Answer key: Average Speed vs Average Velocity vs Instantaneous Velocity

Physics with Tiaotiao 跳跳 · Kinematics · High School Physics
Study sheet for the video "Average Speed vs Average Velocity vs Instantaneous Velocity": answer key

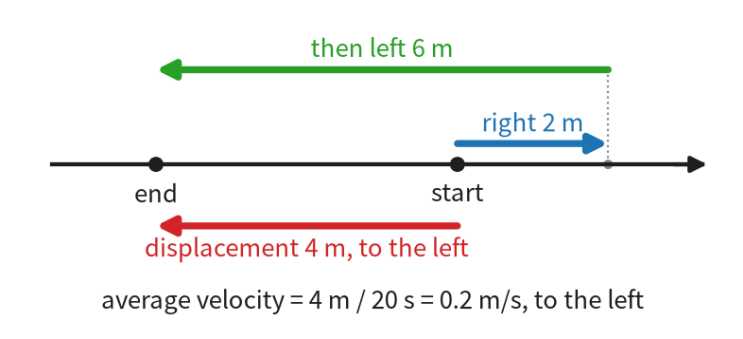
Answers and explanations

Tap a blue time to jump to the part of the video that explains the question.

1. (a) **Trip 1** gets there sooner: same start and end, less time. (b) Trip 1: 7.5 ÷ 14 ≈ **0.54 km/min**. Trip 2: 10 ÷ 15 ≈ **0.67 km/min**. Trip 2 covers more ground per minute, so Trip 2 "runs faster".
"Gets there fast" = average velocity (displacement ÷ time). "Runs fast" = average speed (distance ÷ time).
▶ **Watch 1:46, Example 1**

2. **0**. After ten full laps the dog is back at the start, so its position has not changed: displacement = 0, and average velocity = 0 ÷ 20 min = 0. The 2000 m is distance, so it is not used.
▶ **Watch 5:45, Example 2**

3. **0.2 m/s, to the left**. Taking right as positive, the cat ends 6 − 2 = 4 m to the left of the start, so the displacement is 4 m to the left. Average velocity = 4 m ÷ 20 s = 0.2 m/s, in the direction of the displacement: to the left.



▶ **Watch 5:45, Example 3**

4. **C**. Average velocity only records the result, so it only roughly reflects how fast an object moves.
A 10 s after setting off is an instant. An average velocity needs a time interval. **B** The same 25 m in 5 s can be 5 m every second, or standing still for 4 s and then 25 m in the 5th second. The average velocity is 5 m/s both times, so it cannot show the process. **D** Average velocity = displacement ÷ time. You do not need to know how the velocity changes.
▶ **Watch 7:41, Example 4**

5. **Average velocity 0.2 m/s to the left; average speed 0.4 m/s.** Average speed = distance ÷ time = (2 + 6) m ÷ 20 s = 8 m ÷ 20 s = 0.4 m/s. The two are not equal.
▶ **Watch 10:59, Example 5**

6. **Average velocity 2 m/s to the right; average speed 2 m/s.** Displacement = 10 m to the right, so v = 10 m ÷ 5 s = 2 m/s, to the right. Distance is also 10 m, so average speed = 10 m ÷ 5 s = 2 m/s.
In one-way straight-line motion, the magnitude of average velocity = average speed.
▶ **Watch 11:48, Example 6**

7. **C**. The 60 km follows a winding mountain road, so it is distance, not displacement. Distance ÷ time is average speed: 60 000 m ÷ (5 × 3600 s) ≈ 3.3 m/s. **A, B** use "velocity", which needs displacement. **D** The problem gives only the total distance and total time, so we cannot say the speed is 3.3 m/s at every instant.
▶ **Watch 12:57, Example 7**

8. **True**. Constant direction means it can only move in a straight line. Constant magnitude means it moves at a steady rate. Together, that is uniform linear motion.
▶ **Watch 18:43, Example 8**

9. (1) **instantaneous**; (2) **average**; (3) **average**; (4) **instantaneous**; (5) **instantaneous**.
Look at the time: an extremely short time (a moment, a position, e.g. 0.0001 s) means instantaneous.
For (2), this is the standard answer for this problem, not a general rule: one instant says nothing about arriving sooner. What counts is the overall speed after the speed-up.
▶ **Watch 18:54, Example 9**

10. **0 m/s; 5 m/s; =**. He ends where he started, so the displacement is 0 and the average velocity is 0. The distance is 400 m, so the average speed is 400 m ÷ 80 s = 5 m/s. At the finish line the time is extremely short, so we mean instantaneous: the magnitude of instantaneous velocity equals instantaneous speed.
▶ **Watch 24:28, Example 10**

11. **C**. All three have the same displacement (N to M) and the same time, so they have the same average velocity: **A** is wrong. A has the longest path, so the largest distance, so the greatest average speed: **B** is wrong and C is right. The problem gives no information about speed at the moment of arrival, so **D** cannot be concluded.
For average velocity, look at displacement. For average speed, look at distance.
▶ **Watch 25:47, Example 11**

12. **(1) F (2) T (3) T (4) F (5) F**
(1) "Instantaneous" means an *extremely* short time, not just a short one. (2) For uniform linear motion, the velocity is the same all the time. (3) That is the definition. (4) Average speed is not the magnitude of average velocity: the two mean different things. (5) One full lap: average velocity is 0 but average speed is not.
▶ **Watch 28:34, Example 12**