

How fast and how quickly speeding up

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet answers

Each answer gives the formula, the substitution and the final result in bold with its unit. Compare your method as well as your numbers, and watch the signs on velocity and acceleration.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 1.2, HS-PS2-1

Problem 1 Scalar or vector

1. distance: **scalar**
2. displacement: **vector**
3. speed: **scalar**
4. velocity: **vector**
5. acceleration: **vector**
6. time: **scalar**

Problem 2 A minibus journey

1. $v = s \div t = 90 \div 1.5 = \mathbf{60 \text{ km/h.}}$
2. $60 \div 3.6 = \mathbf{16.7 \text{ m/s.}}$

Problem 3 Distance from speed

1. $2.0 \times 60 = \mathbf{120 \text{ s.}}$
2. $s = v \times t = 6.0 \times 120 = \mathbf{720 \text{ m.}}$

Problem 4 Time for a sound to arrive

1. $t = s \div v.$
2. $t = 1650 \div 330 = \mathbf{5.0 \text{ s.}}$

Problem 5 First acceleration

1. It starts from rest, so $u = \mathbf{0 \text{ m/s.}}$
2. $a = (10 - 0) \div 4.0 = \mathbf{2.5 \text{ m/s}^2}.$

Problem 6 Changing km/h and m/s

1. $36 \div 3.6 = \mathbf{10 \text{ m/s}}$.
2. $15 \times 3.6 = \mathbf{54 \text{ km/h}}$.
3. $108 \div 3.6 = \mathbf{30 \text{ m/s}}$.

Problem 7 Distance and displacement

1. $150 + 360 = \mathbf{510 \text{ m}}$.
2. $d^2 = 150^2 + 360^2 = 22\,500 + 129\,600 = 152\,100$, so $d = \mathbf{390 \text{ m}}$.
3. Distance follows the path walked, but displacement is the straight line from start to finish, so it is shorter.

Problem 8 Two-stage average speed

1. Stage 1: $40 \div 80 = 0.50 \text{ h}$. Stage 2: $60 \div 60 = 1.0 \text{ h}$.
2. Distance = 100 km; time = 1.5 h.
3. $v = 100 \div 1.5 = \mathbf{66.7 \text{ km/h}}$. It is not the mean of 80 and 60, because more time is spent at the lower speed.

Problem 9 Negative velocity

1. Displacement = $-8 - 12 = \mathbf{-20 \text{ m}}$.
2. $v = -20 \div 5.0 = \mathbf{-4.0 \text{ m/s}}$, which is 4.0 m/s towards the west.
3. Speed = $\mathbf{4.0 \text{ m/s}}$.

Problem 10 A train slows

1. $a = (12 - 30) \div 9.0 = \mathbf{-2.0 \text{ m/s}^2}$.
2. The negative sign shows the velocity decreases, so the train decelerates.

Problem 11 Final speed

1. $v = u + a t$.
2. $v = 3.0 + 1.5 \times 8.0 = 3.0 + 12 = \mathbf{15 \text{ m/s}}$.
3. $15 \times 3.6 = \mathbf{54 \text{ km/h}}$.

Problem 12 Speed readings of a motorbike

1. The bar at 4 s reads **12 m/s**.
2. $a = (12 - 3) \div (4 - 1) = 9 \div 3 = \mathbf{3 \text{ m/s}^2}$.
3. The speed rises by 3 m/s every second, so the acceleration is **constant**.

Problem 13 Which is fastest

Convert to m/s: 18 km/h = 5.0 m/s and 90 km/h = 25 m/s.

Order: **1.4 m/s, 18 km/h (5.0 m/s), 90 km/h (25 m/s), 330 m/s**.

Problem 14 Harbour ferry

1. $t = s \div v = 4500 \div 7.5 = \mathbf{600 \text{ s}}$.
2. $600 \div 60 = \mathbf{10 \text{ min}}$.
3. $7.5 \times 3.6 = \mathbf{27 \text{ km/h}}$.

Problem 15 Market round trip

1. Out: $2400 \div 6.0 = 400 \text{ s}$. Back: $2400 \div 4.0 = 600 \text{ s}$.
2. Total distance 4800 m in 1000 s: **4.8 m/s**.
3. The displacement is zero because he ends where he started, so the average velocity is **0 m/s**.

Problem 16 Cyclists approaching

1. The gap closes at $5.0 + 4.0 = \mathbf{9.0 \text{ m/s}}$.
2. $t = 900 \div 9.0 = \mathbf{100 \text{ s}}$.
3. $s = 5.0 \times 100 = \mathbf{500 \text{ m}}$.

Problem 17 Light gates

1. 5.0 cm = **0.050 m**.
2. At gate 1: $0.050 \div 0.050 = \mathbf{1.0 \text{ m/s}}$. At gate 2: $0.050 \div 0.025 = \mathbf{2.0 \text{ m/s}}$.
3. $a = (2.0 - 1.0) \div 0.40 = \mathbf{2.5 \text{ m/s}^2}$.

Problem 18 Braking car

1. $t = (0 - 20) \div (-5.0) = \mathbf{4.0 \text{ s}}$.

2. Average speed = $(20 + 0) \div 2 = \mathbf{10 \text{ m/s}}$ because the acceleration is constant.

3. $s = 10 \times 4.0 = \mathbf{40 \text{ m}}$.

Problem 19 Spot the errors

1. The speed is constant but the direction changes, so the velocity changes. Acceleration is a change in velocity, so the car **is accelerating**.

2. Each half is 1.0 km. Time at 20 km/h = 0.050 h and at 40 km/h = 0.025 h, so total time = 0.075 h. Speed = $2.0 \div 0.075 = \mathbf{26.7 \text{ km/h}}$, not 30 km/h.

Problem 20 Speed trap

1. $v = 20 \div 0.80 = \mathbf{25 \text{ m/s}}$.

2. $25 \times 3.6 = \mathbf{90 \text{ km/h}}$.

3. It is over the limit by $90 - 80 = \mathbf{10 \text{ km/h}}$.