

Kinematics Equations Worksheet

Level: GCSE / AP Physics 1 / IB SL | Difficulty: Intermediate | Topic: Mechanics

Practice the four kinematic equations (SUVAT) with this set of 12 progressively challenging problems. Includes a full worked answer key. Ideal for GCSE, AP Physics 1, and IB Physics students.

Equations you will need

$v = u + at$	Final velocity from initial velocity, acceleration, and time
$s = ut + \frac{1}{2}at^2$	Displacement from initial velocity, time, and acceleration
$v^2 = u^2 + 2as$	Final velocity squared (no time needed)
$s = \frac{1}{2}(u + v)t$	Displacement from average velocity and time

Symbol key

Symbol	Quantity	Unit
s	displacement	m (metres)
u	initial velocity	m/s
v	final velocity	m/s
a	acceleration	m/s ²
t	time	s (seconds)

Practice problems

1. A car accelerates from rest at 3 m/s² for 8 seconds. Find its final velocity.
2. A cyclist travelling at 5 m/s accelerates uniformly to 15 m/s in 4 seconds. Calculate the acceleration.
3. A stone is dropped from a cliff and falls for 3 seconds. How far does it fall? ($g = 9.8 \text{ m/s}^2$)
4. A train decelerates from 30 m/s to rest over a distance of 450 m. Find the deceleration.
5. A ball is thrown vertically upward at 20 m/s. How high does it rise? ($g = 9.8 \text{ m/s}^2$)
6. A car travels at 25 m/s and brakes uniformly, stopping in 5 seconds. Find the braking distance.
7. An object accelerates from 4 m/s to 12 m/s over 32 m. Find the acceleration.

8. A skydiver falls from rest. After 4 s of free fall, find her velocity. ($g = 9.8 \text{ m/s}^2$)
9. A car accelerates from 10 m/s at 2 m/s^2 for 6 s. Find the distance covered.
10. A rocket reaches 200 m/s from rest with acceleration 8 m/s^2 . Find the time taken.
11. A ball rolls down a ramp with constant acceleration. It covers 9 m in the first 3 s starting from rest. Find the acceleration.
12. A car travels at 20 m/s, then accelerates at 1.5 m/s^2 for 8 s. Find the final velocity and the total distance.

Answer key

Full worked solutions for each problem.

1. $v = u + at = 0 + (3)(8) = 24 \text{ m/s}$
2. $a = (v - u)/t = (15 - 5)/4 = 2.5 \text{ m/s}^2$
3. $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(9.8)(3^2) = 44.1 \text{ m}$
4. $v^2 = u^2 + 2as \rightarrow 0 = 900 + 2a(450) \rightarrow a = -1 \text{ m/s}^2$
5. $v^2 = u^2 + 2as \rightarrow 0 = 400 - 2(9.8)s \rightarrow s = 20.4 \text{ m}$
6. $s = \frac{1}{2}(u+v)t = \frac{1}{2}(25+0)(5) = 62.5 \text{ m}$
7. $v^2 = u^2 + 2as \rightarrow 144 = 16 + 64a \rightarrow a = 2 \text{ m/s}^2$
8. $v = u + at = 0 + 9.8(4) = 39.2 \text{ m/s}$
9. $s = ut + \frac{1}{2}at^2 = 10(6) + \frac{1}{2}(2)(36) = 60 + 36 = 96 \text{ m}$
10. $t = (v - u)/a = 200/8 = 25 \text{ s}$
11. $s = \frac{1}{2}at^2 \rightarrow 9 = \frac{1}{2}a(9) \rightarrow a = 2 \text{ m/s}^2$
12. $v = 20 + 1.5(8) = 32 \text{ m/s}$; $s = 20(8) + \frac{1}{2}(1.5)(64) = 160 + 48 = 208 \text{ m}$