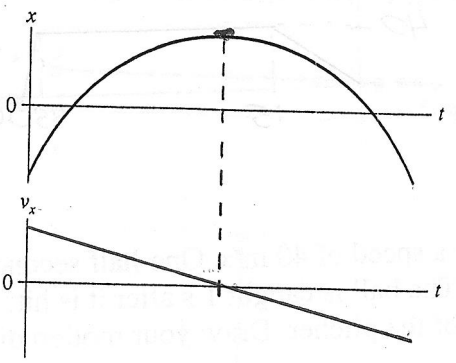
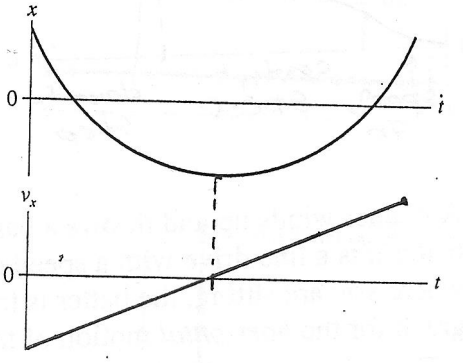
2.3 Instantaneous Velocity

12. Below are two position-versus-time graphs. For each, draw the corresponding velocity-versus-time graph directly below it. A vertical line drawn through both graphs should connect the velocity v_x at time t with the position x at the *same* time t. There are no numbers, but your graphs should correctly indicate the *relative* speeds.

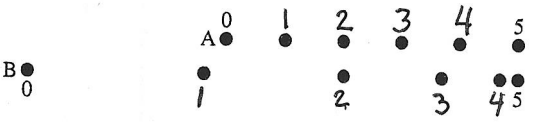
a.



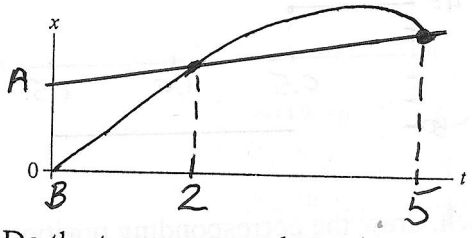
b.

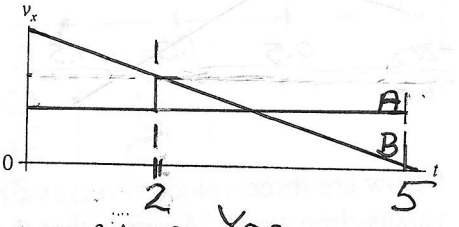


13. The figure shows six frames from the motion diagram of two moving cars, A and B.



a. Draw both a position-versus-time graph and a velocity-versus-time graph. Show *both* cars on each graph. Label them A and B.





b. Do the two cars ever have the same position at one instant of time? Yes

If so, in which frame number (or numbers)? 2 and 5

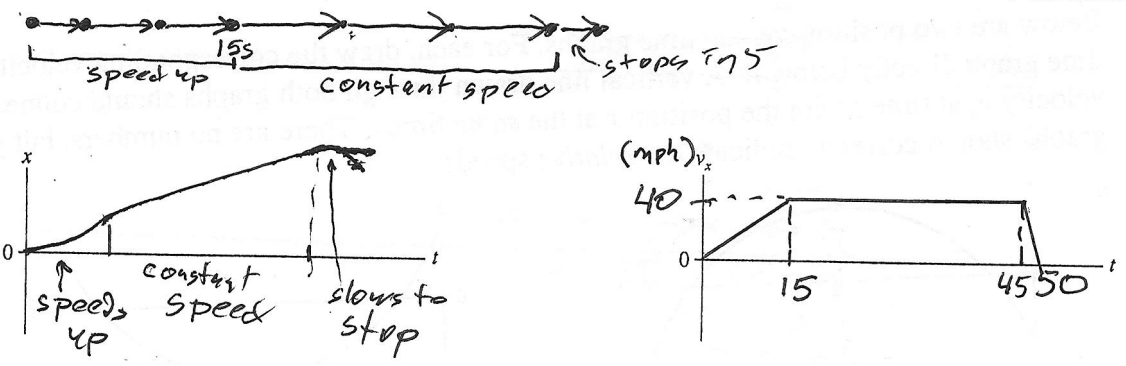
Draw a vertical line through your graphs of part a to indicate this instant of time.

c. Do the two cars ever have the same velocity at one instant of time? yes

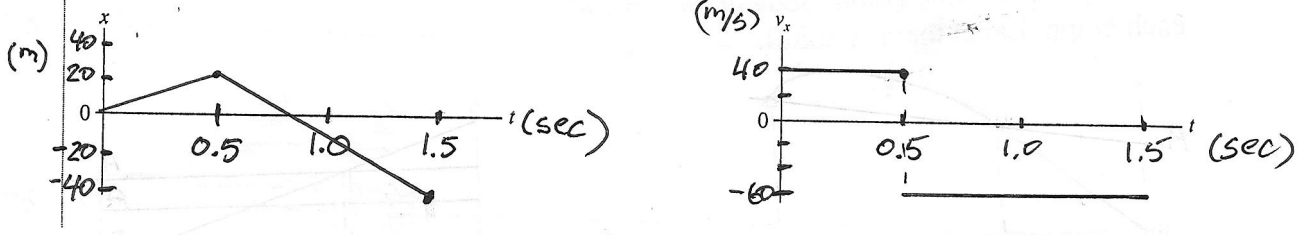
If so, between which two frames? 3 and 4

14. For each of the following motions, draw
    - A motion diagram and
    - Both position and velocity graphs.

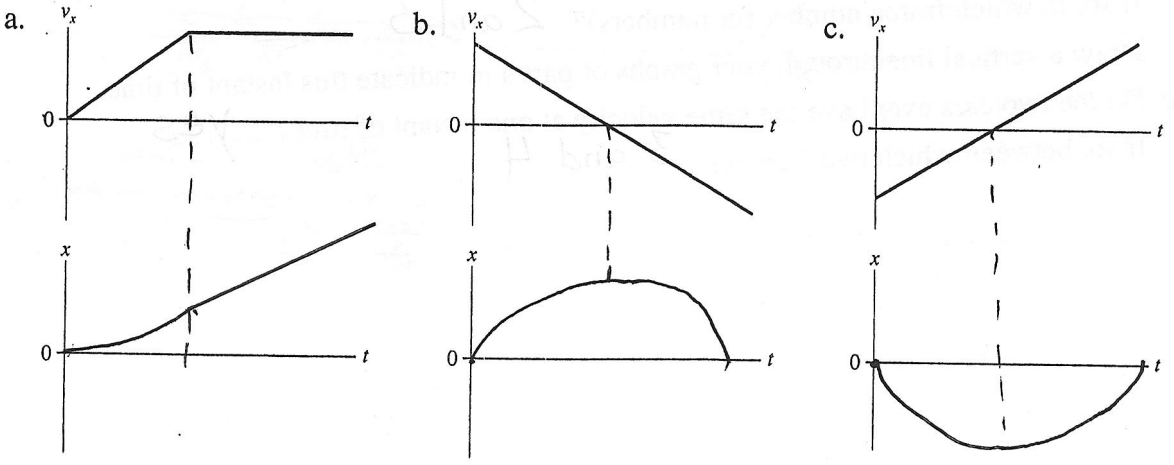
    a. A car starts from rest, steadily speeds up to 40 mph in 15 s, moves at a constant speed for 30 s, and then comes to a halt in 5 s.



    b. A pitcher winds up and throws a baseball with a speed of 40 m/s. One-half second later, the batter hits a line drive with a speed of 60 m/s. The ball is caught 1 s after it is hit. From where you are sitting, the batter is to the right of the pitcher. Draw your motion diagram and graph for the *horizontal* motion of the ball.

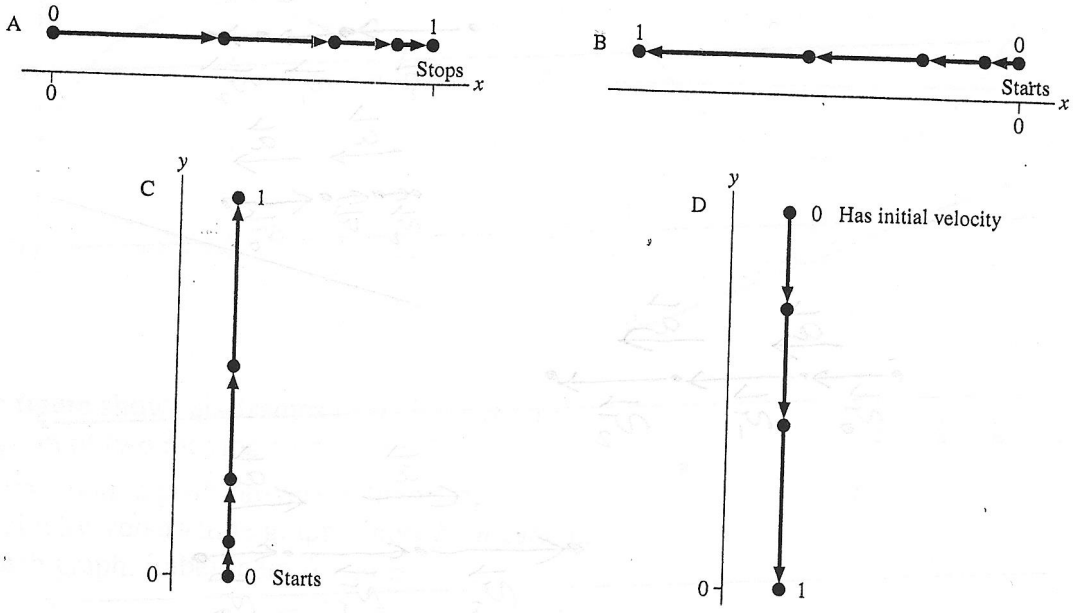


15. Below are three velocity-versus-time graphs. For each, draw the corresponding position-versus-time graph. Assume that the motion is horizontal and that $x_i = 0$.



2.4 Acceleration

16. The four motion diagrams below show an initial point 0 and a final point 1. A pictorial representation would define the five symbols: x_0, x_1, v_{0x}, v_{1x}, and a_x for horizontal motion and equivalent symbols with y for vertical motion. Determine whether each of these quantities is positive, negative, or zero. Give your answer by writing +, −, or 0 in the table below.



	A	B	C	D
x_0 or y_0	0	0	0	+
x_1 or y_1	+	−	+	0
v_{0x} or v_{0y}	+	0	0	−
v_{1x} or v_{1x}	0	−	+	−
a_x or a_y	−	−	+	−

17. The three symbols x, v_x, and a_x have eight possible combinations of *signs*. For example, one combination is $(x, v_x, a_x) = (+, -, +)$.

a. List all eight combinations of signs for x, v_x, a_x.

1. + + +
2. + + −
3. + − +
4. − + +
5. + − −
6. − + −
7. − − +
8. − − −

b. For each of the eight combinations of signs you identified in part a:
- Draw a four-dot motion diagram of an object that has these signs for x, v_x, and a_x.
- Draw the diagram *above* the axis whose number corresponds to part a.
- Use **black** and **red** for your $\vec{v}$ and $\vec{a}$ vectors. Be sure to label the vectors.