The first meters of a 100-meter dash are covered in 2 seconds by a sprinter who starts from rest and accelerates with a constant acceleration. The remaining 90 meters are run with the same velocity the sprinter had after 2 seconds. ('82)

a. Determine the sprinter's constant acceleration during the first 2 seconds.

b. Determine the sprinter's velocity after 2 seconds have elapsed.

c. Determine the total time needed to run the full 100 meters.

d. On the axes provided below, draw the displacement vs time curve for the sprinter.
A world-class runner can complete a 100 m dash in about 10 s. Past studies have shown that runners in such a race accelerate uniformly for a time $t$ and then run at constant speed for the remainder of the race. A world-class runner is visiting your physics class. You are to develop a procedure that will allow you to determine the uniform acceleration $a$ and an approximate value of $t$ for the runner in a 100 m dash. By necessity your experiment will be done on a straight track and include your whole class of eleven students. ('06)

a. By checking the line next to each appropriate item in the list below, select the equipment, other than the runner and the track, which your class will need to do the experiment.

   ___Stopwatches     ___Tape measures     ___ Rulers     ___ Masking tape
   ___Metersticks     ___ Starter’s pistol  ___ String     ___ Chalk

b. Outline the procedure that you would use to determine $a$ and $t$, including a labeled diagram of the experimental setup. Use symbols to identify carefully what measurements you would make and include in your procedure how you would use each piece of the equipment you checked in part (a).

c. Outline the process of data analysis, including how you will identify the portion of the race that has uniform acceleration, and how you would calculate the uniform acceleration.
A student stands in an elevator and records his acceleration as a function of time. The data are shown in the graph above. At time $t = 0$, the elevator is at displacement $x = 0$ with velocity $v = 0$. Assume that the positive directions for displacement, velocity, and acceleration are upward. ('93)

a. Determine the velocity $v$ of the elevator at the end of each 5-second interval.
   
i. Indicate your results by completing the following table.
   
<table>
<thead>
<tr>
<th>Time Interval (s)</th>
<th>0–5</th>
<th>5–10</th>
<th>10–15</th>
<th>15–20</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v$ (m/s)</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

   ii. Plot the velocity as a function of time on the following graph.

b. Determine the displacement $x$ of the elevator above the starting point at the end of each 5-second interval.
   
i. Indicate your results by completing the following table.
   
<table>
<thead>
<tr>
<th>Time Interval (s)</th>
<th>0–5</th>
<th>5–10</th>
<th>10–15</th>
<th>15–20</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x$ (m)</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>
ii. Plot the displacement as a function of time on the following graph.

A 0.50 kg cart moves on a straight horizontal track. The graph of velocity \( v \) versus time \( t \) for the cart is given below. (’00)

4 A 0.50 kg cart moves on a straight horizontal track. The graph of velocity \( v \) versus time \( t \) for the cart is given below. (’00)

a. Indicate every time \( t \) for which the cart is at rest.

b. Indicate every time interval for which the speed (magnitude of velocity) of the cart is increasing.
c. Determine the horizontal position $x$ of the cart at $t = 9.0 \, \text{s}$ if the cart is located at $x = 2.0 \, \text{m}$ at $t = 0 \, \text{s}$.

d. On the axes below, sketch the acceleration $a$ versus time $t$ graph for the motion of the cart from $t = 0 \, \text{s}$ to $t = 25 \, \text{s}$.

e. From $t = 25 \, \text{s}$ until the cart reaches the end of the track, the cart continues with constant horizontal velocity. The cart leaves the end of the track and hits the floor, which is 0.40 m below the track. Neglecting air resistance, determine each of the following:

i. The time from when the cart leaves the track until it first hits the floor

ii. The horizontal distance from the end of the track to the point at which the cart first hits the floor
5  The vertical position of an elevator as a function of time is shown above.

a. On the grid below, graph the velocity of the elevator as a function of time.

b. i. Calculate the average acceleration for the time period \( t = 8 \text{ s} \) to \( t = 10 \text{ s} \).

ii. On the box below that represents the elevator, draw a vector to represent the direction of this average acceleration.