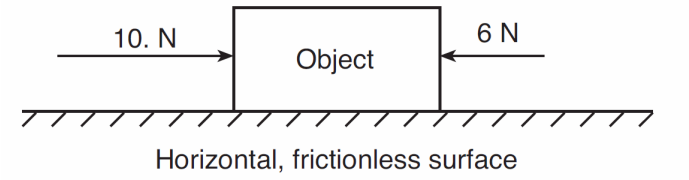
Name

Forces and Vectors
(And a Projectile Problem- mooah-ha!)

1. Base your answer to the following question on 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?

A) 16 N toward the right
B) 16 N toward the left
C) 4 N toward the right
D) 4 N toward the left

2. On the surface of Earth, a spacecraft has a mass of 2.00×10^4 kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?

A) 5.00×10^3 kg
B) 2.00×10^4 kg
C) 4.90×10^4 kg
D) 1.96×10^5 kg

3. A person weighing 785 newtons on the surface of Earth would weigh 298 newtons on the surface of Mars. What is the magnitude of the gravitational field strength on the surface of Mars?

A) 2.63 N/kg
B) 3.72 N/kg
C) 6.09 N/kg
D) 9.81 N/kg

4. What is the weight of a 2.00-kilogram object on the surface of Earth?

A) 4.91 N
B) 2.00 N
C) 9.81 N
D) 19.6 N

5. **Note that the following question has only three choices.**

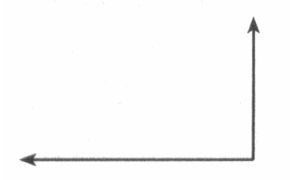
A 6.0-newton force and an 8.0-newton force act concurrently on a point. As the angle between these forces increases from 0° to 90°, the magnitude of their resultant

A) decreases
B) increases
C) remains the same

6. Two students are pushing a car. What should be the angle of each student's arms with respect to the flat ground to maximize the horizontal component of the force?

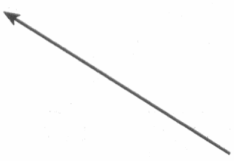
A) 0º
B) 30º
C) 45º
D) 90º

7. Base your answer to the following question on The diagram below represents two concurrent forces.

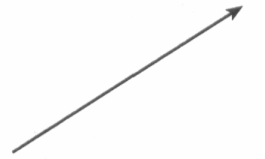


Which vector represents the force that will produce equilibrium with these two forces?

A)



B)



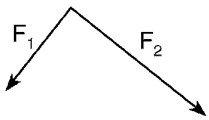
C)

D)

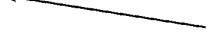
8. A soccer player kicks a ball with an initial velocity of 10. meters per second at an angle of 30.° above the horizontal. The magnitude of the horizontal component of the ball's initial velocity is

A) 5.0 m/s
B) 8.7 m/s
C) 9.8 m/s
D) 10. m/s

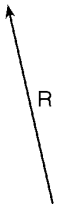
9. The vector diagram below represents two forces, F_1 and F_2 simultaneously acting on an object.

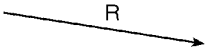


Which vector best represents the resultant of the two forces?

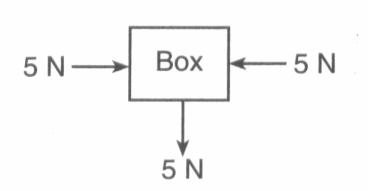
A) 

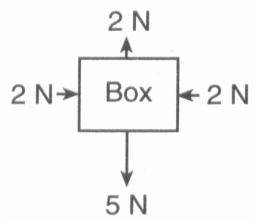
B) 

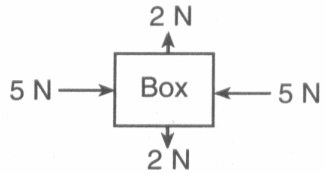
C) 

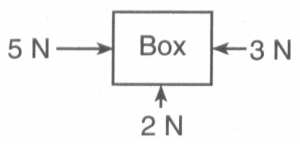
D) 

10. Which diagram represents a box in equilibrium?

A) 

B) 

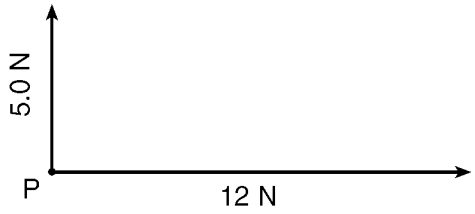
C) 

D) 

11. As the angle between a force and level ground decreases from 60º to 30º, the vertical component of the force

A) decreases B) increases
C) remains the same

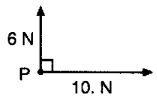
12. Base your answer to the following question on The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.



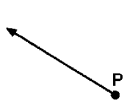
The resultant of the two forces has a magnitude of

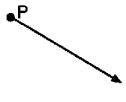
A) 5.0 N B) 7.0 N C) 12 N D) 13 N

13. The diagram below represents two forces acting concurrently on an object at point *P*.

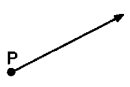


Which diagram best represents the resultant of these two forces?

A) 

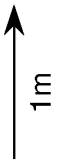
B) 

C) 

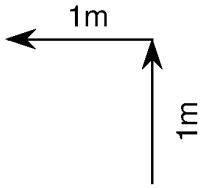
D) 

14. Which vector diagram represents the greatest magnitude of displacement for an object?

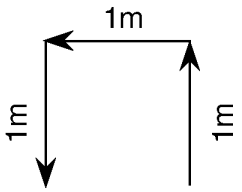
A)



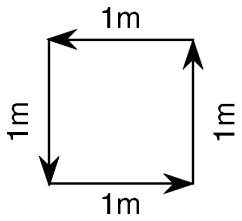
B)



C)

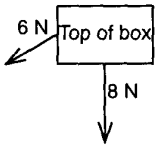


D)

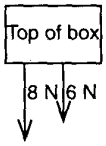


15. A 6-newton force and an 8-newton force act concurrently on a box located on a frictionless horizontal surface. Which top-view diagram shows the forces producing the *smallest* magnitude of acceleration of the box?

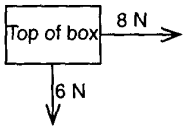
A)



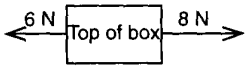
B)



C)



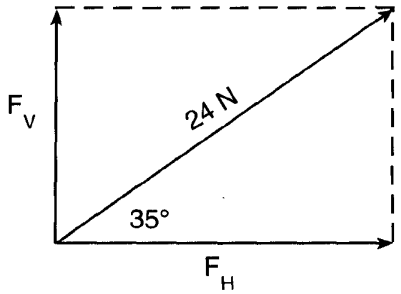
D)



16. A resultant force of 10. Newtons is made up of two component forces acting at right angles to each other. If the magnitude of one of the components is 6.0 Newtons, the magnitude of the other component must be

A) 16 N B) 8.0 N C) 6.0 N D) 4 N

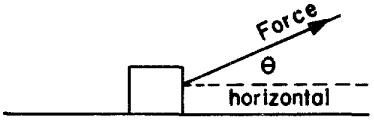
17. Base your answer to the following question on The vector diagram below represents the horizontal component, F_H, and the vertical component, F_V, of a 24-newton force acting at 35° above the horizontal.



What are the magnitudes of the horizontal and vertical components?

A) $F_H = 3.5$ N and $F_V = 4.9$ N
B) $F_H = 4.9$ N and $F_V = 3.5$ N
C) $F_H = 14$ N and $F_V = 20.$ N
D) $F_H = 20.$ N and $F_V = 14$ N

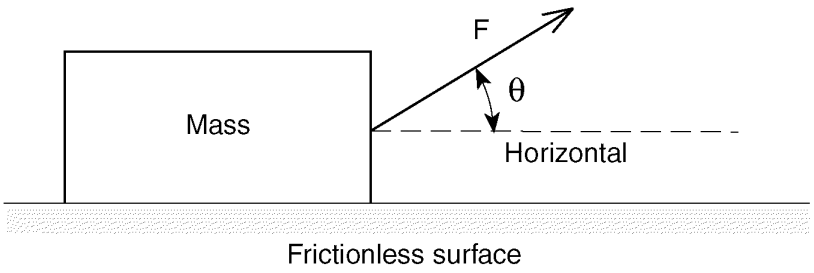
18. A constant force is exerted on a box as shown in the diagram.



As the angle θ decreases to 0° , the magnitude of the horizontal component of the force

A) decreases B) increases
C) remains the same

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

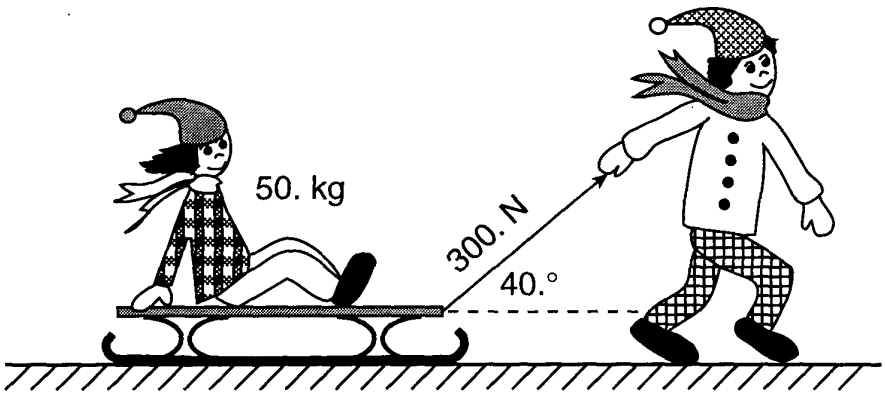


As angle θ is increased, the horizontal acceleration of the mass

A) decreases B) increases

C) remains the same

20. Base your answer to the following question on The diagram below shows a child pulling a 50.-kilogram friend on a sled by applying a 300.-newton force on the sled rope at an angle of 40.º with the horizontal.



The vertical component of the 300.-newton force is approximately

A) 510 N B) 230 N C) 190 N D) 32 N

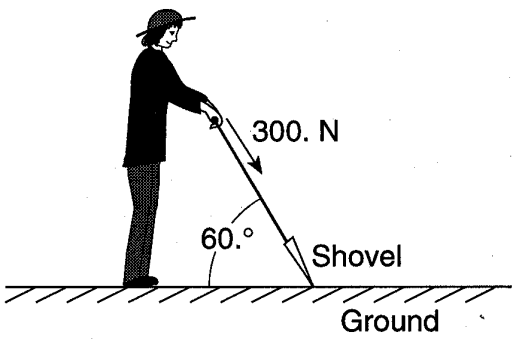
Base your answers to questions **21** and **22** on the information below.

A kicked soccer ball has an initial velocity of 25 meters per second at an angle of 40º above the horizontal, level ground. [Neglect friction.]

21. On the diagram below, sketch the path of the ball's flight from its initial position at point P until it returns to level ground.

22. Calculate the maximum height the ball reaches above its initial position. [Show all work, including the equation and substitution with units.]

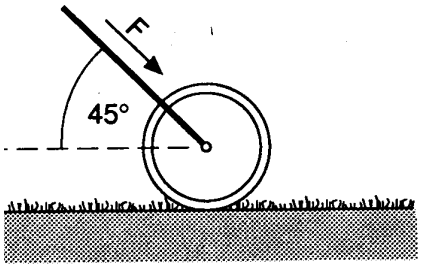
23. The diagram below shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of 60.° with the horizontal ground.



The component of the 300.-newton force that acts perpendicular to the ground is approximately

A) 150. N B) 260. N
C) 300. N D) 350. N

24. The handle of a lawn roller is held at 45° from the horizontal. A force, *F*, of 28.0 Newtons is applied to the handle as the roller is pushed across a level lawn, as shown in the diagram below.



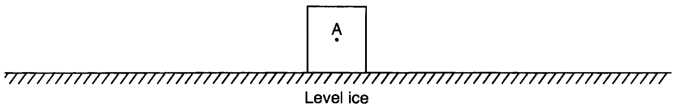
What is the magnitude of the force moving the roller forward?

A) 7.00 N B) 14.0 N
C) 19.8 N D) 39.0 N

25. Base your answer to the following question on the information below.

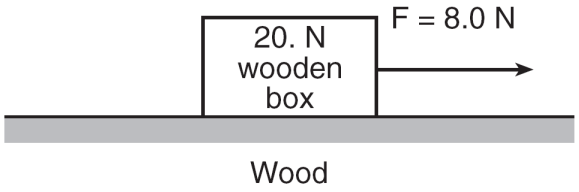
An ice skater applies a horizontal force to a 20.-kilogram block on frictionless, level ice, causing the block to accelerate uniformly at 1.4 meters per second^2 to the right. After the skater stops pushing the block, it slides onto a region of ice that is covered with a thin layer of sand. The coefficient of kinetic friction between the block and the sand-covered ice is 0.28.

On the diagram below, starting at point *A*, draw a vector to represent the force applied to the block by the skater. Begin the vector at point *A* and use a scale of 1.0 centimeters = 5.0 newtons.



Base your answers to questions **26** through **29** on the information below.

A horizontal force of 8.0 newtons is used to pull a 20.-newton wooden box moving toward the right along a horizontal, wood surface, as shown.

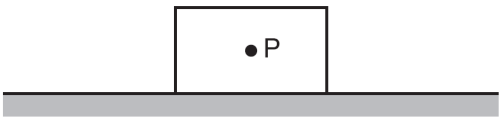


26. Calculate the magnitude of the acceleration of the box. [Show all work, including the equation and substitution with units.]

27. Determine the mass of the box.

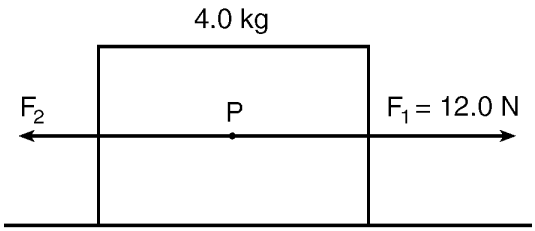
28. Determine the magnitude of the net force acting on the box.

29. Starting at point *P* on the diagram below, use a metric ruler and a scale of 1.0 cm = 4.0 N to draw a vector representing the normal force acting on the box. Label the vector F_N.



Base your answers to questions **30** through **32** 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 12.0 newtons, and is directed toward the right.



(Drawn to scale)

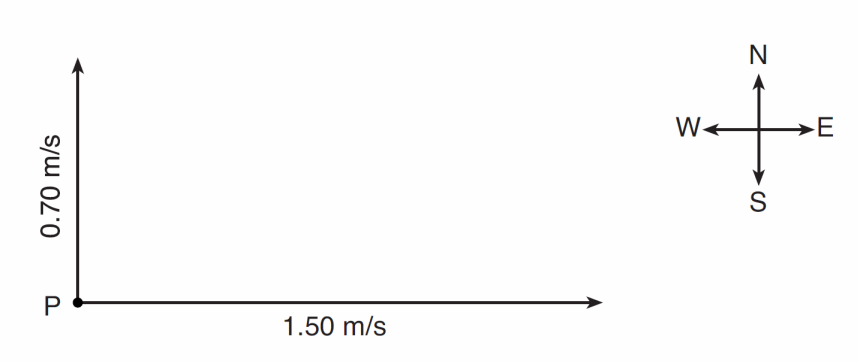
30. Using a ruler and the scaled diagram, determine the magnitude of F_2 in newtons.

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

32. Calculate the magnitude of the acceleration of the block.

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

A model airplane heads due east at 1.50 meters per second, while the wind blows due north at 0.70 meter per second. The scaled diagram below represents these vector quantities.



33. Determine the angle between north and the resultant velocity.

_____ °

34. Determine the magnitude of the resultant velocity.

_____ **m/s**