Kinematics (motion)

1. The average speed of a plane was 600 kilometers per hour. How long did it take the plane to travel 120 kilometers?

a) 0.2 h
b) 0.5 h
c) 0.7 h
d) 5 h

2. What is the total distance traveled by an object that moves with an average speed of 6.0 meters per second for 8.0 seconds?

a) .75 m
b) 1.3 m
c) 14 m
d) 48 m

3. An object travels for 8.00 seconds with an average speed of 160 meters per second. The distance traveled by the object is

a) 20.0 m
b) 200 m
c) 1280 m
d) 2560 m

4. A car is accelerated at 4.0 meters per second ^{2} from rest. The car will reach a speed of 28 meters per second at the end of

a) 3.5 m
b) 7.0 s
c) 14 s
d) 24 s

5. An object that is originally moving at a speed of 20 meters per second accelerates uniformly for 5.0 seconds to a final speed of 50 meters per second. What is the acceleration of the object?

a) 14 m / s^2
b) 10 m / s^2
c) 6.0 m / s^2
d) 4.0 m / s^2

6. If a car increases its speed from 15 m/s to 30 m/s in 15 seconds, the average acceleration during this time is

a) 1.0 m/s^2
b) 15 m/s^2
c) 30 m/s^2
d) 45 m/s^2

7. A block starting from rest slides down the length of an 18-meter plank with a uniform acceleration of 4.0 meters per second^2. How long does the block take to reach the bottom?

a) 4.5 s
b) 2.0 s
c) 3.0 s
d) 9.0 s

8. As the projectile rises and then falls back to the ground, its acceleration

a) decreases, then increases
b) increases, then decreases
c) increases, only
d) remains the same

9. A freely falling object near the Earth's surface has a constant

a) velocity of -1.00 m/s
b) velocity of -9.81 m/s
c) acceleration of -1.00 m/s^2
d) acceleration of -9.81 m/s^2

10. A 2.0 kilogram stone that is dropped from the roof of a building takes 4.0 seconds to reach the ground. Neglecting air resistance, the maximum speed of the stone will be approximately

a) 8.0 m/s
b) 9.8 m/s
c) 29 m/s
d) 39 m/s

11. Starting from rest, an object rolls freely down an incline that is 10 meters long in 2 seconds. The acceleration of the object is approximately

a) 5 m/s
b) 5 m/s^2
c) 10 m/s
d) 10 m/s^2

12. An object initially traveling in a straight line with a speed of 5.0 meters per second is accelerated at 2.0 meters per second^2 for 4.0 seconds. The total distance traveled by the object in the 4.0 seconds is

a) 36 m
b) 24 m
c) 16 m
d) 4.0 m

13. An object starts from rest and falls freely. What is the speed of the object at the end of 3.00 seconds?

a) 9.81 m/s
b) 19.6 m/s
c) 29.4 m/s
d) 88.2 m/s

14. Starting from rest, object A falls freely for 2.0 seconds, and object B falls freely for 4.0 seconds. Compared with object A, object B falls

a) one-half as far
b) twice as far
c) 3 times as far
d) 4 times as far

15. A softball is thrown straight up, reaching a maximum height of 20 meters. Neglecting air resistance, what is the ball's approximate vertical velocity when it hits the ground?

a) -10 m/s
b) -20 m/s
c) -15 m/s
d) -40 m/s

Forces

1. Compared to the inertia of a 1 kg mass, the inertia of a 4 kg mass is
    a. ¼ as great
    b. 1/16 as great
    c. 16 times as great
    d. 4 times as great

2. As the mass of an object decreases, its inertia will
    a. Decrease
    b. Increase
    c. Remain the same

3. The fundamental unit for a force of 1 N is
    a. m / s^2
    b. kg
    c. $m / s^2 / kg$
    d. $kg * m / s^2$

4. An object with a mass of 2 kg is accelerated at 5 m/s^2. The net force acting on the mass is
    a. 5 N
    b. 2 N
    c. 10 N
    d. 20 N

5. What force is needed to give an electron an acceleration of 1×10^{10} m / s^2? GIVE MASS OF e-
    a. 9.11×10^{-41} N
    b. 9.11×10^{-21} N
    c. 9.11×10^{-31} N
    d. 1.10×10^{43} N

6. Assume that an object has no unbalanced force acting on it. Which statement about the object is true?
    a. The object may be in motion
    b. The object must be slowing down
    c. The object must be at rest
    d. The object may be speeding up

7. What is the gravitational acceleration on a planet where a 2 kg mass has a weight of 16 N on the planet's surface?
    a. 1/8 m/s^2
    b. 8 m/s^2
    c. 10 m/s^2
    d.32 m/s^2

8. On planet Gamma, a 4.0 a 4 kg mass experiences a gravitational force of 24 N. What is the acceleration due to gravity on planet Gamma?
    a. .17 m/s^2
    b. 6 m/s^2
    c. 9.8 m/s^2
    d. 96 m/s^2

9. What is the weight of a 5 kg object at the surface of the Earth?
    a. .5 N
    b. 5 N
    c. 49 N
    d. 490 N

10. For a freely falling object, the ratio of the force of gravity to its acceleration is
    a. Weight
    b. Momentum
    c. Kinetic energy
    d. Mass

11. A force of 10 N applied to mass M accelerates the mass at 2 m/s^2. The same force applied to a mass of 2M would produce an acceleration of
    a. 1 m/s^2
    b. 2 m/s^2
    c. .5 m/s^2
    d. 4 m/s^2

12. If an object is moving north, the direction of the frictional force is
    a. North
    b. South
    c. East
    d. West

13. A horizontal force of 15 N pulls a 5 kg block along a horizontal surface. If the force produces an acceleration of 2 m/s^2, the frictional force action on the block is
    a. 1 N
    b. 2 N
    c. 5 N
    d. 15 N

14. A 1 kg bird stands on a limb. The force that the limb exerts on the bird is
    a. 1 N
    b. 2 N
    c. 0 N
    d. 9.8 N

15. A baseball bat moving at high velocity strikes a feather. If air resistance is neglected, compared to the force exerted by the bat on the feather, the force exerted by the feather on the bat will be
    a. Smaller
    b. Larger
    c. The same

Vectors

1) Which quantity has both magnitude and direction?
   a) Distance
   b) Speed
   c) Mass
   d) Velocity

2) Which is a scalar quantity?
   a) Force
   b) Energy
   c) Displacement
   d) Velocity

3) Two concurrent forces of 6 Newtons and 12 Newtons could produce the same effect as a single force of
   a) 5.0 N
   b) 15 N
   c) 20 N
   d) 72 N

4) A girl attempts to swim directly across a stream 14 meters wide. When she reaches the other side, she is 15 meters downstream. The magnitude of her displacement is closest to
   a) 30 m
   b) 21 m
   c) 17 m
   d) 15 m

5) A 5 N force directed north and a 5 N force directed west both act on the same point. The resultant of these two forces is approximately
   a) 5 N [NW]
   b) 7 N[NW]
   c) 5 N [SW]
   d) 7 N [SW]

6) Two 10.0 N forces act concurrently on a point at an angle of 180 degrees to each other. The magnitude of the resultant of the two forces is
   a) 0 N
   b) 10 N
   c) 18 N
   d) 20 N

7) The resultant of a 12 N force and a 7 N force is 5 N. The angle between the forces is
   a) 0 degrees
   b) 45 degrees
   c) 90 degrees

d) 180 degrees

8) Three forces act concurrently on an object in equilibrium. These forces are 10 N, 8 N, and 6 N. The resultant of the 6 N and 8 N forces is
   a) 0
   b) 10 N
   c) Between 0 and 10 N
   d) Greater than 10 N

9) As the angle between two concurrent forces of 5 N and 7 N increases from 0 to 180 degrees, the magnitude of their resultant changes from
   a) 0 N to 35 N
   b) 2 N to 12 N
   c) 12 N to 2 N
   d) 12 N to 0 N

10) An object weighing 600 N is pulled up a frictionless incline at a constant speed. If the incline makes an angle of 30 degrees with the horizontal, the force on the object parallel to the incline is
   a) 200 N
   b) 300 N
   c) 520 N
   d) 600 N

11) A projectile is fired with a velocity of 150 meters per second at an angle of 30 degrees with horizontal. What is the magnitude of the vertical component of the velocity at the time the projectile is fired?
   a) 75 m/s
   b) 130 m/s
   c) 150 m/s
   d) 225 m/s

12) An object rests on an incline. As the angle between the incline and the horizontal increases, the force needed to prevent the object from sliding down the incline
   a) Decreases
   b) Increases
   c) Remains the same

13) A batted softball leaves the bat with an initial velocity of 44 meters per second at an angle of 37 degrees above the horizontal. What is the magnitude of the initial vertical component of the softball's velocity?
   a) 0 m/s
   b) 26 m/s
   c) 35 m/s
   d) 44 m/s

14) How many seconds does the ball take to reach the ground?
    a) 4.5
    b) 20
    c) 9.8
    d) 2

15) A bullet is fired horizontally from the roof of a building 100 meters tall with a speed of 850 meters per second. Neglecting air resistance, how far will the bullet drop in 3 seconds?
    a) 29.4 m
    b) 44.1 m
    c) 100 m
    d) 2550 m

Circular Motion Practice

1) An object travels in a circular path of radius 5 meters at a uniform speed at 10 meters per second. What is the magnitude of the object's centripetal acceleration?
   a) 10 m/s^2
   b) 2 m/s^2
   c) 5 m/s^2
   d) 20 m/s^2

2) A mass of 10 kg is revolving at a linear speed of 5 meters per second in a circle with a radius of 10 meters. The centripetal force acting on the mass is
   a) 5 N
   b) 10 N
   c) 20 N
   d) 25 N

3) If the velocity of the ball is doubled, the centripetal acceleration
   a) Is halved
   b) Is doubled
   c) Remains the same
   d) Is quadrupled

4) If the mass of an object near the surface of the Earth is increased from M to 3M, the acceleration of the object due to gravity will be
   a) 1/3 as great
   b) 9 times as great
   c) 3 times as great
   d) Unchanged

5) Gravitational force of attraction **F** exists between two point masses, A and B, when they are separated by a fixed distance. After mass A is tripled and mass B is halved, the gravitational attraction between the two masses is
   a) 1/6 **F**
   b) 2/3 **F**
   c) 3/2 **F**
   d) 6 **F**

6) A rocket weighs 10,000 N at the Earth's surface. If the rocket rises to a height equal to the Earth's radius, its weight will be
   a) 2500 N
   b) 5000 N
   c) 10000 N
   d) 40000 N

7) Two masses of 10 kg and 1 kg, respectively, are located 1 meter apart. The gravitational force that each mass exerts on the other is
   a) 6.7×10^{-9} N
   b) 6.7×10^{-10} N
   c) 6.7×10^{-11} N
   d) 6.7×10^{-12} N

8) Two identical planets are orbiting the Sun. The mean radius of the orbit of the second planet is 4 times the mean radius of the orbit of the first planet. Compared to the orbital period of the first planet, the period of the second planet will be
   a) ¼ as great
   b) ½ as great
   c) 8 times as great
   d) 4 times as great

9) A dog with a mass of 8 kg is running at 3 m/s. At what speed must a 2-kg cat run in order to have the same kinetic energy as the dog?
   a) 6 m/s
   b) 12 m/s
   c) 36 m/s
   d) 48 m/s

10) If the mass of one of two particles is doubled and the distance between them is doubled, the force of attraction between the two particles will
   a) Decrease
   b) Increase
   c) Remain the same

11) An object has a weight W at the surface of the Earth. At a distance of 3 Earth radii from the center of the Earth, the weight of the object will be
   a) W/9
   b) W/3
   c) 3W
   d) 9W

12) The acceleration due to gravity at appoint near the surface of the Moon is 1/6 that near the surface of the Earth. The weight of a 2 kg mass at the same point near the surface of the Moon is approximately
   a) 1.6 N
   b) 2 N
   c) 3.3 N
   d) .33 N

13) The gravitational field at a given location is 9.73 N / kg. The gravitational acceleration at this location is
    a) 4.9 m/s^2
    b) 9.73 m/s^2
    c) 9.81 m/s^2
    d) 19.6 m/s^2

14) As the distance between the Moon and Earth increases, the Moon's orbital speed
    a) Decreases
    b) Increases
    c) Remains the same

Work and Energy

1) Which represents a scalar quantity?
   a) Acceleration
   b) Momentum
   c) Energy
   d) Displacement

2) Which terms represent scalar quantities?
   a) Power and force
   b) Time and energy
   c) Work and displacement
   d) Distance and velocity

3) Which symbolic expression shows how the energy unit (joule) is related to the fundamental units of kg, m and s?
   a) Kg * m^2/s^2
   b) N * m
   c) Kg * m/s
   d) Kg * m^2 * s^2

4) A force of 80 N pushes a 50 kg object across a level floor for 8 m. The work done is
   a) 10 J
   b) 400 J
   c) 640 J
   d) 3920 J

5) An object has a mass of 8 kg. A 2 N force displaces the object a distance of 3 m to the east, and then 4 m to the north. What is the total work done on the object?
   a) 10 J
   b) 14 J
   c) 28 J
   d) 56 J

A 2 kg mass is pushed along a horizontal, frictionless surface by a 3 N force that is parallel to the surface (Use for 6 and 7)

6) How much work is done in moving the mass 1.5 m horizontally?
   a) 4.5 J
   b) 2 J
   c) 3 J
   d) 30 J

7) How much gravitational potential energy would be gained by the mass if it is moved 2 m horizontally?
   a) 0 J
   b) 6 J
   c) 40 J
   d) 4 J

8) The work done in raising an object must result in an increase in the object's
   a) Gravitational potential energy
   b) Kinetic energy
   c) Internal energy
   d) Heat energy

9) As the power of a machine is increased, the time required to move an object a fixed distance
   a) Decreases
   b) Increases
   c) Remains the same

10) An electric motor lifts a 10 kg mass 100 meters in 10 s. The power developed by the motor is
   a) 9.8 W
   b) 98 W
   c) 980 W
   d) 9800 W

11) A horizontal force of 40 N pushes a block along a level table at a constant speed of 2 m/s. How much work is done on the block in 6 seconds?
   a) 80 J
   b) 120 J
   c) 240 J
   d) 480 J

12) Car A and car B are of equal mass and travel up a hill. Car A moves up the hill at a constant speed that is twice the constant speed of car B. Compared to the power developed by car B, the power developed by car A is
   a) The same
   b) Twice as great
   c) Half as great
   d) 4 times as great

13) A weightlifter lifts a 2000 N weight a vertical distance of .5 m in .1 s. What is the power output?
   a) 1×10^{-4} W
   b) 4×10^{-4} W
   c) 1×10^{4} W
   d) 4×10^{4} W

14) What is the maximum distance that a 60 W motor may vertically lift a 90 N weight in 7.5 seconds?
   a) 2.3 m
   b) 5 m
   c) 140 m
   d) 1100 m

15) If the kinetic energy of a 10 kg object is 2000 J, its velocity is
   a) 10 m/s
   b) 20 m/s
   c) 100 m/s
   d) 400 m/s

Momentum

1) If the direction of the momentum of an object is west, the direction of the velocity of the object is
   a) North
   b) South
   c) East
   d) West

2) A 2 N force acts on a mass. If the momentum of the mass changes by 120 kg * m/s, the force acts for a time of
   a) 8 s
   b) 30 s
   c) 60 s
   d) 120 s

3) As an object falls freely toward the Earth, its momentum
   a) Decreases
   b) Increases
   c) Remains the same

4) An impulse J is applied to an object. The change in the momentum of the object is
   a) J
   b) 2J
   c) J/2
   d) 4J

5) The momentum of an object is the product of its
   a) Mass and acceleration
   b) Mass and velocity
   c) Force and displacement
   d) Force and distance

6) If a 3 kg object moves 10 m in 2 seconds, its average momentum is
   a) 60 kg * m/s
   b) 30 kg * m/s
   c) 15 kg * m/s
   d) 10 kg * m/s

7) A force of 3 N applied to an object produces a change in velocity of 12 meters per second in .4 seconds. The mass of the object is
   a) 1 kg
   b) .1 kg
   c) 10 kg
   d) .31 kg

8) Momentum may be expressed in
   a) Joules
   b) Watts
   c) Kilogram m / s^2
   d) N * s

9) What is the magnitude of the velocity of a 25 kg mass that is moving with a momentum of 100 kg * m/s?
   a) .25 m/s
   b) 2500 m/s
   c) 40 m/s
   d) 4 m/s

10) An object is brought to rest by a constant force. Which factor other than the mass and velocity of the object must be known in order to determine the magnitude of the force required to stop the object?
   a) The time that the force acts on the object
   b) The gravitational potential energy of the object
   c) The density of the object
   d) The weight of the object

11) A car with a mass of 1×10^3 kilograms is moving with a speed of 1.4×10^2 m/s. The impulse required to bring the car to rest is
   a) 1.4×10^2 N * s.
   b) 1.4×10^4N * s.
   c) 7×10^4 N * s.
   d) 1.4×10^5 N * s.

12) An 80 kg skater and a 60 kg skater stand at rest in the center of a skating rink. The two skaters push each other apart. The 60 kg skater moves with a velocity of 10 m/s east. What is the velocity of the 80 kg skater? [Neglect friction]
   a) .13 m/s [W]
   b) 7.5 m/s [W]
   c) 10 m/s [E]
   d) 13 m/s [E]

13) Two carts having masses of 5 kg and 1 kg, respectively, are pushed apart by a compressed spring. If the 5 kg cart moves westward at 2 m/s, the magnitude of the velocity of the 1 kg cart will be
   a) 2 kg * m/s
   b) 2 m/s
   c) 10 kg * m/s
   d) 10 m/s

14) Two carts resting on a frictionless surface are forced apart by a spring. One cart has a mass of 6 kg and moves to the left at a speed of 3 m/s. If the second cart has a mass of 9 kg, it will move to the right at a speed of
    a) 1 m/s
    b) 2 m/s
    c) 3 m/s
    d) 6 m/s

15) As a ball falls freely toward the Earth, the momentum of the Earth-ball system
    a) Decreases
    b) Increases
    c) Remains the same

Blair Physics Name _____
SEMESTER 1 Final Review

It's best to do these problems on a separate sheet of paper

KINEMATICS

Graphing: Using the velocity vs. time graph:

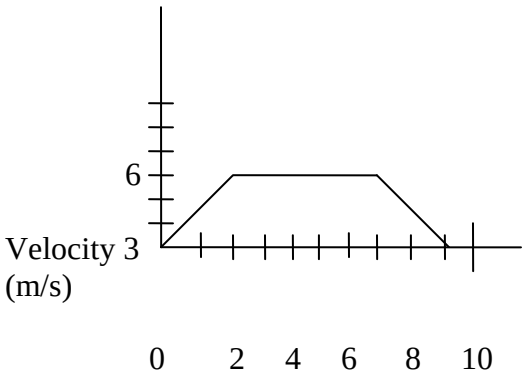
a. Create a corresponding displacement versus time graph and an acceleration – time graph.

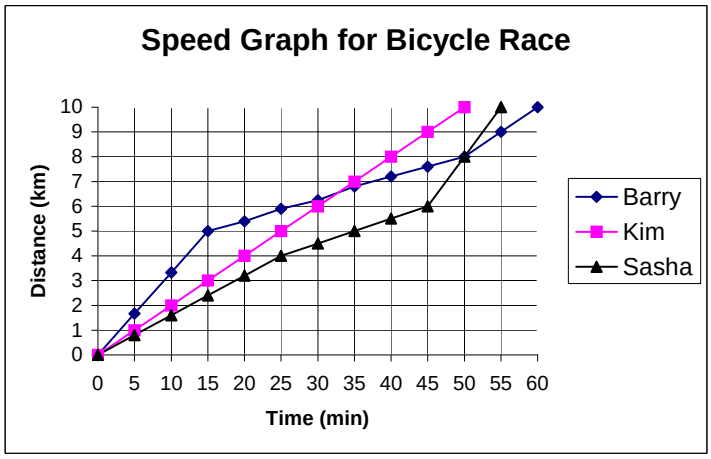
b. Calculate the acceleration of each segment.

Using the distance (position) vs. time graph:

a. Who won the race?

b. What was the winner's average speed?





1. As a projectile rises and then falls back to the ground, what happens to its acceleration?

A. decreases, then increases
B. increases, then decreases
C. increases, only
D. remains the same

2. Object A is dropped from rest on a planet that has acceleration A and it falls for 2 seconds. Object B is dropped from rest on a planet where the acceleration is twice as large and it is allowed to fall for 1 sec. What can be said about the distance each object has traveled?

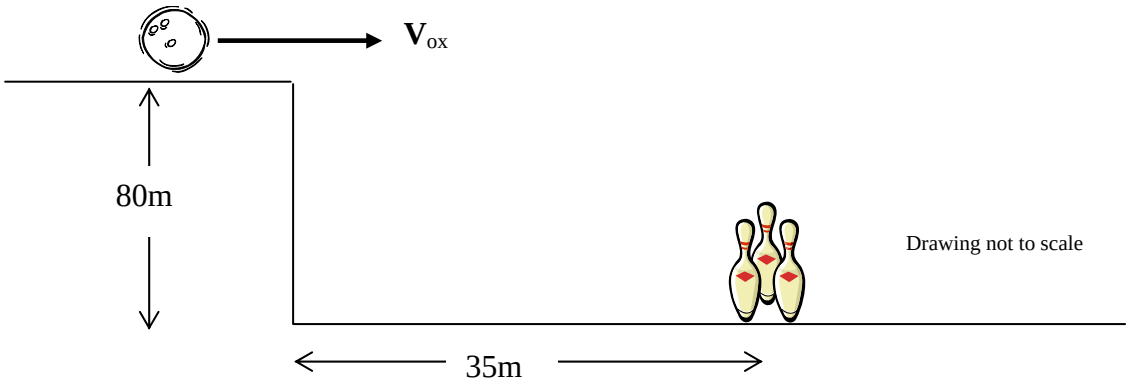
A. B travels one-half as far
B. B travels twice as far
C. B travels 3 times as far
D. B travels 4 times as far

2b. If you dropped one object from 10 m, and another object from 5 m at the *same time*, describe the distance between the two objects the entire trip down to the ground.

3. A man walks **west** on a boat at a speed of 3 m/s. The boat is traveling **south** at 5 m/s. If you were watching the man from above, what velocity would you see him travel at? Draw the resultant vector.

4. What are the horizontal and vertical components of a 10 m/s at 40° velocity?

5. How fast would you have to roll a bowling ball off an 80 m cliff to land on a stack of pins 35 m away. Assume the initial velocity of the bowling ball is horizontal.



NEWTON'S LAWS:

1) A TV is pushed across the floor with a force of 60 N at a constant speed of 2 m/s. If I push it harder with a force of 100 N, causing it to increase its speed to 4 m/s in 2 seconds, what is the TV's mass?

2) A 1.5 kg brick is pushed across a floor with a force of 10 N at a constant speed. What is the acceleration of the brick if I increase the push to 20 N? What is the speed of the brick after 2 seconds of the new push if its initial speed was 5 m/s? Draw free-body diagrams of both scenarios.

3) A) What happens to the force of gravitation between 2 objects when the mass of object 1 is doubled and the mass of object 2 becomes half?

   B) What would happen to the force if the masses were held constant and the distance between them is tripled?

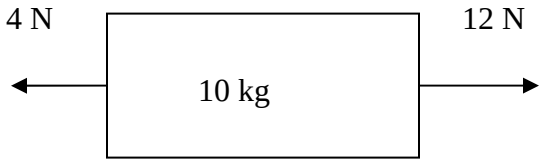
4) Draw a free-body diagram (force diagram) of your ID being spun in a circle.

5) Draw a free-body diagram of a planet orbiting a star.

6) A bat hits a baseball. Which one exerts more force, the ball on the bat, the bat on the ball or another answer? Explain your reasoning behind your answer.

7) Explain the difference between mass and weight. Where do you weight more than on Earth?

8) Two forces of 4 N and 12 N act on a 10-kg object as shown. What's the object's acceleration?



9) An apple sitting on a table experiences a weight force and a normal force. Are those forces a third law action/reaction pair? If not, what are the pairs?

10) Describe the forces acting on a box being carried on a rolling cart. What keeps the box moving forward?

11) What would happen to all the free fall problems in this class if we included air resistance? What factors control air resistance (from Hewitt reading 5.7)?

12) A Hewitt "Think and Explain" Problem: A rocket fired from its launching pad not only picks up speed, but its acceleration also increases significantly as firing continues. Why? (Hint: About 90% of the mass of a newly launched rocket is fuel.)

BCR

Athletes that train for short distance races in the Olympic Games have to maintain the perfect balance in their bodies. They need strong muscles in their legs and even arms. Building a lot of muscles would increase the runners' masses significantly. However, these runners are generally thin. They do not develop their muscles too much and their masses stay low.

How does keeping the balance of strong muscles and light bodies help the runners win?

In your response, be sure to:

- Define Newton's Second Law.
- Apply Newton's Second Law to explain how strong muscles will affect the runners' performance.
- Apply Newton's Second Law to explain how keeping a low body mass will affect the runners' performance.
- Describe how the runners' velocities would change based on their mass.

IMPULSE MOMENTUM

1) A 5 kg cat is stuck up in a tree. She drops down to a trampoline below, hitting it with a speed of 8 m/s and rebounds with a speed of 7.5 m/s. If the impulse lasts for 0.8 seconds, how much force does the trampoline provide to her?

2) Draw a Force vs. Time graph that shows a change in momentum of 8 kg-m/s.

3) Two astronauts floating at rest with respect to their ship in space decide to play catch with a 0.500-kg asteroid. Tim (whose mass is 80 kg) heaves the asteroid at 15.0 m/s toward Gina (whose mass is 50 kg). She catches it and heaves it back at 15.0 m/s. Before Tim catches it a second time, how fast is each person moving, and in what direction?

WORK-ENERGY

1) Describe a situation where work is being done in the English sense of the word but not in the Physics sense.

2) What does work on a falling rock?

   What does work on a sled sliding to rest? How does this work change the sled's kinetic energy?

3) Does pushing a boulder up a ramp require more work or less work than lifting that boulder up to the same height? Why?

   Why would you use a ramp instead of lifting the object?

4) Describe why changing the speed affects an object's kinetic energy more than changing its mass.

EXPERIMENTAL DESIGN

Design an experiment to test whether completing a review sheet improves scores on tests. Include a hypothesis, independent variable, dependent variable, control, constants, and the data you are going to collect. How are you going to ensure accuracy?

`Work and Energy Review Problems

1) c

2) b

3) a

4) c

5) b

6) a

7) a

8) a

9) a

10) c

11) d

12) d

13) c

14) b

15) b

Circular Motion Review Problems

1) d
2) d
3) d
4) c
5) c
6) a
7) b

8) Don't need

9) a

10) a

11) a

12) c

13) b

14) Don't need

Forces Review Problems

1) d

2) a

3) d

4) c

5) b

6) a

7) b

8) b

9) c

10) d

11) d

12) b

13) c

14) d

15) c

Momentum Review Problems

1) d
2) c
3) b
4) a
5) b
6) c
7) b
8) d
9) d
10) a
11) d
12) b
13) d
14) b
15) c

Kinematics Review Problems

1) a
2) d
3) c
4) b
5) c
6) a
7) c
8) d
9) d
10) d
11) b
12) a
13) c
14) d
15) b

Vectors Review Problems

1) d
2) b
3) b
4) b
5) b
6) a
7) d
8) b
9) d
10) b
11) a
12) b
13) b
14) a
15) b