Oscillations and Waves — Position from Velocity Worksheet

Consider the following velocity as a function of time t:

$$v(t) = 6\,\frac{m}{s^2} \cdot t$$

Time is measured in seconds (s) and velocity in meters/second ($\frac{m}{s}$). However, we aren't going to carry units around, so

$$v(t) = 6t$$

← BTW, with the units we have in mind, this is VW-bug-level acceleration

Let's consider 15 time steps each 0.4 long

The midpoint times will be

0.2, 0.6, 1.0, ..., 5.4, 5.8

midpoint time of 0.0 to 0.4

midpoint time of 5.6 to 6.0

Fill in this table

	Midpoint time	Midpoint velocity
0→1	0.2	1.2
1→2	0.6	3.6
2→3	1.0	6.0
3→4		
4→5		
5→6		
6→7		
7→8		
8→9		
9→10		
10→11	4.2	25.2
11→12	4.6	27.6
12→13	5.0	30.0
13→14	5.4	32.4
14→15	5.8	34.8

You'll be using these midpoint velocities on the next page

Now we need to apply the theory and the midpoint approximation to get the positions

Step	Begin Time	Position at beginning of step
0	0.0	0.00
1	0.4	$0.48^{+1.2 \cdot 0.4}$
2	0.8	$1.92^{+3.6 \cdot 0.4}$
3	1.2	$+6.0 \cdot 0.4$
4		
5		
6		
7		
8		
9		
10		
11		
12		
13	5.2	$81.12^{+32.4 \cdot 0.4}$
14	5.6	$94.08^{+34.8 \cdot 0.4}$
15	6.0	108.00

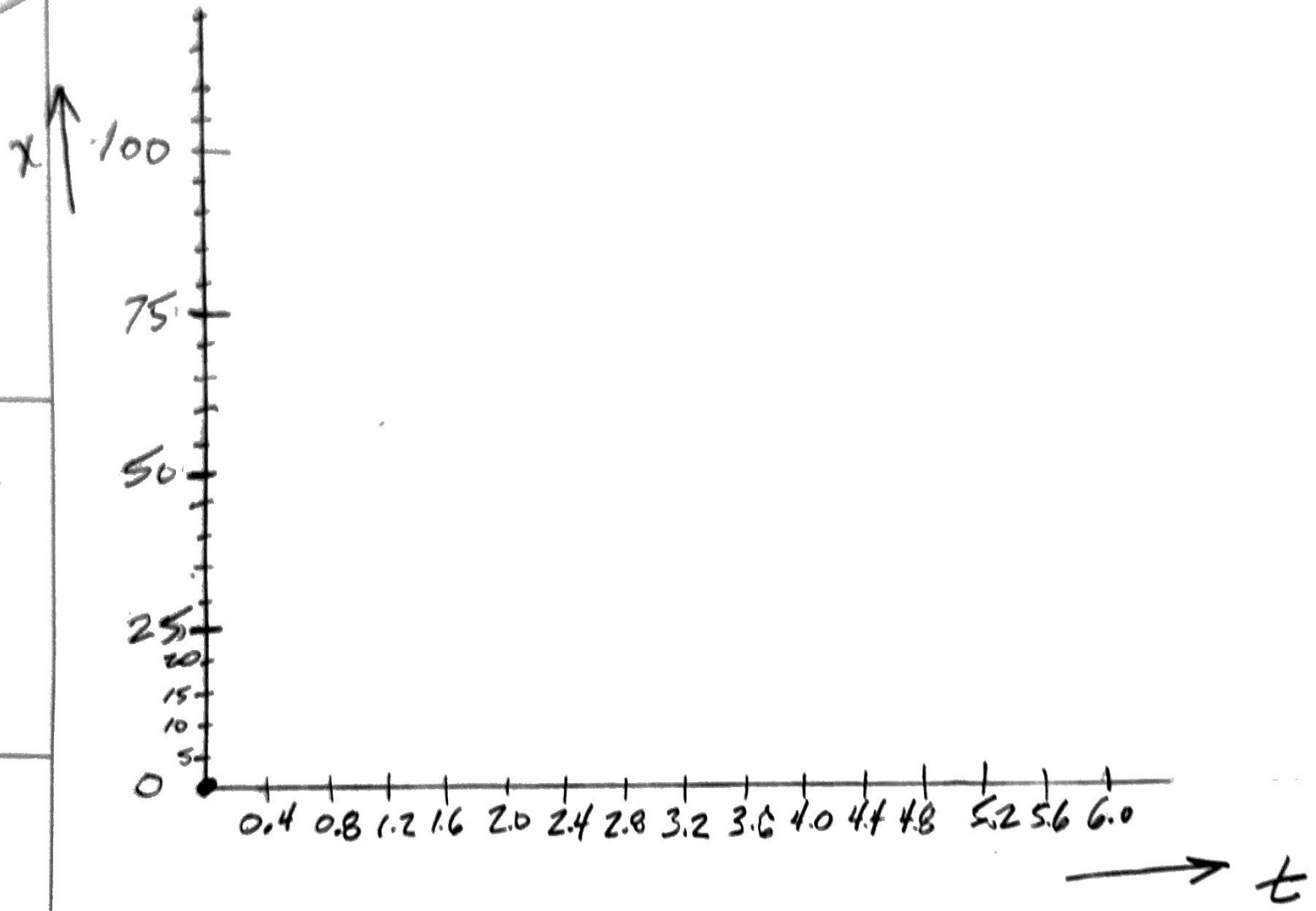
What formula do you need to make this step ??

How about

$$x_1 = x_0 + v\left(\frac{t_0+t_1}{2}\right)\Delta t$$

In general, you need

$$x_{i+1} = x_i + v\left(\frac{t_{i+1}+t_i}{2}\right)\cdot\Delta t$$


x
100
75
50
25
20
15
10
5
0
0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0 4.4 4.8 5.2 5.6 6.0
t