

Relative Motion

KS3 Physics · Follows the national curriculum

Name _____ Class _____ Date _____

1. Worked example

You sit still on a bus moving at 15 m/s. What is your speed?

Step 1 · Compared with the bus

You are not moving relative to the bus: 0 m/s.

Step 2 · Compared with the road

You move with the bus: 15 m/s.

Answer: 0 m/s relative to the bus; 15 m/s relative to the road

Check: Speed depends on what you measure it against (the frame of reference).

2. Now try one with the steps

A car at 30 m/s overtakes a lorry at 25 m/s. How fast does the car pass the lorry?

Step 1 · Same direction

Step 2 · Calculate

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. What does 'relative motion' mean? [1]

2. Two cars travel in the same direction at 30 m/s and 25 m/s. What is their relative speed, in m/s? [1]

3. Two cars travel towards each other at 30 m/s and 25 m/s. What is their relative speed, in m/s? [1]

4. A passenger walks forwards at 1 m/s along a train moving at 20 m/s. What is her speed relative to the ground, in m/s? [1]

5. The passenger turns round and walks towards the back of the train at 1 m/s. What is her speed relative to the ground, in m/s? [1]
- _____
- _____
6. You sit still on a bus moving at 15 m/s. What is your speed relative to the bus, in m/s? [1]
- _____
- _____
7. Two trains approach each other at 40 m/s and 35 m/s, 1500 m apart. How long until they meet, in seconds? [2]
- _____
- _____
8. A car at 30 m/s overtakes a lorry at 25 m/s. How long does it take to gain 50 m on the lorry, in seconds? [2]
- _____
- _____
9. Explain why a train passing in the opposite direction seems to rush past very quickly. [2]
- _____
- _____
10. Sam walks up an escalator at 0.5 m/s. The escalator moves up at 0.7 m/s. What is his speed relative to the ground, in m/s? [1]
- _____
- _____
11. The escalator in the last question is 24 m long. How long does Sam take to reach the top, in seconds? [2]
- _____
- _____
12. A plane flies at 250 m/s through the air with a 30 m/s tailwind. What is its ground speed, in m/s? [1]
- _____
- _____
13. Two runners go the same way at 6 m/s and 4 m/s. The slower runner is 30 m ahead. How long does the faster runner take to catch up, in seconds? [2]
- _____
- _____
14. On a smoothly moving train you drop a coin. It lands at your feet, not behind you. Explain why. [2]
- _____
- _____

4. Before you hand it in

Always adding the speeds.

Same direction: subtract. Opposite directions: add.

"I'm not moving, I'm sitting down."

Say 'stationary relative to the bus' or 'moving at 15 m/s relative to the road'.

Using one vehicle's speed to find the time to meet.

Time = gap $\div$ relative speed.