

# On speed

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## Warm-up problems

1. What is the formula linking the *average speed* of an object, the *distance* it has travelled, and the *time taken*? Don't forget to say what any symbols you use mean, and what units they are normally measured in.
2. Give at least three common units of measurement of speed and show how values for speed in these units can be converted into values in the usual unit used in physics.

## Regular problems

3. Thunder from a distant electrical storm is heard 8 s after the lightning. If sound travels at 340 m/s, how far away is the point where the lightning happened?
4. Find the average speed of Mr Townsend in the men's quadruple scull in heat 2 of the 2016 Rio olympics. Their time was 5:52.770 over a 2000 m course.
5. A laser beam can be bounced off the Moon (from a retro-reflector left by astronauts). The light travels there and back in 2.6 s. If light travels at 300 000 000 m/s, calculate the distance to the moon.

## Extension problems

6. Other galaxies in space are moving away from us, owing to the expansion of space. In fact, the further away the galaxy, the faster it is moving - this is described by the Hubble constant,  $H_0 = 160 \text{ km/s per million-light-years}$ .
  - (a) Use the Hubble constant to estimate how fast the Pinwheel Galaxy (M101 / NGC 5457), at 21 million light years distance from the Earth, is moving away from us.
  - (b) How much farther away will it be in a year's time?
7. Read this passage from *The memoirs of Sherlock Holmes* (the Silver Blaze adventure)

“We are going well,” said he, looking out the window and glancing at his watch.  
“Our rate at present is fifty-three and a half miles an hour.”  
“I have not observed the quarter-mile posts,” said I.  
“Nor have I. But the telegraph posts upon this line are sixty yards apart, and the calculation is a simple one.”

Repeat Holmes' calculation of the train's speed.



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