EngineeringRise

Spring and pendulum oscillations

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Hooke law	F = -k x; spring energy U = (1/2) k x^2 Valid when: ideal spring within the elastic limit; x from natural length	N (J; k in N/m)
Spring-mass period	T = 2 pi sqrt(m/k); omega = sqrt(k/m) Valid when: ideal massless spring, no friction, within Hooke range	s (rad/s)
Parallel springs	k = k1 + k2 (also block between two springs) Valid when: both springs stretched by the same displacement	N/m
Series springs	1/k = 1/k1 + 1/k2, k = k1 k2/(k1 + k2) Valid when: springs joined end to end, same force in both	N/m
Cut spring	piece of length L/n has k_piece = n k Valid when: uniform spring cut into equal pieces	N/m
Vertical spring	k x0 = m g; T = 2 pi sqrt(x0/g) Valid when: ideal spring hanging vertically, block at equilibrium	m (s)
Simple pendulum (small angle)	T = 2 pi sqrt(L/g) Valid when: small angle (under about 10 degrees), point mass, light string	s (with L in m)
Effective gravity	lift up/down: g + a, g - a; horizontal a: sqrt(g^2 + a^2) Valid when: pendulum in a frame accelerating with a; g_eff replaces g	m/s^2
Seconds pendulum	T = 2 s; L = g/pi^2 (about 0.99 m) Valid when: small amplitude; g about 9.8 m/s^2	m
Small changes	dT/T = (1/2) dL/L - (1/2) dg/g Valid when: small changes in L and g (first-order)	dimensionless

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/oscillations-and-waves/spring-and-pendulum-oscillations

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