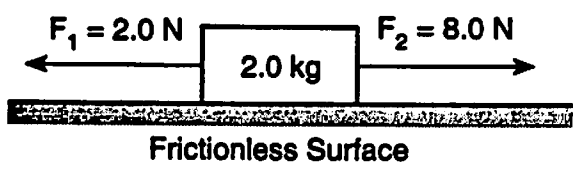1. Two forces are applied to a 2.0-kilogram block on a frictionless, horizontal surface, as shown in the diagram below.

$F_1 = 2.0$ N   2.0 kg $F_2 = 8.0$ N

Frictionless Surface

The acceleration of the block is

(1) 5.0 m/s² to the right
(2) 5.0 m/s² to the left
(3) 3.0 m/s² to the right
(4) 3.0 m/s² to the left

2. Compared to the inertia of a 0.10-kilogram steel ball, the inertia of a 0.20-kilogram Styrofoam ball is

1 one-half as great   3 the same
2 twice as great   4 four times as great

3. A 3.0-kilogram mass weighs 15 newtons at a given point in the Earth's gravitational field. What is the magnitude of the acceleration due to the gravity at this point?

(1) 45 m/s²
(2) 9.8 m/s²
(3) 5.0 m/s²
(4) 0.20 m/s²

4. As shown in the diagram below, an inflated balloon released from rest moves horizontally with velocity v.
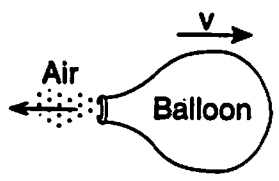
The velocity of the balloon is most likely caused by

1 action-reaction
2 centripetal force
3 gravitational attraction
4 rolling friction

5. In the diagram below, a 0.4-kilogram steel sphere and a 0.1-kilogram wooden sphere are located 2.0 meters above the ground. Both spheres are allowed to fall from rest.

STEEL   WOOD

1.0 m

2.0 m

GROUND
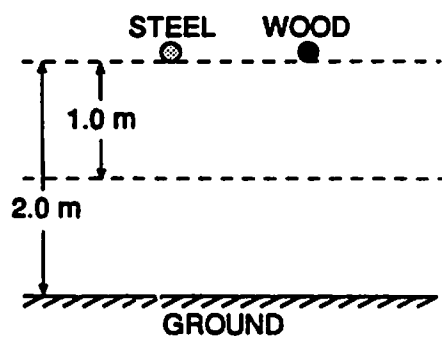
Which statement best describes the spheres after they have fallen 1.0 meter? [Neglect air resistance.]

1 Both spheres have the same speed and momentum.
2 Both spheres have the same speed and the steel sphere has more momentum than the wooden sphere.
3 The steel sphere has greater speed and has less momentum than the wooden sphere.
4 The steel sphere has greater speed than the wooden sphere and both spheres have the same momentum.

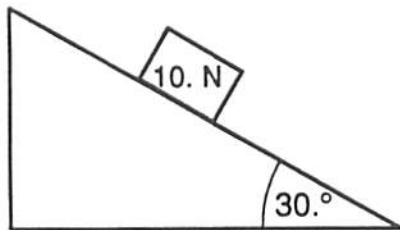6. The graph below shows the weight of three objects on planet X as a function of their mass.

Weight vs. Mass on Planet X
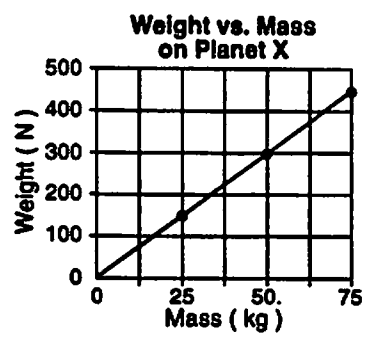
The acceleration due to gravity on planet X is approximately

(1) 0.17 m/s²
(2) 6.0 m/s²
(3) 9.8 m/s²
(4) 50. m/s²

7 The diagram below represents a 10.-newton block sliding down a 30.° incline at a constant speed.

The force of friction on the block is approximately

(1) 5.0 N
(2) 10. N
(3) 49 N
(4) 98 N

8. Which statement explains why a book resting on a table is in equilibrium?

1 There is a net force acting downward on the book.

2 The weight of the book equals the weight of the table.

3 The acceleration due to gravity is 9.8 m/s² for both the book and the table.

4 The weight of the book and the table's upward force on the book are equal in magnitude, but opposite in direction.

Base your answers to questions 9 and 10 on the information below.

A 1,000-kilogram car traveling with a velocity of +20. meters per second decelerates uniformly at –5.0 meters per second² until it comes to rest.

9 What is the total distance the car travels as it decelerates to rest?

(1) 10. m
(2) 20. m
(3) 40. m
(4) 80. m

10 What is the magnitude of the impulse applied to the car to bring it to rest?

(1) 1.0×10^4 N•s
(2) 2.0×10^4 N•s
(3) 3.9×10^4 N•s
(4) 4.3×10^4 N•s

11. Which pair of concurrent forces could produce a resultant force having a magnitude of 10. newtons?

(1) 10. N, 10. N
(2) 10. N, 30. N
(3) 4.7 N, 4.7 N
(4) 4.7 N, 5.0 N

12. The diagram below shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of 60.° with the horizontal ground.
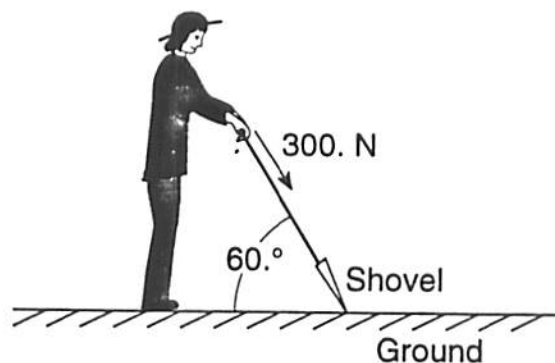
The component of the 300.-newton force that acts perpendicular to the ground is approximately

(1) 150. N
(2) 260. N
(3) 300. N
(4) 350. N

13. Which graph best represents the motion of an object that has no unbalanced force acting on it?
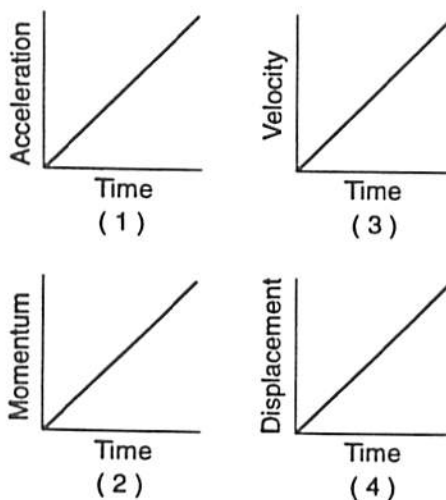
14. The handle of a lawn roller is held at 45° from the horizontal. A force, F, of 28.0 newtons is applied to the handle as the roller is pushed across a level lawn, as shown in the diagram below.
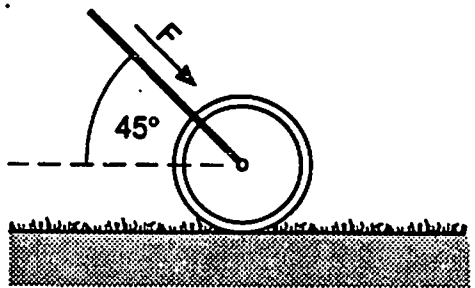
What is the magnitude of the force moving the roller forward?

(1) 7.00 N   (3) 19.3 N
(2) 14.0 N   (4) 39.0 N

15. A 1.0×10^2-kilogram box rests on the bed of a truck that is accelerating at 2.0 meters per second^2. What is the magnitude of the force of friction on the box as it moves with the truck without slipping?

(1) 1.0×10^3 N   (3) 5.0×10^2 N
(2) 2.0×10^2 N   (4) 0.0 N

16. A student weighing 500. newtons stands on a spring scale in an elevator. If the scale reads 520. newtons, the elevator must be

1 accelerating upward
2 accelerating downward
3 moving upward at constant speed
4 moving downward at constant speed

17. A box decelerates as it moves to the right along a horizontal surface, as shown in the diagram at the right. Which vector best represents the force of friction on the box?

(1)   (2)   (3)   (4)

18. Which term represents a vector quantity?
1 work   3 force
2 power   4 distance

19. A river flows due east at 1.5 meters per second. A motorboat leaves the north shore of the river and heads due south at 2.0 meters per second, as shown in the diagram below.
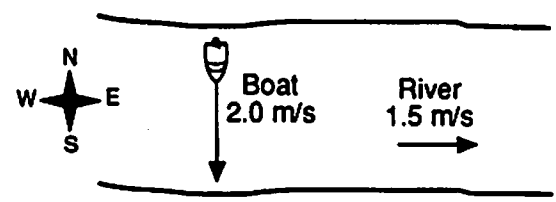

Which vector best represents the resultant velocity of the boat relative to the riverbank?

(1) 2.0 m/s   (2) 2.0 m/s   (3) 3.5 m/s   (4) 2.5 m/s

20. Which combination of concurrent forces could not produce equilibrium?
(1) 10. N, 20. N, and 50. N
(2) 20. N, 30. N, and 50. N
(3) 30. N, 40. N, and 50. N
(4) 40. N, 40. N, and 50. N

21. A 60.-kilogram astronaut weighs 96 newtons on the surface of the Moon. The acceleration due to gravity on the Moon is
(1) 0.0 m/s^2 (3) 4.9 m/s^2
(2) 1.6 m/s^2 (4) 9.8 m/s^2

22. A 150.-newton force, F_1, and a 200.-newton force, F_2, are applied simultaneously to the same point on a large crate resting on a frictionless, horizontal surface. Which diagram shows the forces positioned to give the crate the greatest acceleration?

(1)   (2)   (3)   (4)
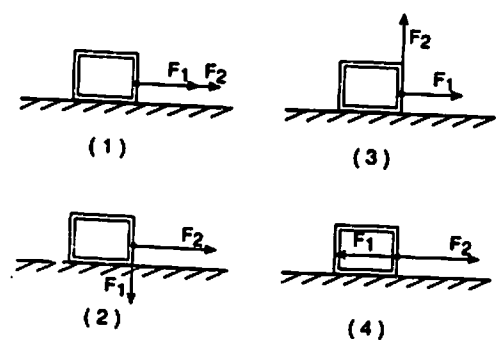
23. What is the magnitude of the net force acting on a 2.0×10^3-kilogram car as it accelerates from rest to a speed of 15 meters per second in 5.0 seconds?

(1) 6.0×10^3 N
(3) 3.0×10^4 N
(2) 2.0×10^4 N
(4) 6.0×10^4 N

24. In the diagram below, surface B of the wooden block has the same texture as surface A, but twice the area of surface A.

Wood block
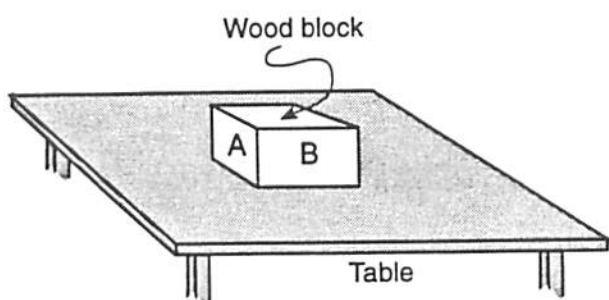
Table

If force F is required to slide the block at constant speed across the table on surface A, approximately what force is required to slide the block at constant speed across the table on surface B?

(1) F
(3) $\frac{1}{2}F$
(2) 2F
(4) 4F

25. A horizontal force is used to pull a 5.0-kilogram cart at a constant speed of 5.0 meters per second across the floor, as shown in the diagram below.
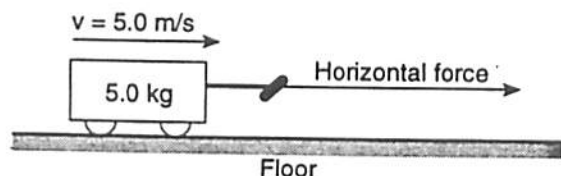
If the force of friction between the cart and the floor is 10. newtons, the magnitude of the horizontal force along the handle of the cart is

(1) 5.0 N
(3) 25 N
(2) 10. N
(4) 50. N

26. The approximate mass of a nickel is
(1) 0.0005 kg
(3) 0.5 kg
(2) 0.005 kg
(4) 5 kg

27. A net force of 5.0×10^2 newtons causes an object to accelerate at a rate of 5.0 meters per second^2. What is the mass of the object?
(1) 1.0×10^2 kg
(3) 6.0×10^2 kg
(2) 2.0×10^{-1} kg
(4) 2.5×10^3 kg

28. The magnitude of the gravitational force between two objects is 20. newtons. If the mass of each object were doubled, the magnitude of the gravitational force between the objects would be
(1) 5.0 N
(3) 20. N
(2) 10. N
(4) 80. N

29. The mass of a space shuttle is approximately 2.0×10^6 kilograms. During lift-off, the net force on the shuttle is 1.0×10^7 newtons directed upward. What is the speed of the shuttle 10. seconds after lift-off? [Neglect air resistance and the mass change of the shuttle.]
(1) 5.0×10^0 m/s
(3) 5.0×10^2 m/s
(2) 5.0×10^1 m/s
(4) 5.0×10^3 m/s

30. A student drops two eggs of equal mass simultaneously from the same height. Egg A lands on the tile floor and breaks. Egg B lands intact, without bouncing, on a foam pad lying on the floor. Compared to the magnitude of the impulse on egg A as it lands, the magnitude of the impulse on egg B as it lands is

1 less
2 greater
3 the same

31. A 2.0-kilogram toy cannon is at rest on a frictionless surface. A remote triggering device causes a 0.005-kilogram projectile to be fired from the cannon. Which equation describes this system after the cannon is fired?

1 mass of cannon + mass of projectile = 0
2 speed of cannon + speed of projectile = 0
3 momentum of cannon + momentum of projectile = 0
4 velocity of cannon + velocity of projectile = 0

32. The magnitude of the gravitational force of attraction between Earth and the Moon is approximately

(1) 2.1×10^{20} N (3) 6.7×10^{-11} N
(2) 6.0×10^{24} N (4) 7.8×10^{28} N

33. Which is a vector quantity?

1 distance   3 speed
2 time   4 acceleration

34. A 3.0-newton force and a 4.0-newton force act concurrently on a point. In which diagram below would the orientation of these forces produce the greatest net force on the point?

(1) 3.0 N / 4.0 N

(3) 3.0 N \ 4.0 N

(2) 3.0 N ⌐ 4.0 N

(4) 3.0 N ⌐ 4.0 N
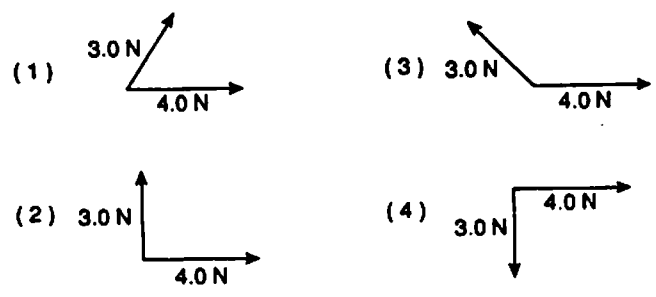
35. As the mass of a body increases, its gravita force of attraction on the Earth

1 decreases
2 increases
3 remains the same

36. A 2-kilogram car and a 3-kilogram car are originally at rest on a horizontal frictionless surface as shown in the diagram below. A compressed spring is released, causing the cars to separate. The 3-kilogram car reaches a maximum speed of 2 meters per second. What is the maximum speed of the 2-kilogram car?

2 kg [spring] 3 kg

(1) 1 m/s   (3) 3 m/s
(2) 2 m/s   (4) 6 m/s

37. If the direction of the momentum of an object is west, the direction of the velocity of the object is

1 north   3 east
2 south   4 west

38. Two forces act on an object concurrently. The resultant will be greatest when the angle between the forces is

(1) 0°   (3) 90°
(2) 60°   (4) 180°

39. Which graph best represents the gravitational force between two point masses as a function of the distance between the masses?
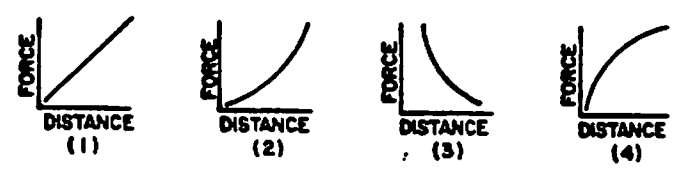
40. A baseball bat moving at high velocity strikes a feather. If air resistance is neglected, compared to the force exerted by the bat on the feather, the force exerted by the feather on the bat will be

1 smaller
2 larger
3 the same

41. An empty wooden crate slides across a warehouse floor. If the crate was filled, the coefficient of kinetic friction between the crate and the floor would (1) decrease (2) increase (3) remain the same

42. An empty wooden crate slides across a warehouse floor. If the crate was filled, the force of kinetic friction between the crate and the floor would (1) decrease (2) increase (3) remain the same

43. As an object initially at rest on a horizontal surface is set in motion, the force of friction between the object and the surface (1) decreases (2) increases (3) remains the same

44. As a thrown baseball is acted on by air friction, the thermal energy of the ball (1) decreases (2) increases (3) remains the same

45. Each of the following diagrams shows a different block being pushed by a force across a surface at constant velocity.

2 kg
2 N
Polished wood

A

6 kg
3 N
Rough wood

C

2 kg
4 N
Smooth wood

B

4 kg
2 N
Glass

D
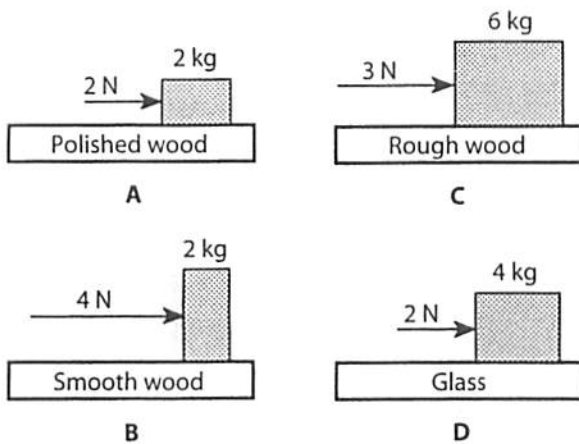
In which two diagrams is the force of friction the same?

46. In the following diagram, surface B of the wooden block has the same texture as surface A, but twice the area of surface A. If force F is required to slide the block at constant speed across the table on surface A, approximately what force is required to slide the block at constant speed across the table on surface B?

Wood block

A   B

Table
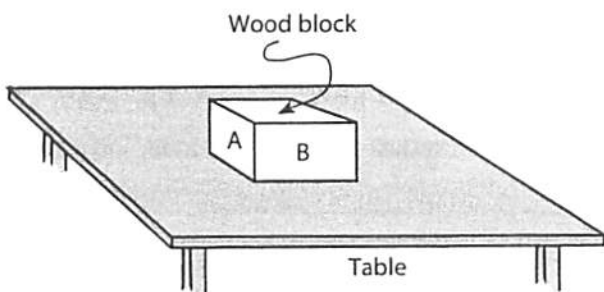
47. The following diagram represents a 10.-newton block sliding down a 30.° incline at constant speed.

10. N

30.°
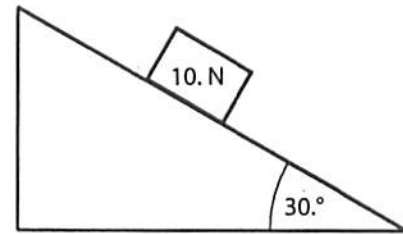
The force of friction on the block is approximately
(1) 5.0 N (2) 10. N (3) 49 N (4) 98 N

48. Sand is often placed on an icy road because the sand (1) decreases the coefficient of friction between the tires of a car and the road (2) increases the coefficient of friction between the tires of a car and the road (3) decreases the gravitational force on a car (4) increases the normal force of a car on the road

A horizontal force is used to pull a 5.0-kilogram cart at a constant speed of 5.0 meters per second across the floor. The force of friction between the cart and the floor is 10. newtons.

v = 5.0 m/s

5.0 kg   Horizontal force

Floor
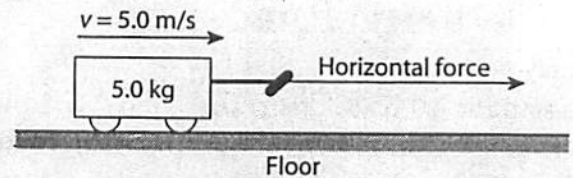
49. What is the magnitude of the horizontal force along the handle of the cart?

50. Determine the weight of the cart.

51. Compare the weight of the cart to the normal force.

52. Determine the coefficient of kinetic friction between the cart and the floor.