A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

17 Simple harmonic motion – 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)		
simple harmonic motion	简谐运动			
displacement	位移			
equilibrium	平衡			
angular frequency	角频率			

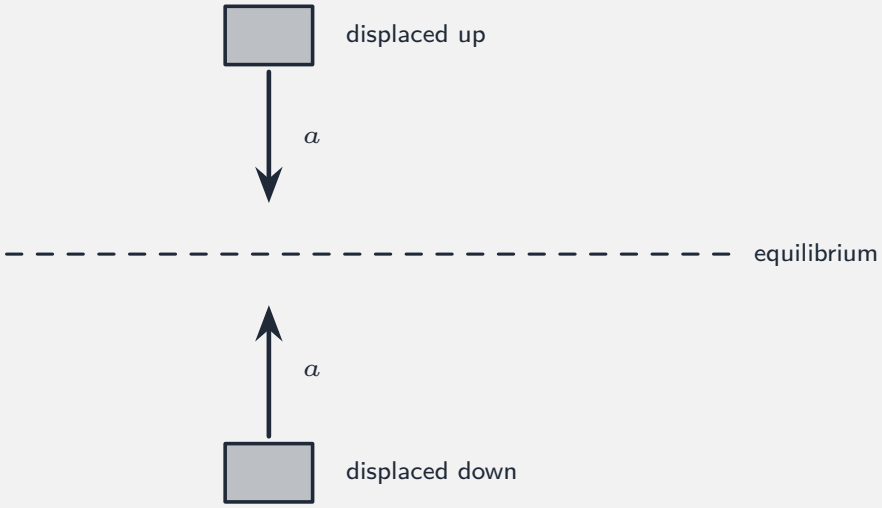
Recall

Many things swing or vibrate around a rest point —a pendulum, a mass on a spring, a guitar string. Many of them do **simple harmonic motion** 简谐运动 (SHM), the motion behind clocks, music and even the swaying of tall buildings.

New ideas

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

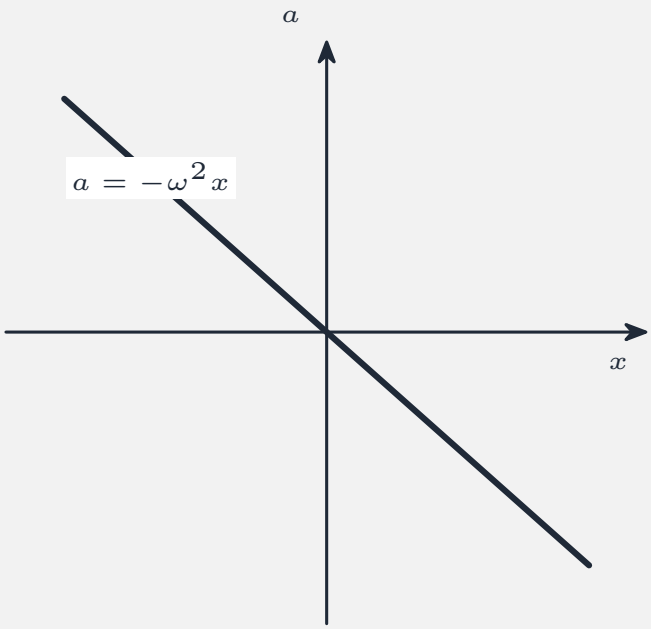
■ 1 The definition



In SHM the **acceleration** is proportional to the **displacement** 位移 from **equilibrium** 平衡, and always points *back* towards it.

Worked example. Pull a mass on a spring to the right and let go. The stretched spring pulls it back to the left, so the acceleration points left —opposite to the displacement. The further you pull it, the larger that pull-back.

2 The graph



The defining equation is $a = -\omega^2 x$, where ω is the **angular frequency** 角频率. The minus sign means "back towards equilibrium".

Worked example. A body with $\omega = 5.0$ rad s^{-1} is at displacement $x = 0.020$ m. Its acceleration is $a = -\omega^2 x = -(5.0)^2(0.020) = -0.50$ m s^{-2} —magnitude 0.50, pointing back to the centre.

Watch out: because $a \propto x$, the acceleration is *largest at the ends* (largest x) and *zero at the centre* —the opposite of where the speed is largest.

Practice

Try these in order.

17.1 In SHM, what is the acceleration proportional to? [1]

17.2 In which direction does the acceleration always point? [1]

17.3 Write the defining equation of SHM. [1]

17.4 What does the minus sign in $a = -\omega^2 x$ mean? [1]

17.5 A body in SHM has $\omega = 4.0$ rad s^{-1}. Find its acceleration when $x = 0.050$ m. [2]

17.6 Where in the motion is the acceleration greatest, and where is it zero? Explain. [2]

17.7 Challenge. A mass on a spring oscillates with no one touching it. Explain why it speeds up as it moves towards the centre and slows down towards the ends. [2]