

## Simple Harmonic Motion Equations Worksheet

Level: A-Level / AP Physics 1 / IB HL | Difficulty: Advanced | Topic: Mechanics

Practice simple harmonic motion with 10 problems on period and frequency of pendulums and mass-spring systems, plus displacement, velocity, and energy in SHM.

### Equations you will need

$T = 2\pi\sqrt{m/k}$	Period of mass-spring system
$T = 2\pi\sqrt{L/g}$	Period of simple pendulum
$x = A \cos(\omega t)$	Displacement (starting at max)
$v_{\max} = \omega A$	Maximum velocity
$a_{\max} = \omega^2 A$	Maximum acceleration
$E = \frac{1}{2}kA^2$	Total energy in SHM
$\omega = 2\pi/T = 2\pi f$	Angular frequency

### Symbol key

Symbol	Quantity	Unit
T	period	s
f	frequency	Hz
m	mass	kg
k	spring constant	N/m
L	pendulum length	m
A	amplitude	m
$\omega$	angular frequency	rad/s
x	displacement	m

### Practice problems

1. A 0.5 kg mass on a spring with  $k = 200 \text{ N/m}$ . Find the period.
2. Find the period of a 1.5 m pendulum. ( $g = 9.8 \text{ m/s}^2$ )
3. A spring oscillates at 2 Hz with amplitude 0.05 m. Find max velocity.
4. Find the spring constant if a 2 kg mass oscillates with period 0.6 s.

5. A pendulum has period 2 s on Earth. Find its period on the Moon ( $g_M = 1.62 \text{ m/s}^2$ ).
6. Mass-spring system:  $m = 1 \text{ kg}$ ,  $k = 100 \text{ N/m}$ ,  $A = 0.1 \text{ m}$ . Find total energy.
7. Find max acceleration for a 0.05 m amplitude oscillation at 5 Hz.
8. A mass on a spring has period 0.4 s. Find ?.
9. A 0.2 kg mass on a spring oscillates with  $v_{\text{max}} = 1.2 \text{ m/s}$  and  $A = 0.06 \text{ m}$ . Find k.
10. Pendulum length needed for period of exactly 1 s? ( $g = 9.8 \text{ m/s}^2$ )