A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

12 Angles in radians – Part 1

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)		
radians	弧度			
arc	弧			
angular displacement	角位移			
angular speed	角速度			

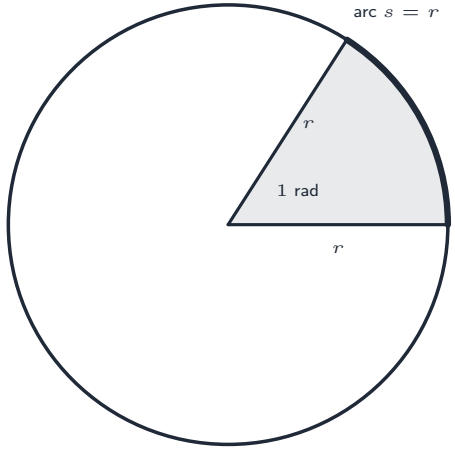
Recall

Anything that spins — a bicycle wheel, a spinning disc, a planet on its orbit — turns through an angle. For circular motion we measure that angle in **radians** 弧度, not degrees, because the radian links the angle directly to distance along the circle. Set your calculator to radian mode for this topic.

New ideas

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

■ 1 The radian

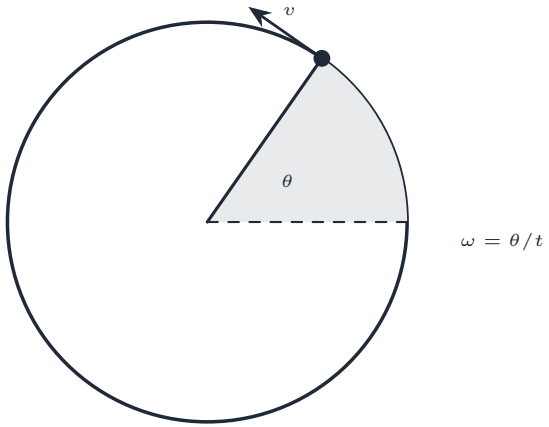


A **radian** is the angle at the centre of a circle whose **arc** 弧 length equals the radius. A full circle is 2π rad, so $360° = 2\pi$ rad and $180° = \pi$ rad. The arc length for an angle θ (in radians) is

$$s = r\theta.$$

Worked example. Convert 90° to radians: $90° = \frac{1}{2} \times 180° = \frac{\pi}{2} \approx 1.57$ rad. A point on a wheel of radius 0.20 m that turns through this angle moves $s = r\theta = 0.20 \times 1.57 = 0.31$ m along the rim.

■ 2 Angular speed



$\omega = \theta / t$

- **angular displacement** 角位移 θ is the angle turned through;
- **angular speed** 角速度 $\omega = \theta/t$ is how fast it turns (rad s^{-1}).

A point at radius r then moves along the rim at speed $v = r\omega$.

Worked example. A disc turns through 6.0 rad in 2.0 s, so $\omega = \theta/t = 6.0/2.0 = 3.0$ rad s^{-1}. A point 0.10 m from the centre moves at $v = r\omega = 0.10 \times 3.0 = 0.30$ m s^{-1}.

Watch out: keep the calculator in radian mode, and give ω in rad s^{-1}, not revolutions per second — one revolution is 2π rad, so multiply revolutions per second by 2π.

Practice

Try these in order.

12.1 What is a *radian*? [1]

12.2 Convert 180° into radians. [1]

12.3 A wheel of radius 0.25 m turns through 2.0 rad. Find the distance a point on the rim moves ($s = r\theta$). [2]

12.4 Write the formula for *angular speed*. [1]

12.5 An object turns through π rad in 2.0 s. Find its angular speed. [2]

12.6 A point 0.30 m from the centre has angular speed 4.0 rad s^{-1}. Find its speed along the rim ($v = r\omega$). [2]

12.7 Challenge. On a spinning disc, two points sit at 0.10 m and 0.20 m from the centre. They have the *same* angular speed. Explain which one moves faster along the rim, and by what factor. [2]