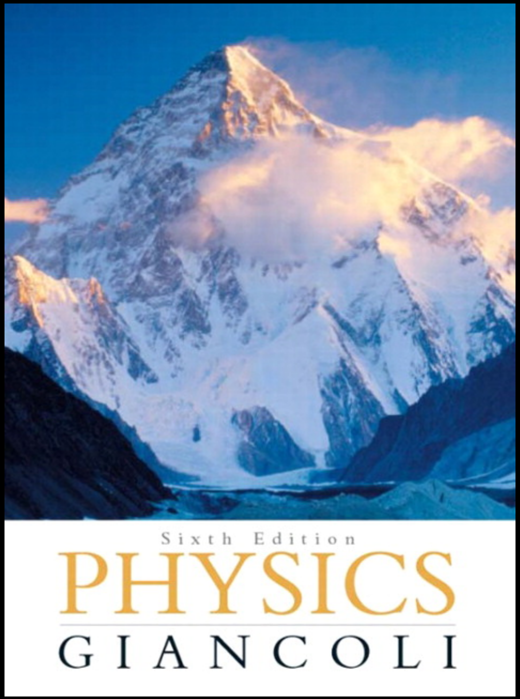


ConcepTest PowerPoints

Chapter 5

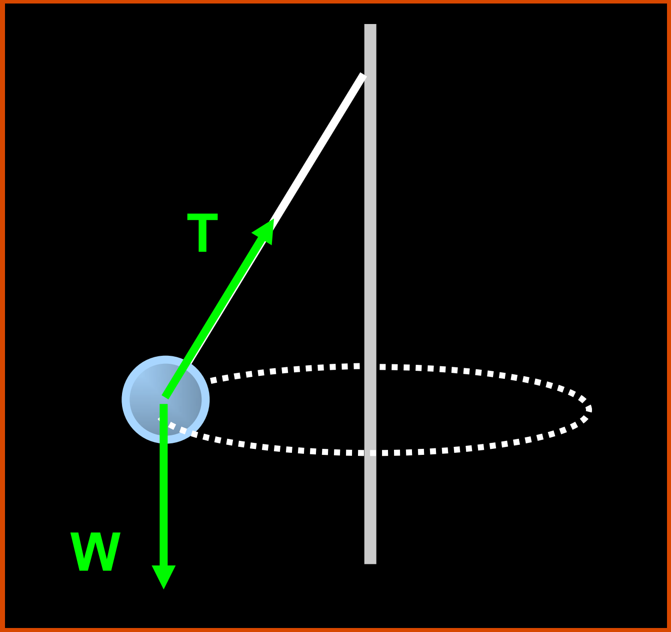
Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 5.1 Tetherball

In the game of tetherball, the struck ball whirls around a pole. In what direction does the **net force** on the ball point?

1) toward the top of the pole
2) toward the ground
3) along the horizontal component of the tension force
4) along the vertical component of the tension force
5) tangential to the circle



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1) toward the top of the pole
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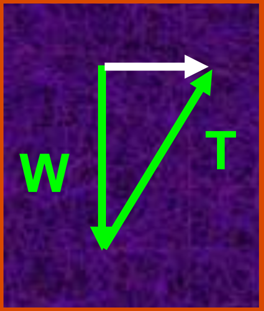
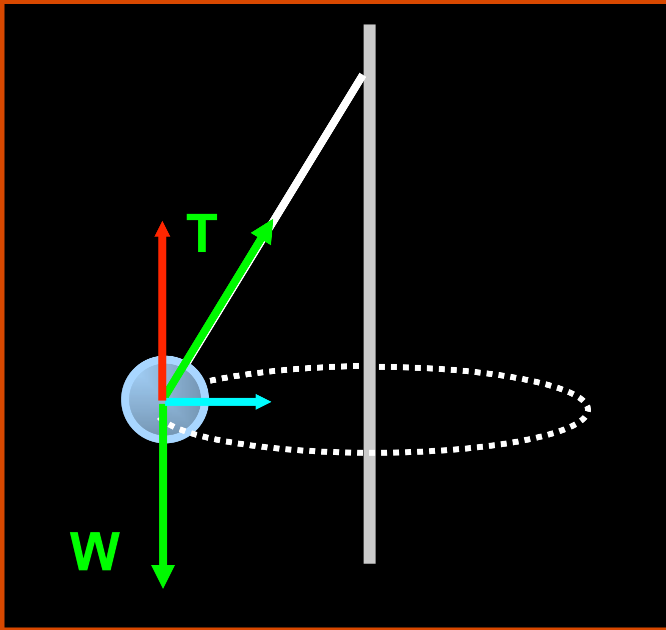
5) tangential to the circle

The **vertical component of the tension** balances the **weight**. The **horizontal component of tension** provides the **centripetal force** that points toward the center of the circle.





ConcepTest 5.2a Around the Curve I

You are a passenger in a car, not wearing a seat belt. The car makes a sharp left turn. From your perspective in the car, what do you feel is happening to you?

(1) you are thrown to the right

(2) you feel no particular change

(3) you are thrown to the left

(4) you are thrown to the ceiling

(5) you are thrown to the floor

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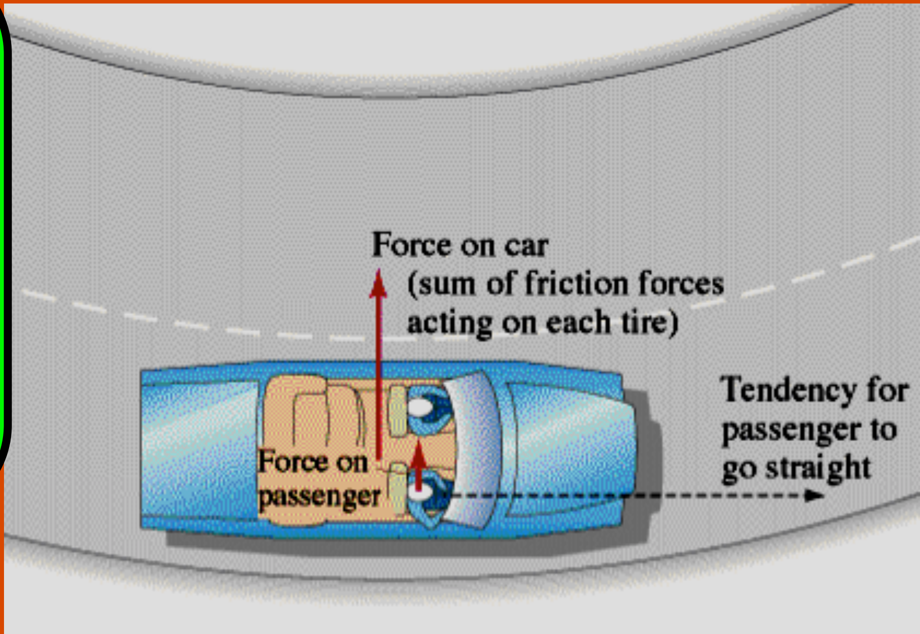
(5) you are thrown to the floor

The passenger has the tendency to continue moving in a straight line. From your perspective in the car, it feels like you are being thrown to the right, hitting the passenger door.



ConcepTest 5.2b Around the Curve II

During that sharp left turn, you found yourself hitting the passenger door. What is the correct description of what is actually happening?

(1) centrifugal force is pushing you into the door

(2) the door is exerting a leftward force on you

(3) both of the above

(4) neither of the above

ConcepTest 5.2b Around the Curve II

During that sharp left turn, you found yourself hitting the passenger door. What is the correct description of what is actually happening?

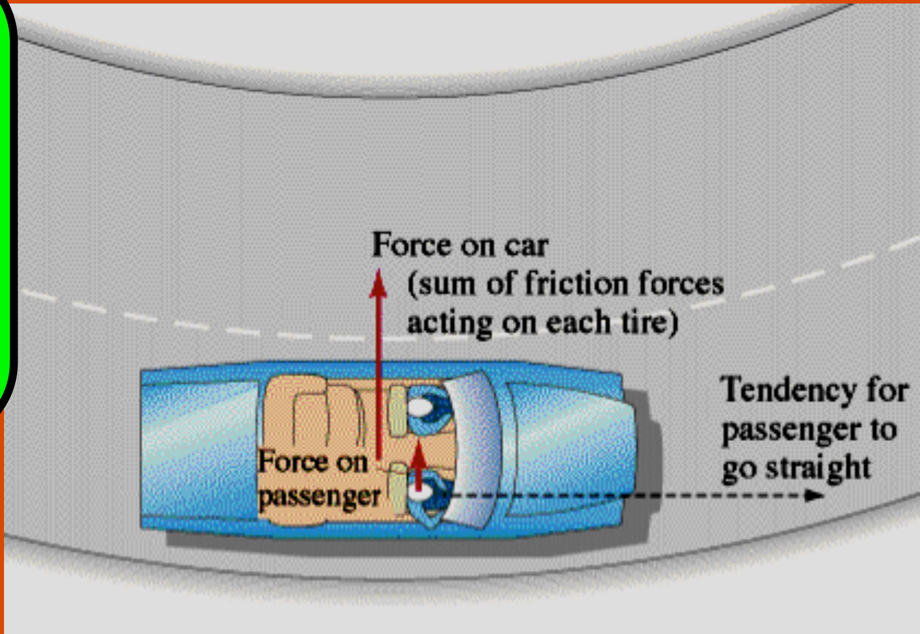
(1) centrifugal force is pushing you into the door

(2) the door is exerting a leftward force on you

(3) both of the above

(4) neither of the above

The passenger has the tendency to continue moving in a straight line. There is a centripetal force, provided by the door, that forces the passenger into a circular path.



ConcepTest 5.2c Around the Curve III

You drive your dad's car too fast around a curve and the car starts to skid. What is the correct description of this situation?

(1) car's engine is not strong enough to keep the car from being pushed out

(2) friction between tires and road is not strong enough to keep car in a circle

(3) car is too heavy to make the turn

(4) a deer caused you to skid

(5) none of the above

ConcepTest 5.2c Around the Curve III

You drive your dad's car too fast around a curve and the car starts to skid. What is the correct description of this situation?

(1) car's engine is not strong enough to keep the car from being pushed out

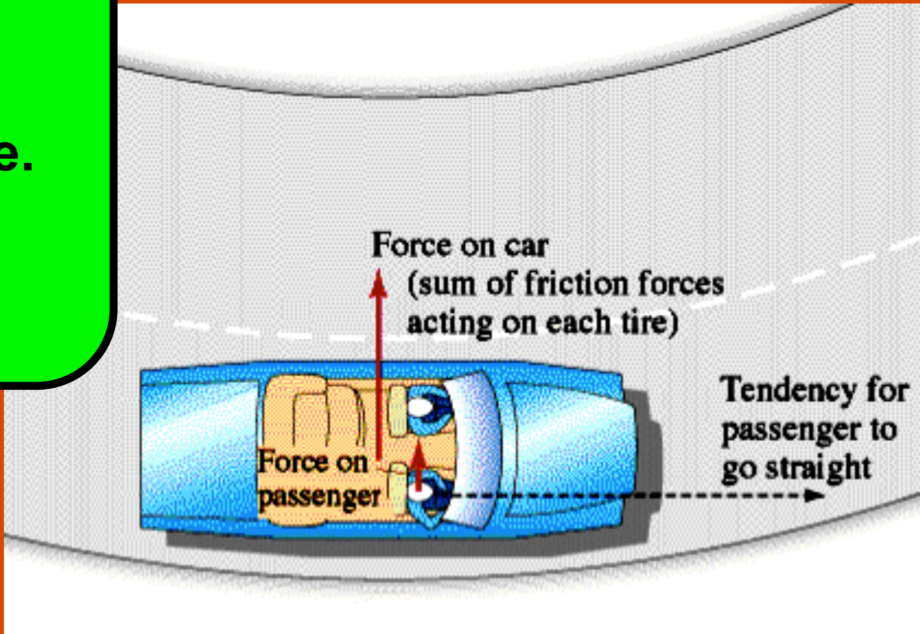
(2) friction between tires and road is not strong enough to keep car in a circle

(3) car is too heavy to make the turn

(4) a deer caused you to skid

(5) none of the above

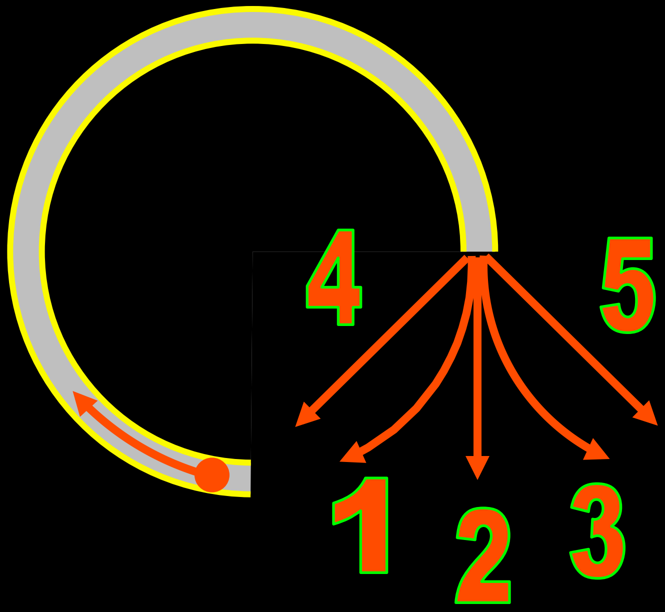
The friction force between tires and road provides the centripetal force that keeps the car moving in a circle. If this force is too small, the car continues in a straight line!



Follow-up: What could be done to the road or car to prevent skidding?

ConcepTest 5.3 Missing Link

A ping pong ball is shot into a circular tube that is lying flat (horizontal) on a tabletop. When the ping pong ball leaves the track, which path will it follow?



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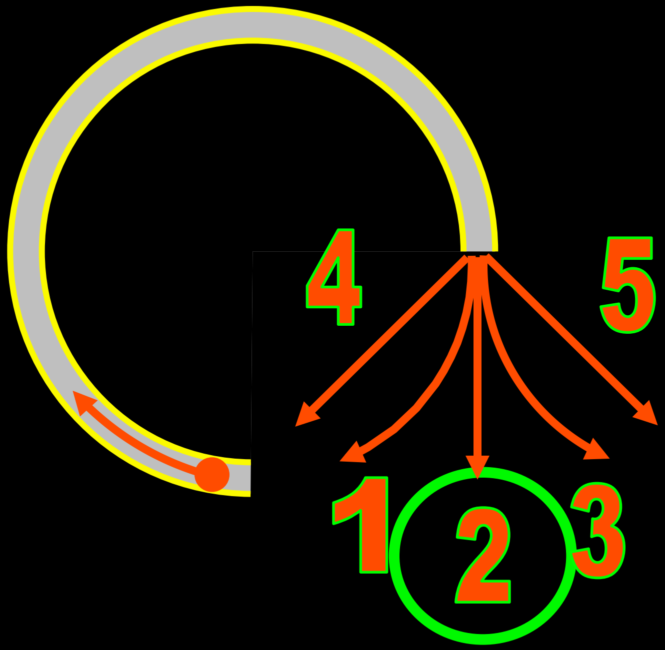


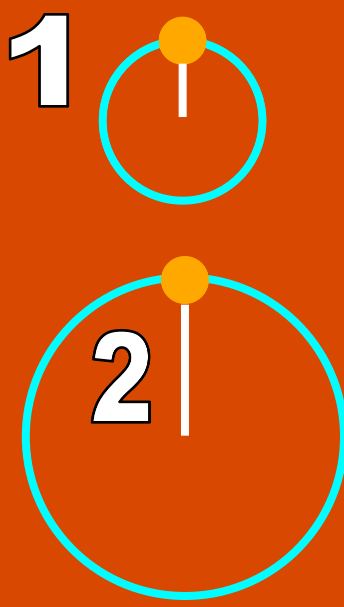
Once the ball leaves the tube, there is no longer a force to keep it going in a circle. Therefore, it simply continues in a straight line, as Newton's First Law requires!

Follow-up: What physical force provides the centripetal force?

ConcepTest 5.4 Ball and String

Two equal-mass rocks tied to strings are whirled in horizontal circles. The radius of circle 2 is twice that of circle 1. If the period of motion is the same for both rocks, what is the tension in cord 2 compared to cord 1?

1) $T_2 = 1/4\ T_1$
2) $T_2 = 1/2\ T_1$
3) $T_2 = T_1$
4) $T_2 = 2\ T_1$
5) $T_2 = 4\ T_1$



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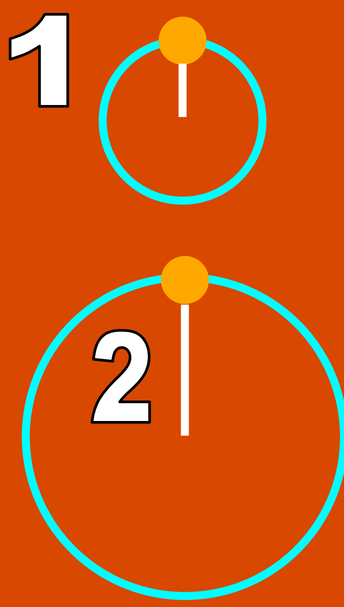
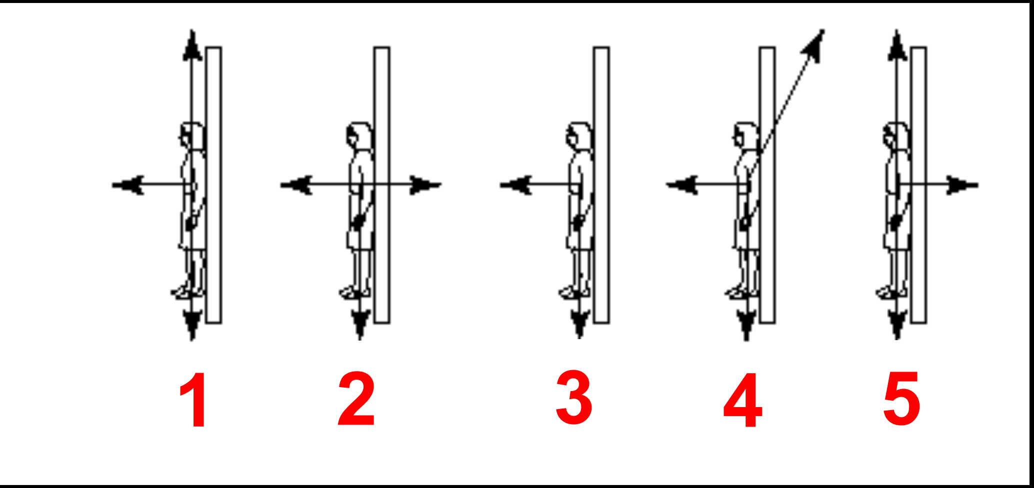
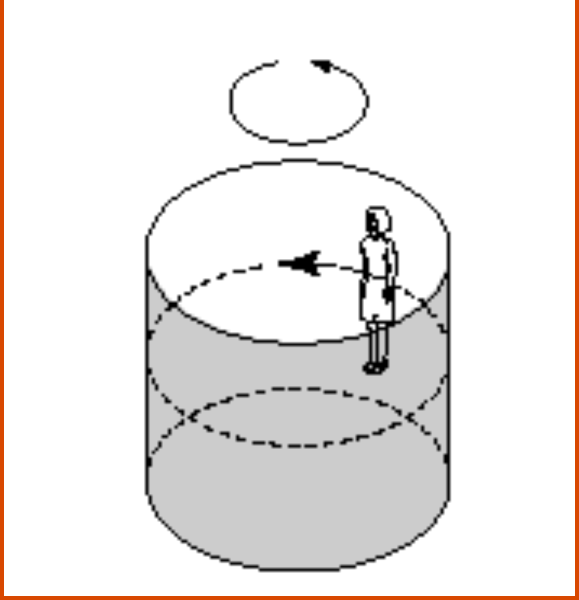
The centripetal force in this case is given by the tension, so $T = mv^2/r$. For the same period, we find that $v_2 = 2v_1$ (and this term is squared). However, for the denominator, we see that $r_2 = 2r_1$ which gives us the relation $T_2 = 2T_1$.



ConcepTest 5.5 Barrel of Fun

A rider in a "barrel of fun" finds herself stuck with her back to the wall. Which diagram correctly shows the forces acting on her?





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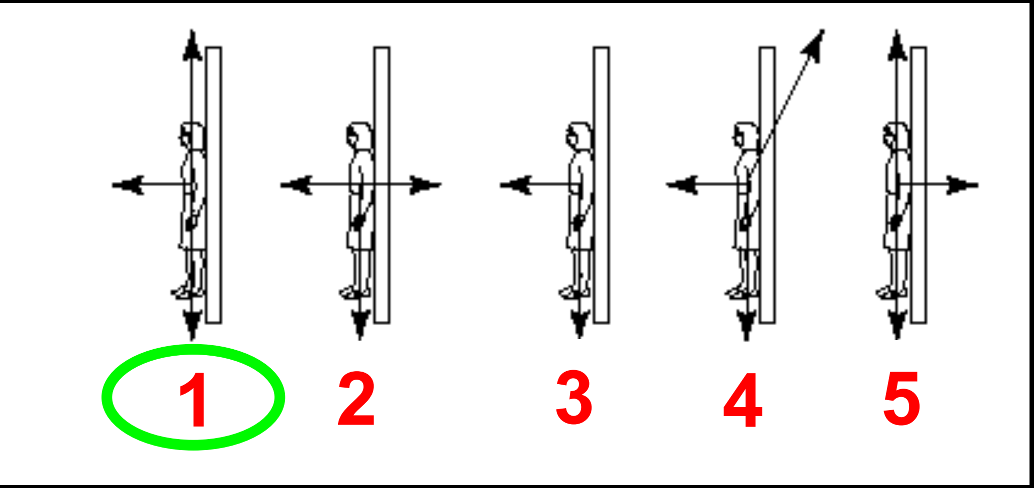
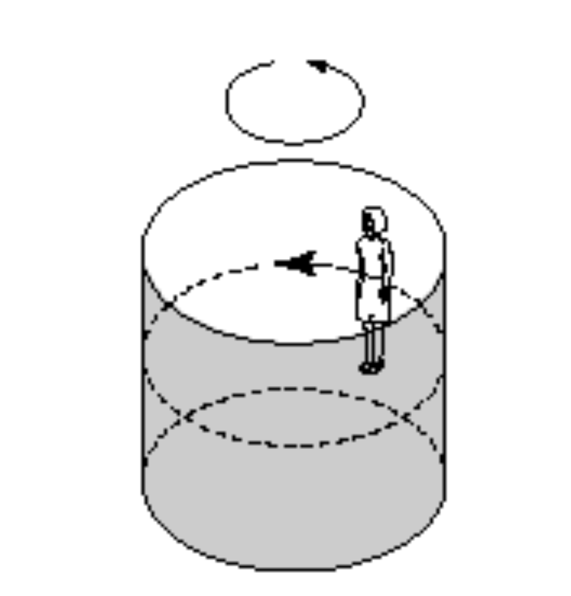


The normal force of the wall on the rider provides the centripetal force needed to keep her going around in a circle. The downward force of gravity is balanced by the upward frictional force on her, so she does not slip vertically.



Follow-up: What happens if the rotation of the ride slows down?

ConcepTest 5.6a Going in Circles I

You're on a Ferris wheel moving in a vertical circle. When the Ferris wheel is at rest, the normal force *N* exerted by your seat is equal to your weight *mg*. How does *N* change at the top of the Ferris wheel when you are in motion?

1) *N* remains equal to *mg*

2) *N* is smaller than *mg*

3) *N* is larger than *mg*

4) None of the above

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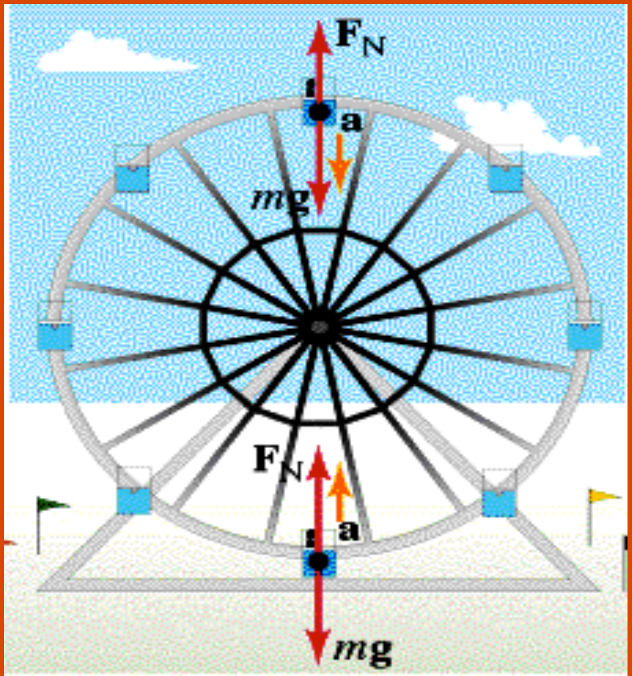
1) *N* remains equal to *mg*
2) *N* is smaller than *mg*
3) *N* is larger than *mg*
4) None of the above

You are in circular motion, so there has to be a centripetal force pointing *inward*. At the top, the only two forces are *mg* (down) and *N* (up), so *N* must be smaller than *mg*.

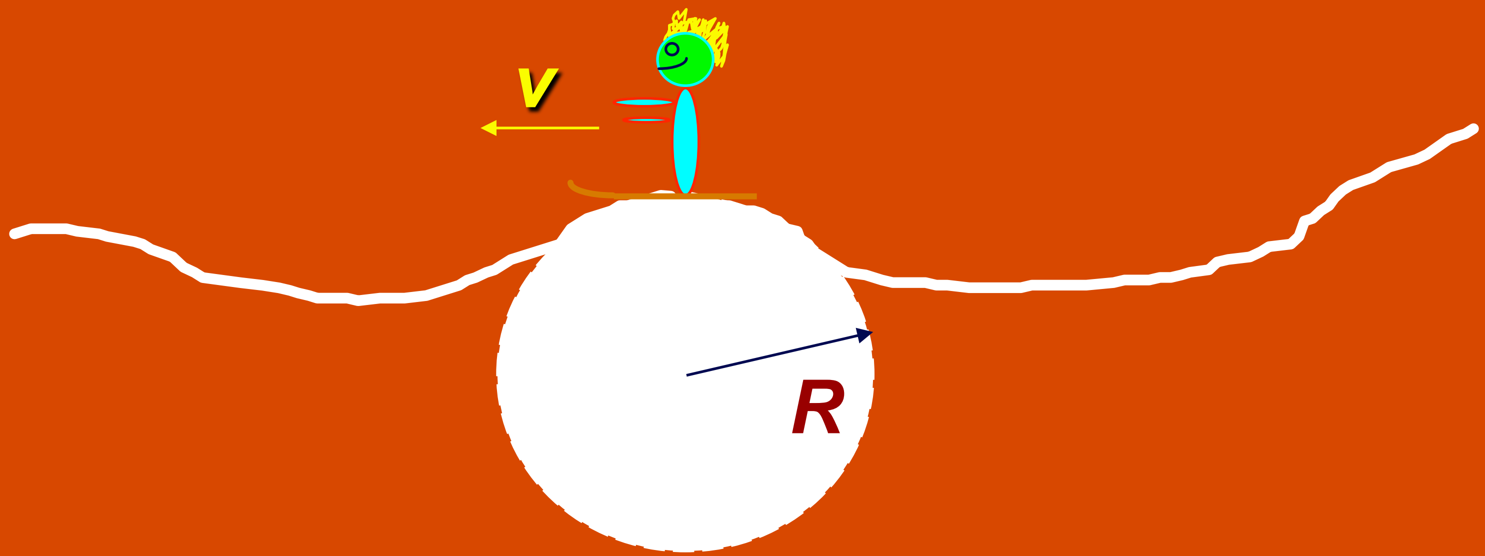
Follow-up: Where is *N* larger than *mg*?



ConcepTest 5.6b Going in Circles II

A skier goes over a small round hill with radius *R*. Since she is in circular motion, there has to be a ***centripetal force.*** At the top of the hill, what is F_c of the skier equal to?

1) $F_c = N + mg$
2) $F_c = mg - N$
3) $F_c = T + N - mg$
4) $F_c = N$
5) $F_c = mg$



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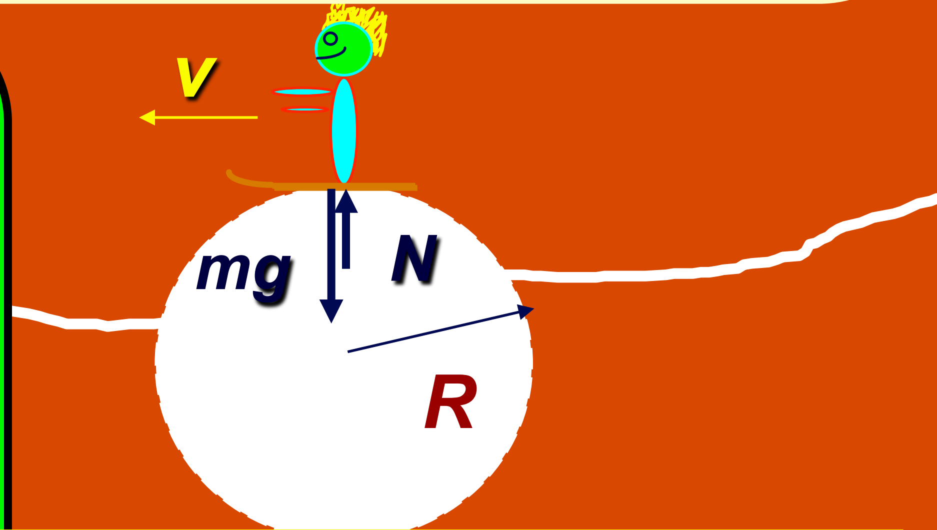
3) $F_c = T + N - mg$
4) $F_c = N$
5) $F_c = mg$

F_c points toward the center of the circle, *i.e.*, downward in this case. The weight vector points down and the normal force (exerted by the hill) points up. The magnitude of the net force, therefore, is:

$F_c = mg - N$

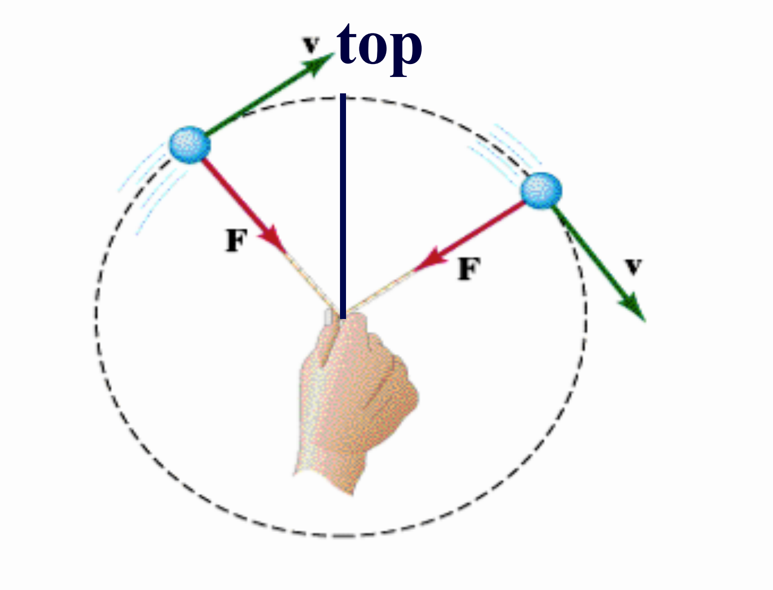


Follow-up: What happens when the skier goes into a small dip?

ConcepTest 5.7c Going in Circles III

You swing a ball at the end of string in a vertical circle. Since the ball is in circular motion there has to be a ***centripetal force.*** At the top of the ball's path, what is F_c equal to?

1) $F_c = T - mg$
2) $F_c = T + N - mg$
3) $F_c = T + mg$
4) $F_c = T$
5) $F_c = mg$



ConcepTest 5.7c Going in Circles III

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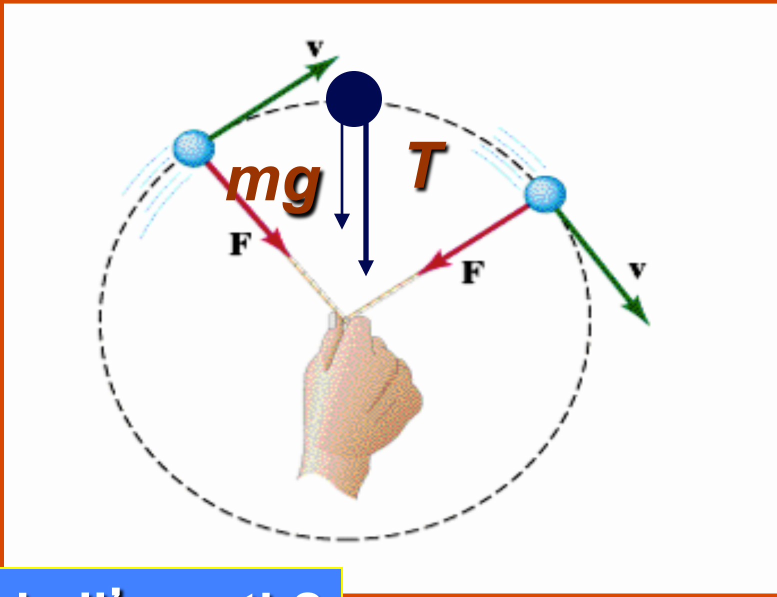
1) $F_c = T - mg$
2) $F_c = T + N - mg$
3) $F_c = T + mg$
4) $F_c = T$
5) $F_c = mg$

F_c points toward the center of the circle, *i.e.* downward in this case. The weight vector points down and the tension (exerted by the string) also points down. The magnitude of the net force, therefore, is: $F_c = T + mg$

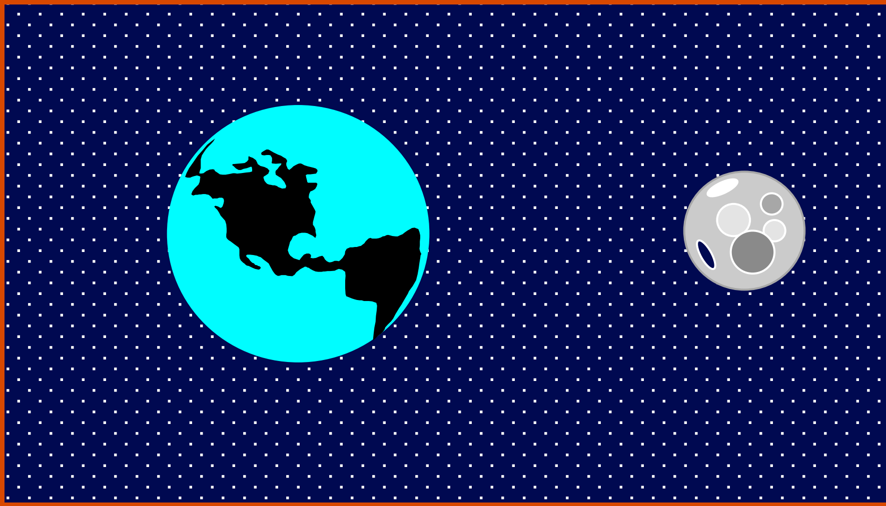


Follow-up: What is F_c at the bottom of the ball's path?

ConcepTest 5.8a Earth and Moon I

Which is stronger, Earth's pull on the Moon, or the Moon's pull on Earth?

1) the Earth pulls harder on the Moon
2) the Moon pulls harder on the Earth
3) they pull on each other equally
4) there is no force between the Earth and the Moon
5) it depends upon where the Moon is in its orbit at that time



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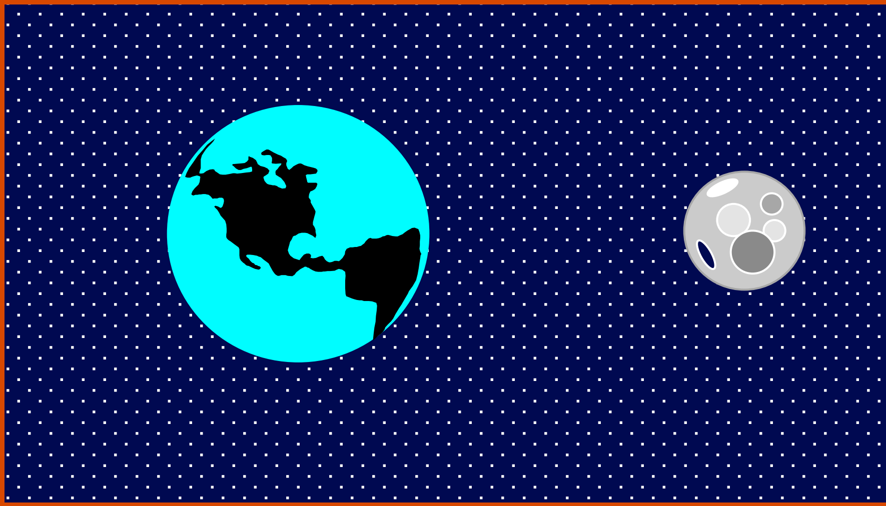
4) there is no force between the Earth and the Moon
5) it depends upon where the Moon is in its orbit at that time

By Newton's 3rd Law, the forces are equal and opposite.



ConcepTest 5.8b Earth and Moon II

If the distance to the Moon were doubled, then the force of attraction between Earth and the Moon would be:

1) one quarter
2) one half
3) the same
4) two times
5) four times

ConcepTest 5.8b Earth and Moon II

If the distance to the Moon were doubled, then the force of attraction between Earth and the Moon would be:

1) one quarter
2) one half
3) the same
4) two times
5) four times

The gravitational force depends inversely on the distance squared. So if you increase the distance by a factor of 2, the force will decrease by a factor of 4.

$$F = G\frac{Mm}{R^2}$$

Follow-up: What distance would increase the force by a factor of 2?

ConcepTest 5.9 Fly Me Away

You weigh yourself on a scale inside an airplane that is flying with constant speed at an altitude of 20,000 feet. How does your measured weight in the airplane compare with your weight as measured on the surface of the Earth?

1) greater than
2) less than
3) same

ConcepTest 5.9 Fly Me Away

You weigh yourself on a scale inside an airplane that is flying with constant speed at an altitude of 20,000 feet. How does your measured weight in the airplane compare with your weight as measured on the surface of the Earth?

1) greater than
2) less than
3) same

At a high altitude, you are farther away from the center of Earth. Therefore, the gravitational force in the airplane will be less than the force that you would experience on the surface of the Earth.

ConcepTest 5.10 Two Satellites

Two satellites A and B of the same mass are going around Earth in concentric orbits. The distance of satellite B from Earth's center is twice that of satellite A. What is the *ratio* of the centripetal force acting on B compared to that acting on A?

1) 1/8
2) 1/4
3) 1/2
4) it's the same
5) 2

ConcepTest 5.10 Two Satellites

Two satellites A and B of the same mass are going around Earth in concentric orbits. The distance of satellite B from Earth's center is twice that of satellite A. What is the *ratio* of the centripetal force acting on B compared to that acting on A?

1) 1/8
2) 1/4
3) 1/2
4) it's the same
5) 2

Using the Law of Gravitation:

$$F = G\frac{Mm}{R^2}$$

we find that the ratio is 1/4.

Note the $1/r^2$ factor

ConcepTest 5.11 Averting Disaster

The Moon does not crash into Earth because:

1) it's in Earth's gravitational field
2) the net force on it is zero
3) it is beyond the main pull of Earth's gravity
4) it's being pulled by the Sun as well as by Earth
5) none of the above

ConcepTest 5.11 Averting Disaster

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3) it is beyond the main pull of Earth's gravity
4) it's being pulled by the Sun as well as by Earth
5) none of the above

The Moon does not crash into Earth because of its high speed. If it stopped moving, it would, of course, fall directly into Earth. With its high speed, the Moon would fly off into space if it weren't for gravity providing the centripetal force.

Follow-up: What happens to a satellite orbiting Earth as it slows?

ConcepTest 5.12 In the Space Shuttle

Astronauts in the space shuttle float because:

1) They are so far from Earth that Earth's gravity doesn't act any more.
2) Gravity's force pulling them inward is cancelled by the centripetal force pushing them outward.
3) While gravity is trying to pull them inward, they are trying to continue on a straight-line path.
4) Their weight is reduced in space so the force of gravity is much weaker.

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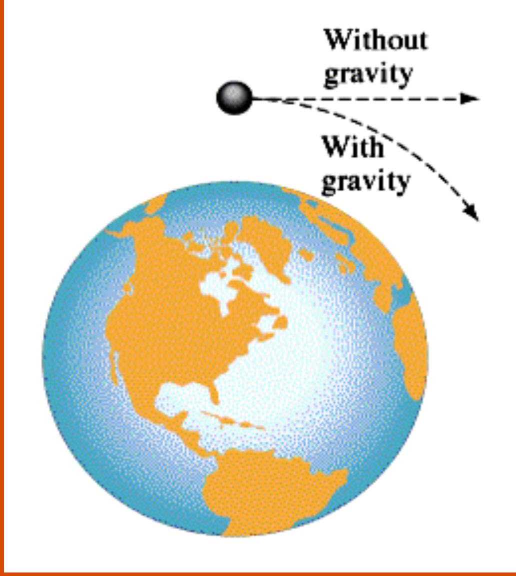
4) Their weight is reduced in space so the force of gravity is much weaker.

Astronauts in the space shuttle float because they are in "free fall" around Earth, just like a satellite or the Moon. Again, it is gravity that provides the centripetal force that keeps them in circular motion.



Follow-up: How weak is the value of *g* at an altitude of 300 km?

ConcepTest 5.13 Guess My Weight

If you weigh yourself at the equator of Earth, would you get a bigger, smaller, or similar value than if you weigh yourself at one of the poles?

1) bigger value
2) smaller value
3) same value

ConcepTest 5.13 Guess my Weight

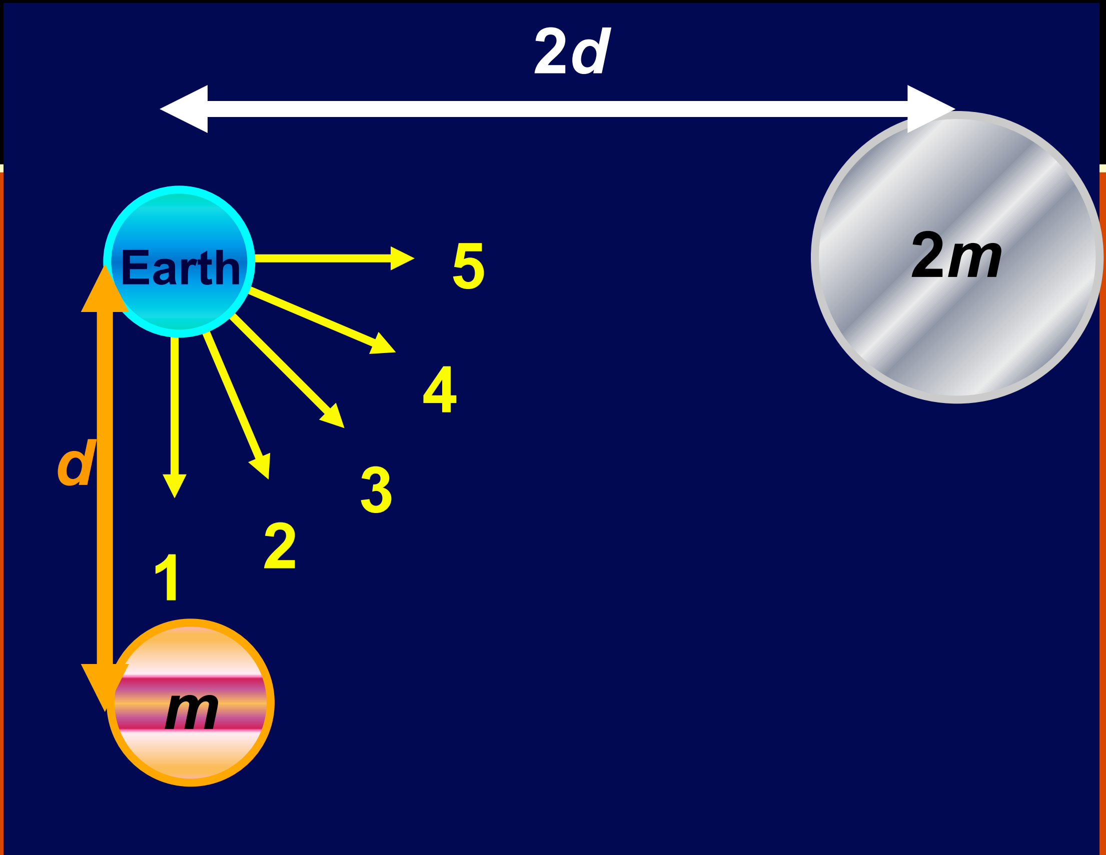
If you weigh yourself at the equator of Earth, would you get a bigger, smaller, or similar value than if you weigh yourself at one of the poles?

1) bigger value
2) smaller value
3) same value

The weight that a scale reads is the **normal force** exerted by the floor (or the scale). At the equator, **you are in circular motion**, so there must be a **net inward force** toward Earth's center. This means that the **normal force must be slightly less than *mg***. So the scale would register something less than your actual weight.

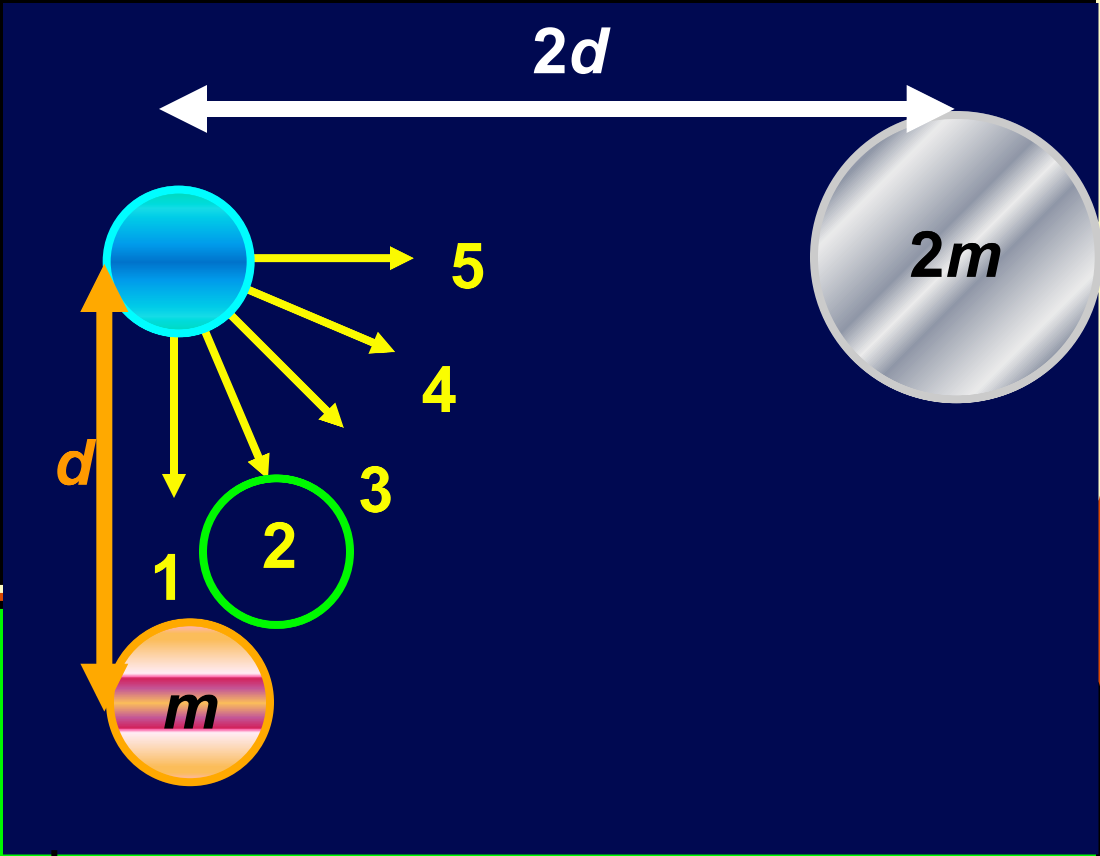
ConcepTest 5.14 Force Vectors

A planet of mass *m* is a distance *d* from Earth. Another planet of mass 2*m* is a distance 2*d* from Earth. Which force vector best represents the direction of the total gravitation force on Earth?



ConcepTest 5.14 Force Vectors

A planet of mass m is a distance d from Earth. Another planet of mass $2m$ is a distance $2d$ from Earth. Which force vector best represents the direction of the total gravitation force on Earth?



The force of gravity on the Earth due to m is greater than the force due to $2m$, which means that the force component pointing down in the figure is greater than the component pointing to the right.

$$F_{2m} = GM_E(2m) / (2d)^2 = 1/2\ GMm / d^2$$

$$F_m = GM_E\ m / d^2 = GMm / d^2$$