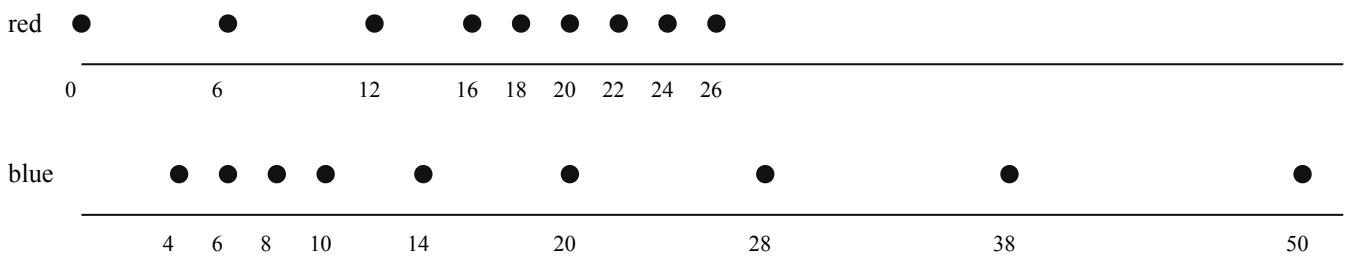
Motion diagram test

Seeley, motion in 1D. Problems first. Answers start on the last page.

Two carts

Both carts move to the right. Dots are every 2.0 s. The number by a dot is the position in meters. Red starts at 0 m. Blue starts at 4 m.



t (s)	0	2	4	6	8	10	12	14	16
red (m)	0	6	12	16	18	20	22	24	26
blue (m)	4	6	8	10	14	20	28	38	50

1. Describe red. Say where the speed is constant and where it is changing. Use the gaps.
2. Describe blue the same way.
3. At what time does red pass blue, and at what position?
4. At what time does blue pass red, and at what position?
5. Is there an interval when they move at the same speed? If yes, which one, and what is that speed in m/s?
6. From t = 0 to t = 2 s, who is faster? Who is ahead at t = 0? How can both be true?
7. Average speed of each cart from t = 0 to t = 16 s. Units on the answer.

One walker

Dots every 0.50 s. Positions: 0, 1.5, 3.0, 4.2, 5.0 m.

8. Where is the speed constant, and where is the walker slowing down?
9. Average speed for the whole 2.0 s, in m/s and in km/h. Multiply m/s by 3.6.

Draw these

Same clock on both objects. Number every dot.

10. A scooter moves at constant speed. A truck is stopped. The instant the scooter is next to the truck, the truck starts and speeds up steadily until it passes the scooter. Circle the pass. Mark where the speeds match. The first shared dot is not the pass.
11. Yellow cart and gray cart, same times. Yellow starts ahead and speeds up the whole time. Gray speeds up quickly, then stays at constant speed. Gray passes yellow. Later, yellow passes gray. Label the same-speed stretch and both passes.

Short calls

12. Equal gaps mean what?
13. Gaps getting smaller along the direction of travel mean what?
14. Two dots share a position at the same time. If that time is the first dot, is it a pass?
15. During the same 2 seconds, A has a bigger gap than B, but A is still behind. Who is faster in that interval?

Answers

1. Red goes right. From 0 to 4 s both gaps are 6 m, so constant speed, 3.0 m/s. From 4 to 8 s the gaps drop from 4 m to 2 m, so slowing down. From 8 to 16 s every gap is 2 m, so constant again, 1.0 m/s.
2. Blue goes right. From 0 to 6 s every gap is 2 m, so constant speed, 1.0 m/s. From 6 to 16 s the gaps are 4, 6, 8, 10, 12 m, so speeding up the rest of the way.
3. t = 2 s, both at 6 m. At t = 0 blue is at 4 m and red is at 0. At t = 4 s red is at 12 m and blue is at 8 m.
4. t = 10 s, both at 20 m. At t = 8 s red is still ahead (18 m vs 14 m). At t = 12 s blue is ahead (28 m vs 22 m).
5. t = 6 s to t = 8 s, both move 2 m, so 1.0 m/s. No other interval matches on the same clock. Red stays at 1.0 m/s after t = 8 s, but blue is already faster then.
6. Red is faster from 0 to 2 s (6 m vs 2 m). Blue is ahead at t = 0. Ahead is position. Faster is the gap.
7. Red: (26 - 0) / 16 = 1.625 m/s. Blue: (50 - 4) / 16 = 2.875 m/s.
8. Gaps are 1.5, 1.5, 1.2, 0.8 m. Constant from 0 to 1.0 s (3.0 m/s), then slowing from 1.0 to 2.0 s.
9. 5.0 m / 2.0 s = 2.5 m/s. 2.5 times 3.6 = 9.0 km/h.
10. Scooter dots stay evenly spaced. Truck dots start close together, then the gaps grow. The first shared position is the start, not a pass. Circle the later time they share a position. Same speed is the truck gap that matches the scooter gap, while the truck is still behind.
11. Yellow's first dot is ahead of gray's. Yellow's gaps keep growing. Gray's gaps grow, then stay equal. They meet once while gray catches up, and again after yellow's gaps get bigger than gray's steady gap. Same speed is the yellow gap that equals gray's constant gap, between the two passes.
12. Constant speed.
13. Slowing down.
14. Same place. The first dot is the start. A pass is a later meeting, after one of them was behind.
15. A is faster. Being behind does not change the gap.