

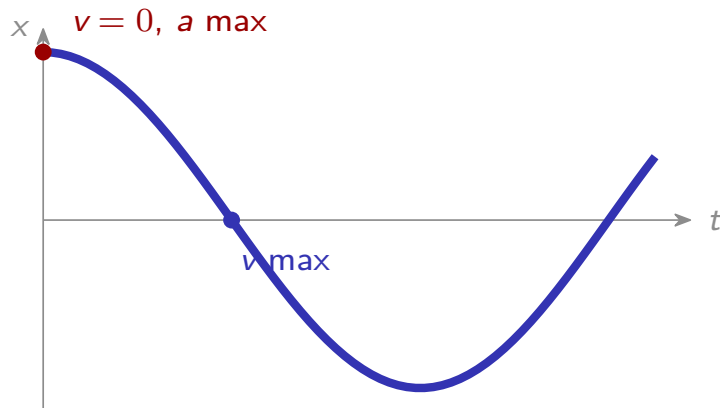
Exercise walk-through

7.2

Frequency and Period of SHM

AP Physics 1

Reading an oscillation



Displacement, velocity and acceleration trace smooth sine curves:

- **velocity** greatest at the **equilibrium** (middle)
- **acceleration** greatest at the extremes

The **phase** sets where in the cycle it is: v peaks a quarter-cycle before x .

Reading the oscillation graph as a story

at the turning point

x is **largest**; v has just fallen to **zero**; a is at its **most negative**, hauling the mass back

passing through the centre

$x = 0$; $a = 0$; v is at its **maximum**

the phases

v leads x by a quarter cycle; a is a half cycle out of phase with x

a against x

a straight line through the origin with a **negative** gradient – and that graph *is* the definition of SHM

the energy

U is greatest at the ends, K greatest at the centre, and the total is constant

Never have maximum speed and maximum acceleration at the same point. If your answer does, a quarter cycle has gone missing.

Exercises 2.1-2.3

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 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]

Exercises 2.1·2.3

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

2.1

- $f = \frac{1}{T} = \frac{1}{2.0} = 0.50 \text{ Hz}$

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

2.2

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

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

2.3

- it does not change – the period is independent of amplitude

Exercises 3.1-3.2

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

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

Exercises 3.1-3.2

3.1 The period of a simple pendulum depends on

[1]

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A its mass

B its amplitude

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D the material of the bob

3.1 C

- its length.

3.2 To double the period of a mass-spring system, the mass must be

[1]

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A doubled

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D left unchanged

3.2 B

- $T \propto \sqrt{m}$, so a factor of 2 in T needs a factor of 4 in m

Exercise 3.3 (a)

3.3 A simple pendulum has length 1.0 m (take $g = 9.8 \text{ m s}^{-2}$).

(a) Find its period.

[2]

Exercise 3.3 (a)

3.3 A simple pendulum has length 1.0 m (take $g = 9.8 \text{ m s}^{-2}$).

(a) Find its period.

[2]

(a)

- $T = 2\pi\sqrt{\frac{1.0}{9.8}} = 2.0 \text{ s}$

Exercise 3.3 (b)

3.3 A simple pendulum has length 1.0 m (take $g = 9.8 \text{ m s}^{-2}$).

(b) Find its frequency.

[1]

Exercise 3.3 (b)

3.3 A simple pendulum has length 1.0 m (take $g = 9.8 \text{ m s}^{-2}$).

(b) Find its frequency.

[1]

(b)

- $f = \frac{1}{2.0} = 0.50 \text{ Hz}$