

Practice

- Practice**

 - What impulse is exerted in each of the following cases?
 - a force of 25 N pushing on a cart for 3.2 s $(80 \text{ N}\cdot\text{s})$
 - a tennis racquet exerting a force of 60 N on a tennis ball during the 0.04 s they are in contact $(2.4 \text{ N}\cdot\text{s})$
 - the Earth pulling down on a 12 kg rock during the 3.0 s it takes to fall from a cliff. $(3.6 \times 10^2 \text{ N}\cdot\text{s})$

billiard ball of mass 200 g is rolling towards the right-hand cushion of a billiard table at 2.0 m/s and rebounds straight back at 2.0 m/s.

 - What is its change in momentum as a result of the collision? $(-0.8 \text{ kg}\cdot\text{m/s})$
 - What impulse is exerted on the ball? $(-0.8 \text{ N}\cdot\text{s})$
 - A puck of mass 0.20 kg is sliding along a smooth flat section of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s.
 - What is the change in momentum of the puck? $(-1.6 \text{ kg}\cdot\text{m/s})$
 - What impulse is exerted on the puck by the snow? $(-1.6 \text{ N}\cdot\text{s})$
 - What average force does the snow exert on the puck? (-0.64 N)

4. A frictionless disc of mass 0.50 kg is moving in a straight line across an air table at a speed of 2.4 m/s when it bumps into an elastic band stretched between two fixed posts. If the elastic band exerts an average opposing force of 1.2 N on the disc for 1.5 s, what will be the final velocity of the disc? (-1.2 m/s)

5. A skateboard of mass 2.0 kg is rolling along a smooth flat floor when a small girl pushes it, causing it to speed up to 4.5 m/s in 0.5 s. If the force exerted by the girl on the skateboard, in its direction of motion, was 6.0 N, with what initial velocity was it moving? (3.0 m/s)

Practice

- A 5000 kg boxcar runs into a stationary 8000 kg tank car at 5.2 m/s. They hook together and move off down the track. How fast will they be going? (2.0 m/s)
 - A large compressed spring is placed between a 4000 kg railway car and a 6000 kg boxcar at rest. The spring is released and the two cars move off in opposite directions. If the heavier car moves at 2.4 m/s, how fast will the other move? (-3.6 m/s)
 - A 0.20 kg golf ball, moving at 80 m/s, hits a watermelon of 10 kg mass at rest on a frictionless table, and sticks in it. How fast does the watermelon move? (1.6 m/s)

Part C
 A 5000 kg boxcar runs into a stationary 8000 kg tank car at 5.2 m/s. They hook together and move off down the track. How fast will they be going? (20 m/s)
 5.2 m/s. They hook together and move off down the track. How far will they be going? (20 m/s)
 A large compressed spring is placed between a 4000 kg railway car and a 6000 kg boxcar at rest. The spring is released and the two cars move off in opposite directions. If the heavier car moves at 2.4 m/s, how fast will the other move? (-3.6 m/s)
 A. 0.20 kg golf ball, moving at 80 m/s, hits a watermelon of 10 kg and causes it to fly across the room at 16 m/s. How fast does the watermelon move? (1.6 m/s)

(c) What average force does the snow exert on the sled?

4. A frictionless disc of mass 0.50 kg is moving in a straight line across an air table at a speed of 2.4 m/s when it bumps into an elastic band stretched between two fixed points. If the elastic band exerts an average opposing force of 1.2 N on the disc for 1.5 s, what will be the final velocity of the disc? (—1.2 m/s)

5. A skateboarder of mass 2.0 kg is riding along a smooth floor when a small gift pushes her, causing her to speed up to 4.5 m/s in 0.5 s. If the force exerted by the gift on the skateboarder, in its direction of motion, was 0.0 N, with what initial velocity was it moving?

- (a) What impulse is exerted in each of the following cases?

(i) A force of 25 N pushing on a cart for 3.2 s ($80 \text{ N} \cdot \text{s}$)

(ii) A tennis racket exertsing a force of 60 N on a tennis ball during a serve for 0.04 s ($2.4 \text{ N} \cdot \text{s}$)

(iii) The Earth pulling down on a 12 kg rock during the night-time ($3.6 \times 10^4 \text{ N} \cdot \text{s}$)

(iv) A bullet ball of mass 200 g is rolling towards the right-hand curtain of a billiard table at 2.0 m/s and rebounds straight back at 2.0 m/s . ($-4.0 \text{ kg} \cdot \text{m/s}$)

(v) A bullet is fired from a rifle. ($-2.0 \text{ kg} \cdot \text{m/s}$)

(vi) A ball rolls off a cliff. ($-1.0 \text{ kg} \cdot \text{m/s}$)

(vii) A ball of mass 200 g is rolling towards the right-hand curtain of a billiard table at 2.0 m/s and rebounds straight back at 2.0 m/s . ($-4.0 \text{ kg} \cdot \text{m/s}$)

(viii) A ball of mass 0.20 kg is sliding along a smooth floor of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s .

(ix) What impulse is exerted on the ball? ($-0.8 \text{ kg} \cdot \text{m/s}$)

(x) What impulse is exerted on the ball? ($-0.8 \text{ N} \cdot \text{s}$)

(xi) A puck of mass 0.20 kg is sliding along a smooth floor of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s .

(xii) What is the change in momentum of the puck?

(xiii) What is the change in momentum as a result of the collision?

(xiv) A smooth ball of mass 0.20 kg is sliding along a smooth floor of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s .

(xv) What impulse is exerted on the puck by the snow? ($-1.6 \text{ kg} \cdot \text{m/s}$)

(xvi) What impulse is exerted on the puck by the snow? ($-1.6 \text{ N} \cdot \text{s}$)

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Practice

1. What impulse is exerted in each of the following cases?

 - a force of 25 N pushing on a cart for 3.2 s $(80 \text{ N}\cdot\text{s})$
 - a tennis racquet exerting a force of 60 N on a tennis ball during the 0.04 s they are in contact $(2.4 \text{ N}\cdot\text{s})$
 - the Earth pulling down on a 12 kg rock during the 3.0 s it takes to fall from a cliff. $(3.6 \times 10^2 \text{ N}\cdot\text{s})$

2. A billiard ball of mass 200 g is rolling towards the right-hand cushion of a billiard table at 2.0 m/s and rebounds straight back at 2.0 m/s.

 - What is its change in momentum as a result of the collision? $(-0.8 \text{ kg}\cdot\text{m/s})$
 - What impulse is exerted on the ball? $(-0.8 \text{ N}\cdot\text{s})$

3. A puck of mass 0.20 kg is sliding along a smooth flat section of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s.

 - What is the change in momentum of the puck? $(-1.6 \text{ kg}\cdot\text{m/s})$
 - What impulse is exerted on the puck by the snow? $(-1.6 \text{ N}\cdot\text{s})$
 - What average force does the snow exert on the puck? (-0.64 N)

4. A frictionless disc of mass 0.50 kg is moving in a straight line across an air table at a speed of 2.4 m/s when it bumps into an elastic band stretched between two fixed posts. If the elastic band exerts an average opposing force of 1.2 N on the disc for 1.5 s, what will be the final velocity of the disc? (-1.2 m/s)

5. A skateboard of mass 2.0 kg is rolling along a smooth flat floor when a small girl pushes it, causing it to speed up to 4.5 m/s in 0.5 s. If the force exerted by the girl on the skateboard, in its direction of motion, was 6.0 N, with what initial velocity was it moving? (3.0 m/s)

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 1. A 5000 kg boxcar runs into a stationary 8000 kg tank car at 5.2 m/s. They hook together and move off down the track. How fast will they be going? (2.0 m/s)
 2. A large compressed spring is placed between a 4000 kg railway car and a 6000 kg boxcar at rest. The spring is released and the two cars move off in opposite directions. If the heavier car moves at 2.4 m/s, how fast will the other move? (-3.6 m/s)
 3. A 0.20 kg golf ball, moving at 80 m/s, hits a watermelon of 10 kg mass at rest on a frictionless table, and sticks in it. How fast does the watermelon move? (1.6 m/s)

Practical

1. A 5000 kg boxcar runs into a stationary 8000 kg train car at 2.2 m/s . They hook together and move off down the track. How fast will they be going?
(20 m/s)
2. A large compressed spring is placed between a 4000 kg railway car and a 600 kg boxcar at rest. The spring is released and the two cars move off in opposite directions. If the heavier car moves at 2.1 m/s , how fast will the other move?
(3.5 m/s)
3. A 0.20 kg golf ball, moving at 80 m/s , has a watermelon of 10 kg masses at rest on a frictionless table, and sticks in it. How fast does the watermelon move?
(1.6 m/s)

4. A frictionless disc of mass 0.50 kg is moving in a straight line at 1.0 m/s . Across it is a table of mass 0.50 kg moving in a straight line at 2.4 m/s . When it bumps into an elastic band stretched between two fixed points, it bounces back at a speed of 2.4 m/s . The elastic band stretches between two fixed points, it bounces back at a speed of 2.4 m/s . When it bounces back at a speed of 2.4 m/s , it is moving in a straight line at 1.0 m/s . The elastic band stretches between two fixed points, it bounces back at a speed of 2.4 m/s . When it bounces back at a speed of 2.4 m/s , it is moving in a straight line at 1.0 m/s .

1. What impulse is exerted in a cart for 25 N pushing on a cart for 3.2 s (80 N·s)

(a) A certain impulse is exerted in a cart for 3.2 s (80 N·s)

(b) A certain impulse is exerted in a cart for 3.2 s (80 N·s)

(c) The Earth pulls down on a 12 kg rock during 3.0 s at 2.0 m/s. (3.6 x 10³ N·s)

(d) A ball is rolling towards the right-hand takes to fall from a cliff. (2.4 N·s)

(e) The Earth is its change in momentum as a result of the collision? (2.4 N·s)

2. A billiard ball of mass 200 g is rolling towards the right-hand cushion of a billiard table at 2.0 m/s and rebounds straight back takes to fall from a cliff. (3.6 x 10³ N·s)

(f) A ball is its change in momentum as a result of the collision? (2.4 N·s)

3. A puck of mass 0.20 kg is sliding along a smooth flat surface of ice at 18 m/s when it encounters some snow. After 2.5 s of sliding through the snow, it returns to smooth ice, continuing at a speed of 10 m/s.

(g) What impulse is exerted on the ball? (-0.8 kg·m/s)

(h) What impulse is exerted on the ball? (-0.8 kg·m/s)

(i) What is the change in momentum of the puck? (-1.6 N·s)

(j) What impulse does the puck by the snow? (-1.6 N·s)

(k) What average force is exerted on the puck by the snow? (-1.6 N)

(l) What average force does the snow exert on the puck? (-0.6 N)