**Newton’s Laws Questions**

**Question 1:**

aa. The standard metric unit of mass is the \_\_\_\_\_\_ and the standard metric unit of force is the \_\_\_\_\_\_\_. (Choose the appropriate words as listed in their respective order.)

a. Newton, pound b. m/s/s, Newton

c. kilogram, Newton d. pound, Newton

e. gram, pound ab. meter, pound

ac. m/s/s, pound

**Question 2:**

aa. Forces, when unbalanced, always cause objects to \_\_\_\_\_\_.

a. maintain their speed b. change direction

c. slow down d. maintain their velocity

e. accelerate

**Question 3:**

aa. Forces, when balanced, always cause moving objects to \_\_\_\_\_\_.

a. accelerate b. come to a rest

c. keep the same speed and direction of motion

d. speed up e. slow down ab. change directions

**Question 4:**

aa. The acceleration of an object is \_\_\_\_\_\_ proportional to the net force and \_\_\_\_\_\_ proportional to its mass. (Choose the appropriate words as listed in their respective order.)

a. inversely, directly b. inversely, inversely

c. directly, directly d. directly, inversely

e. ...nonsense! The acceleration of an object is independent of the net force and of its mass.

**Question 5:**

aa. Which of the following would have the effect of decreasing the acceleration of an object? Choose all that apply

a. Increasing the mass of the object.

b. Halving the mass of the object.

c. Decreasing the mass of the object.

d. Decreasing the net force experienced by the object.

e. Tripling the net force experienced by the object.

**Question 6:**

aa. A 6-kg object is moving to the right with a **constant velocity** of 4 m/s. The net force encountered by the object is \_\_\_\_.

a. 240 N, left b. 24 N, right c. 24 N, left d. 0.667 N, left

e. 1.5 N, right ab. 0 N ac. 240 N, right ad. 1.5 N, left

ae. 0.667 N, right

**Question 7:**

aa. Suppose that an astronaut throws a rock in outer space at a location far from significant influences of gravity and air resistance. One would expect that the rock would \_\_\_\_.

a. eventually stop since all objects ultimately "lose their steam"

b. continue in motion with the same speed and direction

c. eventually stop as its inertia slowly becomes used up

d. either of the above -- depending on whether the astronaut continues to push it

**Question 8:**

aa. If you were in a spaceship and fired a missile into deep space (assumed frictionless), the amount of force needed to keep the missile in motion would be \_\_\_\_.

a. more than the force with which it was fired

b. equal to the force with which it was fired

c. equal to the weight of the missile

d. less than the force with which it was fired

e. zero, since no force is necessary to keep an object moving

**Question 9:**

aa. An object moving at a constant velocity MUST \_\_\_\_\_.

a. be experiencing a balance of forces

b. not have a force of friction acting on it

c. eventually stop due to the force of gravity

d. not have any forces exerted upon it

e. not have a force of gravity acting on it

ab. have a net force acting on it

ac. none of these

**Question 10:**

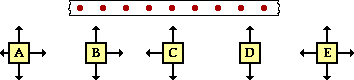
aa. The diagrams below depict the individual forces acting upon an object.



Each arrow represents a force and the length of the arrow represents the size of the force. Based on this information, which objects could be moving to the right at a constant speed? Select all that apply.

**Question 11:**

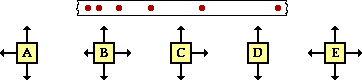
aa. The dot diagram below depicts the motion of a rightward-moving object. Which one of the force diagrams is consistent with the dot diagram?



The arrows on the force diagrams represent forces; the arrow length represents the size of the force. Select all that apply.

**Question 12:**

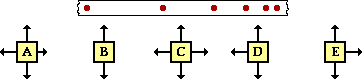
aa. The dot diagram below depicts the motion of a rightward-moving object. Which of the force diagrams is consistent with the dot diagram?



The arrows on the force diagrams represent forces; the arrow length represents the size of the force. Select all that apply.

**Question 13:**

aa. The dot diagram below depicts the motion of a rightward-moving object. Which of the force diagrams is consistent with the dot diagram?



The arrows on the force diagrams represent forces; the arrow length represents the size of the force. Select all that apply.

**Question 14:**

aa. Which of the following descriptions COULD be true of an object that is at equilibrium? Select all that apply.

a. The object is moving. b. The object is at rest.

c. The object is changing its velocity. d. The object is slowing down.

e. The object is moving with a constant velocity.

**Question 15:**

aa. If an object is at equilibrium, then which of the following MUST be true? Select all that apply.

a. The forces are balanced. b. The acceleration is 0 m/s/s.

c. The net force is 0 N. d. The velocity is changing.

e. The object is at rest.

**Question 16:**

aa. When all individual forces acting upon an object are balanced, it is the natural tendency of an object to \_\_\_\_\_. Select all that apply.

a. eventually stop

b. accelerate

c. maintain its state of motion

d. either stay at rest or come to a rest position

e. keep its velocity constant (either at a zero or non-zero value)

**Question 17:**

aa. Inertia refers to \_\_\_\_\_. Select all that apply.

a. the force which keeps moving objects in motion with a constant velocity

b. the tendency of stationary objects to remain at rest

c. the force that keeps stationary objects at rest

d. the tendency of moving objects to maintain the same speed and direction

**Question 18:**

aa. An **upward** moving elevator is **slowing down**. Which of the following force diagrams could be representative of the forces acting upon the elevator?



The arrows on the force diagrams represent forces; the arrow length represents the size of the force. Select all that apply.

**Question 19:**

aa. A 10-kg object is moving to the right at a constant velocity of 4 m/s. Which one of the following horizontal forces is required to maintain this state of motion?

a. 0.4 N b. 40 N     c. 2.5 N d. 0 N

**Question 20:**

aa. A westward-moving object is changing its speed. The net force on the object \_\_\_\_.

a. must be directed east b. must be directed west

c. must be zero d. must either be directed east or west

e. could be directed east or west or be zero

**Question 21:**

aa. The forces acting upon an object are BALANCED. Therefore, one can know for certain that the object \_\_\_\_. Select all that apply.

a. is at rest

b. is not accelerating

c. has an acceleration of 0 m/s/s

d. is moving and moving in a straight line

e. is moving and moving with a constant velocity

**Question 22:**

aa. Consider the following statements made about force. Which of these statements are TRUE? Choose all that apply.

a. There are no forces on your body as you sit at your desk.

b. A force (when unbalanced) causes an object to accelerate.

c. Force is the result of an interaction of an object with the external world.

d. A force is a push or pull exerted upon an object by some other external object.

e. On a diagram, a force can be represented by an arrow which points in the direction of the force and whose size is relative to the magnitude of the force.

**Question 23:**

aa. In a physics demonstration, Noah Formula stands on a skateboard and holds a spring scale (for measuring forces). Anna Litical holds the other end of the spring scale and pulls in order to accelerate Noah along the floor. If the system is considered to be the combination of Noah and the skateboard, then the forces that act upon the system are \_\_\_\_. Choose all that apply.

a. The force of the spring scale on Noah.

b. The force of Noah on the skateboard.

c. The force of the skateboard on Noah.

d. The force of the floor on the skateboard.

e. The force of Earth's gravity on Noah and the skateboard.

**Question 24:**

aa. Consider all the types of forces that could act upon an object. Which of the listed types of forces act upon **the falling skydiver**? Select all that apply.

a. Air resistance b. Gravity c. Normal

d. Spring e. Surface Friction

**Question 25:**

aa. The standard metric unit of force is the \_\_\_\_\_.

a. kilogram b. gram c. Newton d. m/s/s e. pound

**Question 26:**

aa. Consider the following statements made about force. Which of these statements are TRUE? Choose all that apply.

a. Force is a vector.

b. Force is an interaction of an object with its environment.

c. A force (when unbalanced) is that which causes an object to accelerate.

d. There are no forces on your body as you sit at your desk.

e. On a diagram, a force can be represented by an arrow which points in the direction of the force and whose size is relative to the magnitude of the force.

**Question 27:**

aa. A person has a mass of 80-kg. The person's mass would be \_\_\_\_ on the moon.

a. much smaller b. much greater  c. the same (80 kg)

**Question 28:**

aa. The amount of force required to keep a 6-kg object moving with a constant velocity of 2 m/s is \_\_\_\_ N.

a. 0.333 b. 2 c. 3 d. 6 e. 12

ab. ... nonsense! A force is NOT required to keep an object in motion.

**Question 29:**

aa. If the net force acting upon an object is 0 N, then the object MUST \_\_\_\_. Choose the ONE best answer.

a. be moving b. be accelerating c. be at rest

d. be moving with a constant speed in the same direction

e. either c or d

**Question 30:**

aa. **True** or **False**:

All forces are essentially field forces (a.k.a. action at a distance forces).

a. True b. False

**Question 31:**

aa. **True** or **False**:

Suppose that an initial velocity is imparted to an object. According to Galileo, under all circumstances, that object will eventually come to a rest position.

a. True b. False

**Question 32:**

aa. **True** or **False**:

Mass and weight refer to the same quantity but different units are used to measure them.

a. True b. False

**Question 33:**

aa. **True** or **False**:

Little Johnny throws a baseball up into the air. In the moments AFTER the ball leaves Johnny's hand, the throwing force on the ball still persists. This force will decrease over time.

a. True b. False

**Question 34:**

aa. **True** or **False**:

Forces cause motion; therefore an object which encounters a force will always move.

a. True b. False

**Question 35:**

aa. **True** or **False**:

When the forces acting upon an object are unbalanced, then the object will always move in the direction of the net force that acts upon it.

a. True b. False

**Question 36:**

aa. **True** or **False**:

Newton's second law does not work for instances in which an object is moving with a constant velocity.

a. True b. False

**Question 37:**

aa. **True** or **False**:

The force of gravitational pull of the Earth on an object is referred to as the object's weight.

a. True b. False

**Question 38:**

aa. **True** or **False**:

The weight of an object is NOT mathematically related to the mass of the object.

a. True b. False

**Question 39:**

aa. **True** or **False**:

Due to the variations of **g** with altitude, a person could decrease their weight by a factor of 2 by climbing to the top of Mount Everest.

a. True b. False

**Question 40:**

aa. **True** or **False**:

Action-reaction force pairs always act upon two different objects, not the same object.

a. True b. False

**Question 41:**

aa. **True** or **False**:

A free-falling object is an object upon which the only force is gravity. Since this is the only force on a free-falling object, there is no reaction force to this force of gravity.

a. True b. False

**Question 42:**

aa. **True** or **False**:

Without friction, a person could easily walk on a surface without expending any energy.

a. True b. False

**Question 43:**

aa. **True** or **False**:

Only moving objects can encounter frictional forces.

a. True b. False

**Question 44:**

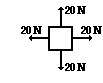
aa. **True** or **False**:

The area of contact between two incompressible surfaces has a significant effect upon the coefficient of friction between those two surfaces.

a. True b. False

**Question 45:**

aa. The diagram below shows an object with a variety of forces acting upon it; the magnitudes of the forces are labeled.



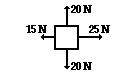
The magnitude of the net force on this object is \_\_\_ N.

a. 0 b. 20 c. 40 d. 80

e. impossible to tell

**Question 46:**

aa. The diagram below shows an object with a variety of forces acting upon it; the magnitudes of the forces are labeled.



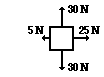
The magnitude of the net force on this object is \_\_\_ N.

a. 0 b. 1 c. 2 d. 25

e. 40 ab. 80

**Question 47:**

aa. The diagram below shows an object with a variety of forces acting upon it; the magnitudes of the forces are labeled.



The magnitude of the net force on this object is \_\_\_ N.

a. 5 b. 20 c. 30 d. 6 e. 90

**Question 48:**

aa. Forces can be categorized as either contact forces or field forces. The force exerted by a punter on a football is an example of a \_\_\_\_\_\_\_\_ force; the force of two magnets attracting each other at a distance of an inch apart is an example of a \_\_\_\_\_\_\_\_ force.

a. contact, contact b. contact, field

c. field, contact d. field, field

**Question 49:**

aa. A person will feel weightless whenever \_\_\_\_. Select all that apply.

a. they drink large quantities of soda pop and the carbonation gives them a floating sensation

b. they are in a free-fall situation, accelerating at a rate of **g**

c. there is no gravitational force acting upon their body

d. they weigh nothing due to the absence of gravitational forces upon their body

e. there are no external contact forces pushing up on their body

**Question 50:**

aa. The force of gravity that acts upon an object is referred to as the \_\_\_\_\_ of the object.

a. kilograms b. pressure c. weight d. inertia e. mass

**Question 51:**

aa. The weight of an object depends primarily upon \_\_\_\_\_\_.

a. its speed b. its mass

c. its acceleration d. its direction of motion

**Question 52:**

aa. A bathroom scale reads your weight when \_\_\_\_\_. Select all that apply.

a. you stand steady on the scale in an elevator which is at rest

b. you stand steadily with one foot on the scale and the other foot suspended in air

c. you put both feet on the scale and bounce up and down

d. you stand at rest with all your weight on the scale

e. you stand steady on the scale in an elevator that is accelerating

**Question 53:**

aa. A downward moving object accelerates upward. The total upward force on the object is \_\_\_\_\_\_.

a. equal to the object's weight

b. less than the object's weight

c. greater than the object's weight

**Question 4:**

aa. Suppose that an elephant and a feather are dropped from a skyscraper (just suppose). In the presence of air resistance, the elephant would fall faster than the feather because \_\_\_\_.

a. the acceleration of gravity is greatest for the elephant

b. the elephant experiences a smaller air resistance force

c. though they have the same mass, the elephant weighs more

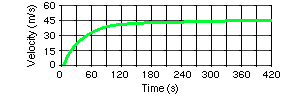
d. the greater mass of the feather provides more resistance to its fall

e. the weight of the elephant is so much greater; air resistance affects it less

ab. ... nonsense! The elephant and the feather would fall at the same rate.

**Questions 55-57:**

The velocity-time plot below represents the motion of a falling skydiver.



Use this graph to answer the following questions.

aa. What is the terminal velocity value of this skydiver?

a. 30 m/s b. 45 m/s c. 60 m/s d. 150 s e. 180 s

aa. What is happening to the speed of the skydiver during the first two minutes (120 seconds)?

a. decreasing b. increasing c. remains the same

aa. What is happening to the acceleration of the skydiver during the first two minutes (120 seconds)?

a. decreasing b. increasing c. remains the same

**Question 58:**

aa. A car is accelerating down the road. As the speed of the car increases, the amount of air drag force experienced by the car \_\_\_\_.

a. is unaffected b. increases c. decreases

**Questions 59-62:**

Suppose that a tennis ball is dropped from the top of a tall building. As the tennis ball falls for the first several seconds, ...

aa. … the mass of the tennis ball \_\_\_\_\_\_.

a. increases b. decreases c. remains the same

aa. … the force of gravity on the tennis ball\_\_\_\_\_.

a. increases b. decreases c. remains the same

aa. … the air drag experienced by the tennis ball \_\_\_\_\_.

a. increases b. decreases c. remains the same

aa. … the net force on the tennis ball \_\_\_\_\_.

a. increases b. decreases c. remains the same

**Question 63:**

aa. Evaluate the following statement.

When a skydiver pulls the cord on the parachute and the parachute opens up, the skydiver experiences a large upward force and immediately moves upward.

a. This statement is always true.

b. This statement is usually true.

c. This statement is never true.

**Question 64:**

aa. When an object has reached terminal velocity, it has stopped \_\_\_\_.

a. moving b. accelerating c. falling

**Question 65:**

aa. A falling object has just reached terminal velocity. Which of the following statements are true of the object? Choose all that apply.

a. The velocity of the object is 0 m/s.

b. The acceleration of the object is 0 m/s/s.

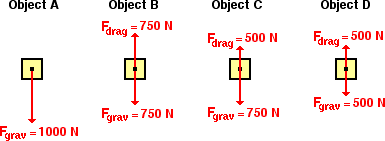
c. The net force on the object is 0 Newton.

d. The force of gravity is equal to the force of air drag force.

e. The velocity of the object has attained a constant value.

**Question 66:**

aa. Which of the following free-body diagrams would be characteristic of an object that has reached terminal velocity?



a. Diagram A b. Diagram B c. Diagram C d. Diagram D

**Question 67:**

aa. A large truck rear-ends a less massive car at a stop sign. The force of the car on the truck is \_\_\_\_\_ the force of the truck on the car; the resulting acceleration of the car is \_\_\_\_ the acceleration of the truck. Which two words fill in the two blanks in the respective order?

a. less than, greater than b. equal to, less than

c. greater than, less than d. less than, equal to

e. greater than, greater than ab. greater than, equal to

ac. equal to, greater than ad. less than, less than

ae. equal to, equal to

**Question 68:**

aa. Shirley Nott sits in her chair in the Physics classroom. As she does, the chair pushes up on Shirley's body. What other force serves as the *other half* of the interaction force pair?

a. Shirley's body pushes down on the Earth.

b. The chair pushes up on Shirley's body.

c. Shirley's body pushes down on the chair.

d. The Earth pulls down on Shirley's body.

e. Shirley's body pulls up on the Earth.

ab. Shirley sits upright in her seat.

**Question 69:**

aa. Joel and Marissa are on skates on an icy pond. They are facing each other with their hands touching. They then push away from each other with their hands. The force of Joel pushing upon Marissa is equal to \_\_\_\_\_.

a. the force of air resistance (air drag) upon Joel

v. the force of Marissa pushing upon Joel

c. the force of the floor pushing upon Marissa

d. the force of the floor pushing upon Joel

e. Nonsense! None of these conclusions can be made.

**Question 70:**

aa. When you sit in your chair, you push down upon the chair. The chair pushes up on you. These two forces are known as \_\_\_\_\_.

a. an anti-gravity feat b. a net force

c. an interaction force pair d. a reciprocal agreement

e. a balancing act ab. a suction force

**Question 71:**

aa. Out on the playground, big Fred comes up to little Harry and gives him a shove. Thus, there is the force of big Fred on little Harry. The other force in the action-reaction force pair is \_\_\_\_\_.

a. the force of Fred pushing himself

b. the force of Fred pulling on Harry

c. the sound of Harry crying

d. the force of Harry on Fred

e. Harry falls backwards to the ground

ab. the force of Harry pushing himself

ac. Harry falls over, gets up, and then shoves Fred

ad. Fred is forced into either a Saturday detention or an in-school suspension

**Question 72:**

aa. In an Olympic boxing match, Ricardo delivers a sharp blow to Sonny's forehead. Thus, there is the force of Ricardo's glove on Sonny's forehead. The other force in the action-reaction force pair is \_\_\_\_\_.

a. Sonny falls backwards to the mat

b. Sonny applies a force to himself

c. Ricardo applies a force to himself

d. Ricardo's glove recoils backwards

e. the sound of Sonny's body striking the mat

ab. the force of Sonny's forehead on Ricardo's glove

ac the force of the Earth pulling Sonny downwards

ad. Sonny falls over, gets up and then reacts by punching Ricardo

**Question 73:**

aa. A fish happily swims through the water due to the marvel of Newton's third law. Identify the two letters corresponding to the action-reaction FORCE pairs force are responsible for the fish's motion. Select two answers.

a. The water pushes forward upon the fish's fins.

b. The muscular and internal pressure of the fish stabilizes its skeletal structure.

c. Small bubbles are created as the water swirls and moves backwards.

d. The fins of the fish push backward on the water.

e. The water moves backward and out of the way of the fish.

f. The water pressure is greatest behind the fish than in front of it.

g. The fish moves forward.

**Question 74:**

aa. A tennis racket collides with a ball and the force on the ball causes the ball to experience an enormous acceleration; the ball pushes on the racket with the same amount of reaction force but the racket does not experience a significant acceleration. This is because \_\_\_\_. (Note: **F** stands for force.)

a. each object encounters the same **F**, but it is mostly concentrated in the ball

b. the racket has a significantly greater mass and thus a smaller acceleration

c. ...nonsense! The racket's acceleration is the same as the ball's.

d. ...nonsense! The ball does NOT push on the racket with the same amount of **F**.

**Question 75:**

aa. In its final effort to reach a terminal velocity, a misbehaving bug collides with the windshield of a fast-moving bus. The force of the bus on the bug is \_\_\_\_\_ the force of the bug on the bus; the resulting acceleration of the bug is \_\_\_\_ the acceleration of the bus.

a. equal to, less than b. equal to, equal to

c. less than, less than d. less than, equal to

e. greater than, greater than ab. less than, greater than

ac. equal to, greater than ad. greater than, equal to

ae. greater than, less than

**Question 76:**

aa. An object experiences a **tension force** whenever it is \_\_\_\_\_.

a. acted upon by a drag force b. being pulled upon by a string or a rope

c. under stress d. being pressed firmly against a surface

**Question 77:**

aa. An object experiences a **normal force** whenever it is \_\_\_\_\_.

a. at rest

b. not in free fall

c. acted upon by a drag force

d. acted upon by the force of gravity

e. in contact with and pressed against the surface of another object

**Question 78:**

aa. In a tug-of-war, team A pulls on a rope with a force of 2000 N. Team B pulls on the rope in the opposite direction with a force of 2000 N. The rope remains steady at equilibrium. What is the tension in the rope?

a. 0 N b. 2000 N c. 4000 N d. None of these.

**Questions 79-83:**

Consider the diagram of the bucket, rope, and ceiling hook as shown at the right. The bucket is at equilibrium.

aa. If the system is the bucket (handle and contents), then the forces that act upon the bucket are \_\_\_\_. Choose all that apply.

a. The ceiling pulling up on the bucket.

b. The rope pulling up on the bucket.

c. Earth's gravity pulling down on the bucket.

d. The bucket pulling up on the Earth.

e. The bucket pulling down on the ceiling.

aa. If the system is the *massless* rope (handle and contents), then the forces that act upon the rope are \_\_\_\_. Choose all that apply.

a. The bucket pulling down on the rope.

b. The hook pulling up on the rope.

c. The rope pulling down on the hook.

d. The rope pulling up on the bucket.

e. Earth's gravity pulling down on the hook.

aa. One of the interaction force pairs is the interaction between the bucket and the rope. Compare the force of the bucket on the rope to the force of the rope on the bucket.

a. They are equal in size.

b. The force on the rope is greater.

c. The force on the bucket is greater.

aa. Another interaction force pair is the interaction between the ceiling hook and the rope. Compare the force of the hook on the rope to the force of the rope on the hook.

a. They are equal in size.

b. The force on the rope is greater.

c. The force on the hook is greater.

aa. Which of the following are true of the tension in the rope.

a. The tension in the rope is everywhere the same.

b. The tension in the rope is greatest at the bottom of the rope.

c. The tension in the rope is greatest at the top of the rope.

**Question 84:**

aa. The direction of the normal force is \_\_\_\_\_\_.

a. always directed straight up

b. always perpendicular to the plane of contact with the surface

c. usually but not always perpendicular to the plane of contact with the surface

**Questions 85-87:**

Consider the three diagrams below of a box at rest on a table. Use the diagram to answer the next three questions.

|  |  |  |
| --- | --- | --- |
| **Diagram A** | **Diagram B** | **Diagram C** |
|  |  |  |
| The box sits at rest on the table. | There is an upward pull upon the box. | There is a downward push upon the box. |

aa. In Diagram A, the normal force exerted by the table upon the box is \_\_\_\_\_.

a. greater than the weight of the box

b. equal to the weight of the box

c. less than the weight of the box

aa. In Diagram B, the normal force exerted by the table upon the box is \_\_\_\_\_.

a. greater than the weight of the box

b. equal to the weight of the box

c. less than the weight of the box

aa. In Diagram C, the normal force exerted by the table upon the box is \_\_\_\_\_.

a. greater than the weight of the box

b. equal to the weight of the box

c. less than the weight of the box

**Question 88:**

aa. The acceleration of an object is \_\_\_\_ proportional to the net force (resultant force) acting upon it and \_\_\_\_ proportional to the mass of the object.

a. inversely, inversely b. directly, inversely

c. directly, directly d. inversely, inversely

**Question 89:**

aa. If the net force acting upon an object is doubled, then the acceleration will be \_\_\_\_; if the mass of an object is doubled, then the acceleration will be \_\_\_\_.

a. halved, doubled b. doubled, halved

c. doubled, doubled d. halved, halved

**Question 90:**

aa. The symbol ∑F stands for the \_\_\_\_\_ of the forces.

a. arithmetic sum b. vector sum

c. derivative d. integral

**Question 91:**

aa. Which of the following is true of a *Newton*? Choose all that apply.

a. The *Newton* is a unit of force.

b. A *Newton* is the amount of force which gives 1 kg an acceleration of 1 m/s2.

c. An object's weight can be expressed in units of Newton.

d. An object's mass can be expressed in units of Newton.

e. A typical weight of an adult male might be around 100 to 220 Newton.

**Question 92:**

aa. The weight of an object is equal to \_\_\_\_. Choose all that apply.

a. its mass

b. the **g** value of the object

c. the force of gravity acting upon the object

d. the mass of the object times the acceleration of the object

**Question 93:**

aa. A hammer is used to drive a nail into a block of wood. The action force is the force of the hammer pushing downwards upon the nail. The reaction force is the force of the \_\_\_.

a. nail pushing upwards on the hammer

b. wood pushing upwards on the nail

c. nail pushing downwards on the wood

**Question 94:**

aa. A tennis racket collides with a ball and the force on the ball causes the ball to experience an enormous acceleration; the ball pushes on the racket with the same amount of reaction force but the racket does not experience a significant acceleration. This is because \_\_\_\_. (Note: **F** stands for force.)

a. the racket has a significantly greater mass and thus a smaller acceleration

b. each object encounters the same **F**, but it is mostly concentrated in the ball

c. ...nonsense! The ball does NOT push on the racket with the same amount of **F**.

d. ...nonsense! The racket's acceleration is the same as the ball's.

**Question 95:**

aa. Which one of the following best describes the cause of surface friction?

a. A suction effect develops as air is pressed out from between two surfaces.

b. Some surfaces have a tendency to be sticky and cause cohesion to each other.

c. When atoms and molecules on different surfaces get close, there are attractive forces between them.

**Question 96:**

aa. The force of static friction tends to be \_\_\_\_\_\_ the force of kinetic friction.

a. greater than b. smaller than c. the same as

**Question 97:**

aa. The symbol µ stands for the \_\_\_\_\_.

a. normal force b. force of friction c. coefficient of friction

**Question 98:**

aa. The units on µ are \_\_\_\_\_.

a. Newton b. kg c. m/s/s

d. ... nonsense! There are no units on .

**Question 99:**

aa. A 30-N force is applied to a 4-kg object to move it with a constant velocity of 2 m/s across a level surface. The coefficient of friction between the object and the surface is approximately \_\_\_\_. (Use the approximation: **g** ~ 10 m/s/s.)

a. 0.20 b. 0.50 c. 0.55 d. 0.75

e. 2.0 ab. 3.0 ac. 7.5 ad. 20

ae. 22 bc. 30

**Question 100:**

aa. The resistance force that is exerted upon a moving object as it slides along a surface is known as \_\_\_\_\_ friction. The resistance force that is exerted upon a stationary object to prevent the onset of its motion is known as \_\_\_\_ friction. Choose the two words that fill in the two blanks in their respective order.

a. static, kinetic b. inertia, equilibrium

c. kinetic, static d. moving, stationary

e. coefficient, inertia ab. thrust, drag

**Question 101:**

aa. A teacher exerts a force upon a large teacher's desk in an effort to move it across the floor. Yet, the teacher's desk will not even budge from rest. There is a \_\_\_\_\_\_\_\_ friction force acting upon the desk.

a. kinetic b. static

**Question 102:**

aa. A book is moving across the table and gradually decelerates to a stop. During this time, there is a \_\_\_\_ friction force acting upon the book.

a. kinetic b. static

**Question 103:**

aa. A 500-N box is at rest on the floor. Dennis Elbo makes several attempts to move the box, pushing against the box with varying amounts of horizontal force. Yet the box never does move. In this situation, the amount of static friction force experienced by the box \_\_\_\_. Select all that apply.

a. is 500 N

b. is equal to the force with which Dennis exerts on the box

c. has an upper limit and Dennis has not yet exceeded the upper limit

d. is always the coefficient of friction multiplied by the normal force value

**Question 104:**

aa. The amount of friction force experienced by an object as it moves across a floor depends primarily upon \_\_\_\_. Select all that apply.

a. the speed of the moving object

b. the surface area of the moving object

c. the normal force which acts upon the object

d. the materials that the object and the floor are made of

**Question 105:**

aa. A 147-Newton horizontal force is exerted upon a 3.1-kg box to move it across a level surface at a constant velocity of 1.4 m/s. The force of friction encountered by the box is \_\_\_\_ Newton.

a. 105 b. 4.84  c. 6.77 d. 47

e. 147 ab. 4.3 ac. 0.21

**Question 106:**

aa. A 30-N force is applied to a 4-kg object to move it with a constant velocity of 2 m/s across a level surface. The coefficient of kinetic friction between the object and the surface is approximately \_\_\_\_.

a. 0.20 b. 0.50 c. 0.38 d. 0.77

e. 2.0 ab. 3.1 ac. 7.3 ad. 7.5

ae. 20 bc. 27 BD. 30

**Question 107:**

aa. An object is at equilibrium when \_\_\_\_.

a. all the individual force values are 0 N

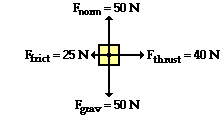
b. all the individual force values are equal to each other

c. all the individual forces acting on the object are balanced

**Calculations and Long Answer**

**Question 108:**

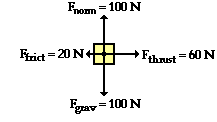
aa. The diagram below is a free-body diagram. It uses arrows and force labels to depict the direction and type of all forces acting upon an object.



What is the magnitude of the net force acting upon the object?

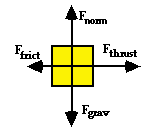
**Question 109:**

aa. The diagram below is a free-body diagram. It uses arrows and force labels to depict the direction and type of all forces acting upon an object.



What is the magnitude of the net force acting upon the object?

**Question 110:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces on a 1.86-kg object are:

Fgrav = Fnorm = 18.2 N

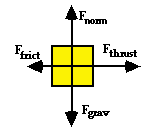
Fapp = 26.6 N

Ffrict = 5.7 N

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 111:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces on a 2.52-kg object are:

Fgrav = Fnorm = 24.7 N

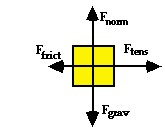
Fthrust (a.k.a., Fapp) = 26.6 N

Ffrict = 5.7 N

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 112:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces acting upon a 1.97-kg object are:

Fgrav = Fnorm = 19.3 N

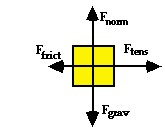
Ftens = 37.7 N

Ffrict = 12.2 N.

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a - value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 113:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces acting upon a 2.15-kg object are:

Fgrav = Fnorm = 21.1 N

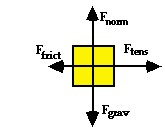
Ftens = 37.7 N

Ffrict = 12.2 N.

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a - value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 114:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces acting upon a 5.23-kg object are:

Fgrav = Fnorm = 52.3 N

Ffrict = 14.8 N.

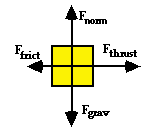
Ftens value is not known.

The acceleration value is 4.12 m/s/s.

a. Given this information, determine the net force (in Newton) acting upon the object. (Enter a - value if the direction is leftward.)

b. Determine the value of the tension force (in N).

**Question 115:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces on a 1.79-kg object are:

Fgrav = Fnorm = 17.5 N

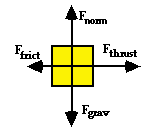
Fthrust = 22.3 N;

Ffrict = 7.5 N.

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 116:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces on a 1.63-kg object are:

Fgrav = Fnorm = 16.0 N

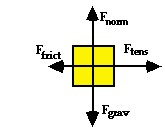
Fthrust (a.k.a, Fapp)= 22.3 N;

Ffrict = 7.5 N.

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 117:**

aa. Consider the free-body diagram shown at the right. The values of the individual forces acting upon a 2.02-kg object are:

Fgrav = Fnorm = 19.8 N

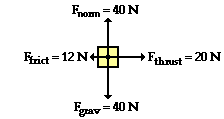
Ftens = 34.3 N

Ffrict = 10.8 N.

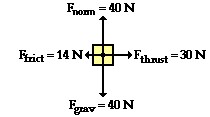
a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 118:**

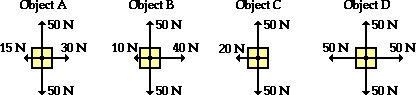
aa. The diagram at the right is a free-body diagram. It uses arrows and force labels to depict the direction and type of all forces acting upon an object. What is the magnitude of the net force acting upon the object?

**Question 119:**

aa. The diagram at the right is a free-body diagram. It uses arrows and force labels to depict the direction and type of all forces acting upon an object. What is the magnitude of the net force acting upon the object?

**Question 120:**

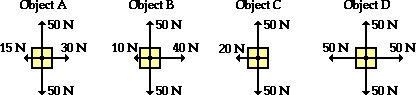
aa. Force diagrams depicting the magnitudes and directions of the forces acting upon four objects are shown below. Each object has the same mass - approximately 5 kg.



Rank these objects in order of their acceleration, from smallest to largest. List the four letters in their proper order with no spaces between letters - like ABCD or DCBA or ACBD. Consider magnitude only when making the ranking; that is, -5 m/s/s is larger than +3 m/s/s.

**Question 121:**

aa. Force diagrams depicting the magnitudes and directions of the forces acting upon four objects are shown below. Each object has the same mass - approximately 5 kg.



Rank these objects in order of their acceleration, from smallest to largest. List the four letters in their proper order with no spaces between letters - like ABCD or DCBA or ACBD. Consider magnitude only when making the ranking; that is, -5 m/s/s is larger than +3 m/s/s.

**Question 122:**

aa. The velocities and masses of four objects are shown in the diagram below. (The arrow represents the magnitude and direction of the velocity vector.)



Rank these objects in order of their inertia, from least to greatest. Type the four letters in the appropriate order with no spaces between letters.

**Question 123:**

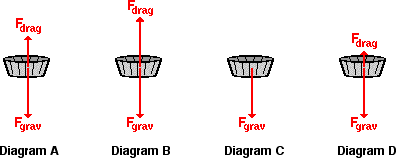
aa. Mass and velocity values for a variety of objects are listed below.



Rank the objects from smallest to greatest inertia.

**Question 124:**

aa. A coffee filter is dropped from ceiling height at a time of 0 seconds and falls to the floor. The diagrams below represent free-body diagram for various moments in time during the filter's fall to the floor.



Rank the diagrams according to the time in which these forces would be experienced, beginning with the earliest time (i.e., the lowest time). Examples: ABCD or DCBA.

**Question 125:**

aa. A 77.5-kg skydiver is experiencing 246 Newton of air resistance. Determine the magnitude of the acceleration (in m/s/s) of the skydiver.

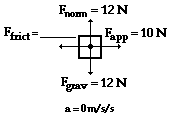
**Question 126:**

aa. A 77.5-kg skydiver has just opened the parachute and is accelerating upward at rate of 3.45 m/s/s. Determine the amount of air resistance (in Newton) experienced by the skydiver.

**Question 127:**

aa. A 89.1-kg vertically-falling skydiver experiences an upward force of air resistance of 1410 N. Determine the acceleration (in m/s/s) of the skydiver.

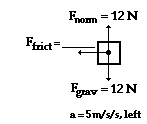
**Questions 128-129:**

Consider the free-body diagram shown at the right.

aa. Determine the value of the friction force

aa. Determine the value of the coefficient of friction.

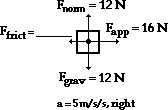
**Questions 130-131:**

Consider the free-body diagram shown at the right.

aa. Determine the value of the friction force

aa. Determine the value of the coefficient of friction.

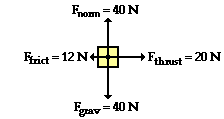
**Questions 132-133:**

Consider the free-body diagram shown at the right.

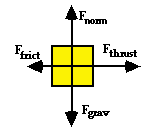
aa. Determine the value of the friction force

aa. Determine the value of the coefficient of friction.

**Question 134:**

aa. The diagram at the right is a free-body diagram. It uses arrows and force labels to depict the direction and type of all forces acting upon an object. What is the magnitude of the mass, net force, and acceleration?

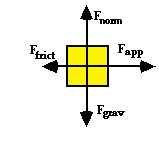
**Question 135:**

aa. Consider the free-body diagram shown at the right. The object has a mass of 2.02-kg, There is a forward thrust force of 31.7 N. the coefficient of friction between the object and the surface is 0.308.

a. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a negative value if the direction is leftward.)

b. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Questions 136-137:**

Consider the free-body diagram shown at the right. The values of the individual forces are:

Fgrav = Fnorm = 32.1 N

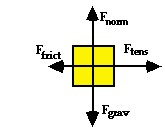
Fapp = 26.1 N

Ffrict = 15.7 N

aa. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right.

aa. Determine the horizontal acceleration (in m/s/s) of the object.

**Questions 138-139:**

Consider the free-body diagram shown at the right. The values of the individual forces are:

Fgrav = Fnorm = 15.0 N

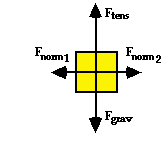
Ftens = 37.4 N

Ffrict = 12.2 N

aa. Determine the net force (in Newton) acting upon the object whose force diagram is depicted at the right. (Enter a - value if the direction is leftward.)

aa. Determine the horizontal acceleration (in m/s/s) of the object. (Enter a - value if the direction is leftward.)

**Question 140:**

aa. A 401-kg elevator is rising up an elevator shaft and approaching its destination. See diagram at right. The following force values are known:

Ftens = 4580 N

Fnorm1 = Fnorm2 = 36.2 N

Determine the acceleration (in m/s/s) of the elevator. (Enter a - value if the direction is downward.)

**Question 141:**

aa. A 68.3-kg skydiver is experiencing 246 Newton of air resistance. Determine the magnitude of the acceleration (in m/s/s) of the skydiver.

**Question 142:**

aa. A 68.3-kg skydiver has just opened the parachute and is accelerating upward at rate of 3.45 m/s/s. Determine the amount of air resistance (in Newton) experienced by the skydiver.

**Question 143:**

aa. What net force (in Newton) would be required to give a mass of 40.2 kg an acceleration of 8.42 m/s/s?

**Question 144:**

aa. The acceleration of gravity on planet X is 12.0 m/s/s. An object weighs 674 Newton on Earth. What mass value (in kg) would occupants of planet X determine this object to have?

**Question 145:**

aa. The acceleration of gravity on planet Y is 5.01 m/s/s. An object has a mass of 67.4 kg. What would be its weight (in Newton) on planet Y?

**Question 146:**

aa. The acceleration of gravity on planet Y is 5.01 m/s/s. An object has a mass of 67.4 kg. What would be its weight (in Newton) on planet Y?

**Question 147:**

aa. Determine the acceleration (in m/s/s) of a 15.1-N object that experiences a net force of 86.8 N.

**Question 148:**

aa. A 90.3-kg vertically-falling skydiver experiences an upward force of air resistance of 1530 N. Determine the acceleration of the skydiver.

**Questions 149-150:**

A 1340-kg car is moving rightward at 24.7 m/s when it starts to skid to a stop. It encounters a force of friction of 7370 N.

aa. Determine the acceleration of the car.

aa. What is the distance that the car skids before it finally stops?

**Question 151:**

aa. A net force of 74.0 Newton will cause a mass of 5.63-kg to accelerate at a rate of \_\_\_\_ m/s/s.

**Question 152:**

aa. A net force of 749 Newton causes an object to accelerate at 10.6 m/s/s. Determine the mass of the object (in kg).

**Question 153:**

aa. Suppose that a net force F gives an object with a mass of m an acceleration of 8.95 m/s/s. Suppose that the net force were increased by a factor of 2.8. What would be the new acceleration (in m/s/s)?

Suppose that the mass were increased by a factor of 11.6. What would be the new acceleration (in m/s/s)?

Suppose that the net force were increased by a factor of 2.8, and the mass were increased by a factor of 11.6. What would be the new acceleration (in m/s/s)?

Suppose that the net force were decreased by a factor of 2.8 and the mass were decreased by a factor of 11.6. What would be the new acceleration (in m/s/s)?

**Question 154:**

aa. A person weighs 760 Newton on Earth. What is the person's mass?

**Question 155:**

aa. A 62.3-N rightward force is applied to a 7.03-kg crate to accelerate it from rest across a horizontal surface. If the crate experiences a friction force of 19.5 Newton, then determine the acceleration.

**Question 156:**

aa. What applied force (in Newton) would be required to give a 18.6-kg object an acceleration of 7.03 m/s/s if the force of friction opposing it is 19.5 Newton?

**Question 157:**

aa. A 7.62-kg object experiences a horizontal acceleration of 2.34 m/s/s when a 96.8-N force is exerted upon it. Determine the force of friction (in Newton) that opposes this object's motion.

**Question 158:**

aa. A 4.60-kg bucket suspended by a rope accelerates upwards at a rate of 1.32 m/s/s. Determine the tension in the rope that pulls on the bucket.

**Question 159:**

aa. A 22.4-N horizontal force is applied to a 0.0750-kg hockey puck to accelerate it across the ice from an initial rest position. Ignore friction and determine the final speed (in m/s) of the puck after being pushed for a time of 0.238 seconds.

**Question 160:**

aa. What upward tension force (in Newton) would allow a 2440-kg elevator to accelerate downwards (i.e., negative) at a rate of 1.68 m/s/s?

**Question 161:**

aa. A 4.79-kg bucket suspended by a rope is accelerated upwards from an initial rest position. If the tension in the rope is 59.5 Newton, then determine the speed (in m/s) of the bucket after 19.4 seconds.

**Question 162:**

aa. A 0.155-kg baseball moving at 24.0 m/s strikes the glove of a catcher. The glove recoils a distance of 12.0 cm. What is the force (in Newton) applied on the ball by the glove?

**Question 163:**

aa. A 1240-kg car skids to a stop across a road surface that has a coefficient of friction of 0.953. Determine the acceleration of the car (in m/s/s).

**Question 164:**

aa. Claire deAisles applies a horizontal force of 823 N to accelerate a 55.7-kg supermarket crate. The coefficient of friction between the crate and the floor is 0.268. Determine the acceleration (in m/s/s) of the crate.

**Question 165:**

aa. A 1490-kg car moving rightward with a speed of 23.4 m/s skids to a stop in 2.7 seconds. Determine the coefficient of friction between the car tires and the roadway.

**Question 166:**

aa. Chuck Wagon applies a horizontal force of 763 N to accelerate a 64.3-kg box from a rest position. The coefficient of friction between the crate and the floor is 0.874. Determine the velocity (in m/s) of the crate after 1.93 seconds.

**Question 167:**

aa. Matthew is attempting to drag his12.0-kg Shetland Sheepdog across the grass by applying a horizontal force. What force (in Newton) must be applied to move the dog with a constant speed of 0.951 m/s? The coefficient of friction between the dog and the ground is 0.434.

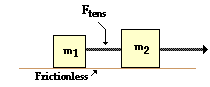
**Question 168:**

aa. Dexter Eius is walking through the cafeteria when he slips on a calculator and falls to the floor. Upon hitting the floor, he skids to a stop with an acceleration of -6.0 m/s/s. Dexter weighs 666 Newton. Determine the coefficient of friction between Dexter and the floor.

**Question 169:**

aa. It is a known fact that every time the school floors are waxed, the physics teacher get together to have a barrel of phun doing friction experiments in their socks (uhm - they have clothes on, its just that they don't have any shoes on their feet). On one occasion, Mr. L applied a horizontal force to accelerate Mr. R (mass of 75.0 kg) rightward at a rate of 1.33 m/s/s. The coefficient of friction between Mr. R’s socks and the freshly waxed floors is 0.651. With what force (in Newton) must Mr. L be pushing?

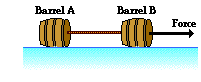
**Question 170:**

aa. Two blocks are connected by a light string and pulled across a horizontal, frictionless surface as shown in the diagram at the right. Their masses are 4.00 kg (m1) and 11.00 kg (m2). A force of 81.2-N is applied to the 11.00-kg block (m2).

a. Determine the acceleration (in m/s/s) of the system of two blocks.

b. Determine the tension (in Newton) in the string which connects the two blocks.

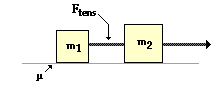
**Question 171:**

aa. Two barrels, of masses 3.00 kg (Barrel A) and 11.00 kg (Barrel B) are pulled across the frictionless surface of a frozen pond by an ice fisherman. He exerts a force of 81.2 N on the lead barrel (Barrel B) as shown in the diagram at the right.

a. Determine the acceleration (in m/s/s) of the system of two barrels.

b. What is the tension (in Newton) in the rope connecting the two barrels?

**Question 172:**

aa. Two blocks are connected by a rope and pulled across a rough, horizontal surface as shown in the diagram at the right. Their masses are 4.00 kg (m1) and 11.00 kg (m2). A force of 81.2-N is applied to the 11.00-kg block (m2). The coefficient of friction between the blocks and the surface is 0.186.

a. Determine the acceleration (in m/s/s) of the each block.

b. Determine the tension (in Newton) in the rope that connects the two blocks.

**Question 173:**

aa. A 79.7-kg skydiver has just opened the parachute and is accelerating upward at rate of 3.50 m/s/s. Determine the amount of air resistance (in Newton) experienced by the skydiver.

**Question 174:**

aa. A 79.7 kg man stands on a spring scale in an elevator. Starting from rest, the man accelerates to an upward velocity of 1.11 m/s in 0.681 seconds. After riding at a constant velocity of 1.11 m/s for 12.6 seconds, he decelerates to a stop in 1.25 seconds.

a. What is the spring scale reading (in Newton) during the first 0.681 seconds?

b. What is the spring scale reading (in Newton) during the 12.6 seconds of constant velocity motion?

c. What is the spring scale reading (in Newton) during the 1.25-second deceleration stage of the motion?

**Question 175:**

aa. An inquisitive yet confused physics student makes the following comment.

Every action force is counter-acted by a reaction force of equal magnitudes and in opposite directions. Thus, the action and reaction forces will always balance each other and there can never be an unbalanced force acting upon the object.

Correct this student's thinking, explaining the fallacy of his logic and help him/her understand the nature of action-reaction force pairs.