

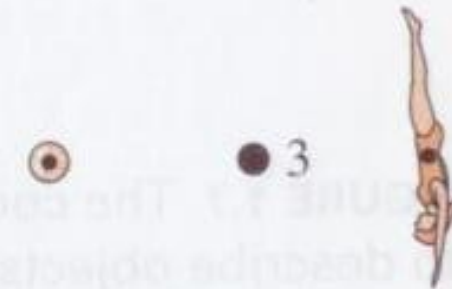
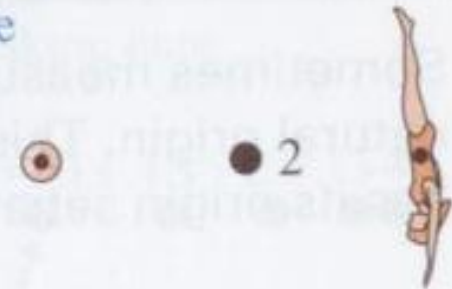
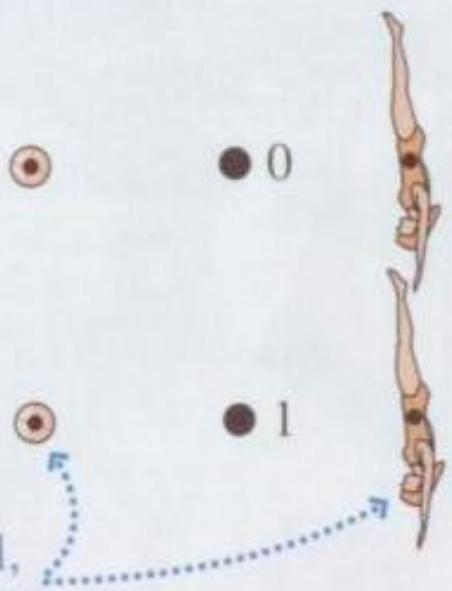
# Gravity

$$10 \text{ m/s}^2$$

Speed changes 10 m/s every second

0 second	0 m/s	●
1 seconds	10 m/s	●
2 seconds	20 m/s	●
3 seconds	30 m/s	●

By using the particle model, we see that a falling baseball and a diver have exactly the same motion diagram.



Which could be a dust particle settling to the floor at constant speed?

A. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

B. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

C. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

Which is a ball dropped from the roof of a building?

A. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

B. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

C. 0 ●

1 ●

2 ●

3 ●

4 ●

5 ●

Which is a descending rocket slowing to make a soft landing on Mars?

A. 0 ●  
1 ●  
2 ●  
3 ●  
4 ●  
5 ●

B. 0 ●  
1 ●  
2 ●  
3 ●  
4 ●  
5 ●

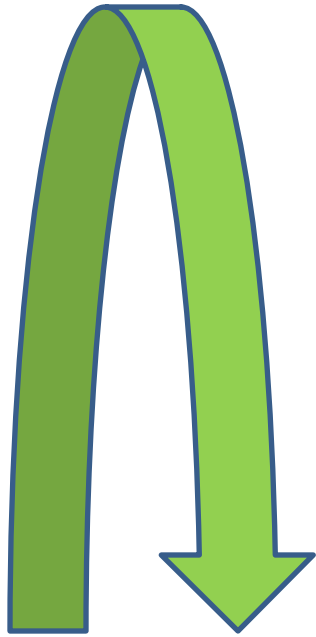
C. 0 ●  
1 ●  
2 ●  
3 ●  
4 ●  
5 ●

# Ball toss

A tennis ball is tossed up over a tall fence.

On the way up, when is it going the fastest?

- A. Maximum speed immediately after release
- B. Maximum speed quite soon after release
- C. Maximum speed about half way up
- D. Maximum speed at the top of the toss

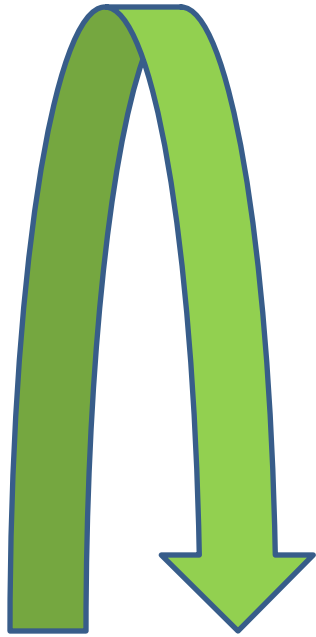


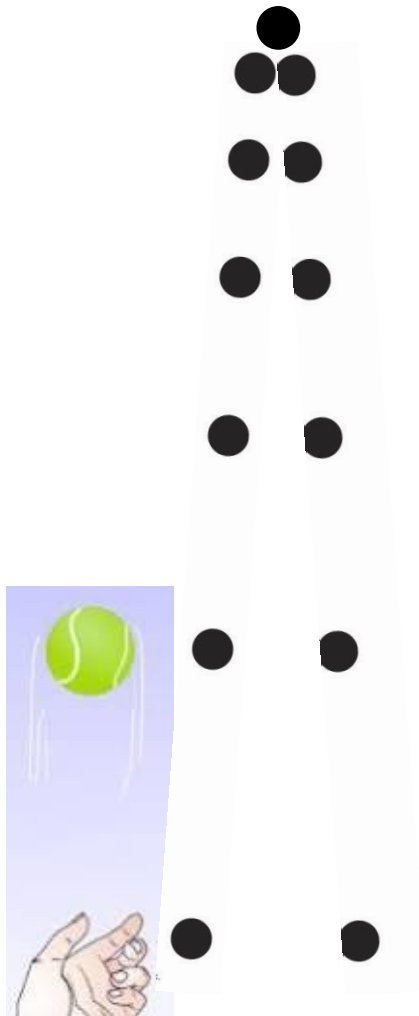
# Ball toss

A tennis ball is tossed up over a tall fence.

On the way down, when is it going the fastest?

- A. Maximum speed at the top of the toss
- B. Maximum speed quite soon after it starts falling
- C. Maximum speed about half down
- D. Maximum speed just before it hits the ground.





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

Speed changing by 10 m/s every second in the downward direction.



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



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

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



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

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



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

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



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

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



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

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



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

# 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.

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- D. a downward force of gravity only.**
- E. none of the above.

# Ball in the face!

Missy takes a header!



# 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!

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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?**

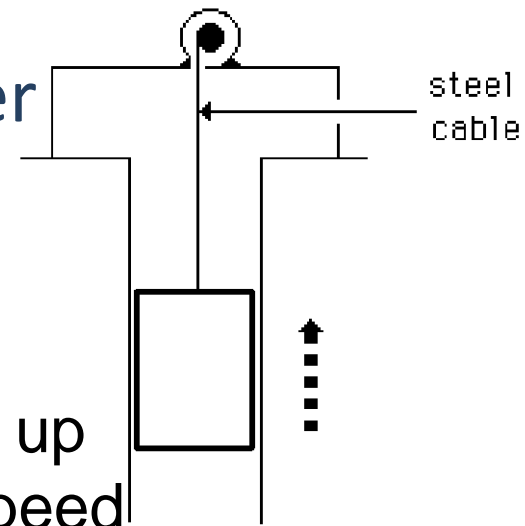
A. Natural motion

**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.

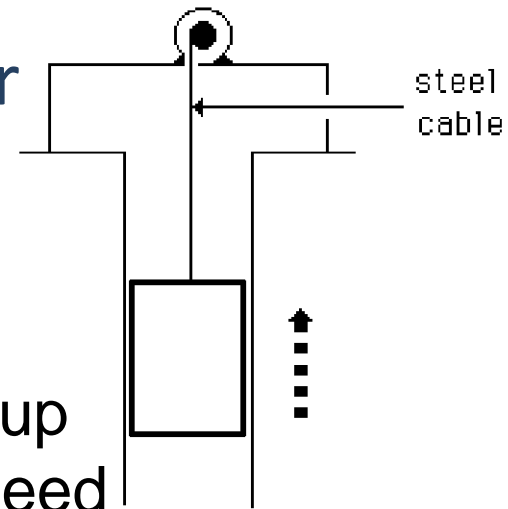
If it is at rest, it will remain at rest;

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

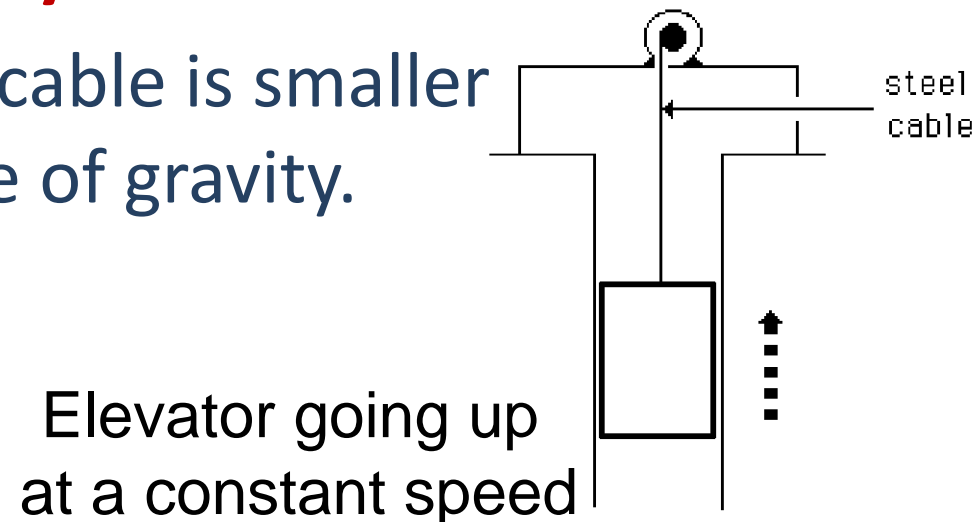
An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects including air resistance are negligible. In this situation, forces on the elevator are such that:

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.



# 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**.

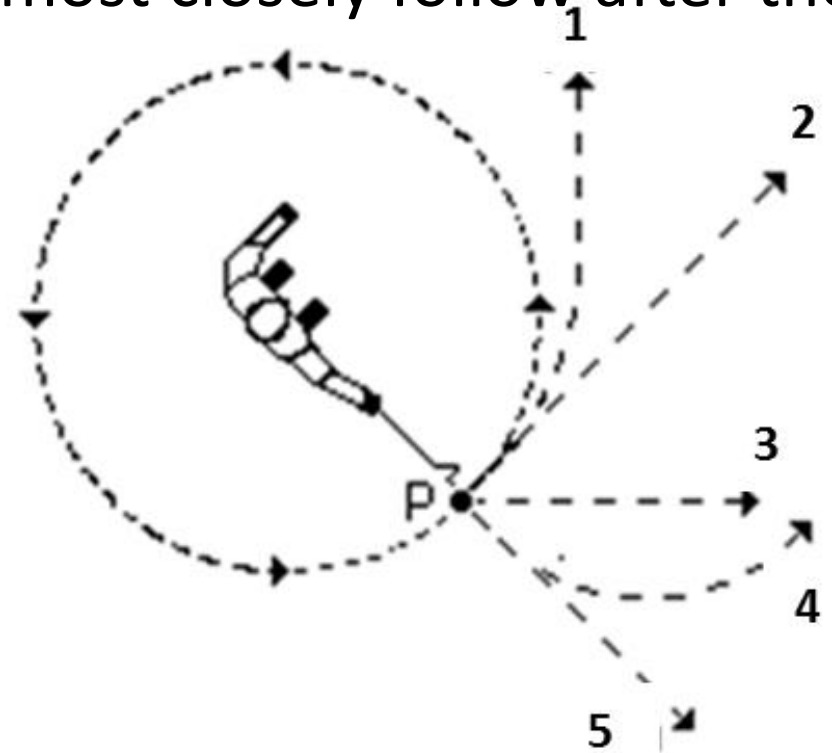
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- E. is greater than either the weight of the box or the total force which resists its motion.

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?

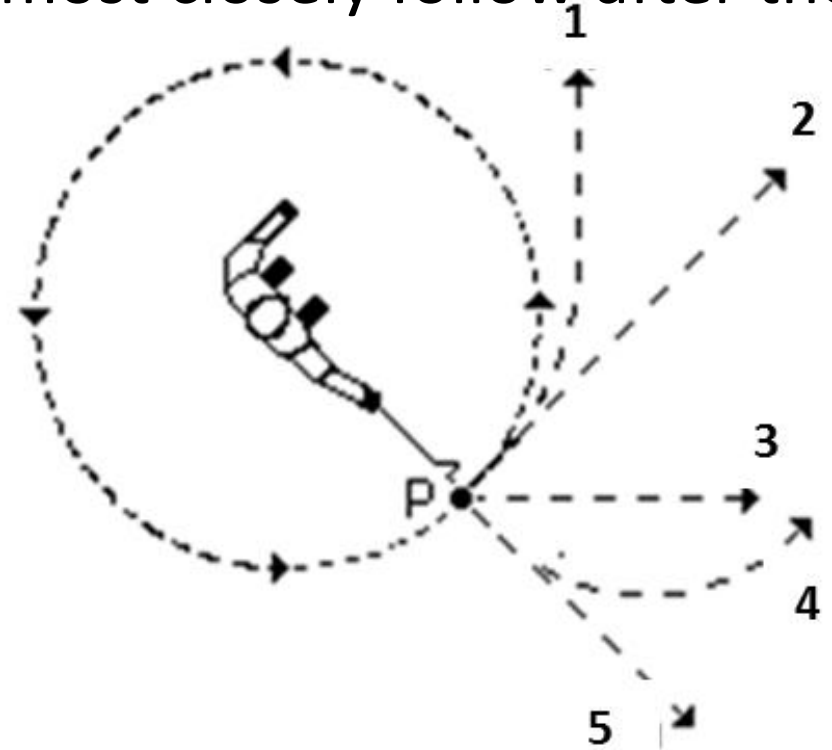


- (A) Path 1
- (B) Path 2
- (C) Path 3
- (D) Path 4
- (E) Path 5

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