In each of the cases shown below, the direction of motion of the object is indicated by the velocity vector $\vec{v}$. One or more forces act on the object as shown in the diagram. How will the velocity of the object change in each case in the direction of motion? Assume the forces shown remain constant in magnitude and direction.

(a)

- magnitude will increase, direction will be the same
- magnitude will decrease, direction will be the same
- magnitude will increase, direction will change
- magnitude will decrease, direction will change
- no change in magnitude or direction

(b)

- magnitude will increase, direction will be the same
- magnitude will decrease, direction will be the same
- magnitude will increase, direction will change
- magnitude will decrease, direction will change
- no change in magnitude or direction

(c)

- magnitude will increase, direction will be the same
- magnitude will decrease, direction will be the same
- magnitude will increase, direction will change
- magnitude will decrease, direction will change
- no change in magnitude or direction
2. **Question Details**

An object of mass 18.0 kg subjected to a non-zero net force moves with an acceleration of 2.6 m/s².

(a) Determine the net force acting on it. (Enter the magnitude only.)

46.8 N

(b) What acceleration would a 36.0-kg object have if the same net force is applied to it?

1.3 m/s²

3. **Question Details**

An object of mass 0.61 kg is initially at rest. When a force acts on it for 2.9 ms it acquires a speed of 14.8 m/s. Find the magnitude of the average force acting on the ball during the 2.9 ms time interval.

3110 N

4. **Question Details**

Tom and Jerry are enjoying an afternoon at the ice rink. They playfully place their hands together and push against each other. Tom’s mass is 60 kg and Jerry’s mass is 15 kg.

(a) Which of the following statements is correct?

- The magnitude of the force Jerry exerts on Tom is equal to the magnitude of the force Tom exerts on Jerry.
- The magnitude of the force Tom exerts on Jerry is less than the magnitude of the force Jerry exerts on Tom.
- The magnitude of the force Jerry exerts on Tom is less than the magnitude of the force Tom exerts on Jerry.
- They both have the same acceleration.
- Tom’s acceleration is less than Jerry’s acceleration.
- Tom’s acceleration is more than Jerry’s acceleration.

(b) Which of the following statements is correct?

- They both have the same acceleration.
- Tom’s acceleration is less than Jerry’s acceleration.
- Tom’s acceleration is more than Jerry’s acceleration.

(c) If Jerry’s acceleration is 2.7 m/s² in magnitude, what is the magnitude of Tom’s acceleration?

0.675 m/s²

5. **Question Details**

A 78-kg man stands on a bathroom scale inside an elevator.

(a) The elevator accelerates upward from rest at a rate of 1.20 m/s² for 1.50 s. What does the scale read during this 1.50 s interval?

858 N

(b) The elevator continues upward at constant velocity for 8.50 s. What does the scale read now?

704 N

(c) While still moving upward, the elevator’s speed decreases at a rate of 0.800 m/s² for 3.00 s. What is the scale reading during this time?

702 N

6. **Question Details**

Two forces \( \vec{P} \) and \( \vec{Q} \) act on an object of mass 7.00 kg with \( \vec{Q} \) being the larger of the two forces. When both forces are directed to the left, the magnitude of the acceleration of the object is 0.900 m/s². However, when the force \( \vec{P} \) is directed to the left and the force \( \vec{Q} \) is directed to the right, the object has an acceleration of 0.400 m/s² to the right. Find the magnitudes of the two forces \( \vec{P} \) and \( \vec{Q} \).

\( P = 1.75 \text{ N} \)

\( Q = 4.57 \text{ N} \)
7. You work at a garden store for the summer. You lift a bag of fertilizer with a force of 150 N, and it moves upward with an acceleration of 0.754 m/s².

(a) What is the mass of the fertilizer bag?

\[ m = \frac{F}{a} = \frac{150}{0.754} \approx 200 \text{ kg} \]

(b) How much does the fertilizer bag weigh?

\[ F = mg = 200 \times 9.8 \approx 1960 \text{ N} \]

8. A contestant in a winter games event pushes a 56.0-kg rock across a frozen lake with a force of 25 N at 24° below the horizontal as shown in Figure (a) below, and it moves with an acceleration of 0.41 m/s² to the right.

(a) What is the normal force exerted by the lake surface on the rock?

\[ N = mg - F \sin(24°) = 56 \times 9.8 - 25 \times 0.41 \approx 559 \text{ N} \]

(b) Instead of pushing on the rock, the contestant now pulls on it with a rope over his shoulder at the same angle above the horizontal as in part (a). See Figure (b) above. Now what is the normal force exerted by the lake surface on the rock?

\[ N = mg - F \cos(24°) = 56 \times 9.8 - 25 \times 0.9 \approx 539 \text{ N} \]

9. The three diagrams below show a block of mass \( m \) being pulled or pushed at constant velocity along a table with a force \( F \). Assume the surfaces to be frictionless.

(a) What is the magnitude of the normal force in each case? Use the following as necessary: \( g \), \( F \), and \( \theta \).

- case (i): \( N = mg \)
- case (ii): \( N = mg + F \sin(\theta) \)
- case (iii): \( N = mg - F \sin(\theta) \)

(b) How would your answer to part (a) change if, all else being the same, the object moved with constant acceleration?

- The normal force will increase.
- The normal force will decrease.
- The normal force will remain the same.
10. The figure below shows Superhero hanging motionless from a rope, with Trusty Sidekick hanging below him. Superhero's mass is 92.0 kg, while Trusty Sidekick's is 54.0 kg, and the mass of the rope is negligible.

(a) Find the tension in the rope at a point between Superhero and Trusty Sidekick.

529 N

(b) Find the tension in the rope at a point above Superhero.

1430 N

11. Tom enlists the help of his friend John to move his car. They apply forces to the car as shown in the diagram. Here \( F_1 = 437 \text{ N} \) and \( F_2 = 332 \text{ N} \) and friction is negligible. In the diagram, the mass of the car = 3500 kg, \( \theta_1 = -25^\circ \) and \( \theta_2 = 12^\circ \). (Assume the car faces the positive \( x \)-axis before the forces are applied.)

(a) Find the resultant force exerted on the car.

magnitude 730 N
direction \(-9.12^\circ\) (counterclockwise from the +\( x \)-axis)

(b) What is the acceleration of the car?

magnitude 0.209 m/s\(^2\)
direction \(-9.12^\circ\) (counterclockwise from the +\( x \)-axis)
12. Suppose your car was mired deeply in the mud and you wanted to use the method illustrated in the figure below to pull it out.

(a) What force would you have to exert perpendicular to the center of a rope to produce a force of 13,500 N on the car if the angle is \( \theta = 2.10° \)? (Enter the magnitude only.)

\[ 989 \text{ N} \]

(b) Real ropes stretch under such forces. What force would be exerted on the car if the angle increases to 7.00° and you still apply the force found in part (a) to its center? (Enter the magnitude only.)

\[ 4060 \text{ N} \]

13. A 16.0-kg traffic light is suspended from two cables as shown in the figure below. Find the tension in each cable.

- Left cable: \[ 136 \text{ N} \]
- Right cable: \[ 78.4 \text{ N} \]

14. A block is acted on by two forces as shown in the diagram below. If the magnitudes of the forces are \( F_1 = 53.0 \text{ N} \) and \( F_2 = 30.5 \text{ N} \), what are the magnitude and direction of the acceleration of the block? Let \( m = 8.00 \text{ kg} \) and \( \theta = 33.0° \).

Magnitude: \[ 3.43 \text{ m/s}^2 \]
Direction: Toward the right
A skier speeds down a smooth ski slope which is at an angle of $\theta = 24^\circ$ with the horizontal. The mass of the skier is 67 kg. Take the downhill direction to be positive and uphill to be negative.

(a) What net force is acting on the skier? (Indicate the direction with the sign of your answer.)

\[ 267 \text{ N} \]

(b) What is the acceleration experienced by the skier? (Indicate the direction with the sign of your answer.)

\[ 3.99 \text{ m/s}^2 \]

(c) How does the net force experienced by the skier change if the ski slope becomes steeper?

- [ ] increases
- [ ] decreases
- [x] remains the same

The block in the figure below has a mass of 6.0 kg and it rests on an incline of angle $\theta$. You pull on the rope with a force $F = 38 \text{ N}$. Assume the incline is smooth and determine the angle of the incline if the block moves with constant speed.

\[ 40.3^\circ \]

A pulley and string arrangement is used to connect two objects A and B as shown in the diagram below. Here, $m_A = 4.75 \text{ kg}$ and $m_B = 6.60 \text{ kg}$. The string connecting the two objects is of negligible mass and the pulley is frictionless. The objects start from rest and move with constant acceleration.

(a) What is the magnitude of the acceleration of each of the objects?

\[ 1.6 \text{ m/s}^2 \]

(b) What is the magnitude of the tension in the string?

\[ 54.1 \text{ N} \]

(c) Through what distance will the two objects move in the first four seconds of motion?

\[ 12.8 \text{ m} \]
The figure below shows two blocks connected by a string of negligible mass passing over a frictionless pulley. \( m_1 = 7.0 \text{ kg} \) and \( \theta = 12.0^\circ \). Assume that the incline is smooth.

(a) For what value of \( m_2 \) will the system be in equilibrium?
\[ m_2 = 33.7 \text{ kg} \]

(b) If the block has to slide down the incline with an acceleration of 1.2 m/s\(^2\), what should be the value of \( m_2 \)?
\[ m_2 = 91.9 \text{ kg} \]