***College Physics* (Etkina)**
Chapter 2 Newtonian Mechanics

2.1 Conceptual Questions

1) In a collision between a huge SUV and a small hybrid car, the SUV exerts a larger force on the hybrid than the hybrid exerts on the SUV.
A) True
B) False
C) It depends on whether the collision is a head-on collision or a rear-end collision.
Answer: B
Var: 1

2) A box is placed on a table which rests on the floor. The box pushes on the table; the Newton's third law pair to the the box's push on the table is the table's push on the floor.
A) True
B) False
Answer: B
Var: 1

3) In order to get an object moving, you must push harder on it than it pushes back on you.
A) True
B) False
Answer: B
Var: 1

5) If you pound a feather with a hammer, on which one is a greater force exerted?
A) always the feather
B) always the hammer
C) The magnitude of the force is always exactly the same on both of them.
D) If the feather moves, then the greater force was exerted on it. Otherwise forces of the same magnitude were exerted on both.
Answer: C
Var: 1

6) A satellite is in orbit around the earth. On which one is the greater force exerted?
A) on the satellite because the earth is so much more massive
B) on the earth because the satellite has so little mass
C) Exactly the same magnitude of force is exerted on both Earth and the satellite.
D) It depends on the distance of the satellite from Earth.
Answer: C
Var: 1

7) You pull on a crate with a rope. If the crate moves, the rope's pull on the crate must have been larger than the crate's pull on the rope, but if the crate does not move, both of these pulls must have been equal.
A) True
B) False
Answer: B
Var: 1

8) In order to lift a bucket of concrete, you must pull up harder on the bucket than the bucket pulls down on you.
A) True
B) False
Answer: B
Var: 1

9) If the rockets of a spaceship in outer space (far from all gravity) suddenly lose power and go off, the spaceship will gradually slow to a stop.
A) True
B) False
Answer: B
Var: 1

10) You are in a train traveling on a horizontal track and notice that a piece of luggage starts to slide directly toward the front of the train. From this observation, you can conclude that this train is
A) speeding up.
B) slowing down.
C) changing direction.
D) speeding up and changing direction.
E) slowing down and changing direction.
Answer: B
Var: 1

11) While flying horizontally in an airplane, you notice that a string dangling from the overhead luggage compartment hangs at rest at 15° away from the vertical toward the front of the plane. Using this observation, you can conclude that the airplane is
A) moving forward.
B) moving backward.
C) accelerating forward.
D) accelerating backward.
E) not accelerating because the string is at rest.
Answer: D
Var: 1

12) An elevator suspended by a vertical cable is moving downward but slowing down.
The force that the cable exerts on the elevator must be
A) greater than the force that Earth exerts on the elevator.
B) less than the force that Earth exerts on the elevator.
C) equal to the force that Earth exerts on the elevator.
Answer: A
Var: 1

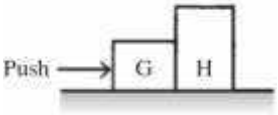
13) A crate is sliding down an inclined ramp at a constant speed of 0.55 m/s. The vector sum of all the forces exerted on this crate must point
A) down the ramp.
B) up the ramp.
C) perpendicular to the ramp.
D) vertically downward.
E) None of the above choices is correct.
Answer: E
Var: 1

14) A bucket is being lowered by a very light rope with a constant downward velocity.
The force that the rope exerts on the bucket must be
A) equal to the force that Earth exerts on the bucket.
B) greater than the force that Earth exerts on the bucket.
C) less than the force that Earth exerts on the bucket.
Answer: A
Var: 1

15) Bill and his daughter Susan are both standing on identical skateboards (with really good

frictionless ball bearings), initially at rest. Bill weighs three times as much as Susan. Bill pushes horizontally on Susan's back, causing Susan to start moving away from Bill. Just after Bill stops pushing,
A) Susan and Bill are moving away from each other, and Susan's speed is three times that of Bill.
B) Susan is moving away from Bill, and Bill is stationary.
C) Susan and Bill are moving away from each other, with equal speeds.
D) Susan and Bill are moving away from each other, and Susan's speed is one-third that of Bill.
Answer: A
Var: 1

16) You push on box G that is next to box H, causing both boxes to slide along the floor, as shown in the figure. The Newton's third law pair to your push is



A) the push of box G on box H.
B) the push of box H on box G.
C) the push of box G against you.
D) the upward force of the floor n box G.
E) the acceleration of box G.
Answer: C
Var: 1

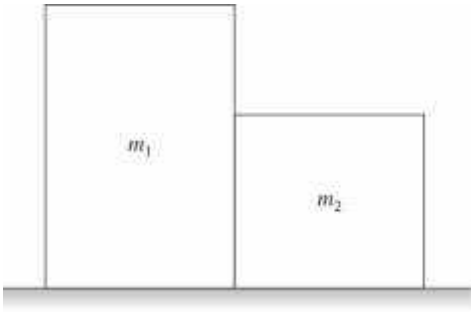
18) An object is moving with constant non-zero velocity. Which of the following statements about it *must* be true?
A) A constant force is being exerted on it in the direction of motion.
B) A constant force is being exerted on it in the direction opposite of motion.
C) A constant force is being exerted on it perpendicular to the direction of motion.
D) The sum of the forces exerted on the object is zero.
E) Its acceleration is in the same direction as it velocity.
Answer: D
Var: 1

19) A 20-ton truck collides with a 1500-lb car. Which of the following statements must be true?
A) During the collision, the force exerted by the car on the truck is greater than the force exerted by the truck on the car.
B) During the collision, the force exerted on the truck by the car is equal to the force exerted on the car by the truck.
C) During the collision, the force that the car exerts on the truck is smaller than the force that he truck exerts on the car.
D) The truck did not slow down during the collision, but the car did.
E) The car did not slow down during the collision, but the truck did.
Answer: B
Var: 1

20) A truck is using a hook to tow a car whose mass is one quarter that of the truck. If the force exerted by the truck on the car is 6000 N, then the force exerted by the car on the truck is
A) 1500 N.
B) 24000 N.
C) 6000 N.
D) 12000 N.
E) We need to know if the car is accelerating to answer this question.
Answer: C
Var: 1

21) A golf club hits a golf ball with a force of 2400 N, sending the ball into the air. The force exerted on the club by the ball must be less than 2400 N or else the ball would not have moved forward.
A) True
B) False
C) The answer depends on whether the golfer followed through with the swing.
Answer: B
Var: 1

22) The figure shows two boxes, with $m_1 > m_2$, that are on a level frictionless surface. We can exert a horizontal force $\vec{\mathbf{F}}$ either toward the right on m_1 or toward the left on m_2. The magnitude of the force that the boxes exert on each other is



A) zero newtons in either case.
B) larger if $\vec{\mathbf{F}}$ is applied toward the right.
C) larger if $\vec{\mathbf{F}}$ is applied toward the left.
D) the same in either case.
Answer: C

Var: 1

23) A horse pulls a cart with force $\vec{F}$. As a result of this force the cart accelerates with constant acceleration. The magnitude of the force that the cart exerts on the horse
A) is zero newtons.
B) is equal to the magnitude of $\vec{F}$.
C) is less than the magnitude of $\vec{F}$.
D) is greater than the magnitude of $\vec{F}$.
E) cannot be determined without knowing the mass of the horse.
Answer: B
Var: 1

24) An object is falling on Earth close to its surface. Earth exerts a force of *W* magnitude on the object. The magnitude of the force that the object exerts on Earth is
A) greater than *W*.
B) less than *W*.
C) equal to *W*.
D) zero.
E) cannot be determined without knowing the relative masses of the object and the earth.
Answer: C
Var: 1

25) An object of mass *m* rests on a flat table. The earth pulls on this object, exerting a force of magnitude *mg*. What is the Newton's third law pair force to this pull?
A) The table pushing up on the object exerting the force *mg*.
B) The object pushing down on the table exerting the force *mg*.
C) The table pushing down on the floor exerting the force *mg*.
D) The object pulling upward on the Earth exerting the force *mg*.
E) The table pulling upward on the Earth exerting the force *mg*.
Answer: D
Var: 1

26) You are standing in a moving bus, facing forward, when you suddenly slide forward as the bus comes to an immediate stop. What force caused you to slide forward from the point of view of the observer on the ground?
A) the force that Earth exerts on you
B) the force exerted by the floor of the bus on you perpendicular to the floor
C) the force exerted by the floor of the bus parallel to the floor (the friction force)
D) There is *not* a force causing you to your fall.
Answer: D
Var: 1

27) A fireman is sliding down a fire pole. As he speeds up, he tightens his grip on the pole, thus increasing the vertical frictional force that the pole exerts on the fireman. When the force exerted on his hands equals the force that Earth exerts on him, what happens to the fireman?
A) The fireman comes to a stop.
B) The fireman descends with slower and slower speed.
C) The fireman descends with a smaller but non-zero acceleration.
D) The fireman continues to descend, but with constant speed.
E) The acceleration of the fireman is now upward.
Answer: D
Var: 1

28) A person is using a rope to lower a 5.0-N bucket into a well with a constant speed of 2.0 m/s. What is the magnitude of the force exerted by the rope on the bucket?
A) 0.00 N
B) 2.0 N
C) 5.0 N
D) 10 N
E) 49 N
Answer: C
Var: 1

29) A person who normally weighs 700 N is riding in a rather swift elevator that is moving at a constant speed of 9.8 m/s. If this person is standing on a bathroom scale inside the elevator, what would the scale read?
A) more than 700 N
B) less than 700 N
C) 700 N
D) It could be more or less than 700 N, depending on whether the elevator is going up or down.
Answer: C
Var: 1

30) A person who normally weighs 700 N is riding in an elevator that is moving upward but slowing down at a steady rate. If this person is standing on a bathroom scale inside the elevator, what would the scale read?
A) more than 700 N
B) less than 700 N
C) 700 N
D) It could be more or less than 700 N, depending on whether the magnitude of the acceleration is greater than or less than 9.8 m/s^2.
Answer: B
Var: 1

31) A 75-N box rests on a perfectly smooth horizontal surface. The minimum force need to start the box moving is
A) 75 N.
B) 7.5 N.
C) 750 N.
D) any horizontal force greater than zero.
Answer: D
Var: 1

32) The acceleration of objects due to the gravitational force exerted on them is lower on the Moon than on Earth. Which one of the following statements is true about the mass and weight of an astronaut on the Moon's surface, compared to Earth?
A) Mass is less, weight is the same.
B) Mass is the same, weight is less.
C) Both mass and weight are less.
D) Both mass and weight are the same.
Answer: B
Var: 1

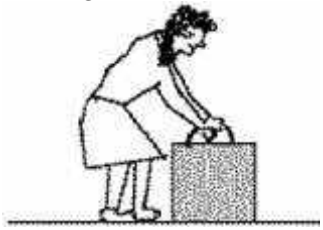
33) When a 45-kg person steps on a scale in an elevator, the scale reads a steady 480 N. Which of the following statements must be true? (There could be more than one correct choice.)
A) The elevator is accelerating upward at a constant rate.
B) The elevator is accelerating downward at a constant rate.
C) The elevator is moving upward at a constant rate.
D) The elevator is moving downward at a constant rate.
E) From the given information, we cannot tell if the elevator is moving up or down.
Answer: A, E
Var: 1

34) When a 45-kg person steps on a scale in an elevator, the scale reads a steady 410 N. Which of the following statements must be true? (There could be more than one correct choice.)
A) The elevator is accelerating upward at a constant rate.
B) The elevator is accelerating downward at a constant rate.
C) The elevator is moving upward at a constant rate.
D) The elevator is moving downward at a constant rate.
E) From the given information, we cannot tell if the elevator is moving up or down.
Answer: B, E
Var: 1

35) In the figure, a 10-lb weight is suspended from two spring scales, each of which has negligible weight. Which one of the following statements about the readings in the scales is true?

A) Each scale will read 5 lb.
B) The top scale will read zero, the lower scale will read 10 lb.
C) The lower scale will read zero, the top scale will read 10 lb.
D) Each scale will show a reading between one and 10 lb, such that the sum of the two is 10 lb. However, exact readings cannot be determined without more information.
E) None of these is true.
Answer: E
Var: 1

36) As shown in the figure, a woman is straining to lift a large crate, but without success because it is too heavy. We denote the forces exerted on the crate as follows: P is the magnitude of the upward force being exerted on the crate by the person, C is the magnitude of the contact force being exerted on the crate by the floor perpendicular to the floor, and W is the the force that Earth exerts on the crate. How are the magnitudes of these forces related while the person is trying unsuccessfully to lift the crate?



A) $P + C = W$
B) $P + C < W$
C) $P + C > W$
D) $P = C$
Answer: A
Var: 1

2.2 Problems

1) What is the mass of an object on which Earth exerts a gravitational force of 685 N near Earth's surface where g = 9.80 m/s^2?
A) 69.9 kg
B) 68.5 kg
C) 71.3 kg
D) 72.7 kg
Answer: A
Var: 50+

2) If I weigh 741 N on Earth at a place where g = 9.80 m/s^2 and 5320 N on the surface of another planet, what is the acceleration of objects due to the gravitational attraction on that planet?
A) 70.4 m/s^2
B) 51.4 m/s^2
C) 61.2 m/s^2
D) 81.0 m/s^2
Answer: A
Var: 50+

3) An astronaut weighs 99 N on the Moon, where the acceleration of objects due to the gravitational attraction is 1.62 m/s^2. How much does she weigh on Earth?
A) 16 N
B) 61 N
C) 99 N
D) 600 N
E) 440 N
Answer: D
Var: 1

4) An object has a mass of 60 kg on Earth. What are the mass and weight of this object on the surface of the Moon where the acceleration of objects due to the gravitational attraction is only 1/6 of what it is on Earth?
Answer: mass = 60 kg, weight = 98 N
Var: 1

5) The sum of the forces exerted on an object of interest is 125 N. As a result, the object accelerates with an acceleration of 24.0 m/s^2. The mass of the object is
A) 3000 kg.
B) 2880 kg.
C) 144 kg.
D) 0.200 kg.
E) 5.21 kg.
Answer: E
Var: 1

6)
If the sum of the forces exerted on a 4.5-kg tool accelerates it at 40 m/s^2, what acceleration would that same sum of the forces give to an 18-kg tool?

A) 180 m/s^2
B) 10 m/s^2
C) 160 m/s^2
D) 9.8 m/s^2
E) 32 m/s^2
Answer: B
Var: 1

7) A block is on a frictionless table, on earth. The block accelerates at 3.0 m/s^2 when a 20 N horizontal force is exerted on it. The block and table are set up on the Moon, where the acceleration of objects due to the gravitational attraction is 1.62 m/s^2. The weight of the block on the Moon is closest to
A) 11 N.
B) 9.5 N.
C) 8.1 N.
D) 6.8 N.
E) 5.5 N.
Answer: A
Var: 50+

8) A block is on a frictionless table, on earth. The block accelerates at 5.3 m/s^2 when a 10 N horizontal force is exerted on it. The block and table are set up on the Moon where the acceleration of objects due to the gravitational attraction is 1.62 m/s^2. A horizontal force of 5 N is now exerted on the block when it is on the Moon. The acceleration of the block due to this force is closest to
A) 2.7 m/s^2.
B) 2.4 m/s^2.
C) 2.9 m/s^2.
D) 3.2 m/s^2.
E) 3.4 m/s^2.
Answer: A
Var: 50+

9) A 40-kg crate is being lowered with a downward acceleration is 2.0 m/s^2 by means of a rope.
(a) What is the magnitude of the force exerted by the rope on the crate?
(b) What would be the magnitude of the force exerted by the rope if the crate were being raised with an acceleration of 2.0 m/s^2?
Answer: (a) 310 N (b) 470 N
Var: 1

10) A 450-kg sports car accelerates from rest to 100 km/h in 4.80 s. What is the magnitude of the net force exerted on a 68.0 kg passenger during the acceleration?
A) 394 N
B) 82.0 N
C) 342 N
D) 311 N
Answer: A
Var: 50

11) On its own, a tow truck has a maximum acceleration of 3.0 m/s^2. What will be its maximum acceleration when the truck is using a light horizontal chain to tow a bus of twice its own mass?
A) 2.5 m/s^2
B) 2.0 m/s^2
C) 1.5 m/s^2
D) 1.0 m/s^2
Answer: D
Var: 1

12) A 75-N object is pulled on a horizontal surface by a horizontal pull of 50 N to the right. The friction force exerted on this object is 30 N to the left. What is the acceleration of the object?
A) 0.27 m/s^2
B) 1.1 m/s^2
C) 2.6 m/s^2
D) 11 m/s^2
Answer: C
Var: 1

13) A 1200-kg car is pulling a 500-kg trailer along level ground. Neglect the friction force exerted by the road on the trailer. The car accelerates with an acceleration of 1.3 m/s^2. What is the force exerted by the car on the trailer?
A) 550 N
B) 600 N
C) 650 N
D) 700 N
E) 750 N
Answer: C
Var: 1

14) In a certain particle accelerator, a proton reaches an acceleration of 9.0×10^{13} m/s^2. The mass of a proton is 1.67×10^{-27} kg. What is the sum of the forces exerted on the proton?
Answer: 1.5×10^{-13} N
Var: 1

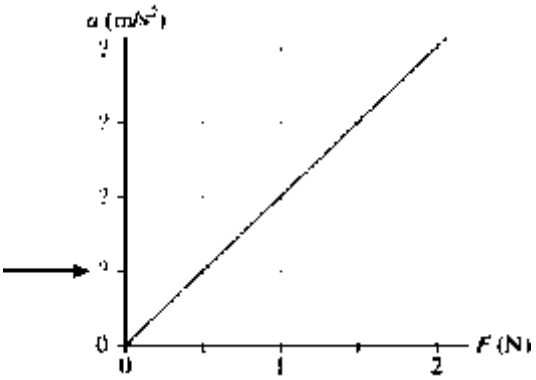
15) During a hard stop, a car and its passengers slow down with an acceleration of 8.0 m/s^2. What magnitude force does a 50-kg passenger exert on the seat belt in such a stop?
Answer: 400 N
Var: 1

16) A flatbed truck is carrying an 800-kg load of timber that is not tied down. The maximum friction force that the truck bed exerts on the load is 2400 N. What is the greatest acceleration that the truck can have without losing its load?
Answer: 3.0 m/s^2
Var: 1

17) A 10-kg object is hanging by a very light wire in an elevator that is traveling upward. The force that the wire exerts on the object is measured to be 75 N. What are the magnitude and direction of the acceleration of the elevator?
Answer: 2.3m/s^2, downward
Var: 1

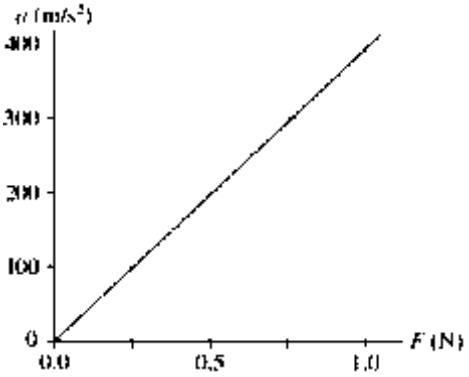
18) A 45.0-kg person steps on a scale in an elevator. The scale reads 460 N. What is the magnitude of the acceleration of the elevator?
A) 4.91 m/s^2
B) 9.81 m/s^2
C) 46.9 m/s^2
D) 0.206 m/s^2
E) 0.422 m/s^2
Answer: E
Var: 1

19) The figure shows a graph of acceleration-versus-sum of the forces exerted on a 125-g object. What should be the value of the first tick-mark on the vertical scale, as indicated by the arrow in the figure?



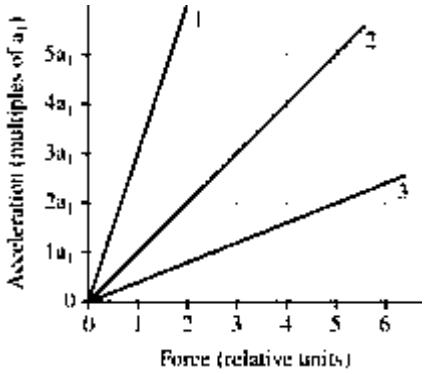
A) 4
B) 8
C) 0.00400
D) 0.00800
Answer: A
Var: 12

20) The figure shows a graph of acceleration-versus-sum of the forces exerted on an object What is the mass of this object?



A) 2.5 g
B) 1.6 g
C) 630 g
D) 400,000 g
Answer: A
Var: 1

21) The figure shows a graph of acceleration-versus-sum of the forces exerted on the objects for three objects pulled by wires. If the mass of object 2 is 36 kg, what are the masses of objects 1 and 3?



A) 12 kg and 90 kg
B) 72 kg and 18 kg
C) 90 kg and 12 kg
D) 12 kg and 72 kg
Answer: A
Var: 1