Physics for Scientists and Engineers, 4e **(Giancoli)**

Chapter 4 Dynamics: Newton's Laws of Motion

4.1 Conceptual Questions

1) State Newton's first law of motion.
Answer: Every object continues in its state of rest, or of uniform velocity in a straight line, as long as no net force acts on it.
Diff: 1 Page Ref: Sec. 4-2

2) State Newton's second law of motion.
Answer: The acceleration of an object is directly proportional to the net force acting on it, and is inversely proportional to the object's mass. The direction of the acceleration is in the direction of the net force acting on the object.
Diff: 1 Page Ref: Sec. 4-4

3) State Newton's third law of motion.
Answer: Whenever one object exerts a force on a second object, the second exerts an equal force in the opposite direction on the first.
Diff: 1 Page Ref: Sec. 4-5

4) Explain how to draw free-body diagrams.
Answer: Choose one object, and draw an arrow to represent each force acting on it. Include every force acting on that object. Do not show forces that the chosen object exerts on other objects. To help identify each and every force that is exerted on the chosen object, ask what other objects could exert a force on it. If the problem involves more than one object, a separate free-body diagram is needed for each object.
Diff: 1 Page Ref: Sec. 4-7

5) A force is required for an object to accelerate.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-1

6) A force is required to keep an object moving along a horizontal line.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-2

7) If no force is applied to a moving object, it will continue to move with constant speed in a straight line.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-2

8) Newton's First law holds in all reference frames, including inertial reference frames.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-2

9) The mass of an object is fixed, but its weight varies from location to location.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-3

10) The acceleration of an object does not have to be in the same direction as the net force applied to it.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-4

11) The acceleration of an object depends only on the net applied force.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-4

12) The acceleration of an object depends only on the object's mass.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-4

13) Newton's second law is valid only in inertial reference frames.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-4

14) According to Newton's Third Law, "action" and "reaction" forces must always act on the same object.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-5

15) A force exerted by an object does not influence that same object; it only influences the other object on which it is exerted.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-5

16) The force you exert on Earth is insignificant compared to the force Earth exerts on you.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

17) The force of gravity acts on an object only when it is falling.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

18) When an object is at rest on the Earth, the gravitational force disappears.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

19) Weight and normal force are action-reaction pairs.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

20) The normal force is always equal to the force of gravity.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

21) The normal force is always vertical.
Answer: FALSE
Diff: 1 Page Ref: Sec. 4-6

22) An ideal pulley changes the direction of the tension in a string without changing its magnitude.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-7

23) If a cord has negligible mass, the force exerted at one end is transmitted undiminished to each adjacent piece of cord along the entire length to the other end.
Answer: TRUE
Diff: 1 Page Ref: Sec. 4-7

24) In the absence of an external force, a moving object will
A) stop immediately.
B) slow down and eventually come to a stop.
C) gradually speed up until it reaches its terminal velocity.
D) move with constant velocity in a straight line.
E) move with constant velocity in a circular orbit.
Answer: D
Diff: 1 Page Ref: Sec. 4-2

25) An object is moving with constant velocity in a straight line. Which of the following statements is true?
A) A constant force is being applied in the direction of motion.
B) A constant force is being applied in the direction opposite of motion.
C) There are no forces acting on the object.
D) The net force on the object is zero.
E) There is no frictional force acting on the object.
Answer: D
Diff: 1 Page Ref: Sec. 4-2

26) You try to pull an object by tugging on a rope attached to the object with a force $\vec{F}$. The object does not move at all. What does this imply?
A) There are no other forces acting on the object.
B) The inertia of the object prevents it from accelerating.
C) The object has reached its natural state of rest and can no longer be set into motion.
D) The rope is not transmitting the force to the object.
E) There are also one or more other forces that act on the object with a sum $-\vec{F}$.
Answer: E
Diff: 1 Page Ref: Sec. 4-2

27) You are standing in a moving bus, facing forward, and you suddenly move forward as the bus comes to an immediate stop. What force caused you to move forward?
A) force of gravity
B) normal force due to your contact with the floor of the bus
C) force due to static friction between you and the floor of the bus
D) force due to kinetic friction between you and the floor of the bus
E) no forces were responsible for your fall.
Answer: E
Diff: 2 Page Ref: Sec. 4-2

28) A constant net force acts on an object. Describe the motion of the object.
A) constant non-zero velocity.
B) constant non-zero acceleration.
C) increasing acceleration.
D) decreasing acceleration.
E) zero acceleration.
Answer: B
Diff: 1 Page Ref: Sec. 4-4

29) If you exert a force F on an object, the force which the object exerts on you will
A) depend on whether or not the object is moving.
B) depend on whether or not you are moving.
C) depend on your mass.
D) depend on the object's mass.
E) always be -F.
Answer: E
Diff: 1 Page Ref: Sec. 4-5

30) Action-reaction forces are
A) equal in magnitude and point in the same direction.
B) equal in magnitude but point in opposite directions.
C) unequal in magnitude but point in the same direction.
D) unequal in magnitude and point in opposite directions
Answer: B
Diff: 1 Page Ref: Sec. 4-5

31) A golf club hits a golf ball with a force of 2400 N. The golf ball hits the club with a force
A) slightly less than 2400 N.
B) exactly 2400 N.
C) slightly more than 2400 N.
D) close to 0 N.
Answer: B
Diff: 1 Page Ref: Sec. 4-5

32) Your bat hits the ball pitched to you with a 1500-N instantaneous force. The ball hits the bat with an instantaneous force, whose magnitude is
A) somewhat less than 1500 N.
B) somewhat greater than 1500 N.
C) exactly equal to 1500 N.
D) essentially zero.
Answer: C
Diff: 1 Page Ref: Sec. 4-5

33) Two cars collide head-on. At every moment during the collision, the magnitude of the force the first car exerts on the second is exactly equal to the magnitude of the force the second car exerts on the first. This is an example of
A) Newton's first law.
B) Newton's second law.
C) Newton's third law.
D) Newton's law of gravitation.
Answer: C
Diff: 1 Page Ref: Sec. 4-5

34) A horse pulls a cart with force $\vec{F}$. As a result of this force the cart accelerates with constant acceleration. What is the magnitude of the force that the cart exerts on the horse?
A) zero Newtons
B) equal to the magnitude of $\vec{F}$
C) less than the magnitude of $\vec{F}$
D) more than the magnitude of $\vec{F}$
E) cannot be determined without additional information
Answer: B
Diff: 1 Page Ref: Sec. 4-5

35) A 20-ton truck collides with a 1500-lb car and causes a lot of damage to the car.
A) The force of collision on the truck is greater then the force of collision on the car.
B) The force of collision on the truck is equal to the force of collision e on the car.
C) The force of collision on the truck is smaller than the of collision force on the car.
D) The truck did not slow down during the collision.
E) The car did not slow down during the collision.
Answer: B
Diff: 2 Page Ref: Sec. 4-5

36) What does the word "normal" mean in the phrase "normal force"?
A) the force that is usually exerted by a surface
B) the total force exerted by a surface
C) the component of the force exerted by a surface parallel to the surface
D) the component of the force exerted by a surface perpendicular to the surface
E) the force is due to contact between two objects.
Answer: D
Diff: 1 Page Ref: Sec. 4-6

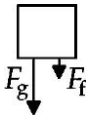
37) An object of weight *W* is in free-fall close to the surface of Earth. What is the force that the object exerts on Earth?
A) a force greater than *W*
B) a force less than *W*
C) a force equal to *W*
D) no force at all
E) cannot be determined without additional information
Answer: C
Diff: 1 Page Ref: Sec. 4-6

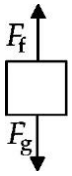
38) A book rests on a level table top. Which force does Newton's third law imply is equal in magnitude but opposite in direction to the weight of the book?
A) the force of the table on the earth
B) the force of the earth on the table
C) the force of the book on the earth
D) the force of the table on the book
E) the force of the book on the table
Answer: C
Diff: 2 Page Ref: Sec. 4-6

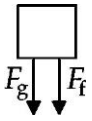
39) An object of mass m sits on a flat table. The Earth pulls on this object with force mg, which we will call the action force. What is the reaction force?
A) The table pushing up on the object with force mg.
B) The object pushing down on the table with force mg.
C) The table pushing down on the floor with force mg.
D) The object pulling upward on the Earth with force mg.
E) The table pulling upward on the Earth with force *mg*.
Answer: D
Diff: 2 Page Ref: Sec. 4-6

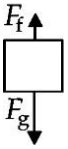
40) You ride on an elevator that is moving upward with constant speed while standing on a bathroom scale. The reading on the scale is
A) equal to your true weight, *mg*.
B) more than your true weight, *mg*.
C) less than your true weight, *mg*.
D) could be more or less than your true weight, *mg*, depending on the value of the speed.
Answer: A
Diff: 1 Page Ref: Sec. 4-7

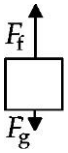
41) You ride on an elevator that is moving with constant upward acceleration while standing on a bathroom scale. The reading on the scale is
A) equal to your true weight, *mg*.
B) more than your true weight, *mg*.
C) less than your true weight, *mg*.
D) could be more or less than your true weight, *mg*, depending on the magnitude of the acceleration.
Answer: B
Diff: 1 Page Ref: Sec. 4-7

42) Which of the following free-body diagrams best represent the free-body diagram, with correct relative force magnitudes, of a person in an elevator that is traveling upward with a constant velocity? F_f is the force of the floor on the person and F_g is the force of gravity on the person.
A) 

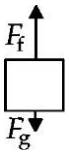
B) 

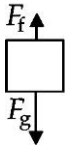
C) 

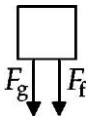
D) 

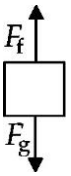
E) 

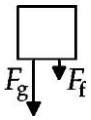
Answer: B
Diff: 1 Page Ref: Sec. 4-7

43) Which of the following free-body diagrams best represent the free-body diagram, with correct relative force magnitudes, of a person in an elevator that is traveling upward with a downward acceleration less than *g*? F_f is the force of the floor on the person and F_g is the force of gravity on the person.
A) 

B) 

C) 

D) 

E) 

Answer: B
Diff: 1 Page Ref: Sec. 4-7

44) A block of mass M slides down a frictionless plane inclined at an angle θ with the horizontal. The normal reaction force exerted by the plane on the block is
A) Mg.
B) Mg sin θ.
C) Mg cos θ.
D) Mg tan θ.
E) zero, since the plane is frictionless.
Answer: C
Diff: 1 Page Ref: Sec. 4-7

45) A block of mass M slides down a frictionless plane inclined at an angle θ with the horizontal. The normal reaction force exerted by the plane on the block is directed
A) parallel to the plane in the same direction as the movement of the block.
B) parallel to the plane in the opposite direction as the movement of the block
C) perpendicular to the plane.
D) toward the center of the Earth.
E) an angle θ above the inclined plane.
Answer: C
Diff: 1 Page Ref: Sec. 4-7

46) An object rests on an inclined surface. If the inclination of the surface is made steeper, what does the normal force on the object do?
A) increase
B) decrease
C) stays the same
D) The normal force is zero.
E) Cannot be determined without additional information.
Answer: B
Diff: 1 Page Ref: Sec. 4-7

47) A block of mass M slides down a frictionless plane inclined at an angle θ with the horizontal. The gravitational force is directed
A) parallel to the plane in the same direction as the movement of the block.
B) parallel to the plane in the opposite direction as the movement of the block
C) perpendicular to the plane.
D) toward the center of the Earth.
E) an angle θ below the inclined plane.
Answer: D
Diff: 1 Page Ref: Sec. 4-7

48) Two objects have masses m and $5m$, respectively. They both are placed side by side on a frictionless inclined plane and allowed to slide down from rest.
A) It takes the lighter object 5 times longer to reach the bottom of the incline than the heavier.
B) It takes the lighter object 10 times longer to reach the bottom of the incline than the heavier.
C) It takes the heavier object 5 times longer to reach the bottom of the incline than the lighter.
D) It takes the heavier object 10 times longer to reach the bottom of the incline than the lighter.
E) The two objects reach the bottom of the incline at the same time.
Answer: E
Diff: 1 Page Ref: Sec. 4-7

49) Two toy cars (16 kg and 2.0 kg) are released simultaneously on an inclined plane that makes an angle of 30° with the horizontal. Make a statement which best describes their acceleration after being released.
A) The 16-kg car accelerates 8 times faster than the 2.0-kg car.
B) The 16-kg car accelerates 2 times faster than the 2.0-kg car.
C) The 2.0-kg car accelerates 8 times faster than the 16-kg car.
D) The 2.0-kg car accelerates 2 times faster than the 16-kg car.
E) Both cars accelerate at the same rate.
Answer: E
Diff: 2 Page Ref: Sec. 4-7

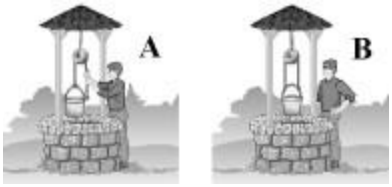
FIGURE 4-1

50) In Fig. 4-1 the scale at left is attached to the ceiling and a mass of 1.00 kg hangs from it. It reads 9.81 N. The identical scale at the right is connected by perfect strings passing over perfect pulleys to two 1.00 kg masses hanging vertically at the end of the strings. The scale at right reads

A) exactly 9.81 N.
B) more than 9.81 N, but not quite twice as much.
C) less than 9.81 N.
D) exactly 19.62 N.
E) more than 19.62 N.

Answer: A
Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-2



51) Compare the two situations shown in Fig. 4-2. On the left (A), James is holding the rope and keeping the bucket at rest. On the right (B), James ties the rope to the bucket so that it keeps the bucket at rest. In both cases the bucket contains the same quantity of water. In what case is the tension in the rope lower?

A) right
B) left
C) It is the same in both cases.
D) need more data to answer

Answer: A
Diff: 2 Page Ref: Sec. 4-7

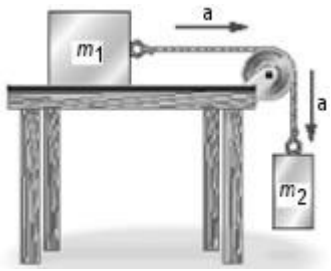
FIGURE 4-3

52) A 16-kg fish is weighed with two spring scales, each of negligible weight, as shown in Fig. 4-3. What will be the readings on the scales?

A) The bottom scale will read 16 kg, and the top scale will read zero.
B) The sum of the two readings will be 32 kg.
C) The top scale will read 16 kg, and the bottom scale will read zero.
D) Each scale will show a reading greater than zero and less than 16 kg, but the sum of the two readings will be 16 kg.
E) Each scale will read 8 kg.

Answer: B
Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-4

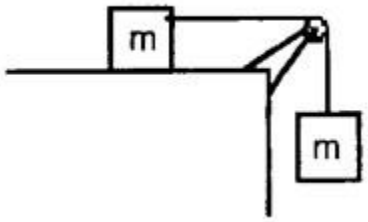


53) Two masses, m_1 and m_2, are connected to each other as shown in Fig. 4-4. Mass m_1 slides without friction on the table surface. Both masses have acceleration of magnitude a as shown. How does the tension in the string compare to the weight, $m_2 g$, of mass m_2?

A) The tension is equal to $m_2 g$.
B) The tension is larger than $m_2 g$.
C) The tension is smaller than $m_2 g$.
D) It depends on m_1 being smaller than m_2.
E) It depends on m_1 being larger than m_2.

Answer: C
Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-5



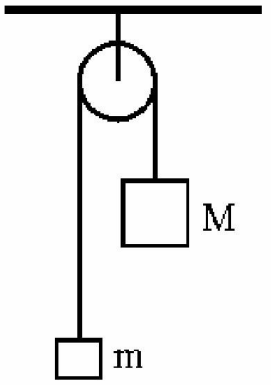
54) Two identical masses are attached by a light string that passes over a small pulley, as shown in Fig. 4-5. The table and the pulley are frictionless. The masses are moving
A) with an acceleration less than g.
B) at constant speed.
C) with an acceleration greater than g.
D) with an acceleration equal to g.
E) with an acceleration that cannot be determined without additional information.
Answer: A
Diff: 2 Page Ref: Sec. 4-7

4.2 Quantitative Problems

1) A block lies on a horizontal frictionless surface. A horizontal force of 100 N is applied to the block giving rise to an acceleration of 3 m/s^2.
(a) Determine the mass of the block.
(b) Calculate the distance the block will travel is the force is applied for 10 s.
(c) Calculate the speed of the block after the force has been applied for 10 s.
Answer: (a) 33 kg
(b) 150 m
(c) 30 m/s
Diff: 2 Page Ref: Sec. 4-4

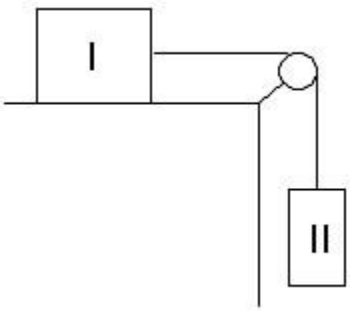
2) A student pulls a box of books on a smooth horizontal floor with a force of 100 N in a direction of 37.0° above the horizontal. The mass of the box and the books is 40.0 kg.
(a) Draw the free-body diagram for the box.
(b) Calculate the acceleration of the box.
(c) Calculate the normal force acting on the box.
Answer: (a) The box is acted on by the force of gravity which points toward the center of the earth. The normal force is directed toward the box perpendicular to the surface of the floor. The pulling force is directed away from the box at an angle 37.0 degrees above the horizontal.
(b) 2.00 m/s^2
(c) 332 N
Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-6



3) In the Atwood machine shown in Fig. 4-6, if M = 0.60 kg and m = 0.40 kg. Ignore friction and the mass of the pulley.
(a) Draw free-body diagrams for mass M and mass m.
(b) Calculate the magnitude of the acceleration of the system.
(c) Calculate the tension in the string.
Answer: (a) The force of gravity and tension act on mass m. The force of gravity and tension act on mass M.
(b) 2.0 m/s^2
(c) 4.7 N
Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-7



4) Two boxes are connected by a cord running over a pulley as shown in Fig. 4-7. Box I of mass 8.0 kg rest on the top of the table; the coefficient of kinetic friction between box I and the table is 0.10. Box II has a mass of 15.0 kg.
(a) Draw the free-body diagrams for the two boxes, identifying all of the forces acting on each of the masses.
(b) Calculate the acceleration of the system.
(c) Calculate the tension in the cord.
Answer: (a) Box one is acted on by the force of gravity in a downward direction, the normal force due to the table top in an upward direction, the tension in the string toward the right, and the force of friction due to the table top toward the left. Box two is acted on by the force of gravity in a downward direction and the tension in the string in an upward direction.
(b) 6.1 m/ s^2
(c) 56 N
Diff: 2 Page Ref: Sec. 4-7

5) A block lies on a smooth inclined plane tilted at an angle of 35° to the horizontal.
(a) Draw the free-body diagram for the block.
(b) Determine the block's acceleration as it slides down the inclined plane.
(c) If the block started from rest 8.5 m up the incline from its base, determine the block's speed when it reaches the bottom of the incline.
(d) How long did it take the block to reach the bottom of the inclined plane?
Answer: (a) The block is acted on by the force of gravity directed downward and the normal force due to the inclined plane directed perpendicular to the inclined surface.
(b) 5.6 m/ s^2
(c) 9.8 m/s
(d) 1.7 s
Diff: 2 Page Ref: Sec. 4-7

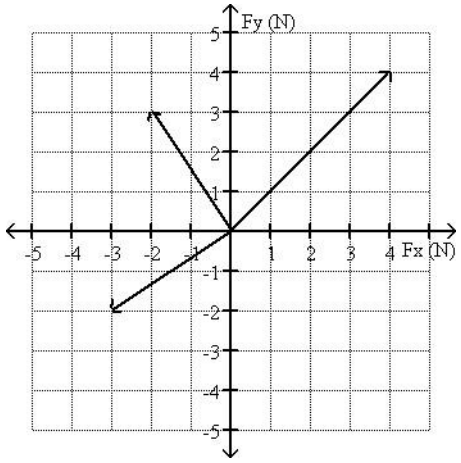
6) A block is pushed up a 20.0° frictionless incline with an initial speed 12.0 m/s.
(a) How high up the plane does the block slide before coming to rest?
(b) How much time does it take to return to its starting position?
Answer: (a) 21.5 m
(b) 7.15 s
Diff: 2 Page Ref: Sec. 4-7

7) Three boxes rest side-by-side on a smooth, horizontal floor. Their masses are 5.0-kg, 3.0-kg, and 2.0-kg, with the 3.0-kg mass in the center. A force of 50 N pushes on the 5.0-kg mass, which pushes against the other two masses.
(a) Draw the free-body diagrams for each of the masses.
(b) What is the contact force between the 5.0-kg mass and the 3.0-kg mass?
(c) What is the contact force between the 3.0-kg and the 2.0-kg mass?
Answer: (a) The following forces act on the 5.0-kg mass: the force due to gravity, normal force, contact force between 5.0-kg mass and 3.0-kg mass, the force of 50 N pushing on the mass. The following forces act on the 3.0-kg force: the force due to gravity, normal force, contact force between the 5.0-kg mass and the 3.0- kg mass, the contact force between the 3.0-kg mass and the 2.0-kg mass. The following forces act on the 2.0-kg mass: the force due to gravity, normal force, contact force between the 3.0-kg mass and the 2.0-kg mass.
(b) 25 N
(c) 10 N
Diff: 3 Page Ref: Sec. 4-7

8) A 2.00-kg object moves with constant velocity 3.00 m/s toward the east. Two forces act on the object. The first is a 40.0 N force toward the west. What is the second force that acts on the object?
A) 23.0 N east B) 40.0 N east C) 26.7 N east D) 46.0 N east E) 46.0 N west
Answer: B
Diff: 1 Page Ref: Sec. 4-2

9) A 1.0-kg object is moving with a constant velocity 2.0 m/s toward the north. There are two forces acting on the object. One of the forces is 2.0 N north. The other force is _____
A) 1.0 N north. B) 3.0 N north. C) 2.0 N south. D) 2.0 N north. E) 0.
Answer: C
Diff: 1 Page Ref: Sec. 4-2

FIGURE 4-8



10) The three forces represented in Fig. 4-8 act on an object. What fourth force must act on the object so that the object does not accelerate?

A) 7.0 N $\hat{i}$ + 2.0 N j

B) 1.0 N $\hat{i}$ - 5.0 N j

C) 3.0 N $\hat{i}$ + 4.0 N j

D) -1.0 N $\hat{i}$ + 5.0 N j

E) 3.0 N $\hat{i}$ - 4.0 N j

Answer: B
Diff: 2 Page Ref: Sec. 4-2

11) A force of 120 N is applied to an object whose mass is 30 kg. The object's acceleration is

A) 3600 m/ s^2. B) 150 m/ s^2. C) 4.0 m/ s^2. D) 2.0 m/ s^2. E) 0.25 m/ s^2.

Answer: C
Diff: 1 Page Ref: Sec. 4-4

12) A 7.0-kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/ s^2 toward the east?

A) 6.0 N east B) 3.0 N west C) 12.0 N east D) 9.0 N west E) 7.0 N west

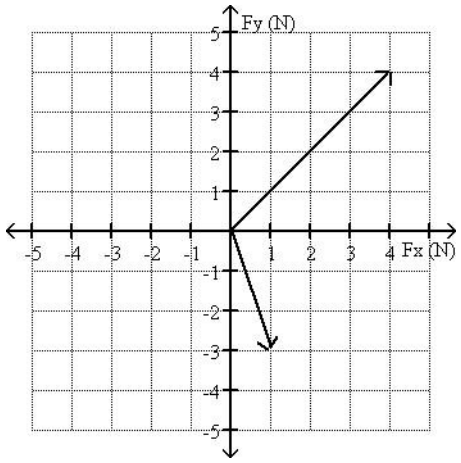
Answer: B
Diff: 1 Page Ref: Sec. 4-4

13) A 1200-kg car starts from rest and accelerates with constant acceleration, traveling 200 m in 9.00 s. What is the force of the road on the car during this acceleration?

A) 1.43 kN B) 3.87 kN C) 5.93 kN D) 4.82 kN E) 11.8 kN

Answer: C
Diff: 1 Page Ref: Sec. 4-4

FIGURE 4-9



14) The two forces indicated in Fig. 4-9 act on a 3.00-kg object. What is the acceleration of the object?

A) (1.67 m/s^2) $\hat{i}$ - (0.333 m/s^2) j

B) (5.00 m/s^2) $\hat{i}$ + (1.00 m/s^2) j

C) (1.67 m/s^2) $\hat{i}$ + (2.333 m/s^2) j

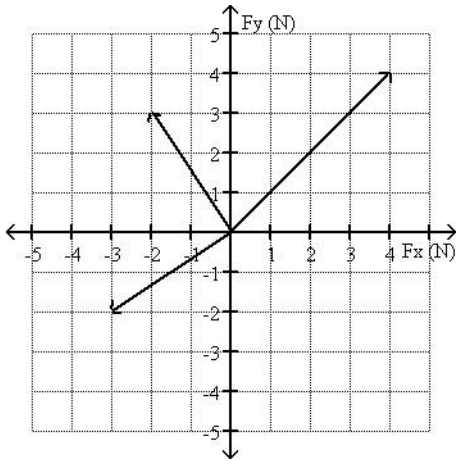
D) (15.0 m/s^2) $\hat{i}$ + (3.00 m/s^2) j

E) (1.67 m/s^2) $\hat{i}$ + (0.333 m/s^2) j

Answer: E

Diff: 2 Page Ref: Sec. 4-4

FIGURE 4-10



15) The three forces represented in Fig. 4-10 act on an object. What is the direction of the acceleration of the object?

A) 11.3° clockwise from the -x-axis

B) 11.3° counterclockwise from the +y-axis

C) 78.7° counterclockwise from the +x-axis

D) 11.3° clockwise from the +y-axis

E) The mass of the object must be known to answer the question.

Answer: B

Diff: 2 Page Ref: Sec. 4-4

16) The following four forces act on a 4.00 kg object:

F_1 = 300 N east

F_2 = 700 N north

F_3 = 500 N west

F_4 = 600 N south

What is the acceleration of the object?

A) 224 N in a direction 63.4° north of west
B) 300 N in a direction 63.4° north of west
C) 300 N in a direction 26.6° north of west
D) 224 N in a direction 26.6° north of west
E) 2100 N in a direction 26.6° north of west

Answer: D
Diff: 2 Page Ref: Sec. 4-4

17) Two forces act on a 4.00-kg object in a manner that the object has an acceleration 3.00 m/s^2 in a direction 20.0° north of east. The first force is 15.00 N in a direction 10.0° west of north. What is the second force?

A) 14.6 N in a direction 28.1° south of east
B) 12.9 N in a direction 28.1° south of east
C) 16.2 N in a direction 30.2° south of east
D) 18.8 N in a direction 41.1° south of east
E) 17.5 N in a direction 37.5° south of east

Answer: E
Diff: 2 Page Ref: Sec. 4-4

18) Starting from rest, a 4.0-kg body reaches a speed of 8.0 m/s in 2.0 s. What is the net force acting on the body?

A) 2.0 N B) 4.0 N C) 8.0 N D) 16 N E) 32 N

Answer: D
Diff: 2 Page Ref: Sec. 4-4

19) A 1000-kg car is driving toward the north along a straight road at a speed of 20.0 m/s. The driver applies the brakes and the car comes to a rest in a distance of 140 m. What is the constant force applied to the car to bring it to rest?

A) 1.43 N north
B) 7.00×10^3 N south
C) 1.43×10^3 N south
D) 1.43 N south
E) 143 N south

Answer: C
Diff: 2 Page Ref: Sec. 4-4

20) A 5.00-kg object is initially at rest. The object is acted on by a 9.00-N force toward the east for 3.00 s. No force acts on the object for the next 4.00 s. How far has the object moved during this 7.00 s interval?

A) 8.10 m B) 29.7 m C) 53.6 m D) 21.7 m E) 16.2 m

Answer: B
Diff: 2 Page Ref: Sec. 4-4

21) Two objects push on each other. The first object has a mass 30.0 kg and it accelerates at 2.00 m/s^2 toward the east. The second object has a mass 7.00 kg. If no other forces are acting on the objects, what is the acceleration of the second object?

A) 4.67 m/s^2 west
B) 1.14 m/s^2 east
C) 2.00 m/s^2 west
D) 8.57 m/s^2 west
E) 4.67 m/s^2 east

Answer: D
Diff: 1 Page Ref: Sec. 4-5

22) The International Space Station has a mass 1.8×10^5 kg. A 70.0-kg astronaut inside the station pushes off one wall of the station so she accelerates at 1.50 m/s^2. What is the magnitude of the acceleration of the space station as the astronaut is pushing off the wall relative to an observer initially at rest relative to the space station before the push?

A) 5.8×10^{-4} m/s^2
B) 1.50 m/s^2
C) 4.7×10^{-4} m/s^2
D) zero
E) 3.9×10^{-3} m/s^2

Answer: A
Diff: 1 Page Ref: Sec. 4-5

23) Object A is acted on by only object B. The mass of object A is 20.0 kg and its acceleration is 4.00 m/s^2 west. Object B is acted on by two forces, the force of object A on object B and another unknown force. If mass of object B is 40.0 kg and the acceleration of object B is 3.00 m/s^2 west, what is the unknown force?

A) 40 N west B) 120 N west C) 80 N east D) 200 N west E) 80 N west

Answer: D
Diff: 2 Page Ref: Sec. 4-5

24) A person has a mass of 45 kg. How much does she weigh on the Moon, where g = 1.62 m/ s^2?

A) 45 N B) 73 N C) 7.4 N D) 220 N E) 440 N

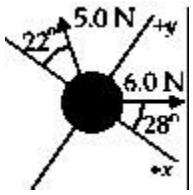
Answer: B
Diff: 1 Page Ref: Sec. 4-6

25) An astronaut weighs 99.0 N on the Moon, where the acceleration of gravity is 1.62 m/ s^2. How much does she weigh on Earth?

A) 16.2 N B) 61.0 N C) 99.0 N D) 600 N E) 440 N

Answer: D
Diff: 1 Page Ref: Sec. 4-6

FIGURE 4-11



26) The free-body diagram of an 8.00 kg object is shown in Fig. 4-11. What is Newton's Second Law for this object?

A) (6.0 N sin 28° - 5.0 N sin 22°) $\hat{i}$ + (6.0 N cos 28° + 5.0 N cos 22°) j = (8.00 kg) $\vec{a}$

B) (6.0 N cos 28° + 5.0 N cos 22°) $\hat{i}$ + (6.0 N sin 28° + 5.0 N sin 22°) j = (8.00 kg) $\vec{a}$

C) (6.0 N cos 28° - 5.0 N sin 22°) $\hat{i}$ + (6.0 N sin 28° + 5.0 N cos 22°) j = (8.00 kg) $\vec{a}$

D) (6.0 N cos 28° - 5.0 N cos 22°) $\hat{i}$ + (6.0 N sin 28° + 5.0 N sin 22°) j = (8.00 kg) $\vec{a}$

E) (6.0 N cos 28° + 5.0 N sin 22°) $\hat{i}$ + (6.0 N sin 28° - 5.0 N cos 22°) j = (8.00 kg) $\vec{a}$

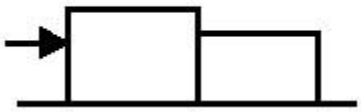
Answer: D
Diff: 1 Page Ref: Sec. 4-7

27) A 4.00-kg block slides down a frictionless inclined plane with an acceleration 3.00 m/s^2. What is the angle of the incline above horizontal?

A) 35.3° B) 45.2° C) 17.8° D) 23.6° E) 53.7°

Answer: C
Diff: 1 Page Ref: Sec. 4-7

FIGURE 4-12



28) A 6.00-kg block is in contact with a 4.00-kg block on a frictionless surface as shown in Fig. 4-12. The 6.00-kg block is being pushed by a 20.0-N force toward the 4.00-kg block. What is the magnitude of the force of the 6.00-kg block on the 4.00-kg block?

A) 6.00 N B) 12.0 N C) 8.00 N D) 4.00 N E) 10.0 N

Answer: C
Diff: 1 Page Ref: Sec. 4-7

29) A 60.0-kg person rides in an elevator while standing on a scale. The scale reads 400 N. What is the acceleration of the elevator?

A) 3.14 m/s^2 downward

B) 6.67 m/s^2 downward

C) zero

D) 9.81 m/s^2 downward

E) 6.67 m/s^2 upward

Answer: A
Diff: 2 Page Ref: Sec. 4-7

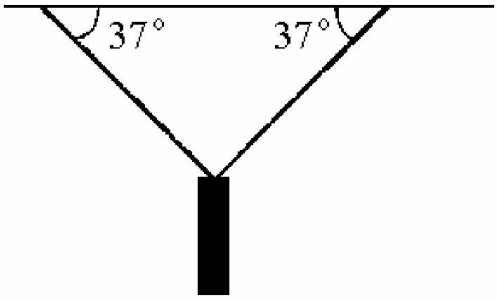
30) A 60.0-kg person rides in elevator while standing on a scale. The elevator has an acceleration 2.00 m/s^2 upward. What is the reading on the scale?

A) 589 N B) 709 N C) 469 N D) zero E) 349 N

Answer: B

Diff: 2 Page Ref: Sec. 4-7

FIGURE 4-13



31) A traffic light of weight 100 N is supported by two ropes as shown in Fig. 4-13. What are the tensions in the ropes?

A) 50 N B) 56 N C) 63 N D) 66 N E) 83 N

Answer: E

Diff: 2 Page Ref: Sec. 4-7

32) An object is on a frictionless inclined plane. The plane is inclined at an angle of 30° with the horizontal. What is the object's acceleration?

A) 0.50 g B) 0.56 g C) 0.68 g D) 0.87 g E) 1.0 g

Answer: A

Diff: 2 Page Ref: Sec. 4-7