(1) At $t = 0$ a particle is at position $x = 1$ m (one meter). At $t = 2$ s (two seconds) the particle has position $x = 2$ m. At $t = 6$ s the particle has position $x = 6$ m.

(a) Assume the velocity is constant between $t = 0$ and $t = 2$ s. Calculate this velocity.

(b) Assume the velocity is constant between $t = 2$ s and $t = 6$ s. Calculate this velocity.

(b) Calculate the average velocity between $t = 0$ and $t = 6$ s.

(d) Make a graph of $x(t)$ during this time period.

(2) Suppose a particle has position given by

$$x(t) = x_0 + kt^3$$

where $k$ is a given constant. Calculate the velocity and acceleration of the particle as functions of time.

(3) Suppose a particle has position given by

$$x(t) = \alpha t - \beta \sqrt{t}$$

where $\alpha$ and $\beta$ are given constants. Calculate the velocity and acceleration of the particle as functions of time.

(4) Consider the same particle as in the previous problem. The position of the particle at $t = 0$ is $x = 0$ (you should be able to see that) and the position initially decreases as $t$ increases, that is, $x$ goes negative (you should be able to see that, too). At some time, the particle reaches a minimum position (largest negative value of $x$) and then its position increases as $t$ increases.

(a) Calculate at what later time the particle will again reach $x = 0$. (Answer: $t = (\beta/\alpha)^2$).

(b) Calculate the minimum value that $x$ reaches. *Hint:* At the moment the particle reaches its minimum position, its velocity will be zero. (Answer: $x = -\beta^2/(4\alpha)$).

(5) Suppose a particle has position given by

$$x(t) = \frac{A}{t^3} - \frac{B}{t^6} + C$$

where $A$, $B$, and $C$ are given constants. Calculate the velocity and acceleration of the particle as functions of time.
(6) Given this graph of $x(t)$, make a graph of $v(t)$:

(7) The speed of a particle moving in one dimension is plotted as a function of time below. Calculate the acceleration of the particle at (a) $t = 10\, \text{s}$ (b) $t = 25\, \text{s}$ and (c) $t = 40\, \text{s}$.

(8) Suppose a particle has velocity given by

\[ v(t) = 2k_1 t + 3k_2 t^2 + 4k_3 t^3 \]

where $k_1$, $k_2$ and $k_3$ are given constants. Calculate the acceleration of the particle as a function of time.

(9) Suppose a particle has velocity given by

\[ v(t) = \frac{\alpha}{\sqrt{t}} + \beta \sqrt{t} \]

where $\alpha$ and $\beta$ are given constants. Calculate the acceleration of the particle as a function of time.