Physics 20

Unit C: Circular motion and energy

Describing circular motion

A teacup seat holds a steady speed

- A midway teacup seat travels a horizontal circle of radius 4.50 m and finishes one full turn every 3.60 s.
- The speed stays steady while the velocity arrow swings through every compass direction around the pole.

Period and frequency

- Uniform circular motion is two dimensional motion with constant speed and a changing direction.
- Radius r, period T, and frequency f are the measurements. Frequency f equals 1 divided by T.
- Speed v equals 2 pi r / T, which is also 2 pi r f.
- Centripetal acceleration a equals v squared over r and points toward the centre.

Key terms

uniform circular motion

Uniform circular motion is two dimensional motion with constant speed and a changing direction.

centripetal acceleration

Centripetal acceleration has magnitude v squared over r and points toward the centre of the circle. ($a = v^2/r$)

period

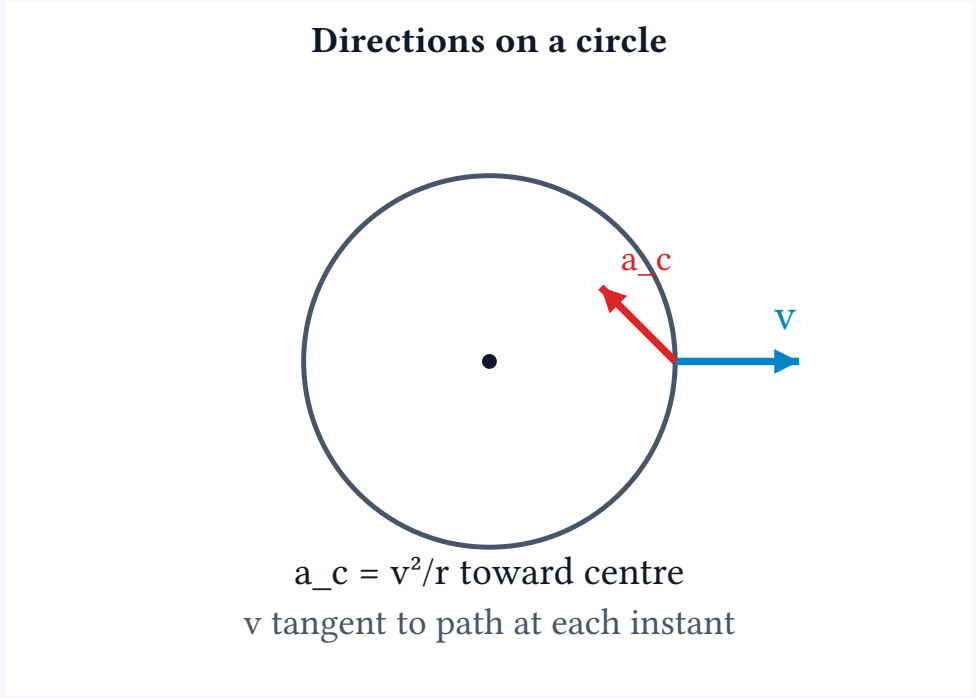
Period is the time for one full cycle, measured in seconds per cycle. (T)

frequency

Frequency is the number of cycles in one second and equals the reciprocal of the period. ($f = 1/T$)

Velocity and acceleration directions

- At each instant the velocity points along the tangent to the circle.
- Centripetal acceleration points toward the centre and has magnitude v squared over r.
- A larger radius at the same period produces a larger speed.

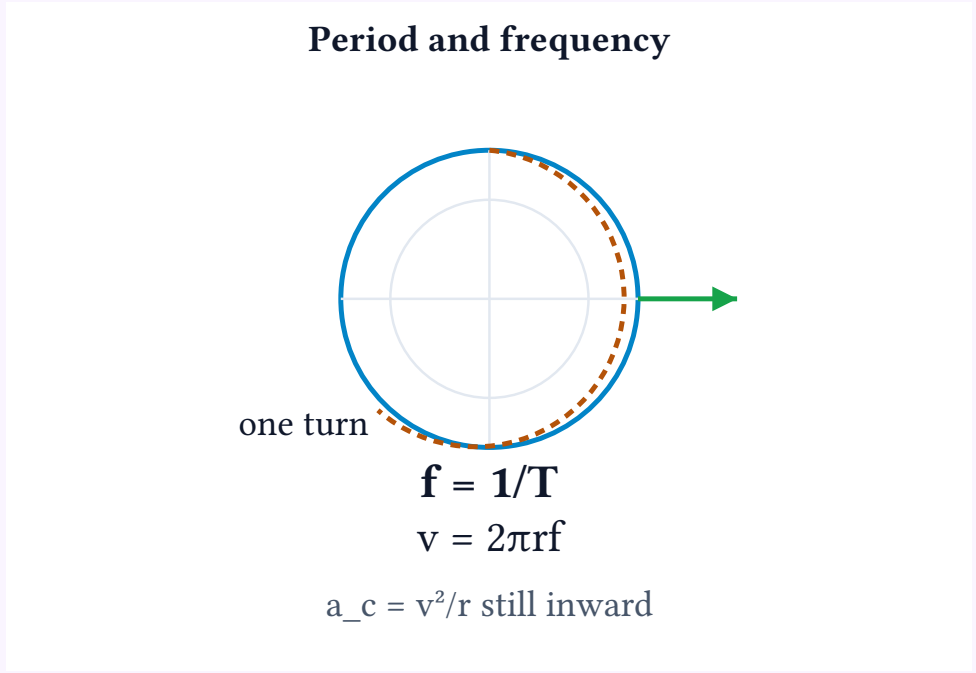


A skater’s lap on the outdoor rink

- The skater’s circle has radius 8.00 m and period 5.00 s.
- Speed = 2 × 3.14 × 8.00 m / 5.00 s = 10.1 m/s.
- With the unrounded speed, $v^2 / r = 12.6\ m/s^2$ toward the centre.

Frequency is one divided by the period

- Frequency f equals 1 divided by the period T.
- The speed can be written as 2 pi r f when the data arrive as turns each second.
- Centripetal acceleration still uses v squared over r and points toward the centre.



A go kart lap

- A go kart follows a circle of radius 25.0 m with a period of 14.0 s.
- Find the speed, the frequency, and the centripetal acceleration.
- State the direction of the acceleration.

A runner’s circular track

- A runner follows a circular track of radius 30.0 m and completes one lap in 18.0 s.
- Find the speed, the frequency, and the centripetal acceleration.
- Include the unit and the direction the acceleration requires.