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EFM Workbook for Students

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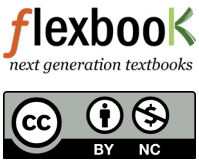

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CHAPTER 1

Motion Worksheets

Chapter Outline

1.1 Distance and Direction

Lesson 12.1: True or False

Name_____ Class_____ Date_____

Determine if the following statements are true or false.

_____ 1. Direction is as important as distance in describing motion.

_____ 2. Most foot races are measured in meters.

_____ 3. Motion is generally defined as an increase in distance.

_____ 4. Direction is the length of the route between two points.

_____ 5. A vector is any quantity that has no units of measurement.

_____ 6. Motion is a vector when it includes only direction.

_____ 7. You could measure distances with a metric ruler.

_____ 8. Words that describe direction include east, up, and left.

Lesson 12.1: Critical Reading

Name_____ Class_____ Date_____

Read this passage from the text and answer the questions that follow.

Frame of Reference

Assume that a school bus passes by as you stand on the sidewalk. It's obvious to you that the bus is moving. It is moving relative to you and the trees across the street. But what about to the children inside the bus? They aren't moving relative to each other. If they look only at the other children sitting near them, they will not appear to be moving. They may be able to tell that the bus is moving only by looking out the window and seeing you and the trees whizzing by.

This example shows that how we perceive motion depends on our frame of reference. Frame of reference refers to something that is not moving with respect to an observer that can be used to detect motion. For the children on the bus, if they use other children riding the bus as their frame of reference, they do not appear to be moving. But if they use objects outside the bus as their frame of reference, they can tell they are moving.

Questions

1. Define frame of reference.
2. How does a frame of reference help an observer detect motion?
3. If you were standing on a sidewalk and saw a bus go by, how could you tell that the bus was moving? What might be your frame of reference?

Lesson 12.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. If you were riding on a moving bus, which frame of reference would allow you to detect the motion?
    a. other people sitting on the bus
    b. trees outside the bus windows
    c. the seats on the bus
    d. the bus driver
2. Which units would most likely be used to measure the distance between two cities?
    a. millimeters
    b. centimeters
    c. meters
    d. kilometers
3. To find the distance of a route that changes direction, you must
    a. consider only the distance traveled in the first direction.
    b. calculate the average distance traveled in one direction.
    c. add up all the distances traveled in different directions.
    d. subtract the starting distance from the ending distance.
4. When both distance and direction are considered, motion
    a. is always measured in meters.
    b. cannot be calculated.
    c. is a force of nature.
    d. is a vector.
5. To determine the distance between two points on a map, you can use a ruler and
    a. a compass.
    b. the compass rose.
    c. a sheet of graph paper.
    d. the scale in the map key.
6. To explain how to get from point A to point B, you must describe both the distance and the
    a. speed.
    b. length.
    c. mileage.
    d. direction.

Lesson 12.1: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. something that is not moving with respect to an observer that can be used to detect motion

_____ 2. quantity that includes both size and direction

_____ 3. location

_____ 4. change in position

_____ 5. line along which something moves

_____ 6. length of the route between two points

_____ 7. SI unit for distance

Terms

a. distance

b. frame of reference

c. motion

d. vector

e. meter

f. direction

g. position

Lesson 12.1: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The perception of motion depends on a person's _____.
2. A vector can be used to represent both the distance and _____ of motion.
3. A(n) _____ is used to represent a vector.
4. Speed is one way to measure _____.
5. Running events in track and field are named for their _____.
6. The way a vector arrow for motion points represents _____.
7. The length of a vector arrow for motion represents _____.

Lesson 12.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why motion is a vector.

1.2 Speed and Velocity

Lesson 12.2: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Speed depends on both distance and direction.

_____ 2. It is easier to calculate average speed than instantaneous speed.

_____ 3. The slope of a distance-time graph represents the direction of motion.

_____ 4. Velocity is the scientific term for speed.

_____ 5. Speed can only be greater than or equal to zero.

_____ 6. Objects moving at the same speed always have the same velocity.

_____ 7. Average speed can be calculated from a distance-time graph.

_____ 8. Speed equals distance multiplied by time.

_____ 9. A change in speed can occur without a change in velocity.

_____ 10. A change in velocity can occur without a change in speed.

Lesson 12.2: Critical Reading

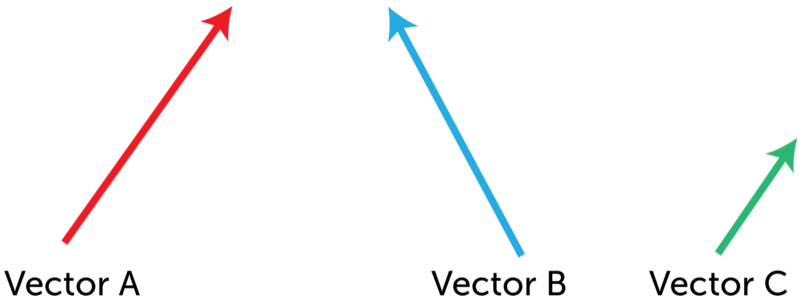
Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Velocity

Speed tells you only how fast an object is moving. It doesn't tell you the direction the object is moving. The measure of both speed and direction is called velocity. Velocity is a vector, or a measure that has both size and direction. In the case of velocity, size refers to speed. Like other vectors, velocity can be represented by an arrow. The length of the arrow represents speed, and the way the arrow points represents direction.

The three arrows shown below represent the velocities of three different objects. Vectors A and B are the same length but point in different directions. They represent objects moving at the same speed but in different directions. Vector C is shorter than vector A or B but points in the same direction as vector A. It represents an object moving at a slower speed than A or B but in the same direction as A.



If two objects are moving at the same speed and in the same direction, they have the same velocity. If two objects are moving at the same speed but in different directions (like A and B above), they have different velocities. If two objects are moving in the same direction but at different speeds (like A and C), they have different velocities.

Questions

1. What is velocity?
2. How does velocity differ from speed?
3. Explain why velocity, but not speed, is a vector.
4. Describe how to use an arrow to represent the velocity of a moving object.

Lesson 12.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

1. When calculating average speed, the symbol δd represents the
   a. change in distance.
   b. change in direction.
   c. instantaneous distance.
   d. division of distance by time.
2. If you run a 100-meter race in 20 seconds, what is your average speed during the race?
   a. 20 m/s
   b. 10 m/s
   c. 5 m/s
   d. 2 m/s
3. Tony ran at a constant speed of 10 m/s for a total of 60 seconds. How far did he run?
   a. 6 m
   b. 60 m
   c. 600 m
   d. 6000 m
4. If you use an arrow to represent velocity, what does the length of the arrow represent?
   a. time
   b. speed
   c. distance
   d. direction
5. Which choice(s) could represent the velocity of a moving car?

a. 80 mi/h
b. 40 km/h
c. 50 km/h north
d. all of the above

6. Which quantity is a vector?

a. speed
b. velocity
c. direction
d. distance

7. If speed is constant, velocity

a. must be zero.
b. must be constant.
c. can be changing.
d. none of the above

Lesson 12.2: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. measure of both speed and direction

_____ 2. distance ÷ speed

_____ 3. speed of a moving object at a given moment

_____ 4. speed × time

_____ 5. general term for how quickly or slowly something moves

_____ 6. total distance traveled divided by the time it took to travel that distance

_____ 7. steepness of a graph line

Terms

a. speed

b. velocity

c. instantaneous speed

d. average speed

e. slope

f. distance

g. time

Lesson 12.2: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The SI unit for speed is _____.
2. The slope of a distance-time graph represents the _____ of a moving object.
3. Change in distance divided by change in time equals _____ speed.
4. A straight line on a distance-time graph represents a(n) _____ speed.
5. A horizontal line on a distance-time graph represents a speed of _____.
6. The velocity of a moving object is constant only if the object's speed and _____ are unchanging.
7. Velocity is a vector because it includes both size and _____.

Lesson 12.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

If you know that a moving object has a constant velocity, you can predict correctly where it will be after a given amount of time. However, if you know only that the object has a constant speed, you cannot predict where it will be. Explain why.

1.3 Acceleration

Lesson 12.3: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Acceleration occurs only when there is a change in speed.

_____ 2. It is easier to calculate acceleration when both speed and direction are changing.

_____ 3. The y-axis of a velocity-time graph represents distance traveled.

_____ 4. If a velocity-time graph slopes downward to the right, then acceleration is negative.

_____ 5. If velocity is not changing, then acceleration is zero.

_____ 6. A change in direction with or without a change in speed is velocity.

_____ 7. If the slope of a velocity-time graph is a straight line, then velocity must be constant.

Lesson 12.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Defining Acceleration

Acceleration is a measure of the change in velocity of a moving object. It shows how quickly velocity changes. Acceleration may reflect a change in speed, a change in direction, or both. Because acceleration includes both size (speed) and direction, it is a vector.

People commonly think of acceleration as in increase in speed, but a decrease in speed is also acceleration. In this case, acceleration is negative. Negative acceleration is called deceleration. A change in direction without a change in speed is acceleration as well.

Questions

1. Define acceleration.
2. What is deceleration? Give an example.
3. How can acceleration occur when speed is constant?

Lesson 12.3: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

1. Acceleration shows
    a. how quickly an object travels.
    b. the direction in which an object moves.
    c. how far an object travels in a given time.
    d. how quickly an object's velocity changes.
2. Which of the following is an example of acceleration?
    a. a change in direction
    b. an increase in speed
    c. a decrease in speed
    d. all of the above
3. If you are riding in a car that decelerates suddenly, you will feel your body
    a. pressed backward.
    b. pushed to the side.
    c. thrust forward.
    d. none of the above
4. To calculate acceleration without a change in direction, you should use the formula
    a. acceleration = $\delta v + \delta t$
    b. acceleration = $\delta t / \delta v$
    c. acceleration = $\delta v / \delta t$
    d. acceleration = $\delta v \times \delta t$
5. When Sara ran a race on a straight track, her speed changed from 3 m/s to 6 m/s over a time period of 3 seconds. What was her acceleration during that time?
    a. 3 m/s^2
    b. 1 m/s^2
    c. 2 m/s^2
    d. none of the above
6. What does a velocity-time graph represent?
    a. how velocity changes over time
    b. how distance changes over time
    c. acceleration
    d. two of the above
7. If speed decreases, then acceleration is
    a. zero.
    b. positive.
    c. negative.
    d. between 0 and 1.

Lesson 12.3: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. speed plus direction of motion

_____ 2. negative acceleration

_____ 3. SI unit for acceleration

_____ 4. symbol for a change in velocity

_____ 5. measure of a change in velocity

_____ 6. symbol for a change in time

_____ 7. how quickly an object changes position

Terms

a. acceleration

b. δt

c. deceleration

d. speed

e. δv

f. velocity

g. m/s^2

Lesson 12.3: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A change in speed, direction, or both is called _____.
2. Acceleration is a(n) _____ because it includes both size and direction.
3. A decrease in speed is called _____.
4. To calculate acceleration without a change in direction, you divide the change in velocity by the change in _____.
5. Acceleration is represented by the _____ of a velocity-time graph.
6. If the line of a velocity-time graph is horizontal, acceleration is _____.
7. If a car is increasing in speed, its acceleration is _____.

Lesson 12.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is a velocity-time graph, and how does it represent acceleration?

CHAPTER 2

Forces Worksheets

Chapter Outline

2.1 What is Force?

Lesson 13.1: True or False

Name_____ Class_____ Date_____

Determine if the following statements are true or false.

_____ 1. Mass is a measure of the force of gravity on an object.

_____ 2. Most objects have at least two forces acting on them at all times.

_____ 3. If opposing forces are unequal in strength, the net force is less than zero.

_____ 4. The SI unit for weight is the newton.

_____ 5. When two forces act on an object in the same direction, the net force equals zero.

_____ 6. When forces act in opposite directions on an object, they are subtracted to yield the net force.

_____ 7. Every sport involves forces.

_____ 8. Forces are always balanced when they act on an object in the same direction.

_____ 9. Whenever an object is stationary, it has no forces acting on it.

_____ 10. Two forces acting in the same direction always result in a stronger force.

Lesson 13.1: Critical Reading

Name_____ Class_____ Date_____

Read this passage from the text and answer the questions that follow.

Forces Acting in Opposite Directions

When two forces act on an object in opposite directions, the net force is equal to the difference between the two forces. The net force is calculated by subtracting the lesser force from the greater force. How opposing forces affect the motion of an object depends on whether the forces are balanced or unbalanced.

- If opposing forces are balanced, they are equal in strength and the net force is zero. With a net force of zero acting on an object, its motion does not change. If it isn't moving, it remains stationary. If it is moving, its speed and direction do not change.
- If opposing forces are unbalanced, they are not equal in strength and the net force is greater than zero. With a net force greater than zero acting on an object, its motion changes. If it is stationary, it starts moving. If it is already moving, its speed or direction changes.

Questions

1. How is net force calculated when two forces act on an object in opposite directions?
2. How do opposing forces affect the motion of an object if the forces are balanced?
3. How do unbalanced forces affect an object's motion?

Lesson 13.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

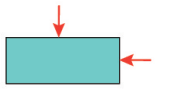
1. Force can cause a
   a. stationary object to start moving.
   b. moving object to change speed.
   c. moving object to change direction.
   d. all of the above
2. Examples of forces include
   a. motion.
   b. friction.
   c. acceleration.
   d. two of the above
3. If gravity pulls you down toward the center of Earth with a force of 500 N, how much upward force does the ground exert on you?
   a. 0 N
   b. 50 N
   c. 500 N
   d. none of the above
4. In the following sketch, what is the net force acting on the box?

   a. 5 N to the right
   b. 5 N to the left
   c. 15 N to the right
   d. 15 N to the left
5. Which diagram represents balanced forces?

a.

b.

c.



d.

6. Which pair of forces in question 5 differ from each other in both strength and direction?
    a. a
    b. b
    c. c
    d. d
7. Which pair of forces in question 5 produces a net force of zero?
    a. a
    b. b
    c. c
    d. d

Lesson 13.1: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. combination of all the forces acting on an object

_____ 2. force that a person or thing exerts on to an object

_____ 3. push or pull acting on an object

_____ 4. forces that produce a net force of zero

_____ 5. example of a force

_____ 6. SI unit for force

_____ 7. forces that produce a net force greater than zero

Terms

a. force

b. unbalanced forces

c. net force

d. applied force

e. newton

f. gravity

g. balanced forces

Lesson 13.1: Fill in the Blank

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Whenever the motion of an object changes, _____ has been applied.
2. Force is a(n) _____ because it has both size and direction.

3. The amount of force needed to cause a mass of 1 kilogram to accelerate at 1 m/s^2 is _____.
4. How a force affects an object's motion depends on the strength of the force and the _____ of the object.
5. If force is represented by an arrow, the length of the arrow represents the _____ of the force.
6. When unequal and opposite forces act on an object, the forces are said to be _____.
7. When two forces act on an object in the same direction, the net force equals the _____ of the two forces.

Lesson 2.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Forces can act on an object in the same direction or in opposite directions. How does each situation affect the motion of the object?

2.2 Friction

Lesson 13.2: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Friction is never useful.

_____ 2. Too much friction can cause parts to wear out.

_____ 3. Friction can cause scrapes on the skin.

_____ 4. Some surfaces are so smooth that they have no friction.

_____ 5. You use friction when you strike and light a match.

_____ 6. It takes more force to slide than to roll a heavy object.

_____ 7. Friction works in the same direction as the force applied to move an object.

_____ 8. When a dolly is stationary, there is rolling friction between the wheels and ground.

_____ 9. Static friction prevents you from sliding out of your chair to the floor.

_____ 10. The brakes on a bike create rolling friction.

Lesson 13.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

What Is Friction?

Friction is a force that opposes motion between two surfaces that are touching. Friction can work for or against us. For example, putting sand on an icy sidewalk increases friction so you are less likely to slip. On the other hand, too much friction between moving parts in a car engine can cause the parts to wear out.

Friction occurs because no surface is perfectly smooth. Even surfaces that look smooth to the unaided eye appear rough or bumpy when viewed under a microscope. For example, new metal pipes are so smooth that they are shiny. But if you examine the metal under a high-power microscope, the surface appears to be bumpy. All those mountains and valleys catch and grab the mountains and valleys of any other surface that contacts the metal. This creates friction.

Questions

1. Define friction.
2. Give an example of friction that is useful and friction that is not useful.
3. Explain what causes friction.

Lesson 13.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. Friction occurs because
    a. all surfaces have some roughness.
    b. surfaces in contact generate heat.
    c. chemical reactions take place when surfaces touch.
    d. none of the above
2. Which factors affect friction?
    a. roughness of the surfaces
    b. area of the surfaces
    c. force of weight pressing on the surfaces
    d. all of the above
3. If you pick up and carry a piece of heavy furniture, which type of friction do you have with the floor?
    a. static friction
    b. lifting friction
    c. sliding friction
    d. rolling friction
4. Why is it easier to slide a heavy box over a floor that it is to start it sliding in the first place?
    a. The box is lighter when it is sliding.
    b. The box has less mass when it is moving.
    c. The box has no friction when it is stationary.
    d. The box has less friction when it is sliding.
5. Which statement about rolling friction is false?
    a. It would be hard to ride a bike without it.
    b. It occurs when ball bearings are used.
    c. It is stronger than sliding friction.
    d. It is weaker than static friction.
6. A skydiver uses a parachute to
    a. increase air resistance.
    b. cushion the landing.
    c. slow the descent.
    d. two of the above
7. Which type of friction occurs between a paddle and the water?
    a. static friction
    b. sliding friction
    c. fluid friction
    d. rolling friction

Lesson 13.2: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. type of friction between ice skates and ice

_____ 2. any substance that can flow and take the shape of its container

_____ 3. force that opposes motion between any two surfaces

_____ 4. type of friction between shoes and pavement

_____ 5. type of friction between a parachute and air

_____ 6. type of friction between roller skates and concrete

_____ 7. type of friction between an object and a gas or liquid

Terms

a. friction

b. static friction

c. air resistance

d. fluid

e. sliding friction

f. fluid friction

g. rolling friction

Lesson 13.2: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Rough surfaces have _____ friction than smooth surfaces.
2. Heavier objects have _____ friction that lighter objects.
3. Increasing the area of surfaces that are touching _____ friction between them.
4. _____ friction occurs between objects that are not moving.
5. When you write with a pencil, you use _____.
6. Sliding friction is stronger than _____ friction.
7. Sliding friction is weaker than _____ friction.

Lesson 13.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Choose a sport with which you are familiar, and describe at least two ways that friction occurs in the sport. Is the friction a help or a hindrance to the players? Explain why.

2.3 Gravity

Lesson 13.3: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Satellites orbit Earth because of gravity.

_____ 2. An object has a greater mass on Earth than it does on the moon.

_____ 3. Molecules of gas are attracted toward one another by gravity.

_____ 4. The mass of an object affects its force of gravity.

_____ 5. Objects that are closer together have a weaker force of gravity.

_____ 6. All objects have the same acceleration due to gravity.

_____ 7. The curved path of an arrow is called its orbit.

_____ 8. The moon has both forward velocity and acceleration toward Earth.

_____ 9. Einstein's theory of gravity is better than Newton's law of gravity at predicting how all objects move.

_____ 10. Einstein defined gravity as a force of attraction between objects with mass.

Lesson 13.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Newton, Einstein, and Gravity

People have known about gravity for thousands of years. After all, they constantly experienced gravity in their daily lives. They knew that things always fall toward the ground. However, it wasn't until the late 1600s that Sir Isaac Newton developed his law of gravity. Newton was the first one to suggest that gravity is universal, that all objects in the universe are attracted to each other. That's why Newton's law of gravity is called the law of universal gravitation. Newton's law also states that more massive objects and objects that are closer together have a greater force of attraction.

Newton's law of gravity can predict the motion of most but not all objects. In the early 1900s, Albert Einstein came up with a theory of gravity that is better at predicting how all objects move. Einstein showed mathematically that gravity is not really a force in the sense that Newton thought. Instead, gravity is a result of the warping, or curving, of space and time. Imagine a bowling ball pressing down on a trampoline. The surface of the trampoline would curve downward instead of being flat. Einstein theorized that Earth and other massive objects affect space and time around them in a similar way. According to Einstein, objects curve toward one another because of the curves in space and time, not because they are pulling on each other with a force of attraction as Newton thought.

Questions

1. State Newton's law of universal gravitation.
2. How does Einstein's theory of gravity differ from Newton's law of gravity?

Lesson 13.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. Gravity always causes objects to
    a. repel each other.
    b. circle each other.
    c. attract each other.
    d. two of the above
2. Unlike friction, gravity
    a. is a force.
    b. acts over a distance.
    c. acts between objects that are not touching.
    d. two of the above
3. What does weight measure?
    a. size
    b. mass
    c. force
    d. volume
4. Jody has a mass of 50 kilograms. What is his weight on Earth?
    a. 5 N
    b. 50 N
    c. 500 N
    d. 5000 N
5. There is gravity between you and
    a. Earth.
    b. the moon.
    c. your desk.
    d. all of the above
6. The moon orbits Earth rather than the sun because
    a. the sun's gravity is weaker than Earth's.
    b. the moon is smaller than Earth.
    c. Earth already orbits the sun.
    d. the moon is closer to Earth.
7. An object with greater mass
    a. has greater acceleration when it falls.
    b. has a weaker force of gravity.
    c. is less affected by gravity.
    d. has greater weight.

Lesson 13.3: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. SI unit for weight

_____ 2. motion of an object subject to horizontal force and the force of gravity

_____ 3. force of attraction between two masses

_____ 4. scientist who proposed that gravity is due to curves in space and time

_____ 5. measure of the force of gravity

_____ 6. path of one object around another, such as the moon around Earth

_____ 7. scientist who proposed the law of universal gravitation

Terms

a. gravity

b. Isaac Newton

c. orbit

d. weight

e. projectile motion

f. Albert Einstein

g. newton

Lesson 13.3: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The force that created the solar system is _____.
2. On Earth, a mass of 1 kilogram has weight of about _____.
3. A scale is a device that measures _____.
4. _____ was the first to suggest that gravity affects all objects in the universe.
5. Because of gravity, objects accelerate toward Earth at a rate of _____.
6. An arrow shot straight ahead from a bow has _____ motion.
7. The moon has _____ motion because of its forward velocity and acceleration due to Earth's gravity.

Lesson 13.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why you would weigh less on the moon than you do on Earth.

2.4 Elastic Force

Lesson 13.4: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Something that is elastic springs back after being stretched.

_____ 2. An elastic material resists a change in shape.

_____ 3. Elastic force is not very useful.

_____ 4. When you use a resistance band, resistance comes from elastic force.

_____ 5. Glass is an example of an elastic material.

Lesson 13.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Elasticity and Elastic Force

Something that is elastic can return to its original shape after being stretched or compressed. This property is called elasticity. As you stretch or compress an elastic material, it resists the change in shape. It exerts a counter force in the opposite direction. This force is called elastic force. Elastic force causes the material to spring back to its original shape as soon as the stretching or compressing force is released.

Questions

1. Define elasticity.
2. What is elastic force?
3. If you stretch a rubber band, in what direction is elastic force exerted?

Lesson 13.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

1. Items that are elastic include
    a. metal wires.
    b. concrete blocks.
    c. plastic spring toys.

d. all of the above

2. A rubber band keeps a newspaper tightly rolled because it

   a. can be tied tightly.
   b. exerts elastic force.
   c. is unbreakable.
   d. none of the above

3. When you compress a spring, it

   a. resists the change in shape.
   b. exerts a force in the same direction.
   c. permanently changes to a new shape.
   d. two of the above

4. Springs are used in

   a. beds.
   b. cars.
   c. scales.
   d. all of the above

5. What happens when the stretching force on an elastic material is released?

   a. The material breaks.
   b. The material remains stretched out.
   c. The material starts to exert elastic force.
   d. The material snaps back to its original shape.

Lesson 13.4: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. force exerted on a material that is pulled apart

_____ 2. structure that returns to its original shape after being stretched or compressed

_____ 3. force exerted on a material that is pushed together

_____ 4. counter force exerted by an elastic material that is stretched or compressed

_____ 5. ability of a material to return to its original shape after being stretched or compressed

Terms

a. elastic force

b. stretching force

c. compressing force

d. elasticity

e. spring

Lesson 13.4: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A rubber band can stretch without breaking because it is _____.
2. _____ force causes a stretchy material to spring back to its original shape.
3. Elastic force is exerted in the _____ direction as the force applied to an elastic material.
4. Bungee cords are made of _____ material.
5. _____ are used to cushion the ride in a car.

Lesson 13.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe three ways that you commonly use elastic force. In each case, identify the job done by elastic force.

CHAPTER 3 Newton's Laws of Motion Worksheets

Chapter Outline

3.1 Newton's First Law

Lesson 14.1: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Inertia is the tendency of an object to resist motion.

_____ 2. Newton's first law of motion is also called the law of acceleration.

_____ 3. If an object is at rest, inertia will keep it at rest.

_____ 4. The inertia of an object is determined by its speed.

_____ 5. The speed of an object changes only when it is acted on by an unbalanced force.

_____ 6. A stationary object resists movement only because of gravity.

_____ 7. The tendency of an object to resist a change in motion depends on its mass.

_____ 8. If the net force acting on an object is zero, its inertia is also zero.

_____ 9. When you are moving at a high rate of speed, inertia makes is hard to stop.

_____ 10. Newton's first law of motion applies only to objects that are already moving.

Lesson 14.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Inertia

Inertia is the tendency of an object to resist a change in its motion. If an object is already at rest, inertia will keep it at rest. If the object is already moving, inertia will keep it moving. Think about what happens when you are riding in a car that stops suddenly. Your body moves forward on the seat. Why? The brakes stop the car but not your body, so your body keeps moving forward because of inertia. That's why it's important to always wear a seat belt.

The inertia of an object depends on its mass. Objects with greater mass also have greater inertia. Think how hard it would be to push a big cardboard box full of books. Then think how easy it would be to push the box if it was empty. The full box is harder to move because it has greater mass and therefore greater inertia.

Questions

1. What is inertia?
2. Describe how inertia affects motion.
3. What is the relationship between mass and inertia?

Lesson 14.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. Newton's first law of motion states than an object's motion will not change unless
    a. the net force acting on it is greater than zero.
    b. a force continues to be applied to the object.
    c. its inertia is stronger than the applied force.
    d. the object has no inertia.
2. Overcoming an object's inertia always requires a(n)
    a. large mass.
    b. massive force.
    c. unbalanced force.
    d. two of the above
3. It is more difficult to start a 50-kg box sliding across the floor than a 5-kg box because the 50-kg box has greater
    a. size.
    b. inertia.
    c. volume.
    d. velocity.
4. Once an object starts moving along a clear path, it would keep moving at the same velocity if it were not for
    a. inertia.
    b. friction.
    c. an unbalanced force.
    d. two of the above
5. An object's velocity will not change unless it is acted on by a(n)
    a. net force.
    b. strong force.
    c. unbalanced force.
    d. opposite but equal force.
6. The direction of a moving object will not change if the net force acting on it is
    a. greater than zero.
    b. less than zero.
    c. zero.
    d. two of the above

Lesson 14.1: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. combination of all the forces acting on an object

_____ 2. force that opposes the motion of any object

_____ 3. an object's motion will not change unless an unbalanced force acts on it

_____ 4. factor that determines the inertia of an object

_____ 5. type of force needed to overcome inertia of an object

_____ 6. tendency of an object to resist a change in motion

Terms

a. inertia

b. unbalanced force

c. friction

d. law of inertia

e. mass

f. net force

Lesson 14.1: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Newton's first law of motion is also called the law of _____.
2. An object at rest will stay at rest unless a(n) _____ force acts on it.
3. When the car you are riding in stops suddenly, you move forward because of _____.
4. Objects with greater mass have _____ inertia.
5. If an object is not moving, _____ will cause it to remain stationary.
6. Once objects start moving, _____ keeps them moving.
7. An object's motion will not change as long as the net force acting on it is _____.

Lesson 14.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how Newton's first law of motion is related to the concept of inertia.

3.2 Newton's Second Law

Lesson 14.2: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. The relationship between mass and inertia is described by Newton's second law of motion.

_____ 2. Newton determined that there is a direct relationship between force and mass.

_____ 3. Any change in velocity for any reason is called acceleration.

_____ 4. The greater the net force applied to a given object, the more it will accelerate.

_____ 5. The greater the mass of an object, the more it will accelerate when a given net force is applied to it.

_____ 6. A net force of 1 N applied to a mass of 1 kg results in an acceleration of 0.5 m/s^2.

_____ 7. Your weight equals your mass multiplied by the acceleration due to gravity.

_____ 8. A 10-kg object has greater acceleration due to gravity than a 5-kg object.

_____ 9. The acceleration of an object equals its mass times the net force applied to it.

_____ 10. The acceleration of an object due to gravity depends on the object's initial velocity

Lesson 14.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Acceleration and Weight

Newton's second law of motion explains the weight of objects. Weight is a measure of the force of gravity pulling on an object of a given mass. It's the force (F) in the acceleration equation that was introduced above:

$$a = \frac{F}{m}$$

This equation can also be written as:

$$F = m \times a$$

The acceleration due to gravity of an object equals 9.8 m/s^2, so if you know the mass of an object, you can calculate its weight as:

$$F = m \times 9.8 \text{ m/s}^2$$

As this equation shows, weight is directly related to mass. As an object's mass increases, so does its weight. For example, if mass doubles, weight doubles as well.

Questions

1. Define weight.
2. How is the weight of an object related to its mass?
3. If an object has a mass of 50 kg, what is its weight?

Lesson 14.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

1. An object is accelerating when it
   a. speeds up.
   b. slows down.
   c. changes direction.
   d. any of the above
2. Newton's second law of motion relates an object's acceleration to
   a. its mass.
   b. its velocity.
   c. the net force acting on it.
   d. two of the above
3. Doubling the net force acting on an object
   a. doubles its acceleration.
   b. decreases it acceleration.
   c. cuts its acceleration in half.
   d. does not affect its acceleration.
4. If you push a 20-kilogram mass with a force of 40 N, what will be the object's acceleration?
   a. 40 m/s^2
   b. 20 m/s^2
   c. 10 m/s^2
   d. 2 m/s^2
5. Which units can be used to express force?
   a. N
   b. kg/s^2
   c. $kg \bullet m/s^2$
   d. two of the above
6. If you know the mass of an object, you can calculate its weight with the formula
   a. $F = m \times 9.8$ m
   b. $F = m \times 9.8$ m/s
   c. $F = m \times 9.8$ m/s^2
   d. $F = m \times 0.98$ m/s^2
7. If the mass of an object doubles, its weight

a. doubles.
b. decreases.
c. is not affected.
d. changes by a factor of $\frac{1}{2}$.

Lesson 14.2: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. acceleration due to gravity

_____ 2. formula for weight

_____ 3. formula for acceleration

_____ 4. measure of the force of gravity pulling on an object

_____ 5. type of relationship between acceleration and mass

_____ 6. measure of the change in velocity of a moving object

_____ 7. type of relationship between acceleration and force

Terms

a. acceleration

b. weight

c. direct relationship

d. $a = \frac{F}{m}$

e. inverse relationship

f. $F = m \times a$

g. 9.8 m/s^2

Lesson 14.2: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ occurs whenever an object is acted upon by an unbalanced force.
2. The acceleration of an object is determined by the net force acting on the object and the object's _____.
3. Newton's second law of motion shows that there is a direct relationship between acceleration and _____.
4. One newton is the force needed to cause a 1-kilogram mass to accelerate at _____.
5. There is a(n) _____ relationship between an object's weight and its mass.
6. To calculate weight from acceleration and mass, mass must be expressed in _____.
7. An object's acceleration is zero when the net force acting on the object is _____.

Lesson 14.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how Newton's second law of motion can be used to calculate the acceleration of an object.

3.3 Newton's Third Law

Lesson 14.3: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Forces always act in pairs.

_____ 2. Action and reaction forces always cancel out.

_____ 3. Action and reaction forces always result in motion.

_____ 4. Only moving objects have momentum.

_____ 5. A smaller mass cannot have as much momentum as a larger mass.

_____ 6. Momentum can be transferred from one object to another.

_____ 7. When an action and reaction occur, momentum is usually lost.

_____ 8. Momentum is conserved only in head-on collisions.

_____ 9. Newton's third law of motion is also called the law of conservation of momentum.

_____ 10. Momentum is another term for acceleration.

Lesson 14.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Action and Reaction

Newton's third law of motion states that every action has an equal and opposite reaction. This means that forces always act in pairs. First an action occurs, such as two skateboarders pushing together. Then a reaction occurs that is equal in strength to the action but in the opposite direction. In the case of the skateboarders, they move apart, and the distance they move depends on how hard they first pushed together.

You might think that actions and reactions would cancel each other out like balanced forces do. Balanced forces, which are also equal and opposite, cancel out because they act on the same object. Action and reaction forces, in contrast, act on different objects, so they don't cancel out. In fact, they often result in motion.

Questions

1. What is Newton's third law of motion?
2. Describe an example of an action and reaction that result in motion.
3. Compare and contrast action-reaction forces and balanced forces.

Lesson 14.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. When an action force occurs, the reaction force is always
   a. in the same direction as the action force.
   b. equal and opposite to the action force.
   c. applied to the same object as the action force.
   d. two of the above
2. When you stand on the floor, the force of your body pushing down on the floor is
   a. matched by the floor pushing up on your body.
   b. less than the reaction force applied by the floor.
   c. a reaction to the floor pushing up.
   d. none of the above
3. When a kangaroo jumps, the kangaroo's action force acts on the ground and the reaction force
   a. is exerted by the ground.
   b. acts on the kangaroo.
   c. is greater than the action force.
   d. two of the above
4. If the following objects are all moving at the same velocity, which of the objects has the greatest momentum?
   a. pea
   b. marble
   c. volleyball
   d. bowling ball
5. Momentum is directly related to
   a. mass.
   b. velocity.
   c. distance.
   d. two of the above
6. Momentum is a
   a. force of nature.
   b. form of energy.
   c. property of an object.
   d. measure of an object's motion.
7. What is the momentum of a 9-kilogram object that has a velocity of 3 m/s?
   a. 3 kg/m/s
   b. 6 kg/s/m
   c. 12 kg • s/m
   d. 27 kg • m/s

Lesson 14.3: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. how to calculate momentum

_____ 2. SI unit for momentum

_____ 3. equal and opposite forces that act on different objects

_____ 4. combined momentum of objects remains the same when an action-reaction occurs

_____ 5. property of a moving object that makes it hard to stop

_____ 6. equal and opposite forces that act on the same object

_____ 7. every action has an equal and opposite reaction

Terms

a. momentum

b. Newton's third law of motion

c. balanced forces

d. kg • m/s

e. law of conservation of momentum

f. action-reaction forces

g. mass × velocity

Lesson 14.3: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Two objects with the same mass have the same momentum only if they also have the same _____.
2. If a very massive object is stationary, its momentum is _____.
3. A 20-kg object moving at a velocity of 3 m/s has a momentum of _____.
4. For every action, there is an equal and _____ reaction.
5. Action and reaction forces are not balanced forces because they act on _____ objects.
6. When moving objects collide, their combined _____ is conserved.
7. If you double the mass of a moving object, the object's momentum _____.

Lesson 14.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Apply Newton's third law of motion to explain movements of a soccer ball during a game of soccer.

CHAPTER 4

Work and Machines Worksheets

Chapter Outline

4.1 Work

Lesson 16.1: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Whenever you move your body you are doing work.

_____ 2. You do work when you push a heavy object even if the object does not move.

_____ 3. Work can be expressed in the unit N • m.

_____ 4. A more powerful device can do the same work in less time than a less powerful device.

_____ 5. If you move an object that weighs 10 newtons a distance of 2 meters, you do 5 joules of work.

_____ 6. If you move the object in question 5 a distance of 5 meters, you do 2 joules of work.

_____ 7. A device that does 100 joules of work in 3 seconds has 300 watts of power.

_____ 8. The unit called the horsepower was introduced by James Watt.

_____ 9. A 2-horsepower device has almost 1500 watts of power.

_____ 10. The more force you apply to move an object, the more work you do.

Lesson 16.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

What Is Power?

Did you ever rake leaves? It can take a long time to do all that work. But if you use an electric leaf blower instead, you can do the job much more quickly. Both the leaf blower and the rake do the work of removing leaves from the yard, but the leaf blower has more power. That's why it can do the same amount of work in less time. Power is a measure of the amount of work that can be done in a given amount of time.

Power can be represented by the equation:

$$\text{Power} = \frac{\text{Work}}{\text{Time}}$$

In this equation, work is measured in joules and time is measured in seconds, so power is expressed in joules per second (J/s). This is the SI unit for power, also known as the watt (W). A watt equals 1 joule of work per second. You may already be familiar with watts. That's because light bulbs and small appliances such as hair dryers are labeled with the watts of power they provide. For example, a hair dryer might have 2000 watts of power. This amount of power could also be expressed kilowatts. A kilowatt equals 1000 watts, so a 2000-watt hair dryer has 2 kilowatts of power.

Questions

1. What is power?
2. How can power be calculated? What units are used to express power?
3. How does the power of a device affect the amount of work it can do?

Lesson 16.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. For work to be done on an object, force must be applied
   a. in an upward direction.
   b. against the force of gravity.
   c. in the same direction as gravity.
   d. in the same direction that the object moves.
2. Work is directly related to the force applied to an object and to the
   a. mass of the object.
   b. distance the object moves.
   c. direction of the applied force.
   d. amount of time the force is applied.
3. If a mover pushes a box weighing 100 newtons a distance of 3 meters, how much work does she do?
   a. 3 J
   b. 33 J
   c. 300 J
   d. 3000 J
4. The power of a device can be expressed in
   a. joules.
   b. joules per meter.
   c. joules per second.
   d. none of the above
5. Work can be calculated as
   a. force $\times$ time.
   b. force $\times$ power.
   c. power $\times$ time.
   d. power $\times$ distance.
6. A device does 2000 joules of work in 10 seconds. What is the power of the device?
   a. 20,000 W
   b. 2000 W
   c. 200 W
   d. 20 W
7. One horsepower is the amount of work a horse can do in one
   a. second.
   b. minute.
   c. hour.
   d. day.

Lesson 16.1: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. unit for power that equals 745 watts

_____ 2. SI unit for work

_____ 3. how to calculate work

_____ 4. use of force to move an object

_____ 5. how to calculate power

_____ 6. SI unit for power

_____ 7. measure of the amount of work that can be done in a given amount of time

Terms

a. joule

b. horsepower

c. power

d. force $\times$ distance

e. watt

f. work $\div$ time

g. work

Lesson 16.1: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The greater the force that is used to move an object, the _____ work that is done.
2. One _____ equals the amount of work that is done when 1 N of force moves an object a distance of 1 m.
3. The SI unit called the _____ equals 1 joule of work per second.
4. A 2000-watt machine produces _____ kilowatts of power.
5. A more powerful device can do _____ work in the same amount of time than a less powerful device.
6. Work can be calculated by multiplying _____ by time.
7. In the 1770s, _____ invented the first powerful steam engine that began the industrial revolution.

Lesson 16.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why the following statement is true, and give examples to illustrate your answer: "Not all force that is used to move an object does work on the object."

4.2 Machines

Lesson 16.2: True or False

Name_____ Class_____ Date_____

Determine if the following statements are true or false.

_____ 1. The output distance of a machine is always greater than the input distance.

_____ 2. Using a machine increases the amount of work that is done for a given amount of force.

_____ 3. A machine increases the applied force by increasing the distance over which the force is applied.

_____ 4. The force you apply to a doorknob is less than the force applied by the doorknob to open the door.

_____ 5. All machines that change the strength of the force also change the distance over which the force is applied.

_____ 6. The actual mechanical advantage of a machine is always greater than its ideal mechanical advantage.

_____ 7. If a machine's output distance is greater than the input distance, the ideal mechanical advantage is less than 1.

_____ 8. If a machine changes only the direction of force, its mechanical advantage is equal to 1.

_____ 9. A lever is a machine that changes the direction of the force that is applied to it.

_____ 10. The force applied by a machine is always greater than the force applied to the machine.

Lesson 16.2: Critical Reading

Name_____ Class_____ Date_____

Read this passage from the text and answer the questions that follow.

How Machines Help Us Do Work

A machine is any device that makes work easier by changing a force. When you use a machine, you apply force to the machine. This force is called the input force. The machine, in turn, applies force to an object. This force is called the output force. The force you apply to a machine is applied over a certain distance, called the input distance. The force applied by the machine to the object is also applied over a certain distance, called the output distance.

Machines make work easier by increasing the amount of force that is applied, increasing the distance over which the force is applied, or changing the direction in which the force is applied. Contrary to popular belief, machines do not increase the amount of work that is done. They just change how the work is done. The work done on a machine or by a machine always equals force multiplied by distance. Because a machine doesn't change the amount of work that is done, a machine that increases force must apply the force over a shorter distance. For the same reason, a machine that increases the distance over which the force is applied must apply less force.

Questions

1. Define machine.

2. How do machines make work easier?
3. If a machine increases force, why must the machine apply the force over a shorter distance?

Lesson 16.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. A machine can make work easier by
   a. increasing the amount of force that is applied.
   b. increasing the distance over which force is applied.
   c. changing the direction in which force is applied.
   d. any of the above
2. Examples of machines that increase force include
   a. doorknobs.
   b. hammers.
   c. canoe paddles.
   d. two of the above
3. How does a nutcracker change the force applied to it?
   a. It increases the force that is applied.
   b. It increases the distance over which force is applied.
   c. It changes the direction in which force is applied.
   d. two of the above
4. A machine that increases the applied force and also changes its direction is a
   a. hammer.
   b. canoe paddle.
   c. pry bar.
   d. doorknob.
5. Which of the following could be the efficiency of a machine?
   a. 200%
   b. 150%
   c. 100%
   d. 75%
6. What is the mechanical advantage of a machine that increases the distance over which force is applied?
   a. less than 1
   b. equal to 1
   c. greater than 1
   d. greater than 2
7. If the output force of a machine is greater than input force, the mechanical advantage of the machine is
   a. greater than 1.
   b. equal to 1.
   c. less than 1.
   d. any of the above

Lesson 16.2: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. number of times a machine multiplies the input force

_____ 2. distance over which force is applied to a machine

_____ 3. percent of input work that becomes output work

_____ 4. force applied to a machine

_____ 5. any device that makes work easier by changing a force

_____ 6. distance over which a machine applies force

_____ 7. force applied by a machine

Terms

a. efficiency

b. input force

c. output force

d. mechanical advantage

e. input distance

f. output distance

g. machine

Lesson 16.2: Fill in the Blank

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. If the output force is greater than the input force, then the output distance must be _____ than the input distance.
2. All machines must use some of the work put into them to overcome the force of _____.
3. The _____ of a machine is a measure of how well the machine reduces friction.
4. How much a machine multiplies force when it is used in the real world is its _____ mechanical advantage.
5. How much a machine would multiply force if there were no friction is its _____ mechanical advantage.
6. The mechanical advantage of a machine that increases force is always _____ than one.
7. The mechanical advantage of a machine that increases the distance over which force is applied is always _____ than one.

Lesson 16.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is mechanical advantage? How can a machine with a mechanical advantage of less than one help you do work? Use examples in your answer.

4.3 Simple Machines

Lesson 16.3: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. There are seven different types of simple machines.

_____ 2. The input distance of an inclined plane is always greater than the output distance.

_____ 3. The input force is always applied to the thinner side of a wedge.

_____ 4. The closer together the threads of a screw are, the harder it is to turn the screw.

_____ 5. When you use a hammer to pry a nail out of board, the hammer is a first class lever.

_____ 6. A lever always increases the force applied to the lever.

_____ 7. The wheel of a Ferris wheel turns more quickly than the axle.

_____ 8. A single fixed pulley has an ideal mechanical advantage of 1.

_____ 9. A compound pulley always contains at least two fixed pulleys.

_____ 10. A zip-line pulley is an example of a single moveable pulley.

Lesson 16.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Inclined Plane

An inclined plane is a simple machine consisting of a sloping surface that connects lower and higher elevations. An inclined plane makes it easier to move objects uphill against the force of gravity. The sloping surface of the inclined plane supports part of the weight of the object as it moves up the slope. As a result, it takes less force to move the object to a higher elevation. The trade-off is that the object must be moved over a greater distance than if it were moved straight up to the higher elevation. On the other hand, the output force is greater than the input force because it is applied over a shorter distance.

As for other simple machines, the ideal mechanical advantage of an inclined plane is given by:

$$\text{Ideal Mechanical Advantage} = \frac{\text{Input distance}}{\text{Output distance}}$$

The input distance is the length of the sloping surface of the inclined plane, and the output distance is the maximum height of the inclined plane. Because the sloping surface is always greater than the height of the inclined plane, the ideal mechanical advantage of an inclined plane is always greater than 1. An inclined plane with a longer sloping surface relative to its height has a greater mechanical advantage and requires less input force to move an object to a higher elevation.

Questions

1. Describe an inclined plane.
2. How is an inclined plane used?
3. Why is the ideal mechanical advantage of an inclined plane always greater than 1?

Lesson 16.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. Which type of simple machine is a chisel?
    a. lever
    b. screw
    c. wedge
    d. none of the above
2. Which of the following is an example of a screw?
    a. spiral staircase
    b. Ferris wheel
    c. seesaw
    d. axe
3. The ideal mechanical advantage of a screw is always
    a. less than 1.
    b. equal to 1.
    c. greater than 1.
    d. greater than 2.
4. Which class of lever does not change the direction of the applied force?
    a. class 1
    b. class 2
    c. class 3
    d. two of the above
5. Which of the following is an example of a third class lever?
    a. seesaw
    b. wheelbarrow
    c. hockey stick
    d. pry bar
6. A wheel and axle increase the applied force when
    a. the input distance is equal to the output distance.
    b. the input distance is less than the output distance.
    c. the input force is applied to the wheel.
    d. the output force is applied by the wheel.
7. How many rope segments pull up on the object in a single moveable pulley?
    a. 1
    b. 2
    c. 3
    d. 4

Lesson 16.3: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. simple machine that consists of a rope and grooved wheel

_____ 2. type of lever in which the fulcrum is between the input and output forces

_____ 3. simple machine consisting of two connected rings or cylinders that both turn around a single center point

_____ 4. simple machine that consists of an inclined plane wrapped around a cylinder or cone

_____ 5. fixed point of a lever around which the bar rotates

_____ 6. simple machine consisting of a sloping surface that connects lower and higher elevations

_____ 7. type of lever in which input and output forces are on the same side of the fulcrum

Terms

a. inclined plane

b. class 2 lever

c. pulley

d. screw

e. class 1 lever

f. wheel and axle

g. fulcrum

Lesson 16.3: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A simple machine that consists of two inclined planes is a(n) _____.
2. A(n) _____ is a simple machine consisting of a bar that rotates around a fixed point.
3. A ramp is an example of the simple machine called a(n) _____.
4. Unlike an inclined plane, a wedge works only when it _____.
5. The ideal mechanical advantage of a third class lever is always _____ than 1.
6. A single fixed pulley changes the _____ of the force applied to the pulley.
7. A single moveable pulley has an ideal mechanical advantage of _____.

Lesson 16.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast single fixed pulleys and single moveable pulleys.

4.4 Compound Machines

Lesson 16.4: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Some compound machines consist of thousands of simple machines.

_____ 2. The output force is exerted by the handle ends of the levers in scissors.

_____ 3. Scissors change the direction of the input force.

_____ 4. The fulcrum in a fishing rod is at the center of the rod.

_____ 5. Compound machines have more moving parts than simple machines.

_____ 6. The fewer simple machines a compound machine contains, the greater its mechanical advantage.

_____ 7. Compound machines have more friction to overcome than do simple machines.

Lesson 16.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Efficiency and Mechanical Advantage of Compound Machines

Because compound machines have more moving parts than simple machines, they generally have more friction to overcome. As a result, compound machines tend to have lower efficiency than simple machines. When a compound machine consists of a large number of simple machines, friction may become a serious problem, and it may produce a lot of heat. Lubricants such as oil or grease may be used to coat the moving parts so they slide over each other more easily. This is how a car's friction is reduced.

Compound machines have a greater mechanical advantage than simple machines. That's because the mechanical advantage of a compound machine equals the product of the mechanical advantages of all its component simple machines. The greater the number of simple machines it contains, the greater is its mechanical advantage.

Questions

1. Why do compound machines tend to have lower efficiency than simple machines?
2. Which will have a greater mechanical advantage: a compound machine that consists of 200 simple machines or a compound machine that consists of 2 simple machines? Explain your answer.

Lesson 16.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

1. Simple machines in a bicycle include
    a. wheels and axles.
    b. pulleys.
    c. levers.
    d. all of the above
2. Which of the following is a compound machine?
    a. wheel and axle
    b. scissors
    c. pulley
    d. lever
3. Which of the following machines contains one or more levers?
    a. wheelbarrow
    b. scissors
    c. fishing rod
    d. all of the above
4. The fulcrum in a pair of scissors is always located
    a. between the input and output points.
    b. closer to the input point.
    c. closer to the output point.
    d. two of the above
5. The mechanical advantage of a compound machine equals the
    a. sum of the mechanical advantages of all its simple machines.
    b. product of the mechanical advantages of all its simple machines.
    c. highest mechanical advantage of all its simple machines.
    d. average mechanical advantage of all of its simple machines.
6. The way friction is reduced in a compound machine such as a car is with
    a. fans.
    b. heaters.
    c. lubricants.
    d. none of the above

Lesson 16.4: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. how greatly a machine increases the applied force

_____ 2. how well a machine deals with friction

_____ 3. example of a third class lever

_____ 4. any machine that consists of more than one simple machine

_____ 5. example of a wheel and axle that works as a pulley

_____ 6. machine consisting of a wheel and axle and a lever

_____ 7. machine consisting of two levers and two wedges

Terms

a. compound machine

b. mechanical advantage

c. fishing rod

d. wheelbarrow

e. fishing reel

f. efficiency

g. scissors

Lesson 16.4: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A bicycle is an example of a(n) _____ machine.
2. The point around which a lever rotates is called the _____.
3. Scissors contain two-_____ class lever.
4. The blades of scissors are simple machines known as _____.
5. A wheelbarrow contains a _____ class lever.
6. Compound machines tend to have _____ efficiency than simple machines.
7. The mechanical advantage of compound machines is generally _____ than the mechanical advantage of simple machines.

Lesson 16.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Name a compound machine and identify at least two simple machines that it contains. Explain how each simple machine contributes to the job done by the compound machine.

CHAPTER 5

Introduction to Energy Worksheets

Chapter Outline

5.1 Types of Energy

Lesson 17.1: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Most forms of energy can also be classified as kinetic or potential energy.

_____ 2. If the mass of an object doubles, its kinetic energy is only half as great.

_____ 3. Kinetic energy and velocity have an inverse relationship.

_____ 4. Clothes hanging motionless on a clothesline do not have any energy.

_____ 5. Changing the shape of an elastic material gives it potential energy.

_____ 6. If you double the weight of an object, its gravitational potential energy also doubles.

_____ 7. The higher above the ground you are, the less gravitational potential energy you have.

_____ 8. The energy of a child on a swing changes back and forth between kinetic and potential energy.

_____ 9. Some of the kinetic energy of the child in question 8 is given off as heat.

_____ 10. Energy conversions are always permanent changes in energy.

Lesson 17.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Energy Conversion

When you stand on a diving board high above a swimming pool, you have gravitational potential energy. That's because you have the potential to fall toward Earth due to gravity. What happens when you jump off the diving board? Your gravitational potential energy changes to kinetic energy as you fall toward the water. However, you can regain your potential energy by getting out of the water and climbing back up to the diving board. This requires an input of kinetic energy. These changes in energy are examples of energy conversion, the process in which energy changes from one type or form to another. Energy conversion between potential and kinetic energy also occurs when you swing on a playground swing or jump on a trampoline.

The law of conservation of energy applies to energy conversions. Energy is not used up when it changes form. However, some energy may be used to overcome friction, and this energy is usually given off as heat. For example, your kinetic energy at the bottom of a dive is the same as your potential energy when you were on the diving board, except for a small amount of heat resulting from friction with the air as you fell.

Questions

1. What is energy conversion?

2. Describe how kinetic and potential energy change as a diver climbs up to a diving board and then dives into the water below.
3. How does the law of conservation of energy apply to these energy conversions?

Lesson 17.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. The ability to cause a change in matter is one definition of
    a. work.
    b. force.
    c. energy.
    d. motion.
2. Forms of energy include
    a. mechanical energy.
    b. electrical energy.
    c. chemical energy.
    d. all of the above
3. What is the kinetic energy of an object that has a mass of 10 kg and a velocity of 1 m/s?
    a. 100 J
    b. 10 J
    c. 5 J
    d. 1 J
4. What is the gravitational potential energy of an object that has a weight of 12 N and is 3 m above the ground?
    a. 108 J
    b. 36 J
    c. 15 J
    d. 4 J
5. Which statement is false about objects with kinetic energy?
    a. They are in motion.
    b. They are doing work.
    c. They are moving matter over a distance.
    d. They are using up their energy by moving.
6. The SI unit for energy is the
    a. joule.
    b. newton.
    c. newton • meter.
    d. two of the above
7. Which type(s) of energy does a person have when jumping on a trampoline?
    a. kinetic energy
    b. elastic potential energy
    c. gravitational potential energy
    d. all of the above

Lesson 17.1: Matching

Name_____ **Class**_____ **Date**_____

Match each definition with the correct term.

Definitions

_____ 1. energy stored in an object because of its position or shape

_____ 2. stored energy due to an object's shape

_____ 3. use of force to move matter

_____ 4. energy of moving matter

_____ 5. stored energy due to an object's position

_____ 6. ability to do work

_____ 7. process in which energy changes from one type or form to another

Terms

a. energy

b. kinetic energy

c. energy conversion

d. work

e. gravitational potential energy

f. elastic potential energy

g. potential energy

Lesson 17.1: Fill in the Blank

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. When work is done, _____ is transferred from one object to another.
2. The two basic types of energy are kinetic energy and _____ energy.
3. Anything that is moving has _____ energy.
4. The amount of kinetic energy in an object depends on its mass and _____.
5. Gravitational potential energy depends on an object's height above the ground and its _____.
6. When energy changes form, the total amount of energy is always _____.
7. Stretching a rubber band gives it _____ potential energy.

Lesson 17.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why an object with kinetic energy always does work.

5.2 Forms of Energy

Lesson 17.2: True or False

Name_____ **Class**_____ **Date**_____

Determine if the following statements are true or false.

_____ 1. Kinetic and potential energy add up to mechanical energy.

_____ 2. There is stored chemical energy in food.

_____ 3. A lightning bolt is a powerful discharge of light energy.

_____ 4. Most of the electrical energy we use is produced in power plants.

_____ 5. The sun produces nuclear energy when hydrogen nuclei undergo fusion.

_____ 6. Some of the sun's energy travels through space to heat and light Earth.

_____ 7. The atoms that make up matter are in constant motion.

_____ 8. Radio waves are a type of sound waves.

_____ 9. Energy rarely changes from one form to another.

_____ 10. One form of energy cannot change into two or more different forms of energy.

Lesson 17.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

How Energy Changes Form

Energy often changes from one form to another. For example, the mechanical energy of a moving drumstick changes to sound energy when it strikes the drumhead and causes it to vibrate. Any form of energy can change into any other form. Frequently, one form of energy changes into two or more different forms. For example, when wood burns, the wood's chemical energy changes to both thermal energy and light energy. Whenever energy changes form, energy is conserved. No energy is lost, although some may be released as thermal energy due to friction.

Many machines change energy from one form to another. For example, a turbine changes mechanical energy to electrical energy. Some of the mechanical energy of the moving parts is used to overcome friction. The more efficient a device is, the less energy it uses to overcome friction and the greater the percentage of usable energy it produces. The U.S. government's Energy Star program certifies the energy efficiency of appliances. Appliances with an "Energy Star" label use energy efficiently and thereby reduce energy use.

Questions

1. Describe how a drumstick changes energy when it strikes the drumhead.
2. How does energy change when wood burns?

3. What is the Energy Star program? What does an "Energy Star" label represent?

Lesson 17.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

1. Which form of energy does your body use to stay warm?
    a. light energy
    b. sound energy
    c. chemical energy
    d. none of the above
2. Which type of energy is stored in wood?
    a. thermal energy
    b. light energy
    c. chemical energy
    d. two of the above
3. Sources of electrical energy include
    a. the sun.
    b. lightning.
    c. batteries.
    d. two of the above
4. Nuclear power plants produce energy by
    a. burning fossil fuels.
    b. splitting atomic nuclei.
    c. causing chemical reactions.
    d. capturing kinetic energy of atoms.
5. The thermal energy of an object depends on
    a. how quickly its atoms are moving.
    b. how much light it gives off.
    c. how many atoms it has.
    d. two of the above
6. Electromagnetic waves include all of the following except
    a. light.
    b. sound.
    c. X rays.
    d. microwaves.
7. Sound waves can travel through all of the following except
    a. air.
    b. space.
    c. water.
    d. glass.

Lesson 17.2: Matching

Name_____ Class_____ Date_____

Match each definition with the correct term.

Definitions

_____ 1. energy released when atomic nuclei split apart

_____ 2. total kinetic energy of all the atoms in an object

_____ 3. energy stored in chemical bonds

_____ 4. energy of an object that is moving or has the potential to move

_____ 5. energy that travels in waves through matter from a vibrating object

_____ 6. kinetic energy of moving electrons

_____ 7. energy that travels in electrical and magnetic waves

Terms

a. chemical energy

b. electrical energy

c. nuclear energy

d. thermal energy

e. electromagnetic energy

f. mechanical energy

g. sound energy

Lesson 17.2: Fill in the Blank

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. _____ energy is the sum of an object's kinetic and potential energy.

2. Chemical energy is a form of _____ energy.

3. A battery converts chemical energy to _____ energy.

4. In nuclear power plants, nuclei split apart, or _____.

5. _____ energy comes from moving atoms in matter.

6. The form of energy that travels from the sun through space is _____ energy.

7. The process in which energy changes form is called energy _____.

Lesson 17.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Think of a device you commonly use that changes energy from one form to two or more different forms. Describe the energy conversions that take place when you use the device.