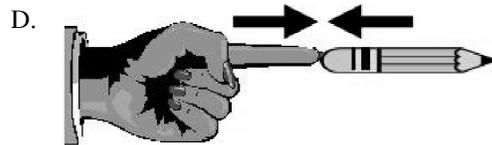
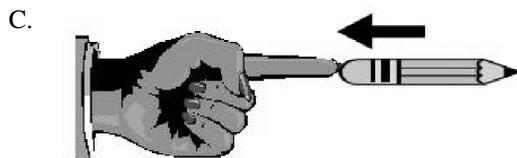
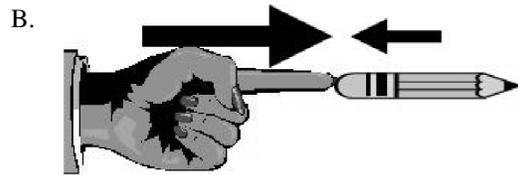
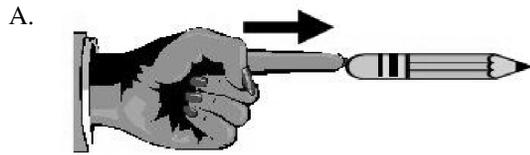


Newton's Laws of Motion Packet

1. Susan gently pushes the tip of her finger against the eraser on her pencil and the pencil does not move. Which of the following figures *best* illustrates the interaction of forces between Susan's finger and her pencil?



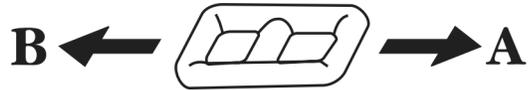
2. The bodies of many cars are designed to compress or crumple during an accident.



Why are cars built with a crumple zone?

- A. The crumple zone is made from cheaper materials, so the car costs less to make.
- B. The crumple zone is made from cheaper materials, so it costs less to repair after an accident.
- C. The crumple zone absorbs the force of an impact, reducing the chance that passengers get injured.
- D. The crumple zone transfers the force of an impact from the car to the object it hits, reducing the chance that passengers will get injured.

3. Use the diagram below to answer the question.



If a person dives out of the raft in the direction indicated by arrow A, the boat will move in the direction indicated by arrow B. Which principle does this illustrate?

- A. Mass can be converted into energy.
 - B. Every action force results in an equal but opposite reaction force.
 - C. Energy is neither created nor destroyed; it only changes form.
 - D. Unless another force is applied, an object in motion will move at a constant speed.
4. A performer pulls a tablecloth out from under a complete set of dinnerware as shown in the illustration below.



Which of the following *best* explains the performer's success at leaving all the dinnerware on the table?

- A. the inertia of the dinnerware
- B. the large mass of the tablecloth
- C. the placement of the dinnerware
- D. the rough material of the tablecloth

5. If each wagon is given the same push, which wagon should go the *fastest*?

A.



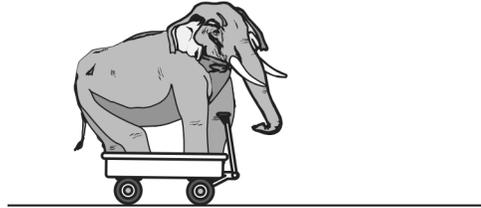
B.



C.



D.



6. A student holds a book at rest in an outstretched hand. The force exerted on the book by the student is equal to the book's

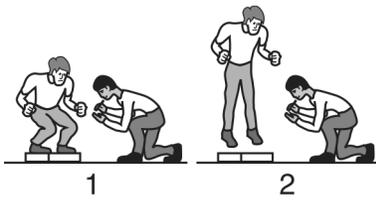
A. mass.

B. weight.

C. volume.

D. density.

7. A student in a lab experiment jumps upward off a common bathroom scale as the lab partner records the scale reading.



What does the lab partner observe during the instant the student pushes off?

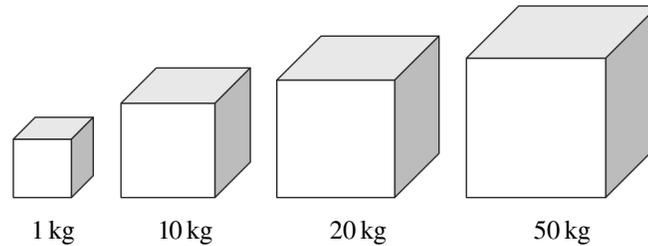
A. The scale reading will remain unchanged during the entire time the student is in contact with the scale.

B. The scale reading will increase momentarily then will decrease as the student is moving upward from the scale.

C. The scale reading will increase during the entire time the student is in contact with the scale.

D. The scale reading will decrease momentarily then will increase as the student is moving upward from the scale.

8. Use the drawing below to answer the following question.



All of the boxes shown above can slide easily. Which box will move farthest if each is struck with the same amount of force?

- A. the 1-kg box B. the 10-kg box C. the 20-kg box D. the 50-kg box

9. **Driving Home Newton's Laws of Motion**

Automobiles, baseballs, skateboards and bicycles — the world is full of things that are in motion. Centuries ago the British physicist Sir Isaac Newton stated three laws that describe the ways in which things move. These are Newton's three laws of motion:

The first law: Unless acted upon by an outside force, a body at rest tends to stay at rest, and a body in motion tends to stay in motion.

The second law: Acceleration is equal to the net force acting on a body divided by its mass.

The third law: For every action force there is an equal and opposite reaction force.

A driver starts her car and steps on the gas pedal. The car gradually accelerates to 50 km/hr. A few minutes later, the driver suddenly slams on the brakes to avoid hitting a box in the road. As the car comes to a stop, the driver's body appears to lurch forward in the seat until it is restrained by the seatbelt.

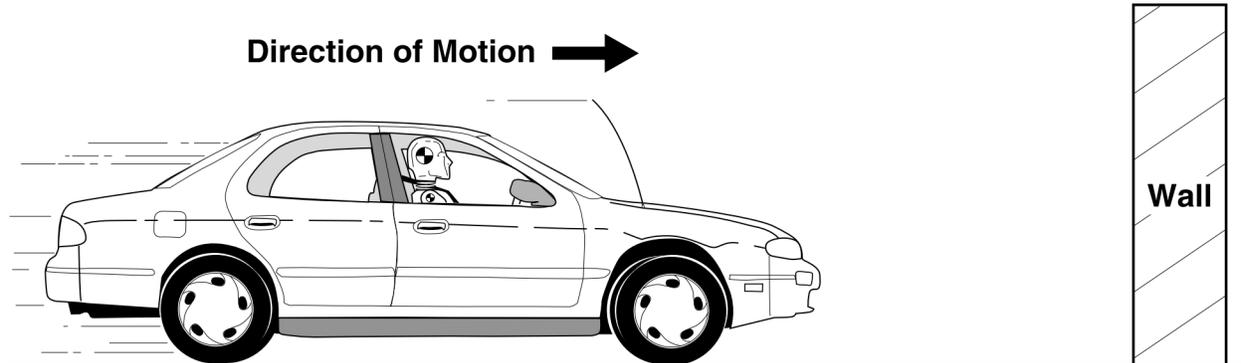
What law *best* explains why the driver's body appears to lurch forward when the brakes are suddenly applied?

- A. Newton's first law B. Newton's second law C. Newton's third law D. The law of gravity

10.

Crash Test Smarties

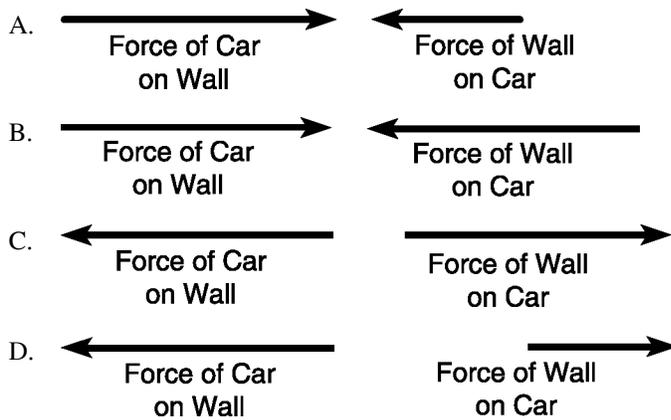
Modern automobiles are tested for collision safety using models of human beings often called crash test dummies. These “dummies” are actually quite “smart.” They are often fitted with sensor devices that can record their motion and force of impact during an automobile collision.



When the car accelerates from a standing start, the crash test dummy appears to be pressed backward into the seat cushions. Which of the following best explains why this happens?

- A. The crash test dummy gets lighter as the car accelerates.
 - B. The car is moving forward faster than the crash test dummy.
 - C. There is no reaction to the force of the car taking off.
 - D. Gravity is pulling the crash test dummy in the direction the car is moving.
11. A car reaches 80 kilometers per hour, then suddenly crashes into the concrete wall. Without a seat belt, the crash test dummy slams into the car's dashboard because _____.
- A. the crash test dummy's kinetic energy drops to zero
 - B. the dash is pushed backwards into the crash test dummy
 - C. the momentum of the car is being transferred to the crash test dummy
 - D. the car has stopped, but the crash test dummy is still moving forward

12. In the diagrams shown below, the length of the arrow indicates the relative amount of force. Which of these diagrams correctly shows the amount and direction of the forces on the wall and the car during the collision?



13. Which equation expresses Newton's second law of motion?

A. $F = ma$

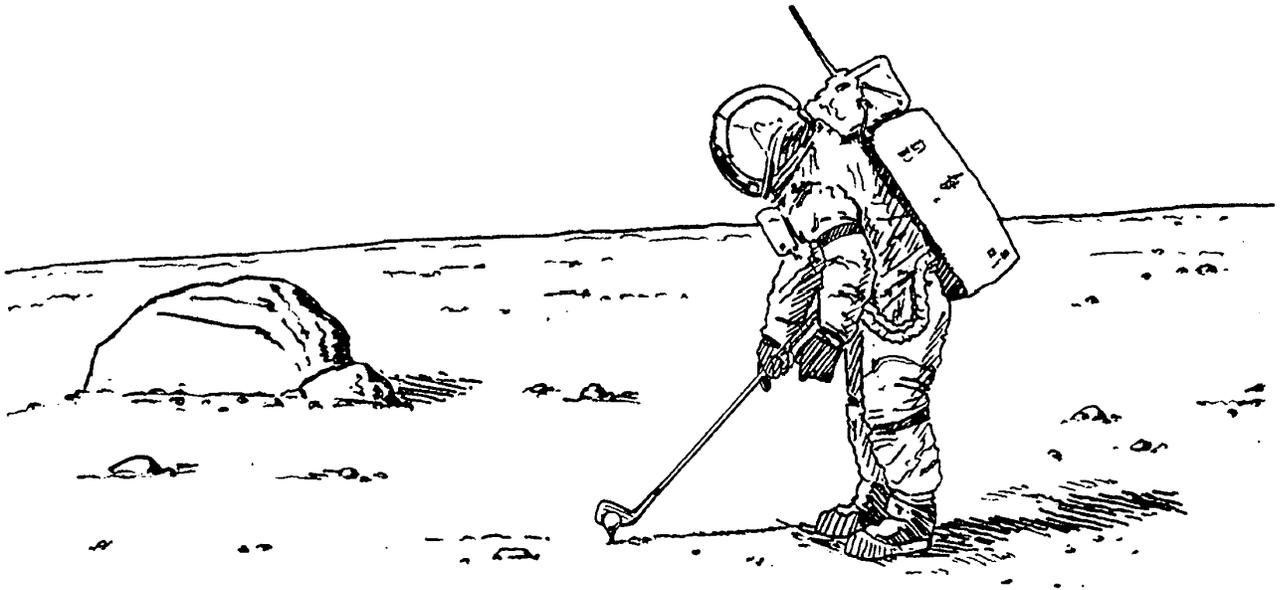
B. $F = \frac{m}{a}$

C. $F = m - a$

D. $F = m + a$

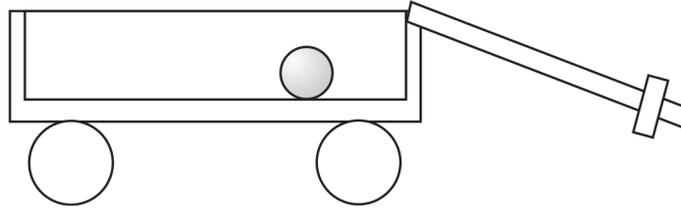
14.

Golfing on the Moon



Explain why a golf ball that is hit on the moon travels much farther than a golf ball that is hit with the same force on the Earth.

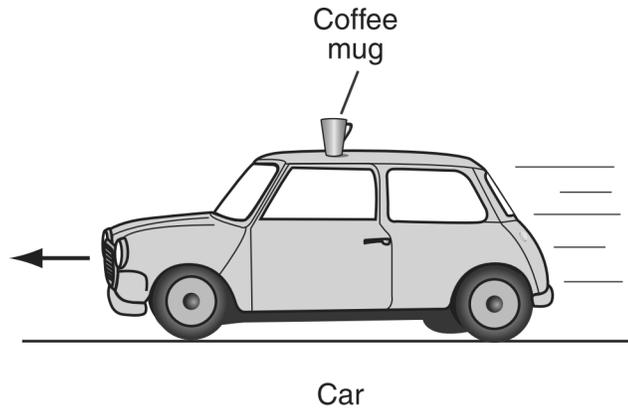
15.



When you pull the wagon forward suddenly, the ball will

- A. hit the front wall. B. hit the back wall. C. fly up in the air. D. stay where it is.

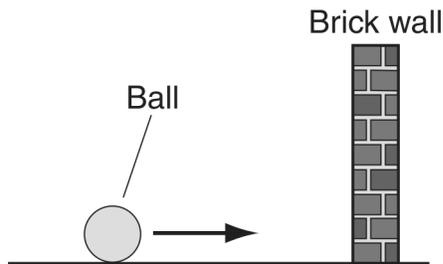
16. A teacher leaves a coffee mug on top of a car, as shown in the diagram below.



The teacher drives the car in a straight line and then stops suddenly. What happens to the coffee mug when the car stops?

- A. The mug moves forward. B. The mug moves backward.
C. The mug moves side to side. D. The mug stays in the same position.

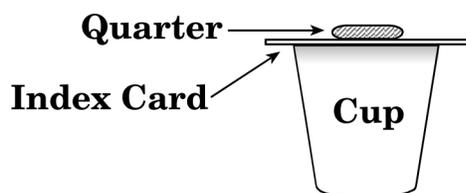
17. The diagram below shows a rubber ball rolling rapidly toward a brick wall.



The ball hits the wall. Which sentence explains what happens next?

- A. The ball moves away from the wall. B. The ball goes through the wall.
C. The ball moves up the wall. D. The ball sticks to the wall.

18. This test paper is sitting at rest on your desk. Which of the following statements best describes this situation?
- A. There are no forces acting on your paper.
 - B. Your paper is at rest in any coordinate system.
 - C. Your paper exerts no force on the desk.
 - D. There are several forces acting on your paper, but they balance each other.
19. Jerry threw a ball into the air. It followed a curved path and soon fell to the ground because
- A. air friction stopped the ball.
 - B. gravity changed the ball's direction.
 - C. the ball was not thrown hard enough.
 - D. the ball was not thrown straight up.
20. A quarter is resting on top of an index card, which has been placed across the top of a small cup.

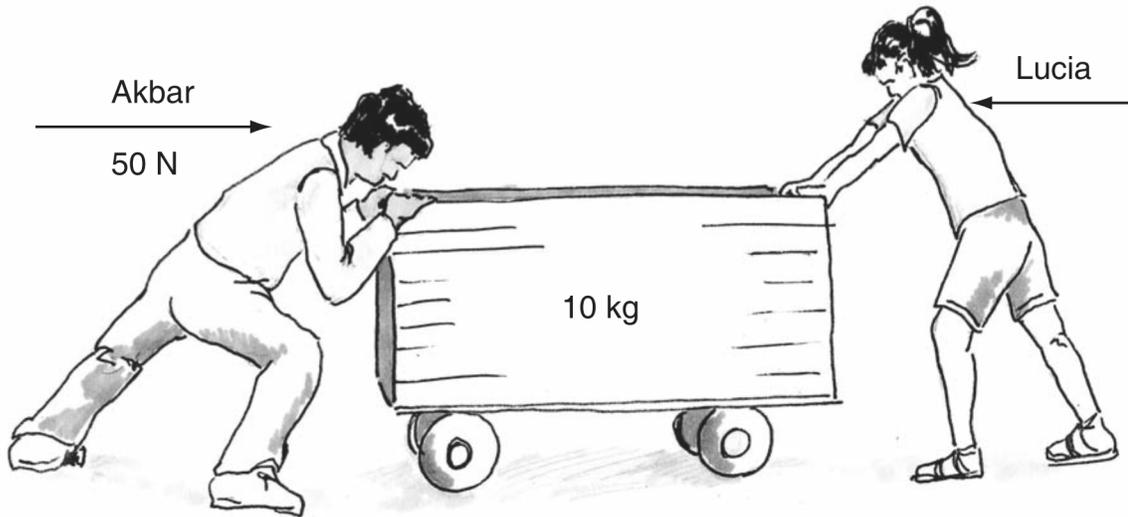


When the card is given a hard horizontal push to the right, what will happen?

- A. The card and quarter will move to the right, off of the cup, and land together.
- B. The card and quarter will move to the right and land on the table, but the quarter will travel farther.
- C. The card will fall off the cup, but the quarter will fall directly into the cup.
- D. The card and quarter will flip off the cup and land upside down on the table.

21. Use the formula and the diagram to answer the following question.

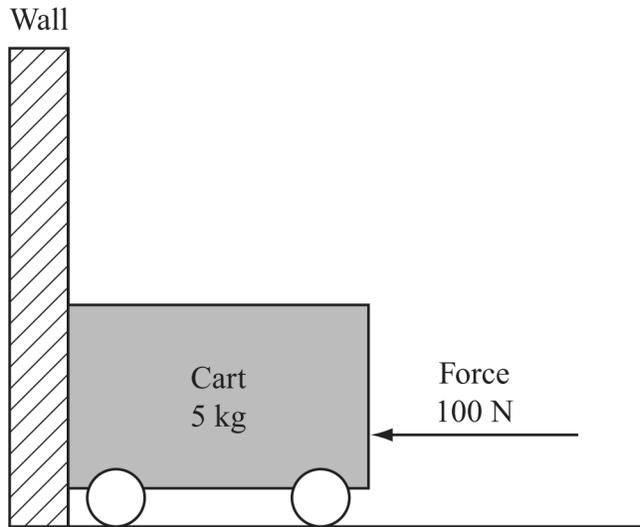
$$\text{force} = \text{mass} \times \text{acceleration}$$



Akbar and Lucia apply opposing forces on a wheeled cart that has a mass of 10 kg. The cart accelerates toward Akbar at a rate of 2 m/s^2 . What is the amount of force applied by Lucia?

- A. 20 newtons B. 30 newtons C. 70 newtons D. 100 newtons
22. The tendency of a stationary object to resist being put into motion is known as
- A. acceleration. B. inertia. C. weight. D. velocity.
23. A hockey player swings her hockey stick and strikes a puck. According to Newton's third law of motion, which of the following is a reaction to the stick pushing on the puck?
- A. the puck pushing on the stick B. the stick pushing on the player
C. the player pushing on the stick D. the puck pushing on the player

24. A cart with a mass of 5 kg rests on a floor next to a wall, as shown in the diagram below.



A person pushes on the cart to the left toward the wall with a force of 100 N. Which of the following statements is true in this situation?

- A. The wall does not push on the cart. B. The floor pushes 100 N up on the cart.
C. The cart pushes 100 N down on the floor. D. The wall pushes 100 N to the right on the cart.
25. A toy cart that has a weight of 10 N moves with a constant velocity of 2 m/s to the right on a horizontal table. According to Newton's laws of motion, which of the following statements is correct?
- A. The table exerts a force of 10 N upward on the toy cart.
B. The toy cart exerts a force of 10 N upward on the table.
C. The toy cart exerts a force of 2 N downward on the table.
D. The table exerts a force of 2 N to the right on the toy cart.
26. Two students are standing next to each other on a level field. One of the students throws a table tennis ball forward toward a line 2.0 m away. At the same time, the second student throws a bowling ball in the same direction. Both balls take the same time to travel the 2.0 m.

Only the second student feels a noticeable backward push when she throws her ball.

Which of the following statements explains why only the second student feels a noticeable backward push?

- A. The bowling ball exerts a much larger reaction force.
B. The bowling ball undergoes a much larger acceleration.
C. The bowling ball requires more force to overcome gravity.
D. The bowling ball converts more inertia into kinetic energy.

27. An object is moving in a straight line at a constant speed.
What will happen to the object if no outside force acts on the object?

- A. The speed and direction of the object will change.
- B. The speed and direction of the object will not change.
- C. The direction of the object will change; the speed will remain constant.
- D. The speed of the object will change; the direction will remain constant.

28. The physical laws discovered by Issac Newton appear to apply

- A. only on the Earth's surface.
- B. only in our Solar System.
- C. most of the time.
- D. always and everywhere in the Universe.

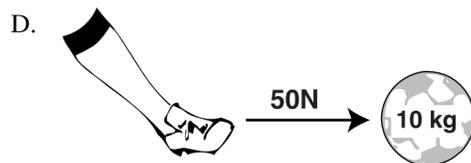
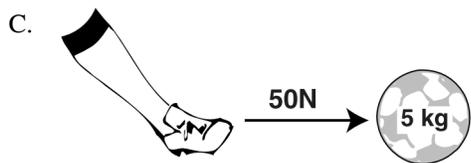
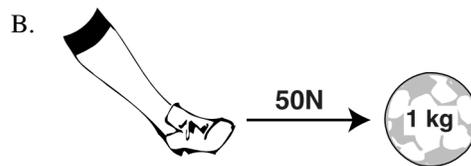
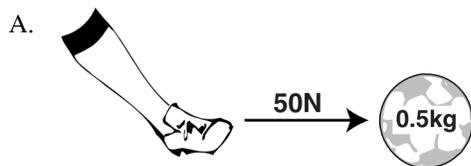
29. A student in a boat decided to go for a swim. He dove off the back of the boat, as shown in the diagram. The boat moved in the direction shown by the arrow.



Which statement *best* explains why the boat moved in the direction shown?

- A. A body in motion tends to remain in motion.
- B. The acceleration of a body is directly proportional to the force applied.
- C. For every action there is an equal and opposite reaction.
- D. Friction on the bottom of the boat was reduced because of the lake water.

30. The illustrations show soccer balls of different masses being kicked with equal force. Which ball will have the greatest acceleration?



35. A probe traveling through outer space is moving at a constant velocity.
Which statement applies to the motion of this probe?
- A. An unbalanced force is acting on the probe, causing it to accelerate.
 - B. The probe will undergo constant acceleration until a force acts on it.
 - C. The probe will continue on its current path until an unbalanced force acts on it.
 - D. The force that makes the probe move through space is equal to its mass divided by its velocity.
36. A force of 5 N is required to increase the speed of a box from a rate of $1.0 \frac{\text{m}}{\text{s}}$ to $3.0 \frac{\text{m}}{\text{s}}$ within 5 s along a level surface. What change would *most* likely require additional force to produce the same results?
- A. reduce the mass of the box
 - B. increase the mass of the box
 - C. make the surfaces of the box smooth
 - D. make the surface of the floor smooth
37. According to Newton's second law of motion, in which of these situations is the object accelerating?
- A. A book on a shelf
 - B. A rock sitting on the ground
 - C. A helium balloon tied to a lamp post
 - D. A ball that has been thrown upward
38. Which situation is explained by Newton's first law of motion?
- A. A basketball bounces upward when it is dropped on the floor.
 - B. You can lift more mass with the same force using a longer lever.
 - C. Even though you stop pedaling your bicycle, you keep moving forward.
 - D. More fuel is required to accelerate a large truck than is required to accelerate a small car.

39. The following picture shows Tasha pulling a wagon holding her brother.

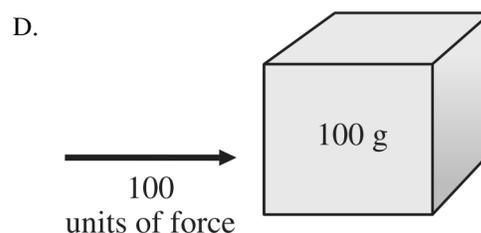
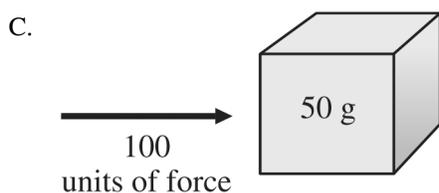
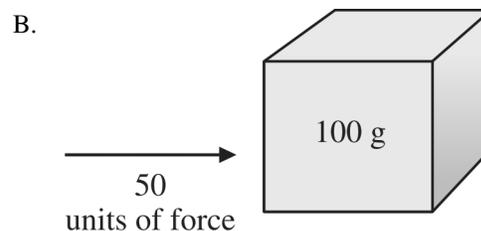
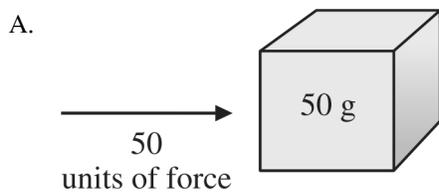


Tasha notices that even though she stops pulling the wagon, her brother's body moves forward. Which of Newton's laws of motion explains Tasha's observation?

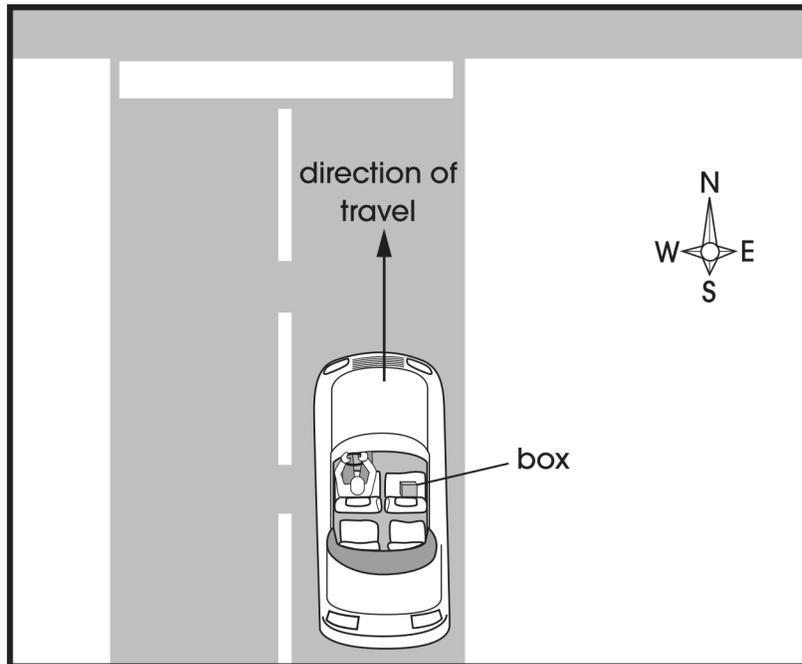
- A. The first law, in which an object moves forward in a straight line unless acted upon by an outside force
 - B. The second law, in which force is a product of an object's acceleration and mass
 - C. The third law, in which every action has an equal and opposite reaction
 - D. The fourth law, in which energy is never lost but is transformed from one object to another
40. Which situation is an example of Newton's third law of motion?
- A. A ball in a vacuum container moves in a straight line at a constant velocity.
 - B. A ball in a vacuum container accelerates when kicked with a great amount of force.
 - C. A person riding in a forward-moving car continues to move forward when the car stops suddenly.
 - D. A person in a canoe moves the paddle backward in the water, and the canoe moves forward in the water.
41. Which of these is one of Newton's laws of motion?
- A. An object's momentum is the product of its mass and velocity.
 - B. A moving object will continue moving until a force acts upon it.
 - C. The force of gravity is proportional to the inverse square of the distance.
 - D. The rate at which an object falls depends on the height from which it is dropped.

42. An object is moving at a constant speed. If a balanced force is applied in the opposite direction the object is moving, what will *most likely* happen?
- A. The object will speed up.
 - B. The object will change direction.
 - C. The object will continue moving at a constant speed.
 - D. The object will slow down and eventually stop moving.
43. If a ball is moved 30 cm by a force, how far will the ball move if the force is tripled?
- A. 30 cm
 - B. 60 cm
 - C. 90 cm
 - D. 120 cm
44. A 100-N force causes an object to accelerate at 2 m/s/s. What is the mass of the object?
- A. 0.02 kg
 - B. 50 kg
 - C. 102 kg
 - D. 200 kg
45. A 100-kg student kicks a 1.5-kg ball with a force of 450 N. What force does the ball apply on the student?
- A. 4.5 N
 - B. 300 N
 - C. 450 N
 - D. 675 N
46. A spaceship in deep space fires its engines for 3 seconds. Which describes its motion at the end of the 3 seconds when the engines are turned off?
- A. It continues to accelerate.
 - B. It moves with a constant speed.
 - C. It moves with increasing speed, then the speed gradually decreases.
 - D. It gradually decreases speed.
47. A 20.0-N physics textbook rests on a table. What is the force the table exerts on the textbook?
- A. 0 N
 - B. 9.80 N
 - C. 20.0 N
 - D. 40.0 N
48. A student is sitting at rest in a chair. How does the force that the student exerts on the chair compare to the force the chair exerts on the student?
- A. the same magnitude and the same direction
 - B. the same magnitude but the opposite direction
 - C. a larger magnitude but the opposite direction
 - D. a smaller magnitude but the same direction

49. A physics student hits a softball with a bat. What is the force exerted on the softball by the bat?
- equal in both size and direction to the force exerted on the bat by the softball
 - equal in size but opposite in direction to the force exerted on the bat by the softball
 - opposite in direction but much smaller than the force exerted on the bat by the softball
 - opposite in direction but much larger than the force exerted on the bat by the softball
50. Kristen pushes an 8 kg ball and a 5 kg ball toward Jeremy. She wants the balls to reach Jeremy at the same time. How does Kristen push the balls?
- She pushes the 8 kg ball more gently than she pushes the 5 kg ball.
 - She pushes the 8 kg ball harder than she pushes the 5 kg ball.
 - She pushes the 8 kg ball in a different direction than she pushes the 5 kg ball.
 - She pushes the 8 kg ball and the 5 kg ball equally.
51. A student is on a train traveling at 60 miles per hour. The student places a basketball on the floor. The basketball remains motionless until the train's brakes are suddenly applied. Which statement describes the motion of the basketball when this occurs?
- The basketball moves forward because it is now moving faster than the train.
 - The basketball moves forward because it is now moving slower than the train.
 - The basketball moves backward because it is now moving faster than the train.
 - The basketball moves backward because it is now moving slower than the train.
52. During a science demonstration, a teacher pushed cubes of different masses with different amounts of force. Which diagram shows the cube that will move most rapidly when pushed with the force represented by the arrow?



53. **Inertia** refers to the tendency of an object at rest to stay at rest, or an object in uniform motion to stay in uniform motion, unless force is applied to the object. Assume that a passenger is riding in a car, and the driver of that car suddenly slams on the brakes. Which of the following best explains why it is a good idea for a passenger to wear a seat belt?
- A. Inertia will keep a passenger moving forward at the same speed as the car before the brakes were applied.
 - B. Inertia will cause the speed of a passenger to decrease.
 - C. Inertia will cause the speed of a passenger to increase.
 - D. Inertia will cause a passenger at rest inside the car to move toward the back of the car.
54. Sir Isaac Newton stated that objects move in a straight line unless some force causes them to change their direction. This law is known as the law of
- A. inertia.
 - B. radiation.
 - C. attraction.
 - D. perpetual motion.
55. A driver is headed north at 50 km/hr. A box is sitting on the seat next to him.

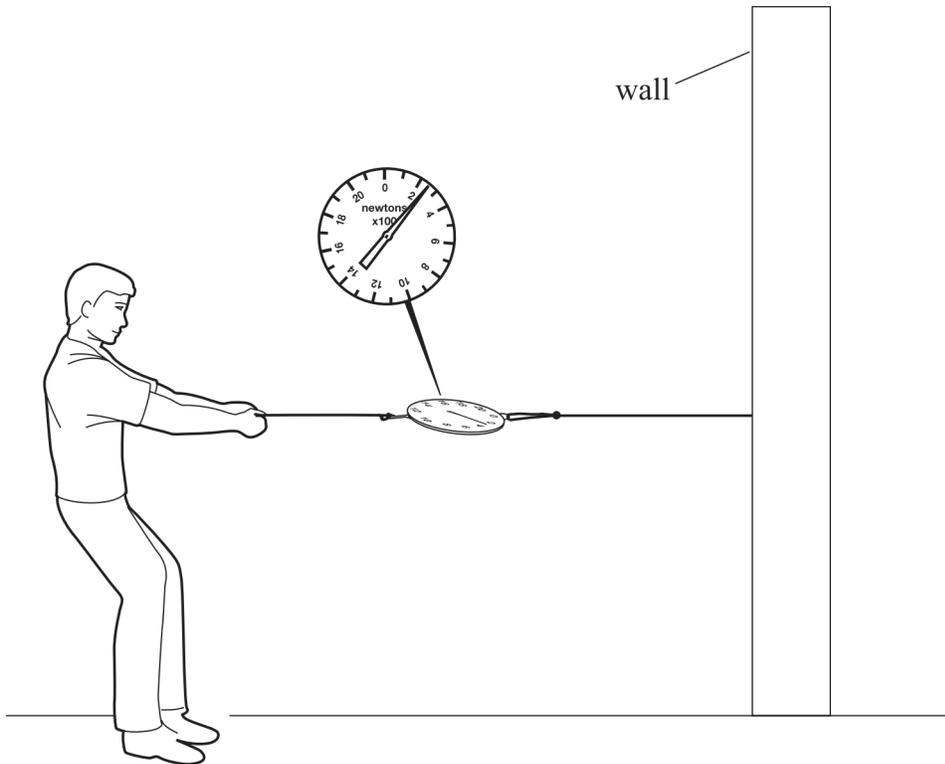


What action by the driver would most likely cause him to observe the box appear to slide to the west?

- A. applying the brakes
- B. speeding up to 60 km/hr
- C. making a turn to the east
- D. making a turn to the west

56. Leshawna used the same force in the same way to push on three boxes. The boxes weighed 3 kg, 5 kg, and 10 kg. Which box moved most quickly, and which moved most slowly?
- A. The 10 kg box moved most quickly; the 3 kg box moved most slowly.
 - B. The 5 kg box moved most quickly; the 10 kg box moved most slowly.
 - C. The 10 kg box moved most quickly; the 5 kg box moved most slowly.
 - D. The 3 kg box moved most quickly; the 10 kg box moved most slowly.
57. Amani was jumping rope. Which of Newton's laws *best* describes why Amani was able to get her body to move up off the ground when she pushed down?
- A. An object at rest remains at rest until an unbalanced force acts on it.
 - B. An object's acceleration is directly proportional to the force acting on it.
 - C. An object exerts an equal and opposite force on another object.
 - D. An object's gravitational force causes an object to fall back toward the Earth.

58. The picture below shows a student pulling on a rope that is attached to a wall. wall



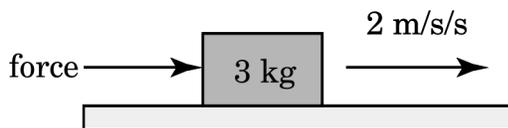
Which statement correctly describes the amount of force applied by the wall as the student continues to apply a 250-newton force?

- A. The wall pulls with a force of 125 newtons against the student.
- B. The wall pulls with a force of 250 newtons against the student.
- C. The wall exerts twice as much force as the student.
- D. The wall exerts no force since it is stationary.

59. A 1500 kg car increases its speed by 2 m/s for each second of travel. What is the net force acting on the car?

- A. 750 N
- B. 1500 N
- C. 3000 N
- D. 6000 N

60. This diagram shows an object being pushed along a frictionless surface. The object accelerates at 2 m/s/s.



What force was applied to the object?

- A. 1 N
- B. 1.5 N
- C. 5 N
- D. 6 N

61. How much force is needed to accelerate a 500.0-kg car at a rate of 4.000 m/s/s?
- A. 125.0 N B. 250.0 N C. 2,000. N D. 4,000. N
62. A 2-kg body of mass is moving on a horizontal frictionless surface with a velocity of 4 m/s. What is the net force required to keep the body moving with the same velocity and direction for 5 s?
- A. 0 N B. 2 N C. 8 N D. 20 N

- | | | | |
|---------|---|---------|---|
| 1. | | 23. | |
| Answer: | D | | |
| 2. | | 24. | |
| Answer: | C | Answer: | D |
| 3. | | 25. | |
| Answer: | B | Answer: | A |
| 4. | | 26. | |
| Answer: | A | Answer: | A |
| 5. | | 27. | |
| Answer: | B | Answer: | B |
| 6. | | 28. | |
| Answer: | B | 29. | |
| 7. | | Answer: | C |
| Answer: | B | 30. | |
| 8. | | Answer: | A |
| Answer: | A | 31. | |
| 9. | | Answer: | A |
| Answer: | A | 32. | |
| 10. | | Answer: | D |
| Answer: | B | 33. | |
| 11. | | Answer: | D |
| 12. | | 34. | |
| 13. | | Answer: | D |
| Answer: | A | 35. | |
| 14. | | Answer: | C |
| 15. | | 36. | |
| Answer: | B | Answer: | B |
| 16. | | 37. | |
| Answer: | A | Answer: | D |
| 17. | | 38. | |
| Answer: | A | Answer: | C |
| 18. | | 39. | |
| 19. | | Answer: | A |
| Answer: | B | 40. | |
| 20. | | Answer: | D |
| Answer: | C | 41. | |
| 21. | | Answer: | B |
| Answer: | C | 42. | |
| 22. | | Answer: | D |
| Answer: | B | | |

43.
Answer: C
44.
Answer: B
45.
Answer: C
46.
Answer: B
47.
Answer: C
48.
Answer: B
49.
Answer: B
50.
Answer: B
51.
Answer: A
52.
Answer: C
53.
Answer: A
54.
Answer: A
55.
Answer: C
56.
Answer: D
57.
Answer: C
58.
Answer: B
59.
Answer: C
60.
Answer: D
61.
Answer: C
62.
Answer: A