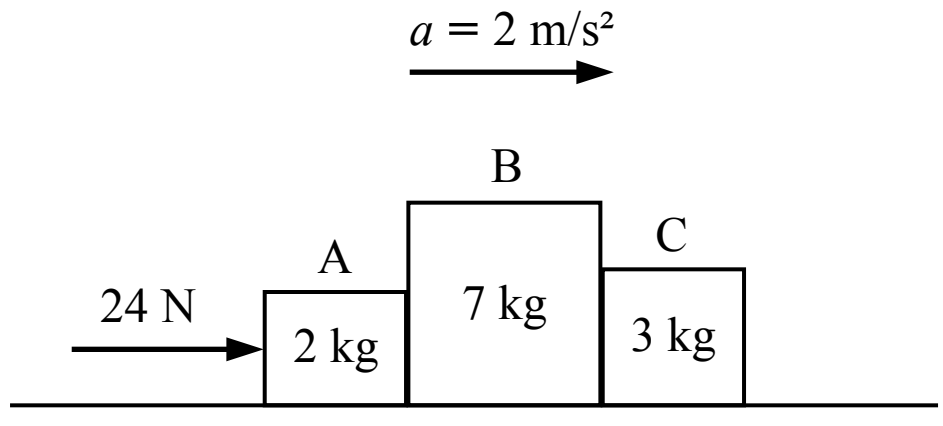
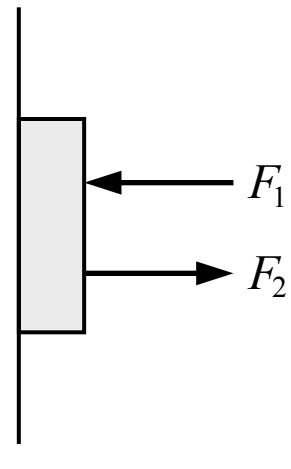
NEWTON'S 3RD LAW OF MOTION



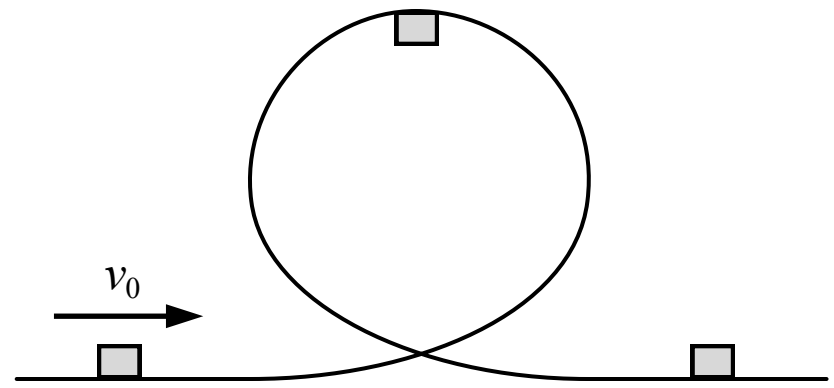
1. A force is applied to the left of three blocks with different masses which are sliding on a frictionless surface as shown in the figure above. The three blocks accelerate together without losing contact. What is the magnitude of the force that block C exerts on block B?

   (A) 0 N
   (B) 6 N
   (C) 8 N
   (D) 24 N



2. A book is at rest against a wall with two forces acting on it as shown in the figure above. Which of the following represent the magnitude of the force acting on the book by the wall?

   (A) $F_2 - F_1$
   (B) $F_1 + F_2$
   (C) $F_1 - F_2$
   (D) $-F_1 - F_2$



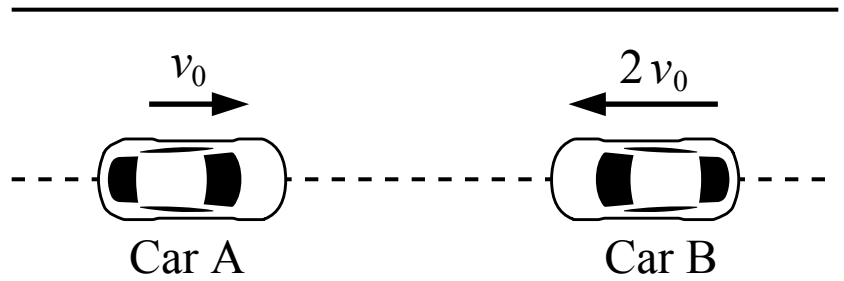
3. A small block slides along a frictionless track with a vertical loop as shown in the figure above. The block is not attached to the track in any way, but its initial velocity is great enough that it moves through the loop without losing contact with the track. What is the direction of the force exerted on the block by the track when the block is at the top of the loop?

(A) 

(B) 

(C) 

(D) 



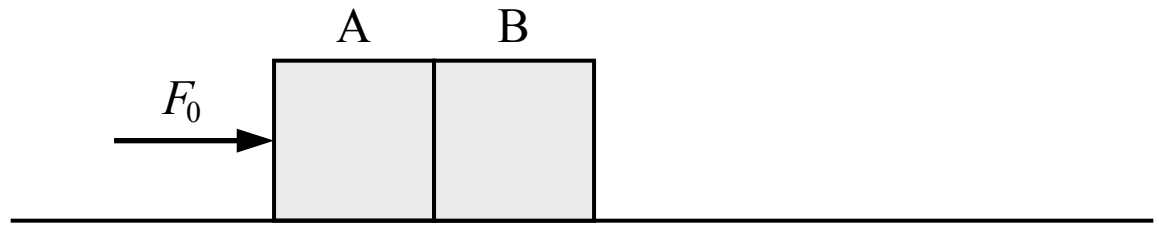
4. During a crash test, cars A and B are driven into each other head on as show in the figure above. Car A is moving at a speed of v_0 and car B is moving at a speed of $2\,v_0$. Which of the following is true during the crash?

(A) The force exerted by car A on car B has twice the magnitude as the force exerted by car B on car A

(B) The force exerted by car B on car A has twice the magnitude as the force exerted by car A on car B

(C) The force exerted by car A on car B has the same magnitude as the force exerted by car B on car A

(D) The relationship of the forces between car A and car B cannot be determined without knowing the masses



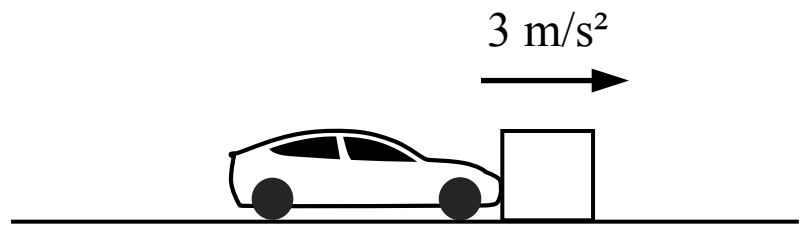
5. Two blocks A and B are on a frictionless surface. At an initial time t_1 a force F_0 acts on block A as shown in the figure above. At a later time of t_2 the force F_0 has been removed. How does F_{BA} , the force of block B on block A, compare between the two times?

   (A) F_{BA} at time t_1 = F_{BA} at time t_2

   (B) F_{BA} at time t_1 > F_{BA} at time t_2

   (C) F_{BA} at time t_1 < F_{BA} at time t_2

   (D) Cannot be determined



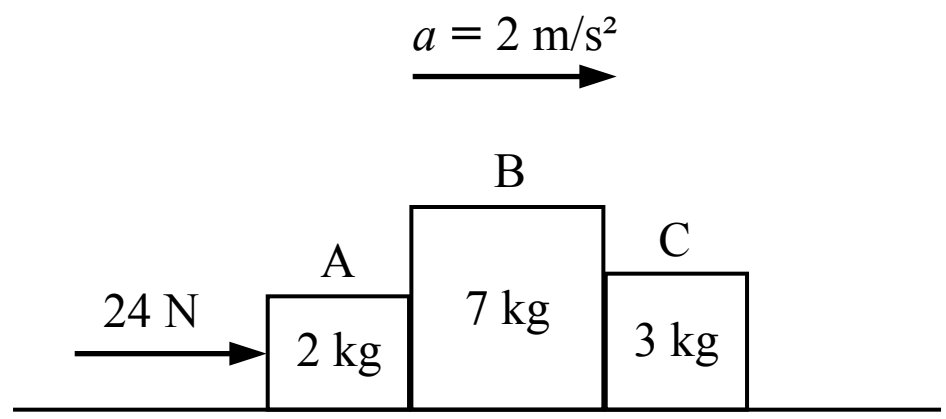
6. A car pushes a large block across a surface where friction is not negligible and the block accelerates at 3 m/s². Which of the following statements is true?

   (A) The block does not exert a force on the car

   (B) The force exerted on the block by the car is greater in magnitude than the force exerted on the car by the block

   (C) The force exerted on the block by the car is smaller in magnitude than the force exerted on the car by the block

   (D) The force exerted on the block by the car is equal in magnitude to the force exerted on the car by the block



1. A force is applied to the left of three blocks with different masses which are sliding on a frictionless surface as shown in the figure above. The three blocks accelerate together without losing contact. What is the magnitude of the force that block C exerts on block B?

(A) 0 N

(B) 6 N

(C) 8 N

(D) 24 N

A Incorrect

This answer incorrectly assumes that the only force involved is the 24 N force on block A.

B Correct

Newton's 2nd law can be applied to blocks A and B to find the force that block C exerts on block B. But since the force that block C exerts on block B is equal in magnitude to the force that block B exerts on block C (Newton's 3rd law), Newton's 2nd law can just be applied to block C to find that force:

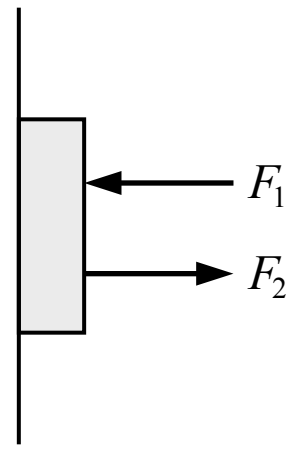
Block C: $\Sigma F_x = m_C a_C \qquad F_{B \text{ on } C} = (3 \text{ kg})(2 \text{ m/s}^2) = 6 \text{ N} = F_{C \text{ on } B}$

C Incorrect

This answer incorrectly divides the 24 N force by 3 because there are 3 blocks.

D Incorrect

This answer incorrectly assumes the 24 N force is being applied to each block, or that the normal forces between each block must be equivalent to the 24 N force.



2. A book is at rest against a wall with two forces acting on it as shown in the figure above. Which of the following represent the magnitude of the force acting on the book by the wall?

(A) $F_2 - F_1$

(B) $F_1 + F_2$

(C) $F_1 - F_2$

(D) $-F_1 - F_2$

A Incorrect

This answer incorrectly assumes the normal force on the book is acting to the left instead of the right:

$F_2 - F_1 - F_n = m(0)$

B Incorrect

This answer incorrectly adds the forces in the following way:

$F_1 + F_2 - F_n = m(0)$

C Correct

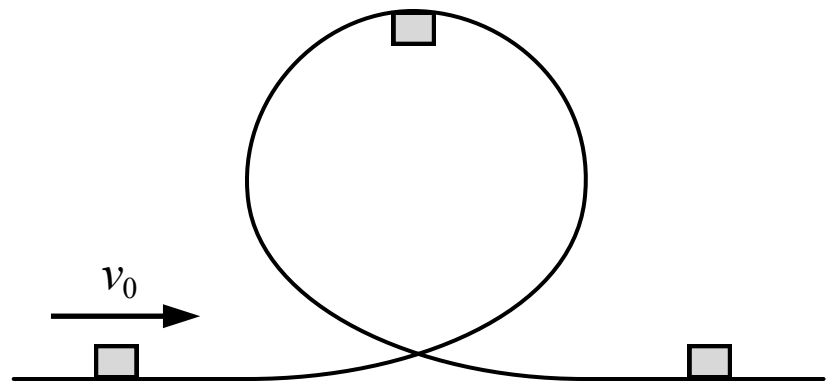
Newton's 1st law can be applied to the book to find the normal force acting on the book by the wall in terms of the other forces:

$\Sigma F_x = m a_x \qquad F_2 - F_1 + F_n = m(0) \qquad F_n = F_1 - F_2$

D Incorrect

This answer incorrectly adds the forces in the following way:

$F_1 + F_2 + F_n = m(0)$



3. A small block slides along a frictionless track with a vertical loop as shown in the figure above. The block is not attached to the track in any way, but its initial velocity is great enough that it moves through the loop without losing contact with the track. What is the direction of the force exerted on the block by the track when the block is at the top of the loop?

(A) 

(B) 

(C) 

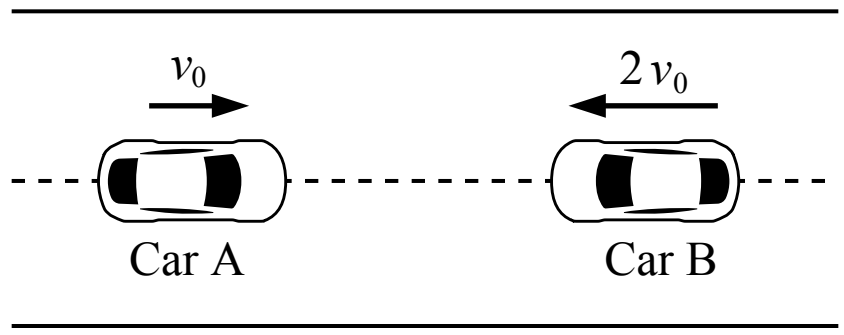
(D) 

A **Correct**
The track is frictionless and the block is not attached to the track so the only force exerted by the track on the block is the normal force, which acts downwards when the block is below the track at the top of the loop.

B Incorrect
This is the direction of the block's velocity when it's at the top of the loop. The track does not apply a force on the block in this direction.

C Incorrect
This is the direction of the force exerted on the track from the block. The block is not attached to the track so the track can't apply an upwards force on the block at this point.

D Incorrect
This would be the direction of the friction force acting on the block by the track, but there is no friction.



4. During a crash test, cars A and B are driven into each other head on as show in the figure above. Car A is moving at a speed of v_0 and car B is moving at a speed of $2\,v_0$. Which of the following is true during the crash?

(A) The force exerted by car A on car B has twice the magnitude as the force exerted by car B on car A

(B) The force exerted by car B on car A has twice the magnitude as the force exerted by car A on car B

(C) The force exerted by car A on car B has the same magnitude as the force exerted by car B on car A

(D) The relationship of the forces between car A and car B cannot be determined without knowing the masses

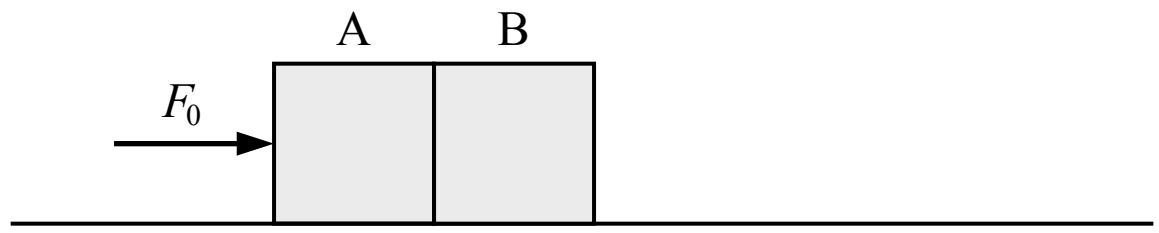
A Incorrect

B Incorrect

C Correct

The force exerted by object A on object B is equal in magnitude and opposite in direction to the force exerted by object B on object A according to Newton's 3rd law of motion, regardless of the velocities and masses.

D Incorrect



5. Two blocks A and B are on a frictionless surface. At an initial time t_1 a force F_0 acts on block A as shown in the figure above. At a later time of t_2 the force F_0 has been removed. How does F_{BA} , the force of block B on block A, compare between the two times?

   (A) F_{BA} at time $t_1 =$ F_{BA} at time t_2

   (B) F_{BA} at time $t_1 >$ F_{BA} at time t_2

   (C) F_{BA} at time $t_1 <$ F_{BA} at time t_2

   (D) Cannot be determined

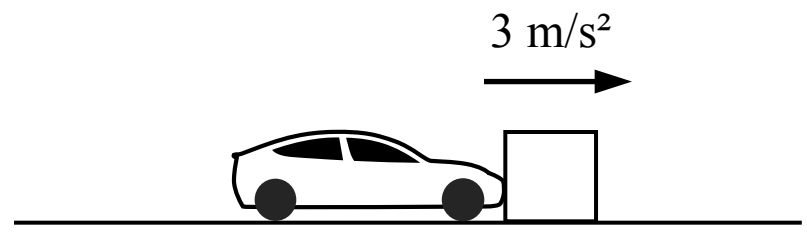
A Incorrect

B Correct

At time t_1 the force acting on block A causes both blocks to accelerate to the right. Block A exerts a force on block B (causing it to accelerate) and block B exerts an equal and opposite force on block A according to Newton's 3rd law of motion. At time t_2 blocks A and B are no longer accelerating and they move to the right with the same velocity. Since neither block is accelerating the net horizontal force on each block is zero, which means the normal force between the two blocks is zero (there are no other horizontal forces).

C Incorrect

D Incorrect



6. A car pushes a large block across a surface where friction is not negligible and the block accelerates at 3 m/s². Which of the following statements is true?

(A) The block does not exert a force on the car

(B) The force exerted on the block by the car is greater in magnitude than the force exerted on the car by the block

(C) The force exerted on the block by the car is smaller in magnitude than the force exerted on the car by the block

(D) The force exerted on the block by the car is equal in magnitude to the force exerted on the car by the block

A Incorrect

B Incorrect

C Incorrect

D Correct

The car and the block are in contact with each other so the force exerted on the block by the car is equal in magnitude and opposite in direction to the force exerted on the car by the block (Newton's 3rd law of motion) regardless of the motion.