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) there is no net force on the book.
D) there is a net force, but the book is too heavy to move.
E) It does move, but too slowly to be seen.

You put your book on the (frictionless) bus seat next to you. When the bus stops suddenly, the book slides forward off the seat. Which of the following best explains this? (Take the perspective of an outside observer)
e 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.

An air-track glider slides at constant speed. There is no friction (assume air resistance is negligible). What can you say about the net force (total force) on the glider?

$$
\mathrm{v}=\mathrm{constant}
$$


A) $F_{\text {net }}=0$
B) $F_{\text {net }} \neq 0$, to the right
C) $F_{\text {net }} \neq 0$, to the left
D) $F_{\text {net }} \neq 0$, perpendicular to the motion
E) None of the above

A sailboat is blown across the sea at a constant velocity. What is the direction of the net force on the boat?

A) Left
B) Right
C) Down
D) The net force is zero
E) None of these

Two forces act on the same object: $\vec{F}_{1}$ and $\vec{F}_{2}$ both have the same magnitude $F$, but are at right angles to each other. What is the magnitude of the net force (total force) acting on the object?

A) F
B) 2 F
C) Something between $F$ and $2 F$
D) More than 2 F
E) Not enough information

From rest, we step on the gas of our Ferrari, providing a force $F$ for 4 secs,
speeding it up to a final speed $v$. If the applied force were only $\frac{1}{2} F$, 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

A force $F$ acts on mass $m_{1}$ giving acceleration $a_{1}$. The same force acts on a different mass $m_{2}$ giving acceleration $a_{2}=2 a_{1}$.


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) $2 / 3 a_{1}$

## An object is being lowered on a cord at a constant speed.

 Assume no air resistance. How does the magnitude of tension $T$ in the cord compare to the magnitude of the weight $m g$ of the object?A) $T=m g$
B) $T>m g$
C) $T<m g$
D) Not enough information
An object is being lowered on a cord at a speed which is
decreasing with time! (Assume the only forces acting are
weight and tension) What is the direction of the acceleration?
A) Up
B) Down
C) $a=0$
D) Not enough information
An object is being lowered on a cord at a speed which is
decreasing with time! (Assume the only forces acting are
weight and tension) Which equation below is true?
A) $T=m g$
B) $T>m g$
C) $T<m g$
D) Not enough information

If I bring the hammer down, which string will break?
A) Upper
B) Lower
C) It depends on how you bring the hammer down!

If I bring the hammer down quickly (meaning the magnitude of the acceleration will be LARGE), which string will break? Hint: Use a FBD and NII to relate the two tension forces. The string with more tension will break first!
A) Upper
B) Lower
C) It will be random

A glider on a level air track is coasting along at constant velocity. Which of the following free-body diagrams correctly indicates all the forces on the glider? Assume that there is no air resistance or friction.

E) None of these

If I bring the hammer down slowly, which string will break?
A) Upper
B) Lower
C) It will be random

Below you see two cases: a physics student pulling or pushing a sled with a force $F$ which is applied at an angle $\theta$. In which case is the normal force greater?


1
A) Case 1
B) Case 2
C) It's the same for both
D) It depends on the magnitude of the force $F$
E) It depends on the ice surface

Which equation matches this free-body diagram?

A) $T+m g=m a$
B) $T-m g=m a$
C) $T+m g=-m a$
D) $T-m g=-m a$
E) None of these

Which equation matches this free-body diagram?

A) $T+m g=m a$
B) $T-m g=m a$
C) $T+m g=-m a$
D) $T-m g=-m a$
E) None of these

Consider a person standing in an elevator that is moving upward at constant speed. The magnitude of the upward normal force, $N$, exerted by the elevator floor on the person's feet is (larger than/same as/smaller than) the magnitude of the downward weight, $W$, of the person.

A) $N>W$
B) $N=W$
C) $N<W$

Now suppose the elevator were accelerating upward. How do the forces compare then?

A) $N>W$
B) $N=W$
C) $N<W$

| A box of mass m is sitting in an elevator which is |
| :--- |
| moving upward, and the speed is decreasing. The |
| magnitude of the acceleration of the elevator is a. |
| The magnitude of the normal force on the box from |
| upward, |
| she floor is N . What is the correct expression for the |
| magnitude of the normal force N on the box? |
| A) $m(g+a)$ |
| B) $m(g-a)$ |
| C) $m(a-g)$ |
| D) $m g$ |

D) $m g$

A person of mass $m$ is sitting in an elevator which is moving down, and the speed is increasing. The magnitude of the acceleration of the elevator is a. The magnitude of the normal force on the person from the floor is N . What is the formula for the normal force N , given the acceleration a?
A) $\mathrm{m}(\mathrm{g}+\mathrm{a})$
B) $\mathrm{m}(\mathrm{g}-\mathrm{a})$
C) $m(a-g)$

D) mg
E) ma

You are pushing a heavy box across a rough floor. When you are initially pushing the box and it is accelerating...
A) the box exerts a force on you, but you do not exert a force on the box
B) you exert a force on the box, but the box does not exert a force on you.
C) the force you exert on the box is greater than the force the box exerts on you.
D) the force the box exerts on you is greater than the force you exert on the box.
E) the force you exert on the box is equal to the force the box exerts on you.

A moving van collides with a sports car in a high-speed head-on collision (don't worry, everyone survives). During the impact, the van exerts a force $F_{\text {van }}$ on the car and the car exerts a force $F_{\mathrm{car}}$ on the van. Which statement about these forces is true?

$$
\mathrm{O}-\mathrm{O} \rightarrow \leftarrow
$$

A) $\quad F_{\text {van }}=F_{\text {car }}$
B) $F_{\text {van }}>F_{\text {car }}$
C) $F_{\text {van }}<F_{\text {car }}$
D) Not enough information

Steve and a Sumo Wrestler are having a tug-of-war. So far, no one is winning. What is the direction of the force of friction from the floor on Steve's feet?

A) Right
B) Left

A book sits on a table. Everything is at rest. The normal force from the table on the book equals (in magnitude) the weight of the book. Are the normal force and the weight force members of an "action-reaction" force pair from Newton's $3^{\text {rd }}$ Law?

A) Yes
B) No
C) Not enough information

How large is the force of friction $\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \text { Steve }}\right|$ on Steve's feet compared to the force of friction $\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \mathrm{W}}\right|$ on the Wrestler's feet? Again, so far no one is winning.

A) $\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \text { Steve }}\right|>\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \mathrm{W}}\right|$
B) $\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \text { Steve }}\right|=\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \mathrm{W}}\right|$
C) $\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \text { Steve }}\right|<\left|\overrightarrow{\boldsymbol{F}}_{\mathrm{f}, \mathrm{W}}\right|$

A heavy-duty truck pulling a light trailer is accelerating forward. How does the magnitude of the force on the truck $\mathrm{F}_{\text {on Truck }}$ from the trailer compare to the magnitude of the force on the trailer $\mathrm{F}_{\text {on Trailer }}$ from the truck?

A) $\mathrm{F}_{\text {on Truck }}>\mathrm{F}_{\text {on Trailer }}$
B) $F_{\text {on Trailer }}>F_{\text {on Truck }}$
C) $F_{\text {on Trailer }}=F_{\text {on Truck }}$


If you push with force $F$ on either the heavy box $\left(m_{1}\right)$ or the light box $\left(m_{2}\right)$, 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


