

CENTRIPETAL & CENTRIFUGAL FORCE

Centrifugal Force	Centripetal Force
Meaning	<p>Tendency of an object following a curved path to fly away from the center of curvature. Might be described as "lack of centripetal force."</p> <p>The force that keeps an object moving with a uniform speed along a circular path.</p>
Direction	<p>Along the radius of the circle, from the center towards the object.</p> <p>Along the radius of the circle, from the object towards the center.</p>
Example	<p>Mud flying off a tire; children pushed out on a roundabout.</p> <p>Satellite orbiting a planet</p>
Formula	<p>$F_c = mv^2/r$</p> <p>$F_c = mv^2/r$</p>
Defined by	<p>Christiaan Hygens in 1659</p> <p>Isaac Newton in 1684</p>
Is it a real force?	<p>No; centrifugal force is the inertia of motion.</p> <p>Yes; centripetal force keeps the object from "flying out".</p>

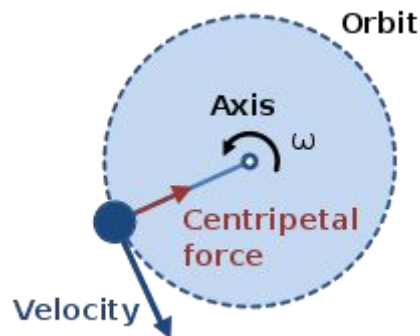
Mechanism

The centrifugal force is not a “real” force – the tendency to fly outwards is observed because objects that are moving in a straight line tend to continue moving in a straight line. This is called [inertia](#), and makes objects resistant to the force that makes them move in a curve.

The centripetal force is a "real" force. It attracts the object toward the center and prevents it from "flying out". The source of the centripetal force depends on the object in question. For satellites in orbit, the force comes from gravity. If an object is being swung around on a rope, the centripetal force is provided by tension in the rope, and for a spinning object, the force is provided by internal stress. For a car moving along an arc, the centripetal force comes from friction between the car tires and the road.

If an object is properly rotating, both the centrifugal and centripetal forces will be equal, so the object will not move towards the center of rotation or outwards from it. It will maintain a constant distance from the center.

Direction



Direction of centripetal force and velocity

The centripetal force is directed inwards, from the object to the center of rotation. Technically, it is directed orthogonal to the velocity of the body, toward the fixed point of the instantaneous center of curvature of the path.

The centrifugal force is directed outwards; in the same direction as the velocity of the object. For circular motion, the velocity at any given point in time is at a tangent to the arc of movement.

Formula

Both forces are calculated using the same formula:

$$F = ma_c = \frac{mv^2}{r}$$

where a_c is the centripetal acceleration, m is the mass of the object, moving at velocity v along a path with radius of curvature r .

Examples

Some common examples of centrifugal force at work are mud flying off a tire and children feeling a [force](#) pushing them outwards while spinning on a roundabout.

A major example of centripetal force is the rotation of satellites around a planet.

Applications

[Knowledge](#) of centrifugal and centripetal forces can be applied to many everyday problems. For example, it is used when designing [roads](#) to prevent skidding and improve traction on curves and access ramps. It also allowed for the invention of the centrifuge, which separates particles suspended in fluid by spinning test tubes at high speeds.