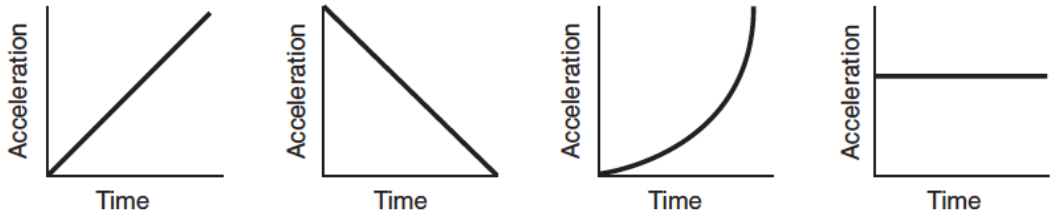
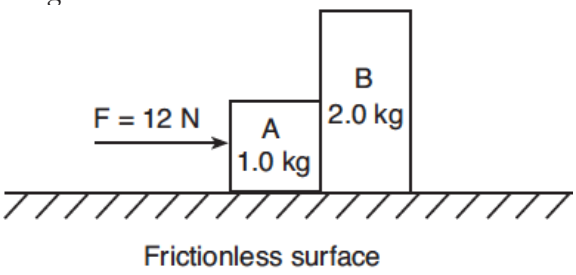
Name: _____ Period: _____

Dynamics-Newton's 2nd Law

1. A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time?



2. The diagram below shows a horizontal 12-newton force being applied to two blocks, A and B, initially at rest on a horizontal, frictionless surface. Block A has a mass of 1 kilogram and block B has a mass of 2 kilograms.

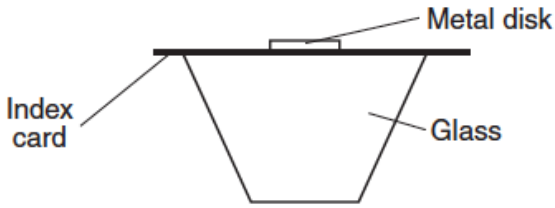


The magnitude of the acceleration of block B is
1. 6.0 m/s^2
2. 2.0 m/s^2
3. 3.0 m/s^2
4. 4.0 m/s^2

3. Which body is in equilibrium?
1. a satellite moving around Earth in a circular orbit
2. a cart rolling down a frictionless incline
3. an apple falling freely toward the surface of Earth
4. a block sliding at constant velocity across a tabletop

4. The weight of a typical high school physics student is closest to
1. 1500 N
2. 600 N
3. 120 N
4. 60 N

Base your answers to questions 5 and 6 on the diagram below, which shows a 1-newton metal disk resting on an index card that is balanced on top of a glass.



5. What is the net force acting on the disk?
1. 1.0 N
2. 2.0 N
3. 0 N
4. 9.8 N

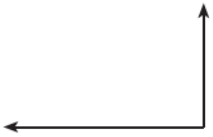
6. When the index card is quickly pulled away from the glass in a horizontal direction, the disk falls straight down into the glass. This action is a result of the disk's
1. inertia
2. charge
3. shape
4. temperature

7. A student is standing in an elevator that is accelerating downward. The force that the student exerts on the floor of the elevator must be
1. less than the weight of the student when at rest
2. greater than the weight of the student when at rest
3. less than the force of the floor on the student
4. greater than the force of the floor on the student

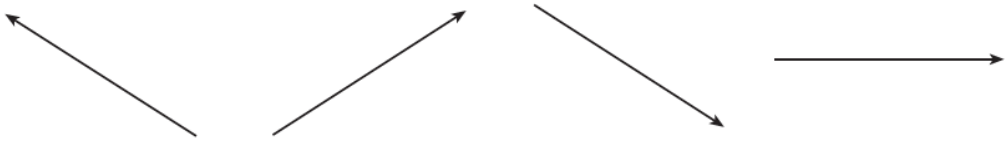
Name: _____ Period: _____

Dynamics-Newton's 2nd Law

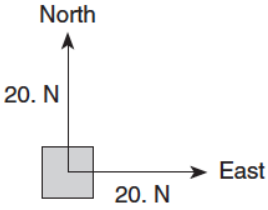
8. The diagram below represents two concurrent forces.



Which vector below represents the force that will produce equilibrium with these two forces?



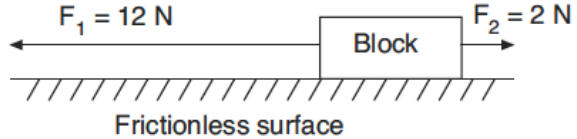
9. In the diagram below, a 20-newton force due north and a 20-newton force due east act concurrently on an object, as shown in the diagram below.



The additional force necessary to bring the object into a state of equilibrium is
1. 20 N, northeast
2. 20 N, southwest
3. 28 N, northeast
4. 28 N, southwest

10. A man standing on a scale in an elevator notices that the scale reads 30 newtons greater than his normal weight. Which type of movement of the elevator could cause this greater-than-normal reading?
1. accelerating upward
2. accelerating downward
3. moving upward at constant speed
4. moving downward at constant speed

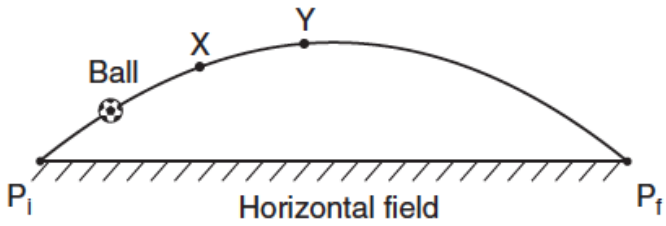
11. Two forces, F_1 and F_2, are applied to a block on a frictionless, horizontal surface as shown below.



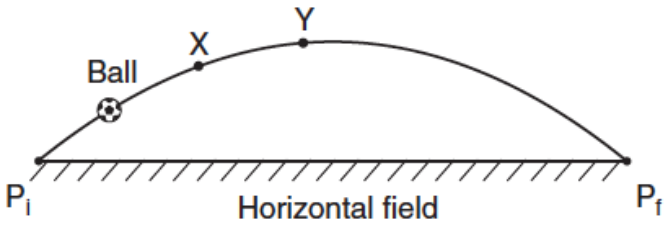
If the magnitude of the block's acceleration is 2 m/s^2, what is the mass of the block?
1. 1 kg
2. 5 kg
3. 6 kg
4. 7 kg

Base your answers to questions 12 and 13 on the information and diagram below.

A soccer ball is kicked from point P_i at an angle above a horizontal field. The ball follows an ideal path before landing on the field at point P_f.



12. On the diagram below, draw an arrow to represent the direction of the net force on the ball when it is at position X. Label the arrow F_{net}. [Neglect friction.]



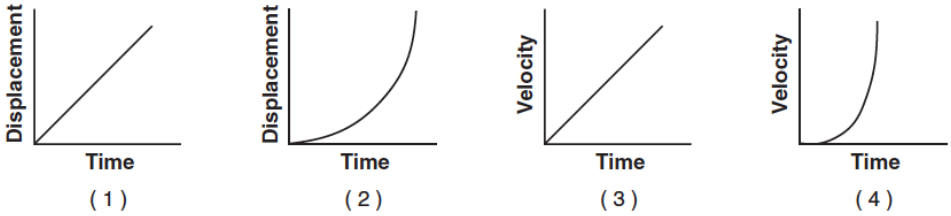
13. On the diagram above, draw an arrow to represent the direction of the acceleration of the ball at position Y. Label the arrow *a*. [Neglect friction.]

14. A 5-newton force could have perpendicular components of
1. 1 N and 4 N
2. 2 N and 3 N
3. 3 N and 4 N
4. 5 N and 5 N

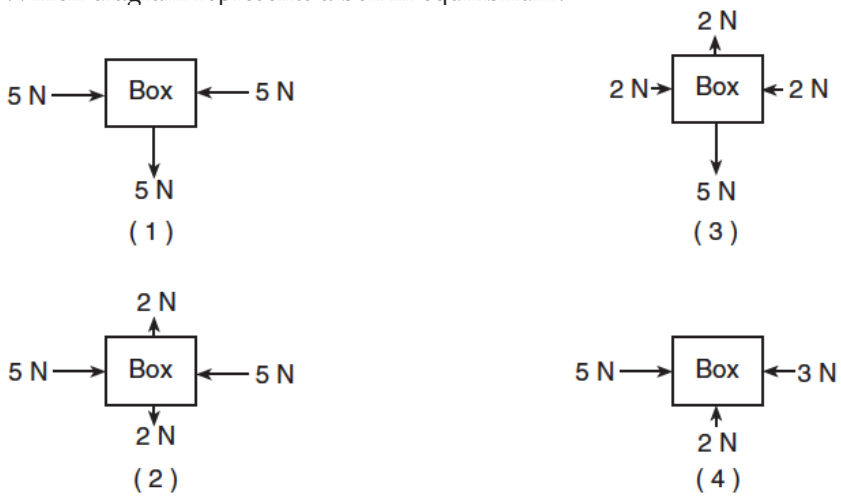
Name: _____ Period: _____

Dynamics-Newton's 2nd Law

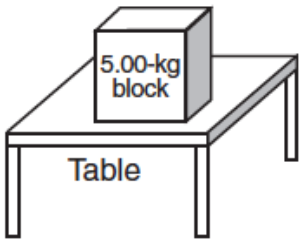
15. Which graph best represents the motion of an object in equilibrium?



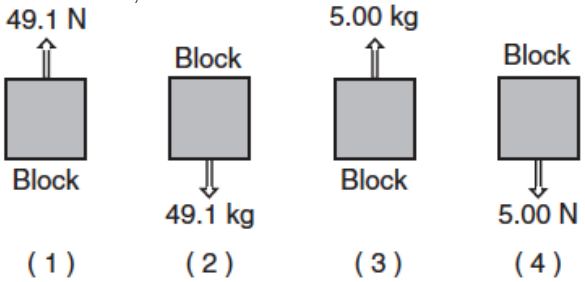
16. Which diagram represents a box in equilibrium?



17. The diagram below shows a 5-kilogram block at rest on a horizontal, frictionless table.



Which diagram best represents the force exerted on the block by the table?



Base your answers to questions 18 and 19 on the information below.

The instant before a batter hits a 0.14-kilogram baseball, the velocity of the ball is 45 meters per second west. The instant after the batter hits the ball, the ball's velocity is 35 meters per second east. The bat and ball are in contact for 1.0×10^{-2} second.

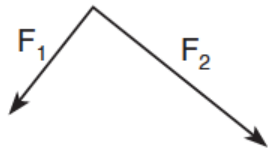
18. Determine the magnitude and direction of the average acceleration of the baseball while it is in contact with the bat.

19. Calculate the magnitude of the average force the bat exerts on the ball while they are in contact. [Show all work, including the equation and substitution with units.]

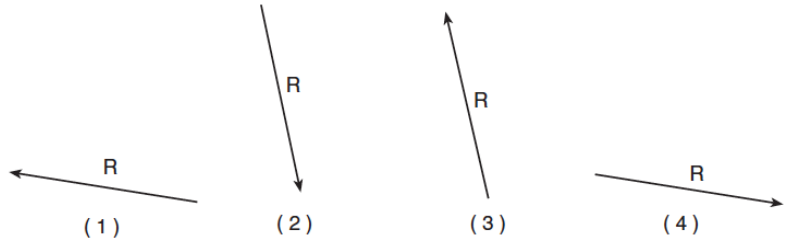
Name: _____ Period: _____

Dynamics-Newton's 2nd Law

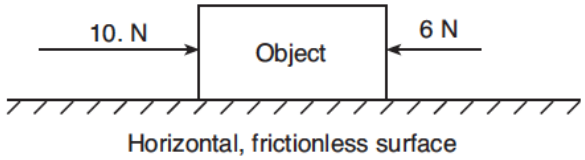
20. The vector diagram below represents two forces, F_1 and F_2, simultaneously acting on an object.



Which vector best represents the resultant of the two forces?



21. Two forces act concurrently on an object on a horizontal, frictionless surface, as shown in the diagram below.



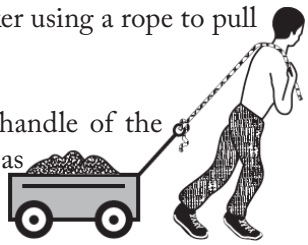
What additional force, when applied to the object, will establish equilibrium?

1. 16 N toward the right
2. 16 N toward the left
3. 4 N toward the right
4. 4 N toward the left

22. A 3-newton force and a 4-newton force are acting concurrently on a point. Which force could *not* produce equilibrium with these two forces?

1. 1 N
2. 7 N
3. 9 N
4. 4 N

23. The diagram shows a worker using a rope to pull a cart.

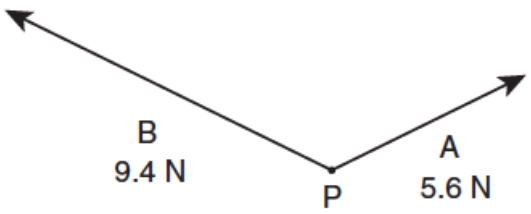


The worker's pull on the handle of the cart can best be described as a force having

1. magnitude, only
2. direction, only
3. both magnitude and direction
4. neither magnitude nor direction

Base your answers to questions 24 through 26 on the information and diagram below.

Force A with a magnitude of 5.6 newtons and force B with a magnitude of 9.4 newtons act concurrently on point P.



24. Determine the scale used in the diagram.

1 cm = _____ N

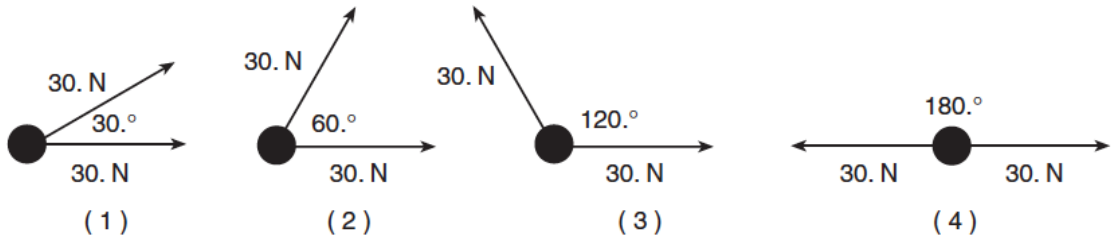
25. On the diagram, use a ruler and protractor to construct a vector representing the resultant of forces A and B.

26. Determine the magnitude of the resultant force.

Name: _____ Period: _____

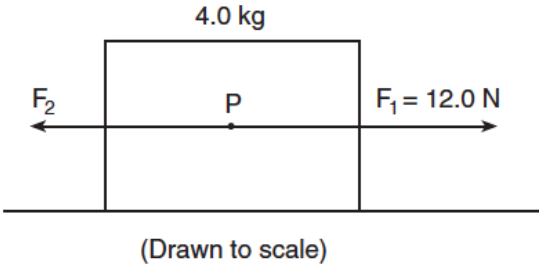
Dynamics-Newton's 2nd Law

27. Two 30-newton forces act concurrently on an object. In which diagram would the forces produce a resultant with a magnitude of 30 newtons?



Base your answers to questions 28 through 30 on the information and diagram below.

In the scaled diagram, two forces, F_1 and F_2, act on a 4.0-kilogram block at point P. Force F_1 has a magnitude of 12 newtons, and is directed toward the right.

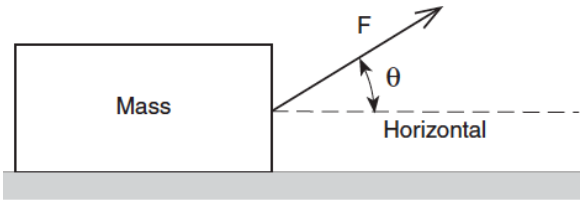


28. Using a ruler and the scaled diagram, determine the magnitude of F_2 in newtons.

29. Determine the magnitude of the net force acting on the block.

30. Calculate the magnitude of the acceleration of the block. [Show all work, including the equation and substitution with units.]

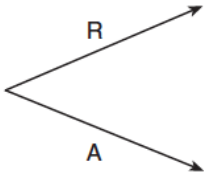
31. The diagram below shows a force of magnitude F applied to a mass at an angle θ relative to a horizontal frictionless surface.



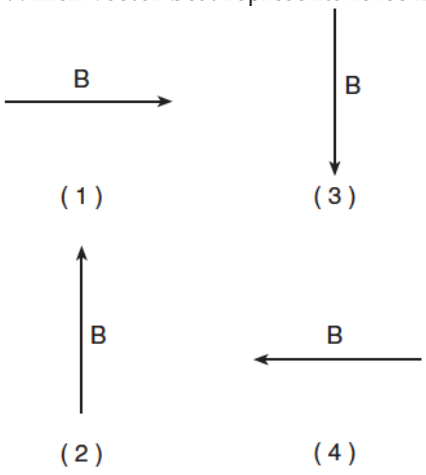
As angle θ is increased, the horizontal acceleration of the mass

1. decreases
2. increases
3. remains the same

32. Forces A and B have a resultant R. Force A and resultant R are represented in the diagram below.



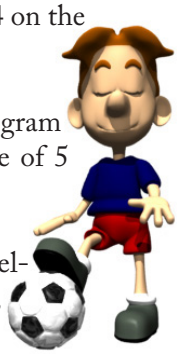
Which vector best represents force B?



Name: _____ Period: _____

Dynamics-Newton's 2nd Law

Base your answers to questions 33 and 34 on the information below.

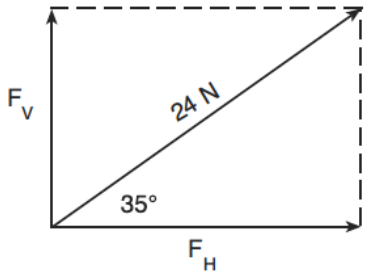


A soccer player accelerates a 0.50-kilogram soccer ball by kicking it with a net force of 5 newtons.

33. Calculate the magnitude of the acceleration of the ball. [Show all work, including the equation and substitution with units.]

34. What is the magnitude of the force of the soccer ball on the player's foot?

35. The vector diagram below represents the horizontal component, F_H, and the vertical component, F_V, of a 24-newton force acting at 35° above the horizontal.



What are the magnitudes of the horizontal and vertical components?

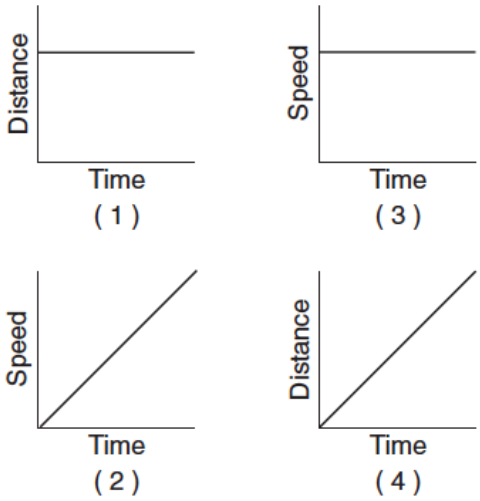
1. F_H = 3.5 N and F_V = 4.9 N
2. F_H = 4.9 N and F_V = 3.5 N
3. F_H = 14 N and F_V = 20 N
4. F_H = 20 N and F_V = 14 N

36. Two forces act concurrently on an object. Their resultant force has the largest magnitude when the angle between the forces is

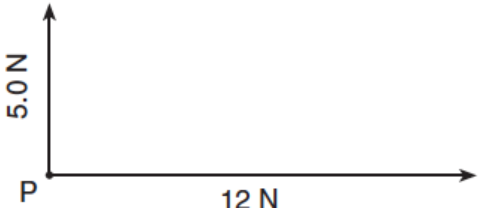
1. 0°
2. 30°
3. 90°
4. 180°

37. A 0.50-kilogram frog is at rest on the bank surrounding a pond of water. As the frog leaps from the bank, the magnitude of the acceleration of the frog is 3.0 meters per second^2. Calculate the magnitude of the net force exerted on the frog as it leaps. [Show all work, including the equation and substitution with units.]

38. Which graph best represents the motion of an object that is *not* in equilibrium as it travels along a straight line?



39. The diagram below represents a 5-newton force and a 12-newton force acting on point P.



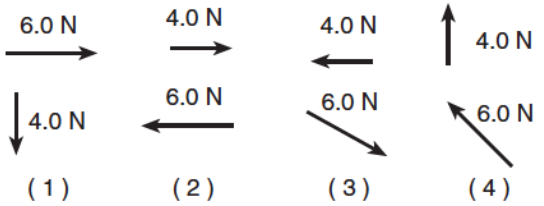
The resultant of the two forces has a magnitude of

1. 5 N
2. 7 N
3. 12 N
4. 13 N

Name: _____ Period: _____

Dynamics-Newton's 2nd Law

40. Which pair of forces acting concurrently on an object will produce the resultant of greatest magnitude?



41. A 5-newton force and a 7-newton force act concurrently on a point. As the angle between the forces is increased from 0° to 180°, the magnitude of the resultant of the two forces changes from
    1. 0 N to 12 N
    2. 2 N to 12 N
    3. 12 N to 2 N
    4. 12 N to 0 N

42. A force of 25 newtons east and a force of 25 newtons west act concurrently on a 5-kilogram cart. What is the acceleration of the cart?
    1. 1.0 m/s^2 west
    2. 0.20 m/s^2 east
    3. 5.0 m/s^2 east
    4. 0 m/s^2

43. A high school physics student is sitting in a seat reading this question. The magnitude of the force with which the seat is pushing up on the student to support him is closest to
    1. 0 N
    2. 60 N
    3. 600 N
    4. 6,000 N

44. As the angle between two concurrent forces decreases, the magnitude of the force required to produce equilibrium
    1. decreases
    2. increases
    3. remains the same

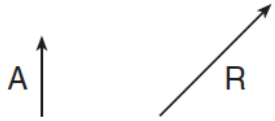
45. A 60-kg skydiver is falling at a constant speed near the surface of Earth. The magnitude of the force of air friction acting on the skydiver is approximately
    1. 0 N
    2. 6 N
    3. 60 N
    4. 600 N

46. The weight of a chicken egg is most nearly equal to
    1. 10^{-3} N
    2. 10^{-2} N
    3. 10^{0} N
    4. 10^{2} N

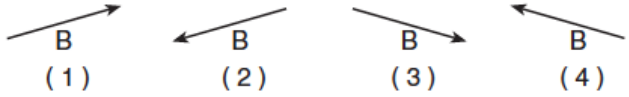
47. A 1.5-kilogram lab cart is accelerated uniformly from rest to a speed of 2.0 meters per second in 0.50 second. What is the magnitude of the force producing this acceleration?
    1. 0.70 N
    2. 1.5 N
    3. 3.0 N
    4. 6.0 N

48. Which body is in equilibrium?
    1. a satellite orbiting Earth in a circular orbit
    2. a ball falling freely toward the surface of Earth
    3. a car moving with a constant speed along a straight, level road
    4. a projectile at the highest point in its trajectory

49. The diagram below represents a force vector, A, and a resultant vector, R.



Which force vector B below could be added to force vector A to produce resultant vector R?



50. A 25-newton horizontal force northward and a 35-newton horizontal force southward act concurrently on a 15-kilogram object on a frictionless surface. What is the magnitude of the object's acceleration?
    1. 0.67 m/s^2
    2. 1.7 m/s^2
    3. 2.3 m/s^2
    4. 4.0 m/s^2

Name: _____ Period: _____

Dynamics-Newton's 2nd Law

51. A woman is standing on a bathroom scale in an elevator car. If the scale reads a value greater than the weight of the woman at rest, the elevator car could be moving

1. downward at constant speed
2. upward at constant speed
3. downward at increasing speed
4. upward at increasing speed

52. A net force of 10 newtons accelerates an object at 5.0 meters per second^2. What net force would be required to accelerate the same object at 1.0 meter per second^2?
1. 1.0 N
2. 2.0 N
3. 5.0 N
4. 50 N

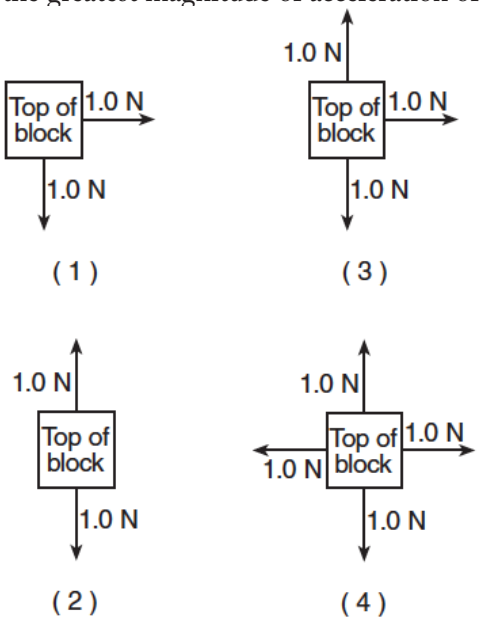
53. A 6.0-newton force and an 8.0-newton force act concurrently on a point. As the angle between these forces increases from 0° to 90°, the magnitude of their resultant
1. decreases
2. increases
3. remains the same

54. Which situation describes an object that has no unbalanced force acting on it?
1. an apple in free fall
2. a satellite orbiting Earth
3. a hockey puck moving at constant velocity across ice
4. a laboratory cart moving down a frictionless 30° incline

55. Two 20-newton forces act concurrently on an object. What angle between these forces will produce a resultant force with the greatest magnitude?
1. 0°
2. 45°
3. 90°
4. 180°

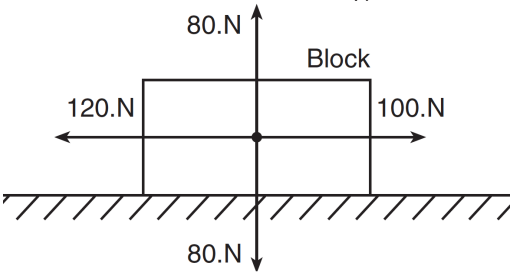
56. Which situation represents a person in equilibrium?
1. a child gaining speed while sliding down a slide
2. a woman accelerating upward in an elevator
3. a man standing still on a bathroom scale
4. a teenager driving around a corner in his car

57. A number of 1-newton horizontal forces are exerted on a block on a frictionless, horizontal surface. Which top-view diagram shows the forces producing the greatest magnitude of acceleration of the block?



58. A rock is thrown straight up into the air. At the highest point of the rock's path, the magnitude of the net force acting on the rock is
1. less than the magnitude of the rock's weight, but greater than zero
2. greater than the magnitude of the rock's weight
3. the same as the magnitude of the rock's weight
4. zero

59. Four forces act concurrently on a block on a horizontal surface as shown in the diagram below.



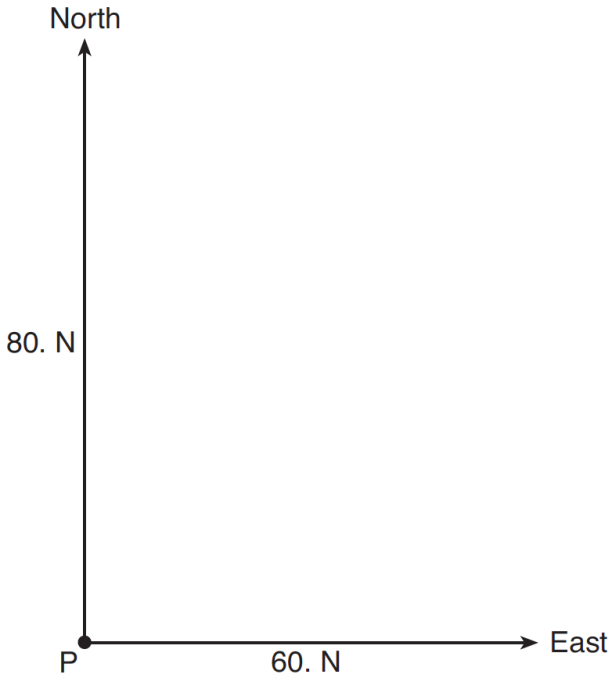
As a result of these forces, the block
1. moves at constant speed to the right
2. moves at a constant speed to the left
3. accelerates to the right
4. accelerates to the left

Name: _____ Period: _____

Dynamics-Newton's 2nd Law

Base your answers to questions 60 through 63 on the information below and diagram at right as well as your knowledge of physics.

Two forces, a 60-newton force east and an 80-newton force north, act concurrently on an object located at point P, as shown.



60. Using a ruler, determine the scale used in the vector diagram.

61. Draw the resultant force vector to scale on the diagram. Label the vector "R."

62. Determine the magnitude of the resultant force, R.

63. Determine the measure of the angle, in degrees, between north and the resultant force, R.

64. A 4.0-kilogram object is accelerated at 3.0 meters per second^2 north by an unbalanced force. The same unbalanced force acting on a 2.0-kilogram object will accelerate this object toward the north at
    1. 12 m/s^2
    2. 6.0 m/s^2
    3. 3.0 m/s^2
    4. 1.5 m/s^2

65. A 750-newton person stands in an elevator that is accelerating downward. The upward force of the elevator floor on the person must be
    1. equal to 0 N
    2. less than 750 N
    3. equal to 750 N
    4. greater than 750 N

66. A 160-kilogram space vehicle is traveling along a straight line at a constant speed of 800 meters per second. The magnitude of the net force on the space vehicle is
    1. 0 N
    2. 1.60×10^2 N
    3. 8.00×10^2 N
    4. 1.28×10^5 N

67. A student throws a 5.0-newton ball straight up. What is the net force on the ball at its maximum height?
    1. 0.0 N
    2. 5.0 N, up
    3. 5.0 N, down
    4. 9.8 N, down

68. An object is in equilibrium. Which force vector diagram could represent the force(s) acting on the object?