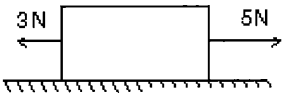
ANSWERS:

1. 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 object

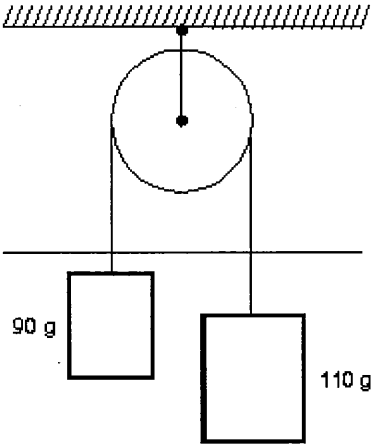
2. The block shown moves with constant velocity on a horizontal surface. Two of the forces on it are shown. A frictional force exerted by the surface is the only other horizontal force on the block. The frictional force is:



A) 0
(B) 2 N, leftward
C) 2 N, rightward
D) slightly more than 2 N, leftward
E) slightly less than 2 N, leftward

3 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

4. 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

5. A 5-kg block is suspended by a rope from the ceiling of an 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

6. A crane operator lowers a 16,000 N steel ball with a downward acceleration of 3 m/s^2. The tension in the cable is:

A) 4900 N
B) 11,000 N
C) 16,000 N
D) 21,000 N
E) 48,000 N

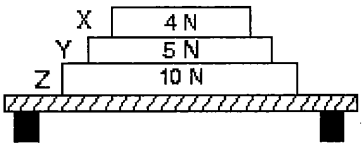
7. A car moves horizontally with a constant acceleration of 3 m/s^2. A ball is suspended by a string from the ceiling of the car; the ball does not swing, being at rest with respect to the car. What angle does the string make with the vertical?

A) 17°
B) 35°
C) 52°
D) 73°
E) Cannot be found without knowing the length of the string

8. 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

9. 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

10. An object moving in a circle at constant speed:
A) must have only one force acting on it
B) is not accelerating
C) is held to its path by centrifugal force
D) has an acceleration of constant magnitude
E) has an acceleration that is tangent to the circle

11. One end of a 1.0-m string is fixed, the other end is attached to a 2.0-kg stone. The stone swings in a vertical circle, passing the top point at 4.0 m/s. The tension force of the string (in newtons) at this point is about:
A) 0
B) 12
C) 20
D) 32
E) 52

12. Two trailers, X with mass 500 kg and Y with mass 2000 kg, are being pulled at the same speed. The ratio of the kinetic energy of Y to that of X is:
A) 1:1
B) 2:1
C) 4:1
D) 9:1
E) 1500:1

13. An object is constrained by a cord to move in a circular path of radius 0.5m on a horizontal frictionless surface. The cord will break if its tension exceeds 16N. The maximum kinetic energy of the object can have is:
A) 4 J
B) 8 J
C) 16 J
D) 32 J
E) 64 J

14. At time $t = 0$ a 2-kg particle has a velocity in m/s of $(4\ \text{m/s})\hat{i} - (3\ \text{m/s})\hat{j}$. At $t = 3$ s its velocity is $(2\ \text{m/s})\hat{i} + (3\ \text{m/s})\hat{j}$. During this time the work done on it was:
A) 4 J
B) –4 J
C) –12 J
D) –40 J
E) $(4\ \text{J})\hat{i} + (36\ \text{J})\hat{j}$

15. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. The total mechanical energy is 0.12 J. The greatest speed of the block is:

A) 0.15 m/s
B) 0.24 m/s
C) 0.49 m/s
D) 0.69 m/s
E) 1.46 m/s

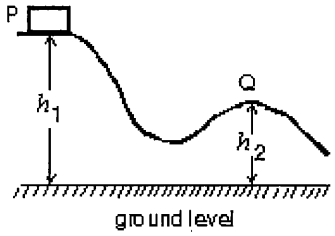
16. A 0.5-kg block slides along a horizontal frictionless surface at 2 m/s. It is brought to rest by compressing a very long spring of spring constant 800 N/m. The maximum spring compression is:

A) 0 cm
B) 3 cm
C) 5 cm
D) 80 cm
E) 80 m

17. The string in the figure is 50 cm long. When the ball is released from rest, it swings along the dotted arc. How fast is it going at the lowest point in its swing?

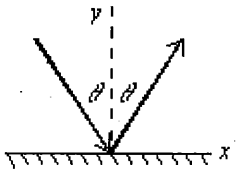
A) 2.0 m/s
B) 2.2 m/s
C) 3.1 m/s
D) 4.4 m/s
E) 6.0 m/s

18. A block is released from rest at point P and slides along the frictionless track shown. At point Q, its speed is:



A) $2g\sqrt{h_1 - h_2}$
B) $2g(h_1 - h_2)$
C) $(h_1 - h_2)/2g$
D) $\sqrt{2g(h_1 - h_2)}$
E) $(h_1 - h_2)^2/2g$

19. A ball hits a wall and rebounds with the same speed, as diagrammed below. The changes in the components of the momentum of the ball are:



A) $\Delta p_x > 0, \Delta p_y > 0$
B) $\Delta p_x < 0, \Delta p_y > 0$
C) $\Delta p_x = 0, \Delta p_y > 0$
D) $\Delta p_x = 0, \Delta p_y < 0$
E) $\Delta p_x > 0, \Delta p_y < 0$

20. A 0.2 kg rubber ball is dropped from the window of a building. It strikes the sidewalk below at 30 m/s and rebounds up at 20 m/s. The magnitude of the impulse due to the collision with the sidewalk is:

A) 10 N · s
B) 6.0 N · s
C) 2.0 N · s
D) 19.6 N · s
E) 9.8 N · s