

Chapter 5: FORCE AND MOTION — I

1. An example of an inertial reference frame is:
 - A. any reference frame that is not accelerating
 - B. a frame attached to a particle on which there are no forces
 - C. any reference frame that is at rest
 - D. a reference frame attached to the center of the universe
 - E. a reference frame attached to Earthans: B
2. An object moving at constant velocity in an inertial frame must:
 - A. have a net force on it
 - B. eventually stop due to gravity
 - C. not have any force of gravity on it
 - D. have zero net force on it
 - E. have no frictional force on itans: D
3. In SI units a force is numerically equal to the _____, when the force is applied to it.
 - A. velocity of the standard kilogram
 - B. speed of the standard kilogram
 - C. velocity of any object
 - D. acceleration of the standard kilogram
 - E. acceleration of any objectans: D
4. Which of the following quantities is NOT a vector?
 - A. Mass
 - B. Displacement
 - C. Weight
 - D. Acceleration
 - E. Forceans: A
5. A newton is the force:
 - A. of gravity on a 1 kg body
 - B. of gravity on a 1 g body
 - C. that gives a 1 g body an acceleration of 1 cm/s^2
 - D. that gives a 1 kg body an acceleration of 1 m/s^2
 - E. that gives a 1 kg body an acceleration of 9.8 m/s^2ans: D

6. The unit of force called the newton is:
- A. $9.8 \text{ kg} \cdot \text{m/s}^2$
 - B. $1 \text{ kg} \cdot \text{m/s}^2$
 - C. defined by means of Newton's third law
 - D. 1 kg of mass
 - E. 1 kg of force

ans: B

7. A force of 1 N is:

- A. 1 kg/s
- B. $1 \text{ kg} \cdot \text{m/s}$
- C. $1 \text{ kg} \cdot \text{m/s}^2$
- D. $1 \text{ kg} \cdot \text{m}^2/\text{s}$
- E. $1 \text{ kg} \cdot \text{m}^2/\text{s}^2$

ans: C

8. The standard 1-kg mass is attached to a compressed spring and the spring is released. If the mass initially has an acceleration of 5.6 m/s^2 , the force of the spring has a magnitude of:

- A. 2.8 N
- B. 5.6 N
- C. 11.2 N
- D. 0
- E. an undetermined amount

ans: B

9. Acceleration is always in the direction:

- A. of the displacement
- B. of the initial velocity
- C. of the final velocity
- D. of the net force
- E. opposite to the frictional force

ans: D

10. The term "mass" refers to the same physical concept as:

- A. weight
- B. inertia
- C. force
- D. acceleration
- C. volume

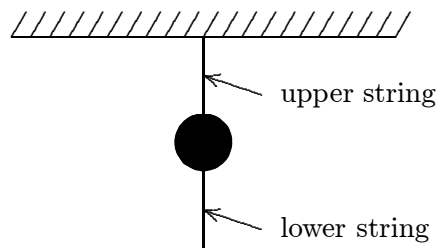
ans: B

11. The inertia of a body tends to cause the body to:

- A. speed up
- B. slow down
- C. resist any change in its motion
- D. fall toward Earth
- E. decelerate due to friction

ans: C

12. A heavy ball is suspended as shown. A quick jerk on the lower string will break that string but a slow pull on the lower string will break the upper string. The first result occurs because:



- A. the force is too small to move the ball
- B. action and reaction is operating
- C. the ball has inertia
- D. air friction holds the ball back
- E. the ball has too much energy

ans: C

13. When a certain force is applied to the standard kilogram its acceleration is 5.0 m/s^2 . When the same force is applied to another object its acceleration is one-fifth as much. The mass of the object is:

- A. 0.2 kg
- B. 0.5 kg
- C. 1.0 kg
- D. 5.0 kg
- E. 10 kg

ans: D

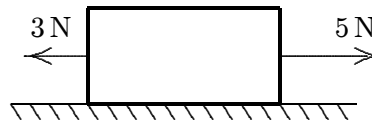
14. Mass differs from weight in that:

- A. all objects have weight but some lack mass
- B. weight is a force and mass is not
- C. the mass of an object is always more than its weight
- D. mass can be expressed only in the metric system
- E. there is no difference

ans: B

15. The mass of a body:
- A. is slightly different at different places on Earth
 - B. is a vector
 - C. is independent of the free-fall acceleration
 - D. is the same for all bodies of the same volume
 - E. can be measured most accurately on a spring scale
- ans: C
16. The mass and weight of a body:
- A. differ by a factor of 9.8
 - B. are identical
 - C. are the same physical quantities expressed in different units
 - D. are both a direct measure of the inertia of the body
 - E. have the same ratio as that of any other body placed at that location
- ans: E
17. An object placed on an equal-arm balance requires 12 kg to balance it. When placed on a spring scale, the scale reads 12 kg. Everything (balance, scale, set of weights and object) is now transported to the Moon where the free-fall acceleration is one-sixth that on Earth. The new readings of the balance and spring scale (respectively) are:
- A. 12 kg, 12 kg
 - B. 2 kg, 2 kg
 - C. 12 kg, 2 kg
 - D. 2 kg, 12 kg
 - E. 12 kg, 72 kg
- ans: C
18. Two objects, one having three times the mass of the other, are dropped from the same height in a vacuum. At the end of their fall, their velocities are equal because:
- A. anything falling in vacuum has constant velocity
 - B. all objects reach the same terminal velocity
 - C. the acceleration of the larger object is three times greater than that of the smaller object
 - D. the force of gravity is the same for both objects
 - E. none of the above
- ans: E
19. A feather and a lead ball are dropped from rest in vacuum on the Moon. The acceleration of the feather is:
- A. more than that of the lead ball
 - B. the same as that of the lead ball
 - C. less than that of the lead ball
 - D. 9.8 m/s^2
 - E. zero since it floats in a vacuum
- ans: B

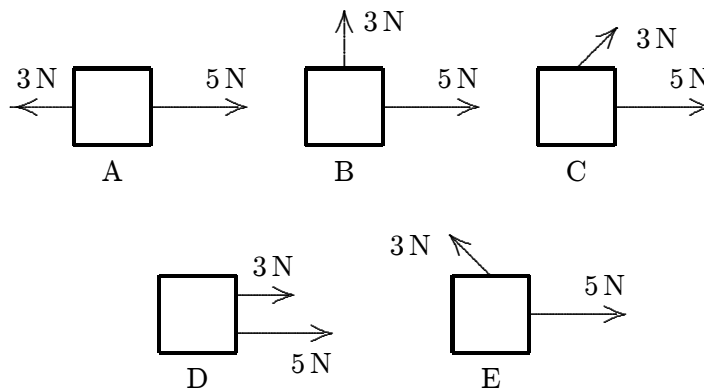
20. The block shown moves with constant velocity on a horizontal surface. Two of the forces on it are shown. A frictional force exerted by the surface is the only other horizontal force on the block. The frictional force is:



- A. 0
- B. 2 N, leftward
- C. 2 N, rightward
- D. slightly more than 2 N, leftward
- E. slightly less than 2 N, leftward

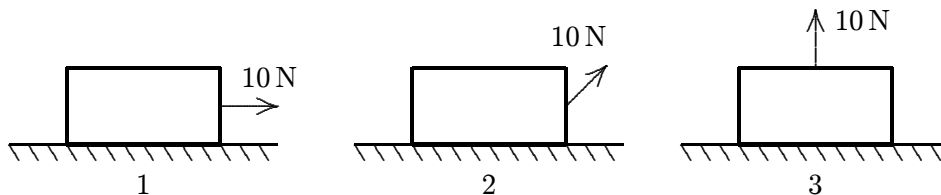
ans: B

21. Two forces, one with a magnitude of 3 N and the other with a magnitude of 5 N, are applied to an object. For which orientations of the forces shown in the diagrams is the magnitude of the acceleration of the object the least?



ans: A

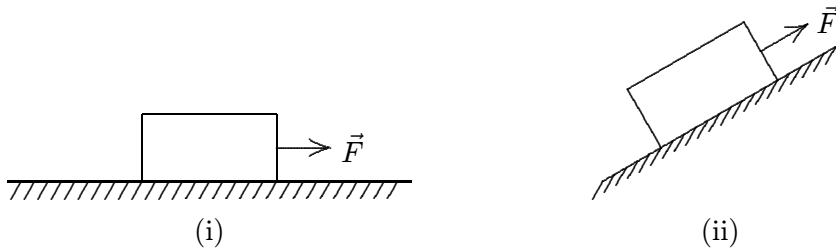
22. A crate rests on a horizontal surface and a woman pulls on it with a 10-N force. Rank the situations shown below according to the magnitude of the normal force exerted by the surface on the crate, least to greatest.



- A. 1, 2, 3
- B. 2, 1, 3
- C. 2, 3, 1
- D. 1, 3, 2
- E. 3, 2, 1

ans: E

23. A heavy wooden block is dragged by a force $\vec{F}$ along a rough steel plate, as shown in the diagrams for two cases. The magnitude of the applied force $\vec{F}$ is the same for both cases. The normal force in (ii), as compared with the normal force in (i) is:



- A. the same
- B. greater
- C. less
- D. less for some angles of the incline and greater for others
- E. less or greater, depending on the magnitude of the applied force $\vec{F}$.

ans: C

24. Equal forces $\vec{F}$ act on isolated bodies A and B. The mass of B is three times that of A. The magnitude of the acceleration of A is:

- A. three times that of B
- B. $1/3$ that of B
- C. the same as B
- D. nine times that of B
- E. $1/9$ that of B

ans: A

25. A car travels east at constant velocity. The net force on the car is:

- A. east
- B. west
- C. up
- D. down
- E. zero

ans: E

26. A constant force of 8.0 N is exerted for 4.0 s on a 16-kg object initially at rest. The change in speed of this object will be:

- A. 0.5 m/s
- B. 2 m/s
- C. 4 m/s
- D. 8 m/s
- E. 32 m/s

ans: B

27. A 6-kg object is moving south. A net force of 12 N north on it results in the object having an acceleration of:
- A. 2 m/s^2 , north
 - B. 2 m/s^2 , south
 - C. 6 m/s^2 , north
 - D. 18 m/s^2 , north
 - E. 18 m/s^2 , south
- ans: A
28. A 9000-N automobile is pushed along a level road by four students who apply a total forward force of 500 N. Neglecting friction, the acceleration of the automobile is:
- A. 0.055 m/s^2
 - B. 0.54 m/s^2
 - C. 1.8 m/s^2
 - D. 9.8 m/s^2
 - E. 18 m/s^2
- ans: B
29. An object rests on a horizontal frictionless surface. A horizontal force of magnitude F is applied. This force produces an acceleration:
- A. only if F is larger than the weight of the object
 - B. only while the object suddenly changes from rest to motion
 - C. always
 - D. only if the inertia of the object decreases
 - E. only if F is increasing
- ans: C
30. A 25-kg crate is pushed across a frictionless horizontal floor with a force of 20 N, directed 20° below the horizontal. The acceleration of the crate is:
- A. 0.27 m/s^2
 - B. 0.75 m/s^2
 - C. 0.80 m/s^2
 - D. 170 m/s^2
 - E. 470 m/s^2
- ans: B
31. A ball with a weight of 1.5 N is thrown at an angle of 30° above the horizontal with an initial speed of 12 m/s . At its highest point, the net force on the ball is:
- A. 9.8 N, 30° below horizontal
 - B. zero
 - C. 9.8 N, up
 - D. 9.8 N, down
 - E. 1.5 N, down
- ans: E

32. Two forces are applied to a 5.0-kg crate; one is 6.0 N to the north and the other is 8.0 N to the west. The magnitude of the acceleration of the crate is:

A. 0.50 m/s^2
B. 2.0 m/s^2
C. 2.8 m/s^2
D. 10 m/s^2
E. 50 m/s^2

ans: B

33. A 400-N steel ball is suspended by a light rope from the ceiling. The tension in the rope is:

A. 400 N
B. 800 N
C. zero
D. 200 N
E. 560 N

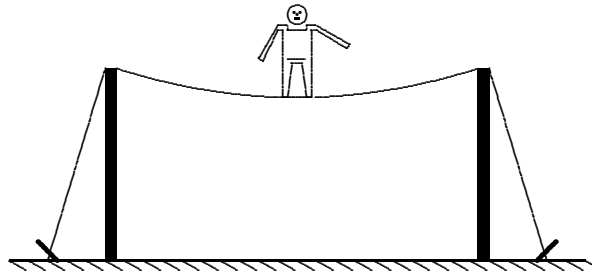
ans: A

34. A heavy steel ball B is suspended by a cord from a block of wood W. The entire system is dropped through the air. Neglecting air resistance, the tension in the cord is:

A. zero
B. the difference in the masses of B and W
C. the difference in the weights of B and W
D. the weight of B
E. none of these

ans: A

35. A circus performer of weight W is walking along a "high wire" as shown. The tension in the wire:



A. is approximately W
B. is approximately $W/2$
C. is much less than W
D. is much more than W
E. depends on whether he stands on one foot or two feet

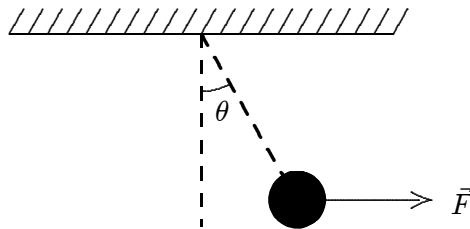
ans: D

36. A 1000-kg elevator is rising and its speed is increasing at 3 m/s^2 . The tension force of the cable on the elevator is:
- A. 6800 N
 - B. 1000 N
 - C. 3000 N
 - D. 9800 N
 - E. 12800 N
- ans: E

- *37. A 5-kg block is suspended by a rope from the ceiling of an elevator as the elevator accelerates downward at 3.0 m/s^2 . The tension force of the rope on the block is:
- A. 15 N, up
 - B. 34 N, up
 - C. 34 N, down
 - D. 64 N, up
 - E. 64 N, down
- ans: B

38. A crane operator lowers a 16,000-N steel ball with a downward acceleration of 3 m/s^2 . The tension force of the cable is:
- A. 4900 N
 - B. 11,000 N
 - C. 16,000 N
 - D. 21,000 N
 - E. 48,000 N
- ans: B

39. A 1-N pendulum bob is held at an angle θ from the vertical by a 2-N horizontal force F as shown. The tension in the string supporting the pendulum bob (in newtons) is:



- A. $\cos \theta$
 - B. $2/\cos \theta$
 - C. $\sqrt{5}$
 - D. 1
 - E. none of these
- ans: C

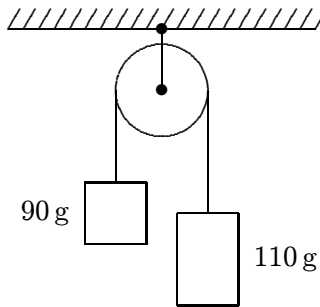
40. A car moves horizontally with a constant acceleration of 3 m/s^2 . A ball is suspended by a string from the ceiling of the car. The ball does not swing, being at rest with respect to the car. What angle does the string make with the vertical?
- A. 17°
 - B. 35°
 - C. 52°
 - D. 73°
 - E. Cannot be found without knowing the length of the string
- ans: A
41. A man weighing 700 N is in an elevator that is accelerating upward at 4 m/s^2 . The force exerted on him by the elevator floor is:
- A. 71 N
 - B. 290 N
 - C. 410 N
 - D. 700 N
 - E. 990 N
- ans: E
42. You stand on a spring scale on the floor of an elevator. Of the following, the scale shows the highest reading when the elevator:
- A. moves upward with increasing speed
 - B. moves upward with decreasing speed
 - C. remains stationary
 - D. moves downward with increasing speed
 - E. moves downward at constant speed
- ans: A
43. You stand on a spring scale on the floor of an elevator. Of the following, the scale shows the highest reading when the elevator:
- A. moves downward with increasing speed
 - B. moves downward with decreasing speed
 - C. remains stationary
 - D. moves upward with decreasing speed
 - E. moves upward at constant speed
- ans: B
44. When a 25-kg crate is pushed across a frictionless horizontal floor with a force of 200 N , directed 20° below the horizontal, the magnitude of the normal force of the floor on the crate is:
- A. 25 N
 - B. 68 N
 - C. 180 N
 - D. 250 N
 - E. 310 N
- ans: E

45. A block slides down a frictionless plane that makes an angle of 30° with the horizontal. The acceleration of the block is:
- A. 980 cm/s^2
 - B. 566 cm/s^2
 - C. 849 cm/s^2
 - D. zero
 - E. 490 cm/s^2
- ans: E
46. A 25-N crate slides down a frictionless incline that is 25° above the horizontal. The magnitude of the normal force of the incline on the crate is:
- A. 11 N
 - B. 23 N
 - C. 25 N
 - D. 100 N
 - E. 220 N
- ans: B
47. A 25-N crate is held at rest on a frictionless incline by a force that is parallel to the incline. If the incline is 25° above the horizontal the magnitude of the applied force is:
- A. 4.1 N
 - B. 4.6 N
 - C. 8.9 N
 - D. 11 N
 - E. 23 N
- ans: D
48. A 25-N crate is held at rest on a frictionless incline by a force that is parallel to the incline. If the incline is 25° above the horizontal the magnitude of the normal force of the incline on the crate is:
- A. 4.1 N
 - B. 4.6 N
 - C. 8.9 N
 - D. 11 N
 - E. 23 N
- ans: E
49. A 32-N force, parallel to the incline, is required to push a certain crate at constant velocity up a frictionless incline that is 30° above the horizontal. The mass of the crate is:
- A. 3.3 kg
 - B. 3.8 kg
 - C. 5.7 kg
 - D. 6.5 kg
 - E. 160 kg
- ans: D

50. A sled is on an icy (frictionless) slope that is 30° above the horizontal. When a 40-N force, parallel to the incline and directed up the incline, is applied to the sled, the acceleration of the sled is 2.0 m/s^2 , down the incline. The mass of the sled is:
- A. 3.8 kg
 - B. 4.1 kg
 - C. 5.8 kg
 - D. 6.2 kg
 - E. 10 kg
- ans: E
51. When a 40-N force, parallel to the incline and directed up the incline, is applied to a crate on a frictionless incline that is 30° above the horizontal, the acceleration of the crate is 2.0 m/s^2 , up the incline. The mass of the crate is:
- A. 3.8 kg
 - B. 4.1 kg
 - C. 5.8 kg
 - D. 6.2 kg
 - E. 10 kg
- ans: C
52. The “reaction” force does not cancel the “action” force because:
- A. the action force is greater than the reaction force
 - B. they are on different bodies
 - C. they are in the same direction
 - D. the reaction force exists only after the action force is removed
 - E. the reaction force is greater than the action force
- ans: B
53. A book rests on a table, exerting a downward force on the table. The reaction to this force is:
- A. the force of Earth on the book
 - B. the force of the table on the book
 - C. the force of Earth on the table
 - D. the force of the book on Earth
 - E. the inertia of the book
- ans: B
54. A lead block is suspended from your hand by a string. The reaction to the force of gravity on the block is the force exerted by:
- A. the string on the block
 - B. the block on the string
 - C. the string on the hand
 - D. the hand on the string
 - E. the block on Earth
- ans: E

55. A 5-kg concrete block is lowered with a downward acceleration of 2.8 m/s^2 by means of a rope. The force of the block on the rope is:
- A. 14 N, up
 - B. 14 N, down
 - C. 35 N, up
 - D. 35 N, down
 - E. 49 N, up
- ans: D
56. A 90-kg man stands in an elevator that is moving up at a constant speed of 5.0 m/s . The force exerted by him on the floor is about:
- A. zero
 - B. 90 N
 - C. 880 N
 - D. 450 N
 - E. 49 N
- ans: C
57. A 90-kg man stands in an elevator that has a downward acceleration of 1.4 m/s^2 . The force exerted by him on the floor is about:
- A. zero
 - B. 90 N
 - C. 760 N
 - D. 880 N
 - E. 1010 N
- ans: C
58. A 5-kg concrete block is lowered with a downward acceleration of 2.8 m/s^2 by means of a rope. The force of the block on Earth is:
- A. 14 N, up
 - B. 14 N, down
 - C. 35 N, up
 - D. 35 N, down
 - E. 49 N, up
- ans: E

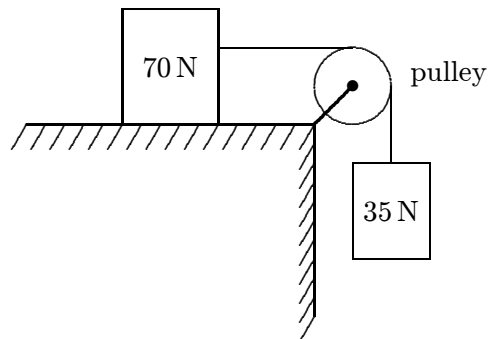
59. Two blocks are connected by a string and pulley as shown. Assuming that the string and pulley are massless, the magnitude of the acceleration of each block is:



- A. 0.049 m/s^2
- B. 0.020 m/s^2
- C. 0.0098 m/s^2
- D. 0.54 m/s^2
- E. 0.98 m/s^2

ans: E

60. A 70-N block and a 35-N block are connected by a string as shown. If the pulley is massless and the surface is frictionless, the magnitude of the acceleration of the 35-N block is:



- A. 1.6 m/s^2
- B. 3.3 m/s^2
- C. 4.9 m/s^2
- D. 6.7 m/s^2
- E. 9.8 m/s^2

ans: B

61. A 13-N weight and a 12-N weight are connected by a massless string over a massless, frictionless pulley. The 13-N weight has a downward acceleration with magnitude equal to that of a freely falling body times:

A. 1
B. $1/12$
C. $1/13$
D. $1/25$
E. $13/25$

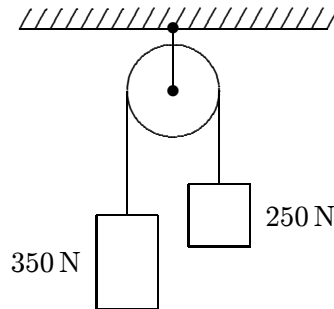
ans: D

62. A massless rope passes over a massless pulley suspended from the ceiling. A 4-kg block is attached to one end and a 5-kg block is attached to the other end. The acceleration of the 5-kg block is:

A. $g/4$
B. $5g/9$
C. $4g/9$
D. $g/5$
E. $g/9$

ans: E

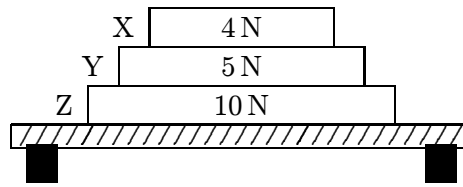
63. Two blocks, weighing 250 N and 350 N, respectively, are connected by a string that passes over a massless pulley as shown. The tension in the string is:



A. 210 N
B. 290 N
C. 410 N
D. 500 N
E. 4900 N

ans: B

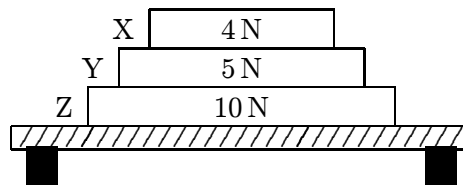
64. Three books (X, Y, and Z) rest on a table. The weight of each book is indicated. The net force acting on book Y is:



- A. 4 N down
- B. 5 N up
- C. 9 N down
- D. zero
- E. none of these

ans: D

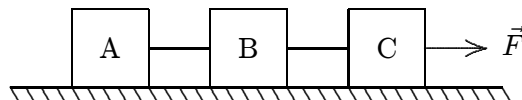
65. Three books (X, Y, and Z) rest on a table. The weight of each book is indicated. The force of book Z on book Y is:



- A. 0
- B. 5 N
- C. 9 N
- D. 14 N
- E. 19 N

ans: C

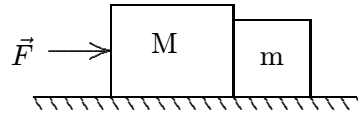
66. Three blocks (A,B,C), each having mass M , are connected by strings as shown. Block C is pulled to the right by a force $\vec{F}$ that causes the entire system to accelerate. Neglecting friction, the net force acting on block B is:



- A. zero
- B. $\vec{F}/3$
- C. $\vec{F}/2$
- D. $2\vec{F}/3$
- E. $\vec{F}$

ans: B

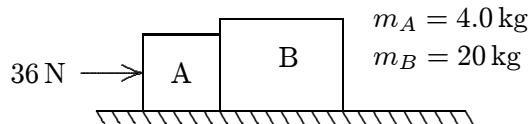
67. Two blocks with masses m and M are pushed along a horizontal frictionless surface by a horizontal applied force $\vec{F}$ as shown. The magnitude of the force of either of these blocks on the other is:



- A. $mF/(m + M)$
- B. mF/M
- C. $mF/(M - m)$
- D. $MF/(M + m)$
- E. MF/m

ans: A

68. Two blocks (A and B) are in contact on a horizontal frictionless surface. A 36-N constant force is applied to A as shown. The magnitude of the force of A on B is:



- A. 1.5 N
- B. 6.0 N
- C. 29 N
- D. 30 N
- E. 36 N

ans: D

69. A short 10-g string is used to pull a 50-g toy across a frictionless horizontal surface. If a 3.0×10^{-2} -N force is applied horizontally to the free end, the force of the string on the toy, at the other end, is:

- A. 0.15 N
- B. 6.0×10^{-3} N
- C. 2.5×10^{-2} N
- D. 3.0×10^{-2} N
- E. 3.5×10^{-2} N

ans: C