

12 Period and centripetal force – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
revolution	圈	_____
period	周期	_____
frequency	频率	_____
centripetal force	向心力	_____

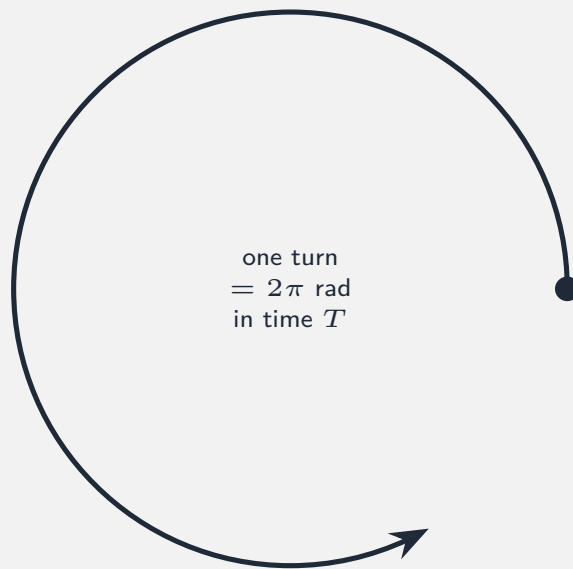
Recall

An object going round once completes one **revolution** 圈 of 2π rad. The time for one revolution is the **period** 周期 T —for a wheel, a planet, or a fairground ride, the period tells you how long one full turn takes.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

■ 1 Period and frequency



$$\omega = 2\pi/T = 2\pi f$$

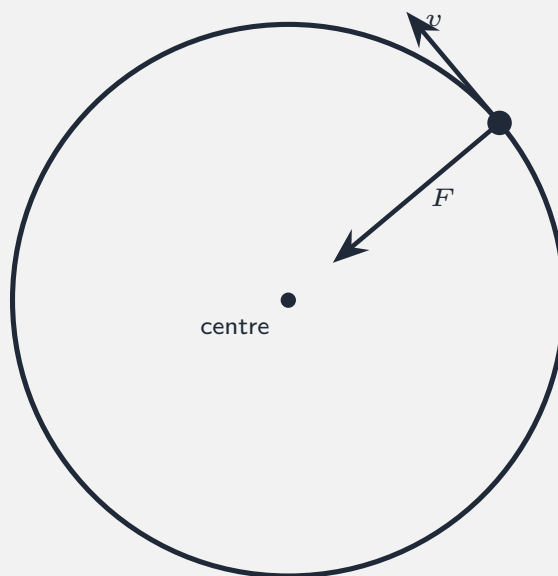
In time T the object turns 2π rad, so

$$\omega = \frac{2\pi}{T} = 2\pi f,$$

where $f = 1/T$ is the **frequency** 频率 (turns per second, in Hz).

Worked example. A wheel turns once every 0.50 s, so $f = 1/T = 1/0.50 = 2.0$ Hz and $\omega = 2\pi/T = 2\pi/0.50 \approx 12.6 \text{ rad s}^{-1}$.

■ 2 Force towards the centre



force points to the centre

The velocity points along the tangent, but a **centripetal force** 向心力 always points to the centre—it keeps changing the *direction* of motion. Its size is

$$F = m\omega^2 r = \frac{mv^2}{r}.$$

Worked example. A 0.20 kg ball on a string moves in a circle of radius 0.50 m at $v = 3.0 \text{ m s}^{-1}$. The string tension provides the centripetal force: $F = mv^2/r = 0.20 \times 3.0^2/0.50 = 3.6 \text{ N}$.

Watch out: the centripetal force is not an extra force you add on—it is the name for whatever real force (string tension, gravity, friction) happens to point to the centre.

Practice

Try these in order.

12.1 What is the *period* of circular motion? [1]

12.2 Write ω in terms of the period T . [1]

12.3 A wheel turns once every 4.0 s. Find its angular speed. [2]

12.4 In which direction does the *centripetal force* point? [1]

12.5 A 0.50 kg ball moves in a circle of radius 0.40 m at 2.0 m s^{-1} . Find the centripetal force ($F = mv^2/r$). [2]

12.6 A car drives at a steady speed around a flat circular track. Name the real force that provides the centripetal force. [1]

12.7 Challenge. A ball on a string is swung in a horizontal circle. Explain *why* the string must be pulled harder if the ball is swung faster, even though the circle stays the same size. [2]