A LESSON ABOUT SPEED, UNITS AND PERCENTAGE CHANGE

Could you keep up with a world-record miler on a bike?

World Athletics has ratified a new men's mile record: **3:42.66**, run by Josh Kerr in London on 18 July 2026. Kerr was 28, and he is from Edinburgh, Scotland. The previous record, 3:43.13 by Hicham El Guerrouj, had stood since 1999. Today you will turn those times into a speed, change the units, and judge how big a 0.47-second improvement really is.

Name _____ **Class / year** _____ **Date** _____

1. From a race time to seconds

A race time such as 3:42.66 means 3 minutes and 42.66 seconds. To do any calculation, first write the time as a single number of seconds:

3 minutes 42.66 seconds = 3 × 60 + 42.66

Q1. Convert Kerr's record, 3:42.66, into seconds.

Q2. Convert El Guerrouj's 1999 record, 3:43.13, into seconds.

Q3. How many seconds faster was Kerr? Show the subtraction.

2. How big is 0.47 seconds?

A world record can look tiny as a raw difference. Percentage change tells you how large that difference is *compared with the old time*:

percentage change = (difference ÷ old time) × 100

The old record was 223.13 s

Kerr was 0.47 s faster

0.47 ÷ 223.13 × 100

≈ 0.21%

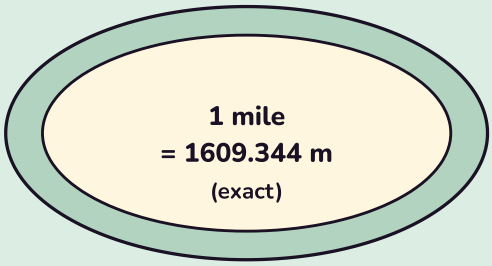
Tiny on paper. A new world record.

Q4. Work out 0.47 ÷ 223.13 × 100. Give your answer to 2 decimal places, and write one sentence about whether 0.21% "feels" large or small for a world record.

3. Speed = distance ÷ time

The international mile is **exactly** 1609.344 metres (from the international yard of 0.9144 m). Use this exact length, not 1600 m.

speed = distance ÷ time



Just over four 400 m laps · leftover 9.344 m

Speed = distance ÷ time

1609.344 m ÷ 222.66 s

≈ 7.23 m/s

× 3.6 to convert to km/h

26.0 km/h

Q5. Using 1609.344 m and your answer to Q1, work out Kerr's average speed in metres per second. Round to 2 decimal places.

Q6. Convert that speed into kilometres per hour. Multiply by 3.6, and give your answer to 1 decimal place.

Why × 3.6?

1 km = 1000 m

1 hour = 3600 s

3600 ÷ 1000 = 3.6

So m/s × 3.6 = km/h

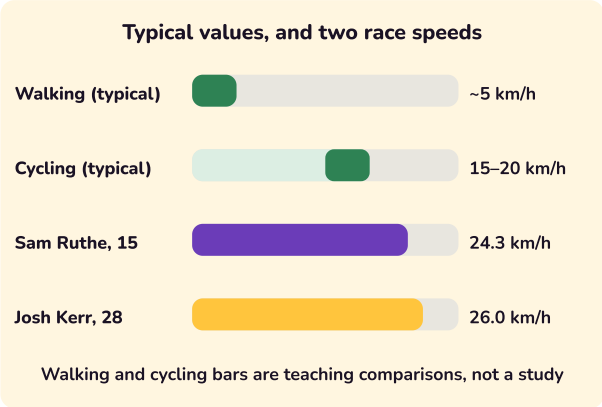
and km/h ÷ 3.6 = m/s

Q7. In your own words, why do we multiply by 3.6 to change m/s into km/h?

Q8. A friend uses 1 mile = 1600 m, instead of 1609.344 m, and divides by 222.66 s. What speed, in m/s and then in km/h, do they get? Why is their answer a little too low?

4. Could you keep up on a bike?

The film compares Kerr's 26.0 km/h with some **typical values**: walking about 5 km/h, and cycling about 15–20 km/h. Those walking and cycling figures are teaching comparisons, not measurements from a particular study, and not Kerr's speed.



Time for a journey is distance ÷ speed. For these questions, use 1 mile = 1.609344 km.

Q9. How long would 1 mile take at a typical cycling pace of 20 km/h? Give the time in seconds, then in minutes and seconds.

Q10. How long would 1 mile take at a typical walking pace of 5 km/h? Again, give seconds, then minutes and seconds.

5. An average 400 m

A standard running track lap is 400 m. A mile is just over four of those laps: 4 × 400 m = 1600 m, with 9.344 m left over.

Q11. Using the rounded speed 7.23 m/s, work out the average time to cover 400 m at Kerr's mean speed. Round to 1 decimal place.

Q12. A friend does 222.66 ÷ 4 to get an "average lap." Why is that not quite right for a 400 m lap?

6. Extension — a New Zealand comparison

On 19 March 2025, at Mount Smart Stadium in Auckland, New Zealand's **Sam Ruthe** ran the mile in **3:58.35**. He was 15 (15 years 341 days; born 12 April 2009), and he became the youngest athlete ever to run a sub-4-minute mile — the first 15-year-old to do it. Sources: Athletics New Zealand, Guinness World Records, Reuters and BBC Sport. The film is still about Kerr's world record; this page is the comparison.

E1. Convert 3:58.35 into seconds.

E2. Using 1609.344 m, work out Ruthe's average speed in m/s (2 decimal places) and in km/h (1 decimal place).

E3. How many seconds quicker is Kerr's 3:42.66 than Ruthe's 3:58.35? What percentage of Ruthe's time is that difference? Give the percentage to 2 decimal places.

E4. Using the rounded speeds 26.0 km/h and 24.3 km/h, by what percentage is Kerr's speed greater than Ruthe's? Why is your answer not the same as in E3?

E5. *If* someone could keep 26.0 km/h for 5 km, how long would that take? Give minutes and seconds. Then explain why this is only a "what if" — not a claim about Kerr's 5 km time.

A useful idea. Speed and time are reciprocals of each other (for a fixed distance). So a percentage change in time is not the same size as the percentage change in speed. That is why E3 and E4 disagree — and both can be right.

Answers — for teachers, or for checking afterwards

Q1. 3 × 60 + 42.66 = **222.66 s**.

Q2. 3 × 60 + 43.13 = **223.13 s**.

Q3. 223.13 − 222.66 = **0.47 s** faster.

Q4. 0.47 ÷ 223.13 × 100 = 0.2106…% = **0.21%** to 2 decimal places. Accept any clear sentence: the improvement looks tiny as a percentage, but it was still enough to break a 27-year-old world record. (The unrounded value 0.2106…% should be rounded to 0.21, not 0.211.)

Q5. 1609.344 ÷ 222.66 = 7.2278… m/s = **7.23 m/s** to 2 decimal places.

Q6. 7.2278… × 3.6 = 26.020… km/h = **26.0 km/h** to 1 decimal place. Using the already-rounded 7.23 × 3.6 = 26.028, which also rounds to 26.0 km/h.

Q7. There are 1000 m in 1 km and 3600 s in 1 hour, and 3600 ÷ 1000 = 3.6. Multiplying m/s by 3.6 therefore converts to km/h. Accept any clear version of this, including "multiply by 3600 and divide by 1000."

Q8. 1600 ÷ 222.66 = 7.1858… m/s = **7.19 m/s** (2 d.p.), and 7.1858… × 3.6 = 25.869… = **25.9 km/h** (1 d.p.). The answer is a little too low because 1600 m is 9.344 m short of a mile, so the friend has used a distance that is too small.

Q9. Time = 1.609344 ÷ 20 × 3600 = 289.6819… s = **289.68 s**, which is **4 minutes 49.68 seconds** (accept 4 min 50 s if clearly rounded to the nearest second).

Q10. Time = 1.609344 ÷ 5 × 3600 = 1158.727… s = **1158.73 s**, which is **19 minutes 18.73 seconds** (accept 19 min 19 s if clearly rounded to the nearest second).

Q11. 400 ÷ 7.23 = 55.325… s = **55.3 s** to 1 decimal place. (Using the unrounded 7.2278… m/s gives 55.341… s, which also rounds to 55.3 s.)

Q12. 222.66 ÷ 4 = 55.665 s would be the average time for a quarter of a mile. A quarter of a mile is 402.336 m, not 400 m, because a mile is 1609.344 m, not 1600 m. So 222.66 ÷ 4 slightly overstates the time for a 400 m lap. Accept any clear version of "a mile is a bit more than 1600 m."

E1. 3 × 60 + 58.35 = **238.35 s**.

E2. 1609.344 ÷ 238.35 = 6.7520… m/s = **6.75 m/s** (2 d.p.). 6.7520… × 3.6 = 24.307… km/h = **24.3 km/h** (1 d.p.).

E3. 238.35 − 222.66 = **15.69 s** quicker. 15.69 ÷ 238.35 × 100 = 6.5827…% = **6.58%** to 2 decimal places. (This is the percentage by which Kerr's time is shorter than Ruthe's.)

E4. (26.0 − 24.3) ÷ 24.3 × 100 = 6.995…% = **7.0%** to 1 decimal place (or 7.00% to 2 d.p.). Using the unrounded speeds 26.020… and 24.307… gives 7.05%. The answers to E3 and E4 are different because a percentage change in time is not the same as a percentage change in speed: for a fixed distance, speed and time are reciprocals. Both calculations can be correct; they answer slightly different questions. Accept 7.0% or 7.05% if the working is clear.

E5. Time = 5 ÷ 26.0 × 3600 = 692.307… s = **11 minutes 32.3 seconds** (accept 11 min 32 s). This is only a "what if," because 26.0 km/h is Kerr's *average for one mile*. There is no claim that he, or anyone else, could hold that pace for 5 km. A 5 km race is more than three times as long, and the average speed would normally be lower.