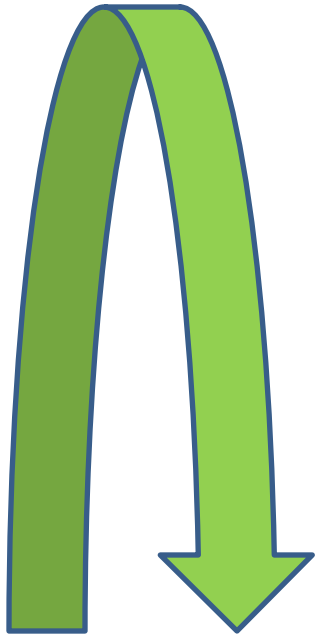
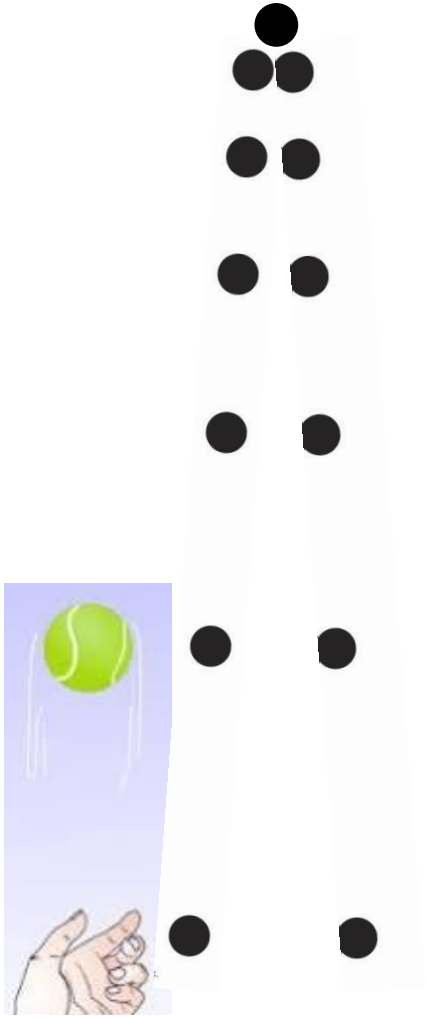
Speed, acceleration, friction, inertia, force, gravity

11/18/15



Ball toss

A tennis ball is tossed up over a tall fence.



Both ways are “**free fall**” because the only force is gravity.
Physically it’s the same.

If the ball was thrown up at 30 m/s then after 1 second it is going

A. 30 m/s
B. 20 m/s
C. 40 m/s
D. 0 m/s
E. Don’t know

$\mathbf{g = -10\ m/s^2}$

If the ball was thrown up at 30 m/s then after 1 second it is going

A. 30 m/s
B. 20 m/s
C. 40 m/s
D. 0 m/s
E. Don’t know

$\mathbf{g = -10\ m/s^2}$

If the ball was thrown up at 30 m/s then after 2 seconds it is going

A. 30 m/s
B. 20 m/s
C. 10 m/s
D. 0 m/s
E. Don’t know

$\mathbf{g = -10\ m/s^2}$

If the ball was thrown up at 30 m/s then after 2 seconds it is going

A. 30 m/s
B. 20 m/s
C. 10 m/s
D. 0 m/s
E. Don’t know

$\mathbf{g = -10\ m/s^2}$

If the ball was thrown up at 30 m/s then after 3 seconds it is going

A. 30 m/s
B. 20 m/s
C. 10 m/s
D. 0 m/s
E. Don’t know

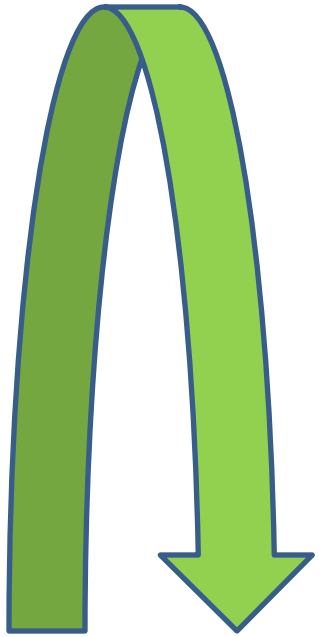
$\mathbf{g = -10\ m/s^2}$

If the ball was thrown up at 30 m/s then after 3 seconds it is going

A. 30 m/s
B. 20 m/s
C. 10 m/s
D. 0 m/s
E. Don’t know

$\mathbf{g = -10\ m/s^2}$

Ball toss



0 m/s

10 m/s

20 m/s

30 m/s

A boy throws a steel ball straight up. Consider the motion of the ball only when it is no longer touching the boy's hand but before it touches the ground. Assume that air resistance is negligible. The force(s) acting on the ball is (are):

A. a downward force of gravity and a steadily decreasing upward force.

B. a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is a steadily increasing downward force of gravity.

C. a downward force of gravity and a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is only a downward force of gravity.

D. a downward force of gravity only.

E. none of the above.

Force: A push or a pull

A boy throws a steel ball straight up. Consider the motion of the ball only when it is no longer touching the boy's hand but before it touches the ground. Assume that air resistance is negligible. The force(s) acting on the ball is (are):

A. a downward force of gravity and a steadily decreasing upward force.

B. a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is a steadily increasing downward force of gravity.

C. a downward force of gravity and a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is only a downward force of gravity.

D. a downward force of gravity only.

E. none of the above.

A boy throws a steel ball straight up. Consider the motion of the ball only when it is no longer touching the boy's hand but before it touches the ground. Assume that air resistance is negligible. The force(s) acting on the ball is (are):

A. a downward force of gravity and a steadily decreasing upward force.

B. a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is a steadily increasing downward force of gravity.

C. a downward force of gravity and a steadily decreasing upward force *after* it leaves the boy's hand until it reaches its highest point; on the way down there is only a downward force of gravity.

D. a downward force of gravity only.

E. none of the above.

Ball in the face!

Ball in the face!

Bill says: *Good thing she wasn't standing further back! That close, the ball didn't have time to get up to speed yet.*

Alexis says: *It's going fastest after it left my foot. It'll be slower further away not faster!*

Do you agree with

A. Bill

B. Alexis

C. Both are wrong

D. A combination of both

Ball in the face!

Bill says: *Good thing she wasn't standing further back! That close, the ball didn't have time to get up to speed yet.*

Alexis says: *It's going fastest after it left my foot. It'll be slower further away not faster!*

Do you agree with

A. Bill

B. Alexis

C. Both are wrong

D. A combination of both

Natural Motion

- Sitting still
- Constant speed

Natural Motion = No acceleration,
no change in speed

Newton's First Law

If an object has no force acting on it,

If it is at rest, it will remain at rest;

If it is moving, it will continue to move in a straight line at a constant speed.

The natural state of an object – its behavior if free of external influences – is *uniform motion* with constant speed!

If it is moving, it will continue to move in a straight line at a constant speed.

Then, why do things slow down?

A. Natural motion
B. Friction
C. Newton was wrong!

If it is moving, it will continue to move in a straight line at a constant speed.

Why do things slow down?

A. Natural motion
B. Friction
C. Newton was wrong!

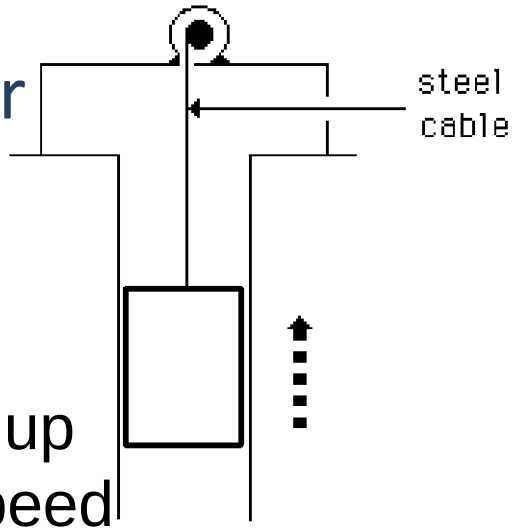
An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects including air resistance are negligible. In this situation, forces on the elevator are such that:

A. the upward force by the cable is greater than the downward force of gravity.

B. the upward force by the cable is equal to the downward force of gravity.

C. the upward force by the cable is smaller than the downward force of gravity.

D. none of the above.



Elevator going up
at a constant speed

Newton's First Law

Consider an object with no force acting on it.

If it is at rest, it will remain at rest;

If it is moving, it will continue to move in a straight line at a constant speed.

The natural state of an object – its behavior if free of external influences – is *uniform motion* with constant velocity!

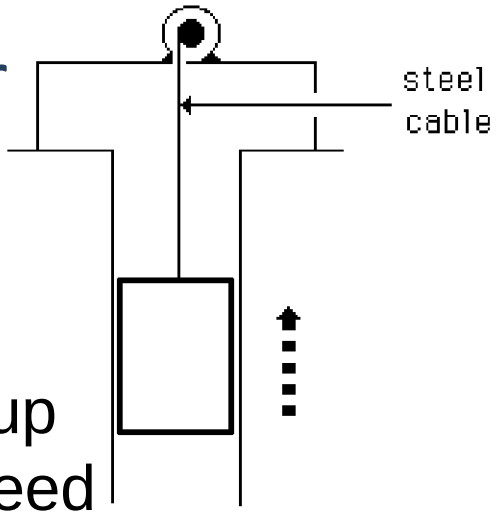
An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects including air resistance are negligible. In this situation, forces on the elevator are such that:

A. the upward force by the cable is greater than the downward force of gravity.

B. the upward force by the cable is equal to the downward force of gravity.

C. the upward force by the cable is smaller than the downward force of gravity.

A. none of the above.



Elevator going up
at a constant speed

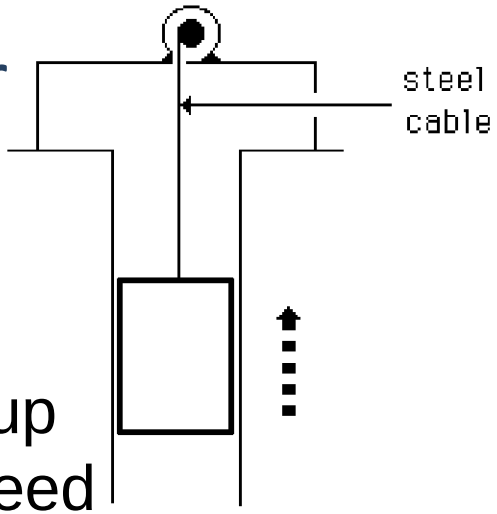
An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects including air resistance are negligible. In this situation, forces on the elevator are such that:

A. the upward force by the cable is greater than the downward force of gravity.

B. the upward force by the cable is equal to the downward force of gravity.

C. the upward force by the cable is smaller than the downward force of gravity.

A. none of the above.



Elevator going up
at a constant speed

Newton's First Law

Consider an object with no force acting on it.

If it is at rest, it will remain at rest;

If it is moving, it will continue to move in a straight line at a constant speed.

The natural state of an object – its behavior if free of external influences – is *uniform motion* with constant velocity!

At rest is $v = 0$

A large box is pulled with a constant horizontal force. As a result, the box moves across a level floor at a constant speed.

The pull:

A. has the same magnitude as the weight of the box.
B. is greater than the weight of the box.
C. has the same magnitude as the total force which resists the motion of the box.
D. is greater than the total force which resists the motion of the box.
E. is greater than either the weight of the box or the total force which resists its motion.

A large box is pulled with a constant horizontal force. As a result, the box moves across a level floor at a **constant speed**.

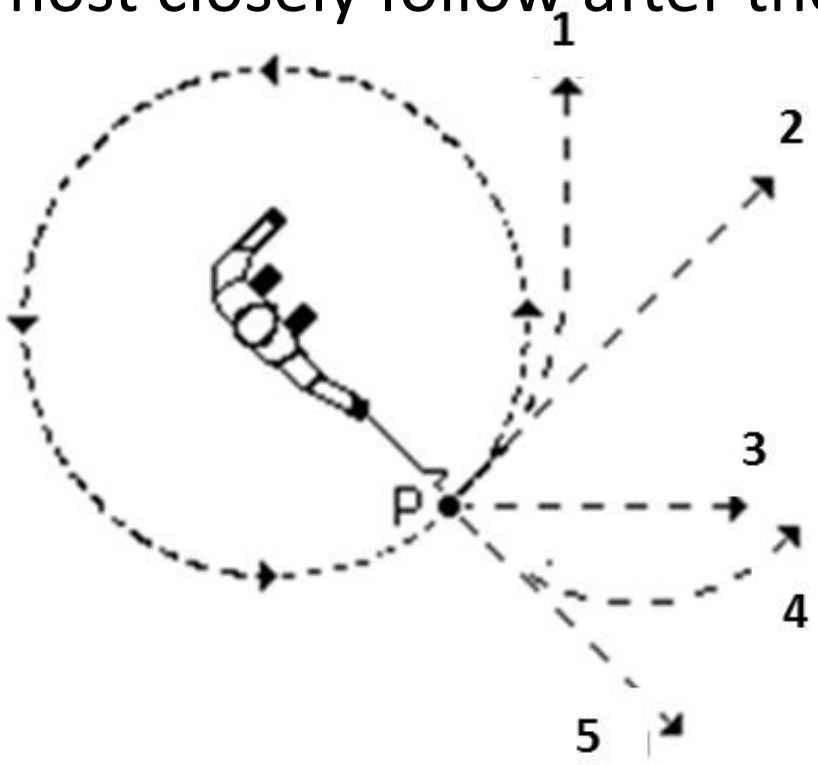
The pull:

A. has the same magnitude as the weight of the box.
B. is greater than the weight of the box.
C. has the same magnitude as the total force which resists the motion of the box.
D. is greater than the total force which resists the motion of the box.
E. is greater than either the weight of the box or the total force which resists its motion.

A steel ball is attached to a string and is swung in a circular path in a horizontal plane as illustrated in the accompanying figure.

At the point P indicated in the figure, the string suddenly breaks near the ball.

If these events are observed from directly above as in the figure, which path would the ball most closely follow after the string breaks?



(A) Path 1

(B) Path 2

(C) Path 3

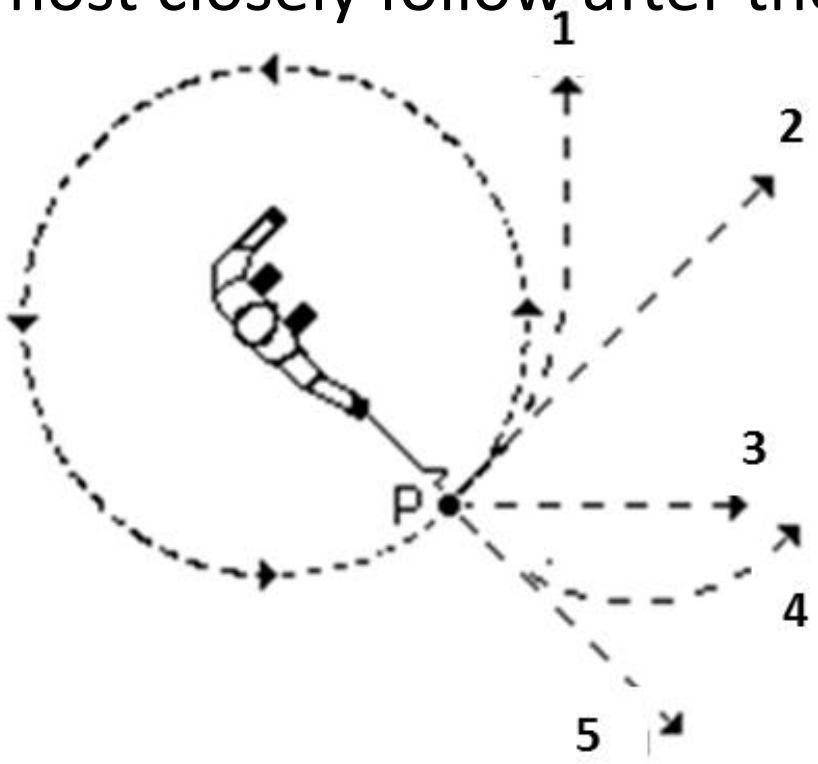
(D) Path 4

(E) Path 5

A steel ball is attached to a string and is swung in a circular path in a horizontal plane as illustrated in the accompanying figure.

At the point P indicated in the figure, the string suddenly breaks near the ball.

If these events are observed from directly above as in the figure, which path would the ball most closely follow after the string breaks?



(A) Path 1

(**B**) **Path 2**

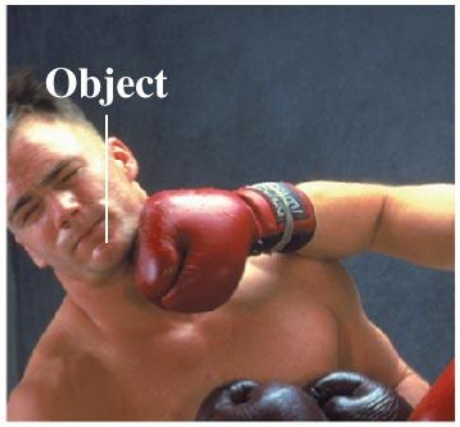
(C) Path 3

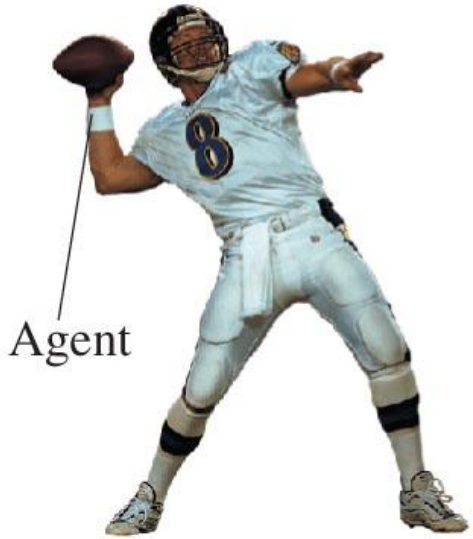
(D) Path 4

(E) Path 5

What is a Force

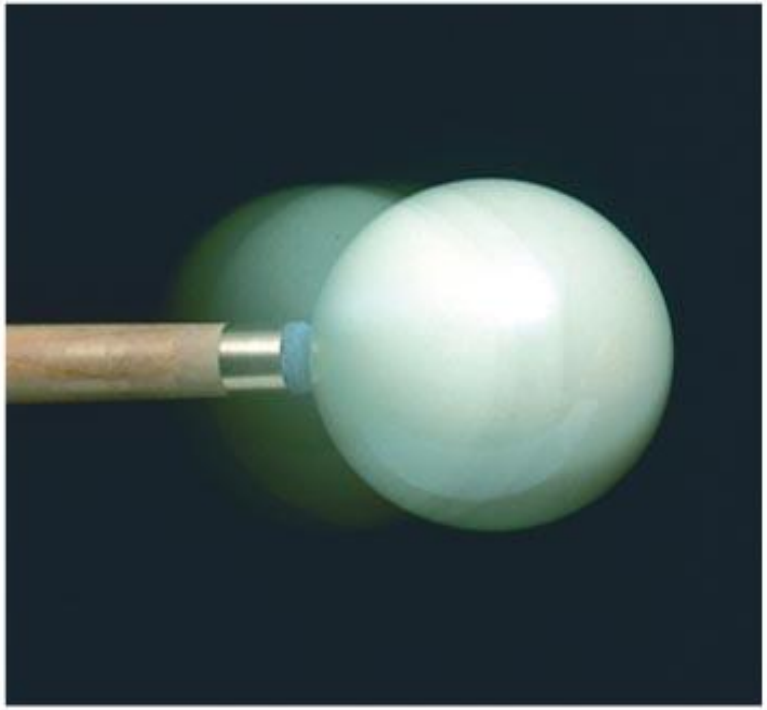
- A force is a push or a pull on an object.
- A force requires an agent. Something does the pushing or pulling.





What is a Force

- A force is a push or a pull on an object.
- A force requires an agent. Something does the pushing or pulling.
- A force is a vector. (magnitude and direction.)



Magnitude and Direction

Magnitude is the amount.

Speed: the amount is the rate

Displacement: the amount is the distance

Force: the amount is the strength of the push/pull

Speed = 100 mi/hr North

Which part of this is the magnitude?

A. 100
B. 100 mi/hr
C. North
D. 100 mi/hr North
E. None of the above

Speed = 100 mi/hr North

Which part of this is the magnitude?

A. 100
B. 100 mi/hr
C. North
D. 100 mi/hr North
E. None of the above

Speed = 100 mi/hr North

Which part of this is the direction?

A. 100
B. 100 mi/hr
C. North
D. 100 mi/hr North
E. None of the above

Speed = 100 mi/hr North

Which part of this is the direction?

A. 100
B. 100 mi/hr
C. North
D. 100 mi/hr North
E. None of the above

Velocity: Speed with Direction

Newton's first law

An object at rest remains at rest

An object in motion remains in motion in a straight line

= ….uniform motion at constant velocity

Natural motion is

Uniform motion

What is a Force

- A force is a push or a pull on an object.

A force requires an agent. Something does the pushing or pulling.

A force is a vector. (magnitude and direction.)

A force is either a contact force or a long-range force. (i.e. gravity, magnetism)

Gravity

- Mass attracts mass

Gravity

- Mass attracts mass

Gravity

- Mass attracts mass

Gravity

- Mass attracts mass

- Is the hand throwing the ball a contact force or long range force?

A. Contact force
B. Long Range Force
C. Both
D. Neither

- Is the hand throwing the ball a contact force or long range force?

A. **Contact force**
B. Long Range Force
C. Both
D. Neither

Catalog of Forces

- Push
- Pull
- Friction
- Gravity (weight)
- Magnetism
- Electrostatic
- Spring (could be a push or a pull)

Catalog of Forces

- Normal Force
- Drag
- Thrust

What do forces do?

They cause acceleration

acceleration = Force/mass

Acceleration = change in speed per time

Cause and Effect

Force is the Cause

Acceleration is the Effect

- After the ball is no longer touching the hand, can the boy change his mind about how hard he throws it?

A. Yes
B. No

- After the ball is no longer touching the hand, can the boy change his mind about how **hard he throws it/pushes it? = Force**

A. Yes

B. No

Would Dear Demi still have won if the Owner rode her? (Assume he's as skilled as the Jockey.)

A. NO

B. YES

C. Maybe

Jockey, Owner, Trainer

Would Dear Demi still have won if the Owner rode her? (Assume he's as skilled as the Jockey.)

A. NO

B. YES

C. Maybe

Jockey, Owner, Trainer