

# 7.2 Frequency and Period of SHM

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

## Objective

Build the skills to answer exam questions on **the frequency and period of SHM**.

**You must be able to:**

- define the **period** 周期  $T$  and **frequency** 频率  $f$  and relate them by  $f = 1/T$
- state that for SHM the period is **independent of amplitude** 振幅
- use  $T = 2\pi\sqrt{m/k}$  for a mass-spring system and  $T = 2\pi\sqrt{L/g}$  for a simple pendulum

## 1 Worked examples

Study these first. Each one shows the method for a question type used later.

### ■ Period and frequency

$T$  is the time for one full oscillation;  $f = \frac{1}{T}$  is the number per second (Hz).

### ■ The two standard formulas

$$T = 2\pi\sqrt{\frac{m}{k}} \quad (\text{mass-spring}), \quad T = 2\pi\sqrt{\frac{L}{g}} \quad (\text{pendulum}).$$

### ■ Amplitude does not matter

For SHM the period does **not** depend on the amplitude—a wider swing simply moves faster.

## 2 Practice

**2.1** A pendulum has a period of 2.0 s. Find its frequency. [1]

**2.2** A 0.20 kg mass oscillates on a spring of constant  $80 \text{ N m}^{-1}$ . Find the period. [2]

2.3 State how the period of a mass-spring system changes if the amplitude is increased.[1]

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### 3 Exam-style questions

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3.1 The period of a simple pendulum depends on [1]

- A its mass
  - B its amplitude
  - C its length
  - D the material of the bob
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3.2 To double the period of a mass-spring system, the mass must be [1]

- A doubled
  - B quadrupled
  - C halved
  - D left unchanged
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3.3 A simple pendulum has length 1.0 m (take  $g = 9.8 \text{ m s}^{-2}$ ).

(a) Find its period. [2]

(b) Find its frequency. [1]

### 4 Go further

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- work through the **7.2 Frequency and Period of SHM** lesson on the **Learn** page;
- read the **Oscillations** section of the AP Physics 1 handout on the **Know** page.

## Solutions

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**2.1**  $f = \frac{1}{T} = \frac{1}{2.0} = 0.50 \text{ Hz}.$

**2.2**  $T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.20}{80}} = 0.31 \text{ s}.$

**2.3** it does not change —the period is independent of amplitude.

**3.1 C.**

**3.2 B** — $T \propto \sqrt{m}$ , so a factor of 2 in  $T$  needs a factor of 4 in  $m$ .

**3.3** (a)  $T = 2\pi\sqrt{\frac{1.0}{9.8}} = 2.0 \text{ s}.$  (b)  $f = \frac{1}{2.0} = 0.50 \text{ Hz}.$