

3.3 Circular motion

Name: _____ Class: _____ Date: _____

Total: 16 marks

KEY WORDS angular speed 角速度 • centripetal acceleration 向心加速度 • vertical circle 竖直圆
• horizontal circle 水平圆 • circular motion 圆周运动

Objective

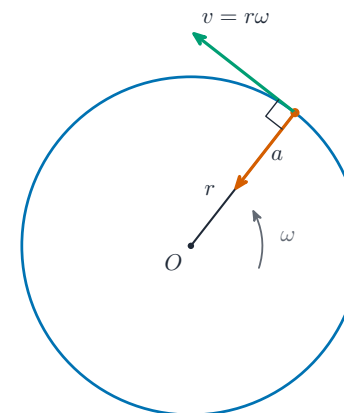
Build the skills to answer exam questions on **circular motion** 圆周运动 — **angular speed** 角速度, **centripetal acceleration** 向心加速度, the **conical pendulum** 圆锥摆, and motion in a **vertical circle** 竖直圆. Take $g = 10 \text{ m s}^{-2}$.

You must be able to:

- use $v = r\omega$ and $a = r\omega^2 = \frac{v^2}{r}$
- analyse a horizontal circle (conical pendulum)
- use energy + the centripetal equation for a vertical circle

1 Worked examples

■ Centripetal force



Velocity points along the tangent; acceleration points inward to the centre

$r = 2 \text{ m}$, $\omega = 3 \text{ rad s}^{-1}$: $v = r\omega = 6 \text{ m s}^{-1}$; $a = r\omega^2 = 18 \text{ m s}^{-2}$.

Centripetal force $= ma = \frac{mv^2}{r}$, provided by tension, friction or a component of weight.

2 Practice

2.1 A particle moves in a circle of radius 0.5 m at 4 m s^{-1} . Find its acceleration. [2]

2.2 Convert an angular speed of 120 rev/min to rad s^{-1} . [2]

3 Exam-style questions

3.1 The centripetal acceleration of a particle moving at speed v in a circle of radius r is: [1]

- | | |
|---|-----------------|
| A | $\frac{v}{r}$ |
| B | $\frac{v^2}{r}$ |
| C | vr |
| D | $\frac{r}{v^2}$ |

3.2 A particle of mass 0.2 kg is attached to a string of length 0.5 m and whirled in a horizontal circle on a smooth table at 3 rev s⁻¹.

(a) Find the angular speed in rad s⁻¹. [2]

(b) Find the tension in the string. [3]

3.3 A conical pendulum has a bob of mass 0.4 kg on a string of length 1 m, which makes an angle of 30° with the vertical.

(a) Find the tension in the string. [3]

(b) Find the angular speed of the bob. [3]
