# 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 + 1/2at^2** | Displacement from initial velocity, time, and acceleration |
| **v^2 = u^2 + 2as** | Final velocity squared (no time needed) |
| **s = 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/s^2 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 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 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 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 m/s
2. a = (v - u)/t = (15 - 5)/4 = 2.5 m/s^2
3. s = ut + 1/2at^2 = 0 + 1/2(9.8)(3^2) = 44.1 m
4. v^2 = u^2 + 2as -> 0 = 900 + 2a(450) -> a = -1 m/s^2
5. v^2 = u^2 + 2as -> 0 = 400 - 2(9.8)s -> s = 20.4 m
6. s = 1/2(u+v)t = 1/2(25+0)(5) = 62.5 m
7. v^2 = u^2 + 2as -> 144 = 16 + 64a -> a = 2 m/s^2
8. v = u + at = 0 + 9.8(4) = 39.2 m/s
9. s = ut + 1/2at^2 = 10(6) + 1/2(2)(36) = 60 + 36 = 96 m
10. t = (v - u)/a = 200/8 = 25 s
11. s = 1/2at^2 -> 9 = 1/2a(9) -> a = 2 m/s^2
12. v = 20 + 1.5(8) = 32 m/s; s = 20(8) + 1/2(1.5)(64) = 160 + 48 = 208 m