CLASS 9 SCIENCE · 2026-27

Motion and the laws of motion

Physics

28	35	3
QUESTIONS	MINUTES	EXERCISES

This belongs to _____ **Date** _____

WHAT YOU'LL GET GOOD AT

- Distinguishes distance from displacement, and speed from velocity
- Selects the right equation of motion for the quantities given
- Converts km/h to m/s before substituting
- Calculates force and momentum, and applies conservation of momentum
- Writes a numerical with formula, substitution, units and a stated answer

Take your time, and have a go at every one. If you get stuck, look at the orange box — Ollie has already done one for you.

Motion and the laws of motion

Physics · 28 questions · tick each box as you finish

Exercise 1 of 3 · 8 questions Find both the distance and the displacement.

WRITE THE ANSWER

HERE'S ONE DONE FOR YOU

One lap of a 400 m track gives a distance of 400 m and a displacement of zero, because displacement is the straight line from start to finish and the athlete finished where they began. Distance asks how far you travelled; displacement asks how far you ended up from where you started. Every question in this pair is testing whether that difference is understood, and 'zero' is very often the correct and unexpected answer.

1) An athlete runs one complete lap of a circular track of length 400 m.

2) A person walks 3 m east, then 4 m north.

3) A ball is thrown 5 m up and caught again at the same point.

4) A car travels 10 km east and then 4 km west along the same road.

5) A cyclist rides 200 m north, turns and rides 200 m south.

6) A runner completes two laps of a 400 m track.

7) A lift goes up 12 m, then down 5 m.

8) A boy walks 6 m east, 8 m north, then 6 m west.

Exercise 2 of 3 · 10 questions Work these out. Formula first, then substitution, with units on every line.

WRITE THE ANSWER

HERE'S ONE DONE FOR YOU

The train question is the one that catches people, and not because of the physics. 72 km/h must become 20 m/s before anything else happens, because the acceleration is asked for in m/s². Multiply by 1000 and divide by 3600, or divide by 3.6 - either way, do it as the first line of the solution rather than halfway through. A units mismatch is the single most common way a correct method produces a wrong answer.

1) A car starts from rest and accelerates at 2 m/s² for 5 s. Find its final velocity and the distance covered.

2) A body moving at 20 m/s decelerates uniformly and stops in 4 s. Find the acceleration and the distance covered.

3) A train travelling at 72 km/h is brought to rest in 20 s. Find its acceleration.

4) An object moving at 5 m/s accelerates at 2 m/s² over a distance of 10 m. Find its final velocity.

5) A stone is dropped from rest and falls for 3 s. Take g as 10 m/s². Find its velocity and the distance fallen.

6) A car starts from rest and accelerates at 4 m/s² for 6 s. Find its final speed and the distance covered.

7) A body moving at 30 m/s comes to rest in 90 m. Find its acceleration.

8) A vehicle at 54 km/h brakes to rest in 5 s. Find the acceleration in m/s².

9) An object at rest falls freely for 3 s. Find its speed and the distance fallen (g = 10 m/s²).

10) A train accelerates uniformly from 10 m/s to 30 m/s in 20 s. Find the acceleration and the distance.

Exercise 3 of 3 · 10 questions Work these out, showing the formula each time.

WRITE THE ANSWER

HERE'S ONE DONE FOR YOU

The boat question is the one worth understanding rather than memorising. Before the jump nothing is moving, so the total momentum is zero, and it must stay zero. The person carries 120 kg m/s forwards, so the boat must carry 120 kg m/s backwards - and being half the mass, it moves twice as fast. The negative sign is not a nuisance; it is the answer telling you the direction.

1) A force of 10 N acts on a body of mass 2 kg. Find the acceleration.

2) A 5 kg object speeds up from 2 m/s to 8 m/s in 3 s. Find the acceleration and the force.

3) Find the change in momentum of that same 5 kg object.

4) Find the momentum of a 20 g bullet travelling at 100 m/s.

5) A person of 60 kg jumps off a stationary 30 kg boat at 2 m/s. Find the velocity of the boat.

6) A force of 12 N acts on a 4 kg body. Find the acceleration.

7) Find the force needed to accelerate a 1,500 kg car at 2 m/s^2.

8) A 3 kg object is brought from rest to 12 m/s. Find the change in momentum.

9) Find the momentum of a 50 g ball moving at 200 m/s.

10) Why does a cricketer move his hands back while catching a ball?

All done? How did that feel?

Colour in a star. Three stars means you could teach it to someone else.

☆ ☆ ☆ Tricky · Getting there · Easy now

Answer key

For grown-ups

Motion and the laws of motion · keep this page back until your child has finished.

1. Find both the distance and the displacement.

1) Distance 400 m; displacement 0, because the athlete finishes where they started.
2) Distance 7 m; displacement 5 m, from the right-angled triangle with sides 3 and 4.
3) Distance 10 m; displacement 0.
4) Distance 14 km; displacement 6 km towards the east.
5) Distance 400 m; displacement 0, because the start and finish are the same point.
6) Distance 800 m; displacement 0, because a complete lap returns to the start.
7) Distance 17 m; displacement 7 m upward.
8) Distance 20 m; displacement 8 m north - the two 6 m legs cancel.

2. Work these out. Formula first, then substitution, with units on every line.

1) $v = u + at = 0 + (2\ m/s^2)(5\ s) = 10\ m/s$. $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(2)(25) = 25\ m$.
2) $a = (v - u)/t = (0 - 20)/4 = -5\ m/s^2$. $s = ut + \frac{1}{2}at^2 = (20)(4) + \frac{1}{2}(-5)(16) = 80 - 40 = 40\ m$.
3) First convert: $72\ km/h = 72 \times 1000/3600 = 20\ m/s$. Then $a = (0 - 20)/20 = -1\ m/s^2$.
4) $v^2 = u^2 + 2as = 25 + 2(2)(10) = 65$, so $v = 65 \approx 8.1\ m/s$.
5) $v = u + at = 0 + (10)(3) = 30\ m/s$. $s = \frac{1}{2}at^2 = \frac{1}{2}(10)(9) = 45\ m$.
6) $v = u + at = 0 + 4 \times 6 = 24\ m/s$. $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 4 \times 36 = 72\ m$.
7) $v^2 = u^2 + 2as$, so $0 = 900 + 2a(90)$, giving $a = -5\ m/s^2$. It is a retardation of $5\ m/s^2$.
8) $54\ km/h = 15\ m/s$. $a = (v - u)/t = (0 - 15)/5 = -3\ m/s^2$.
9) $v = 0 + 10 \times 3 = 30\ m/s$. $s = \frac{1}{2} \times 10 \times 9 = 45\ m$.
10) $a = (30 - 10)/20 = 1\ m/s^2$. $s = ut + \frac{1}{2}at^2 = 10 \times 20 + \frac{1}{2} \times 1 \times 400 = 400\ m$.

3. Work these out, showing the formula each time.

1) $a = F/m = 10\ N \div 2\ kg = 5\ m/s^2$.
2) $a = (8 - 2)/3 = 2\ m/s^2$. $F = ma = (5\ kg)(2\ m/s^2) = 10\ N$.
3) Change in momentum $= m(v - u) = 5(8 - 2) = 30\ kg\ m/s$.
4) Convert 20 g to 0.02 kg. $p = mv = (0.02)(100) = 2\ kg\ m/s$.
5) By conservation of momentum, total momentum stays zero. So $(60)(2) + (30)(v) = 0$, giving $v = -4\ m/s$ - that is, 4 m/s in the opposite direction.
6) $a = F/m = 12/4 = 3\ m/s^2$.
7) $F = ma = 1500 \times 2 = 3{,}000\ N$.
8) Change in momentum $= m(v - u) = 3 \times 12 = 36\ kg\ m/s$.
9) $p = mv = 0.05 \times 200 = 10\ kg\ m/s$.
10) To increase the time over which the ball is stopped. The change in momentum is fixed, so a longer time means a smaller force on his hands.

WHILE YOUR CHILD WORKS

- Convert units in the first line, before any formula. 72 km/h is 20 m/s, and doing it later is how correct methods produce wrong answers.
- Units belong on every line, not only on the answer. Layout is marked independently.
- In momentum questions, a negative answer means direction, not error. Ask your child what the sign is telling them.