Linear Motion Practice Problems

1. 2012 AP Calculus AB Free-Response Question 6 (No Calculator)

For $0 \leq t \leq 12$, a particle moves along the x-axis. The velocity of the particle at time t is given by $v(t) = \cos\left(\frac{\pi}{6}t\right)$.

a. Assume that the particle is at position $x = -2$ at time $t = 0$. Find the position of the particle at time $t = 4$.

b. Assume that the particle is at position $x = 3$ at time $t = 8$. Find the position of the particle at time $t = 0$.

2. Adapted from 2015 AP Calculus AB Free-Response Question 3 (No Calculator)

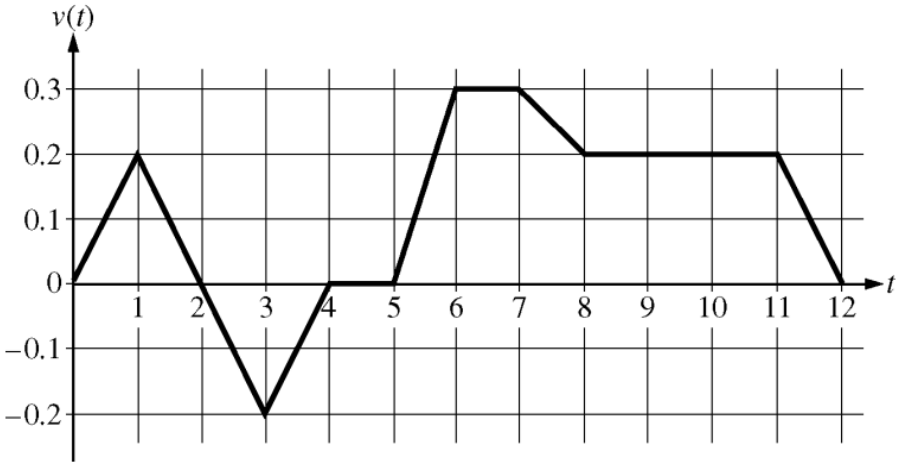
Johanna jogs back and forth along a straight path from home to the park. For $0 \leq t \leq 40$ Johanna's velocity is given by a differentiable function v. Selected values of $v(t)$, where t is measured in minutes and $v(t)$ is measured in meters per minute, are given in the table below.

t (minutes)	0	12	20	24	40
$v(t)$ (meters per minute)	0	200	240	–220	150

a. Assume she starts running at time $t = 0$ when she was 20 meters from her house jogging towards the park. Write an expression $J(t)$ involving integral that gives the Johanna's position. Using a right Riemann sum with the four subintervals indicated in the table, approximate Johanna's position at time $t = 40$ minutes.

3. 2009 AP Calculus AB Free-Response Question1 (Calculator)

Caren rides her bicycle along a straight rode from home starting to school. During the time interval $0 \leq t \leq 12$ minutes, her velocity $v(t)$, in miles per minute, is modeled by the piecewise-linear function whose graph is shown below.



a. At time $t = 10$ Caren was 2 miles from home. Write an expression involving an integral that gives Caren's position at time $t = 0$. Use the expression to find Caren's position at time $t = 0$.

b. At time $t = 0$ Caren starts riding her bike from home. Write an expression involving an integral that gives Caren's position at time $t = 8$. Find Caren's position at time $t = 8$.

4. 2014 AP Calculus AB Free-Response Question 4 (No Calculator)

Train A runs back and forth on an east-west section of railroad track. Train A's velocity, measured in meters per minute is given by a differentiable function $v_a(t)$, where time t is measured in minutes. Selected values for $v_a(t)$ is given in the table below.

t (minutes)	0	2	5	8	12
$v_A(t)$ (meters/minute)	0	100	40	−120	−150

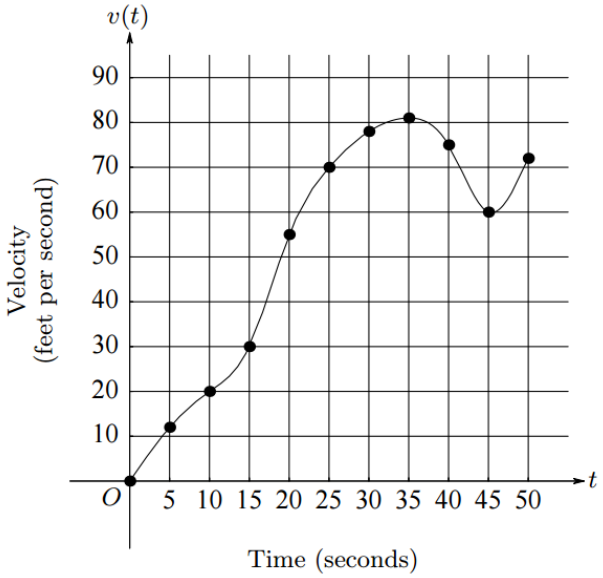
At time $t = 2$, train A's position is 300 meters east of the Origin Station, and the train is moving to the east. Write an expression involving an integral that gives the position of train A, in meters from the Origin Station, at time $t = 12$. Use a trapezoidal sum with three sum intervals indicated by the table to approximate the position of the train at time $t = 12$.

5. 2005 AP Calculus AB Free-Response Question Form B Question 3 (Calculator)

A particle moves along the x-axis so that its velocity v at time t, for $0 \le t \le 5$, is give by $v(t) = \ln(t^2 - 3t + 3)$. The particle is at a position $x = 8$ at time $t = 0$. Find the position of the particle at time $t = 2$.

6. Adapted from 1998 AP Calculus AB Free-Response Question 3 (Calculator)

The graph of the velocity $v(t)$, in ft/sec, of a car traveling on straight road, for $0 \le t \le 50$, is shown below. A table of values for $v(t)$, at 5 seconds intervals at time t, is shown to the right of the graph. At time $t = 40$ the car had traveled 2000 feet from its starting location.



t (seconds)	$v(t)$ (feet per second)
0	0
5	12
10	20
15	30
20	55
25	70
30	78
35	81
40	75
45	60
50	72

Write an expression involving an integral that gives the car's position at time $t = 0$. Use a midpoint Riemann sum of 4 equal length subintervals to approximate the car's position at time $t = 0$.