Forces

Physics Clicker Quizzes

A book is lying at rest on a table. The book will remain there at rest because:

A There is a net force but the book has too much inertia

B There are no forces acting on it at all

C It does move, but too slowly to be seen

D There is no net force on the book

E There is a net force, but the book is too heavy to move

D There is no net force on the book

There are forces acting on the book, **but the only forces acting are in the *y*-direction. Gravity acts downward, but the table exerts an upward force that is equally strong, so the two forces cancel, leaving no net force.**

A hockey puck slides on ice at constant velocity. What is the net force acting on the puck?

A More than its weight

B Equal to its weight

C Less than its weight but more than zero

D Depends on the speed of the puck

E Zero

E Zero

The puck is moving at a constant velocity, and therefore it is not accelerating. Thus, there must be no net force acting on the puck.

Follow-up:
Are there any forces acting on the puck? What are they?

You put your book on the bus seat next to you. When the bus stops suddenly, the book slides forward off the seat. Why?

A A net force acted on it

B No net force acted on it

C It remained at rest

D It did not move, but only seemed to

E Gravity briefly stopped acting on it

B No net force acted on it

The book was initially moving forward (since it was on a moving bus). When the bus stopped, the book continued moving forward, which was its initial state of motion, and therefore it slid forward off the seat.

Follow-up:
What is the force that usually keeps the book on the seat?

You kick a smooth flat stone out on a frozen pond. The stone slides, slows down and eventually stops. You conclude that:

A The force pushing the stone forward finally stopped pushing on it
B No net force acted on the stone
C A net force acted on it all along
D The stone simply "ran out of steam"
E The stone has a natural tendency to be at rest

C A net force acted on it all along

After the stone was kicked, no force was pushing it along! However, there must have been some force acting on the stone to slow it down and stop it. This would be friction!!

Follow-up:
What would you have to do to keep the stone moving?

A very large truck sits on a frozen lake. Assume there is no friction between the tires and the ice. A fly suddenly smashes against the front window. What will happen to the truck?

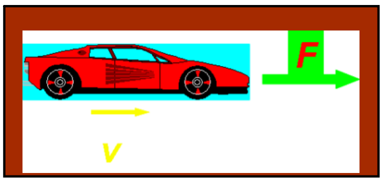
A It is too heavy, so it just sits there
B It moves backward at constant speed
C It accelerates backward
D It moves forward at constant speed
E It accelerates forward

B It moves backwards at constant speed

When the fly hit the truck, it exerted a force on the truck (only for a fraction of a second). So, in this time period, the truck accelerated (backwards) up to some speed. After the fly was squashed, it no longer exerted a force, and the truck simply continued moving at constant speed.

Follow-up:
What is the truck doing 5 minutes after the fly hit it?

From rest, we step on the gas of our Ferrari, providing a force F for 4 secs, speeding it up to a final speed v_f. If the applied force were only 1/2 F, how long would it have to be applied to reach the same final speed?



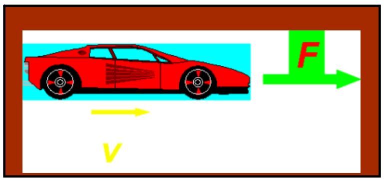
A 16 s
B 8 s
C 4 s
D 2 s
E 1 s

B **8 s**

In the first case, the acceleration acts over time $T = 4$ s to give velocity $v_f = aT$. In the second case, the force is half, therefore the acceleration is also half, so to achieve the *same final speed*, the time must be doubled.

From rest, we step on the gas of our Ferrari, providing a force F for 4 secs. During this time, the car moves 50 m. If the same force would be applied for 8 secs, how much would the car have traveled during this time?

A 250 m
B 200 m
C 150 m
D 100 m
E 50 m

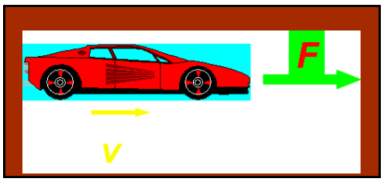


B **200 m**

In the first case, the acceleration acts over time $T = 4$ s, to give a distance of $x = \frac{1}{2}aT^2$ (why is there no v_0T term?). In the 2nd case, the time is doubled, so the distance is quadrupled because it goes as the square of the time.

From rest, we step on the gas of our Ferrari, providing a force F for 40 m, speeding it up to a final speed 50 km/hr. If the same force would be applied for 80 m, what final speed would the car reach?

A 200 km/hr
B 100 km/hr
C 90 km/hr
D 70 km/hr
E 50 km/hr



D **70 km/hr**

In the first case, the acceleration acts over a distance $x = 40$ m, to give a final speed of $v^2 = 2ax$ (why is there no v_0^2 term?). In the 2nd case, the distance is doubled, so the speed increases by a factor of $\sqrt{2}$.

A force F acts on mass M for a time interval T, giving it a final speed v. If the same force acts for the same time on a different mass 2M, what would be the final speed of the bigger mass?

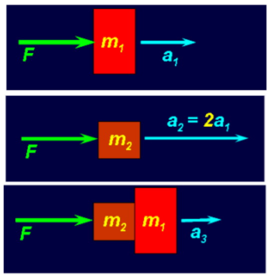
A 4v
B 2v
C v
D 1/2v
E 1/4v

D 1/2 v

In the first case, the acceleration acts over time T to give velocity $v = aT$. In the second case, the mass is doubled, so the acceleration is cut in half, therefore, in the same time T, the final speed will only be half as much.

Follow-up:
What would you have to do to get $2M$ to reach speed v?

A force F acts on mass m_1 giving acceleration a_1. The same force acts on a different mass m_2 giving acceleration $a_2 = 2a_1$. If m_1 and m_2 are glued together and the same force F acts on this combination, what is the resulting acceleration?



- A $3/4\ a_1$
- B $3/2\ a_1$
- C $1/2\ a_1$
- D $4/3\ a_1$
- E $2/3\ a_1$

E $2/3\ a_1$

Mass m_2 must be $(1/2)m_1$ because its acceleration was $2a_1$ with the same force. Adding the two masses together gives $(3/2)m_1$, leading to an acceleration of $(2/3)a_1$ for the same applied force.

An astronaut on Earth kicks a bowling ball and hurts his foot. A year later, the same astronaut kicks the same bowling ball on the Moon with the same force. His foot hurts...

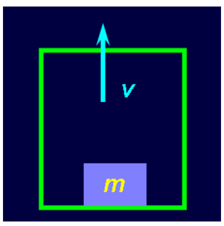
- A more
- B less
- C the same

C the same

The *masses* of both the bowling ball and the astronaut remain the same, so his foot feels the same resistance and hurts the *same* as before.

Follow-up:
What is different about the bowling ball on the Moon?

A block of mass m rests on the floor of an elevator that is moving upward at constant speed. What is the relationship between the force due to gravity and the normal force on the block?

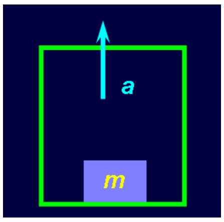


- A $N > mg$
- B $N = mg$
- C $N < mg$ (but not zero)
- D $N = 0$
- E Depends on the size of the elevator

(B) N = mg

The block is moving at constant speed, so it must have no net force on it. The forces on it are *N* (up) and *mg* (down), so *N* = *mg*, just like the block at rest on a table.

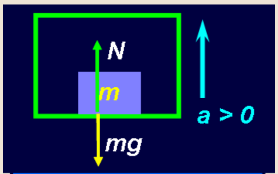
A block of mass m rests on the floor of an elevator that is accelerating upward. What is the relationship between the force due to gravity and the normal force on the block?



A. N > mg
B. N = mg
C. N < mg (but not zero)
D. N = 0
E. Depends on the size of the elevator

(A) N > mg

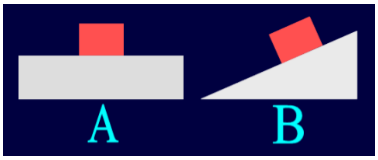
The block is accelerating upward, so it *must* have a net upward force. The forces on it are *N* (up) and *mg* (down), so *N* must be greater than *mg* in order to give the net upward force!



$\Sigma F = N - mg = ma > 0$
$\therefore\ N > mg$

Follow-up:
What is the normal force if the elevator is in free fall downward?

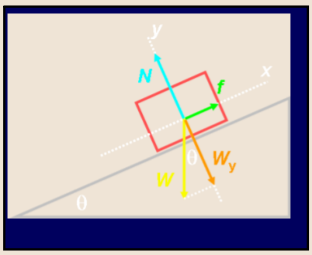
Consider two identical blocks, one resting on a flat surface, and the other resting on an incline. For which case is the normal force greater?

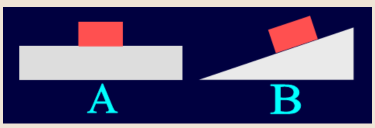


A. Case A
B. Case B
C. Both the same (N = mg)
D. Both the same (0 < *N* < *mg*)
E. Both the same (N = 0)

(A) Case A

In Case A, we know that *N* = *W*. In Case B, due to the angle of the incline, *N* < *W*. In fact, we can see that *N* = *W* cos(θ).





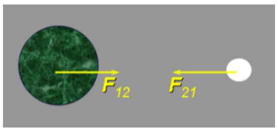
When you climb up a rope, the first thing you do is pull (down) on the rope. How do you manage to go up the rope by doing that?

A. Your initial upward velocity slows down
B. You don't go up, you're too heavy
C. You're not really pulling down – it just seems that way
D. The rope actually pulls you up
E. You are pulling the ceiling down towards you

D The rope actually pulls you up

When you pull down on the rope, the rope pulls up on you!! It is actually this upward force by the rope that makes you move up! This is the "reaction" force (by the rope on you) to the force that you exerted on the rope. And voilá, this is Newton's 3rd Law.

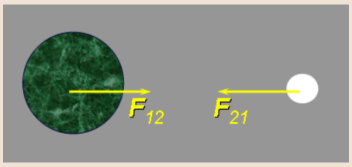
In outer space, a bowling ball and a ping-pong ball attract each other due to gravitational forces. How do the magnitudes of these attractive forces compare?



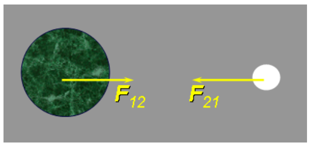
A The bowling ball exerts a greater force on the ping-pong ball
B The ping-pong ball exerts a greater force on the bowling ball
C The forces are equal
D The forces are zero because they cancel out
E There are actually no forces at all

C The forces are equal

The forces are equal and opposite by Newton's 3rd Law!



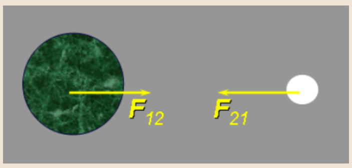
In outer space, gravitational forces exerted by a bowling ball and a ping-pong ball on each other are equal and opposite. How do their accelerations compare?



A They do not accelerate because they are weightless
B Accelerations are equal, but not opposite
C Accelerations are opposite but bigger for the bowling ball
D Accelerations are opposite but bigger for the ping-pong ball
E Accels. are equal and opposite

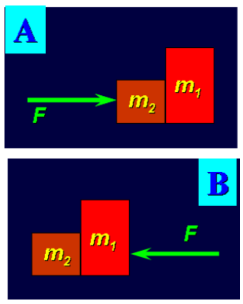
D Accelerations are opposite but bigger for the ping-pong ball

The forces are equal and opposite -- this is Newton's 3rd Law!! But the acceleration is *F/m* and so the smaller mass has the bigger acceleration.



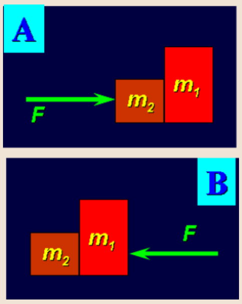
Follow-up:
Where will they meet if they are released from this position?

If you push with force F on either the heavy box (m1) or the light box (m2), in which of the two cases below is the contact force between the two boxes larger?



A Case A
B Case B
C Same in both cases

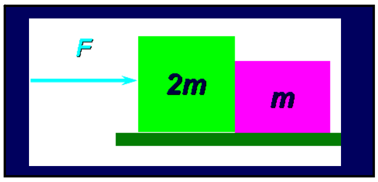
(A) Case A



The acceleration of both masses together is the same in either case. But the contact force is the *only* force that accelerates m_1 in case A (or m_2 in case B). Since m_1 is the larger mass, it requires the larger contact force to achieve the same acceleration.

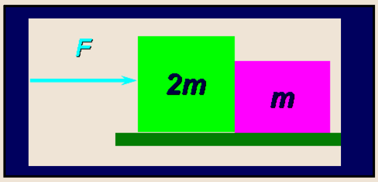
Two blocks of masses 2m and m are in contact on a horizontal frictionless surface. If a force F is applied to mass 2m, what is the force on mass m ?

- A 2 F
- B F
- C 1/2 F
- D 1/3 F
- E 1/4 F



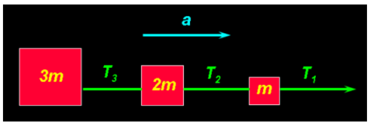
(D) 1/3 F

The force *F* leads to a specific acceleration of the entire system. In order for mass *m* to accelerate at the same rate, the force on it must be smaller! How small?? Let's see...



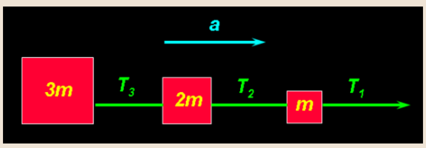
Three blocks of mass 3m, 2m, and m are connected by strings and pulled with constant acceleration a. What is the relationship between the tension in each of the strings?

- A $T_1 > T_2 > T_3$
- B $T_1 < T_2 < T_3$
- C $T_1 = T_2 = T_3$
- D All tensions are zero
- E Tensions are random



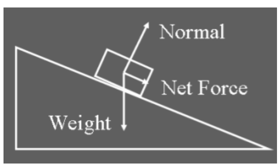
(A) $T_1 > T_2 > T_3$

T_1 pulls the whole set of blocks along, so it must be the largest. T_2 pulls the last two masses, but T_3 only pulls the last mass.



A box sits on a flat board. You lift one end of the board, making an angle with the floor. As you increase the angle, the box will eventually begin to slide down. Why?

- A Component of the gravity force parallel to the plane increased
- B Coefficient of static friction decreased
- C Normal force exerted by the board decreased
- D All the above (A, B, and C)
- E Both A and C



E Both A and C

As the angle increases, the component of weight parallel to the plane increases and the component perpendicular to the plane decreases (and so does the Normal force). Since friction depends on Normal force, we see that the friction force gets smaller and the force pulling the box down the plane gets bigger.