Name: Answer Key Date: ________________ Class: ____________

"Gaitway" to Acceleration Summative Assessment

1. What is acceleration?
   Acceleration is the rate of change in (derivative of) velocity with respect to time. Velocity is the rate of change in (derivative of) position with respect to time.

2. How can acceleration be calculated using position vs. time data?
   Velocity can be approximated by calculating slopes (derivatives) of position vs. time data, and acceleration can be approximated by calculating slopes (derivatives) of the resulting velocity vs. time data.

3. How can position be calculated using acceleration vs. time data?
   Velocity can be approximated by calculating areas (integrals) using acceleration vs. time data, and position can be approximated by calculating areas (integrals) using the resulting velocity vs. time data.

4. Solve the following problem:
   The velocity of a moving person measured at different times is provided in the following table:

time *t* (s)	0.0	0.2	0.4	0.6	0.8	1.0
velocity *v* (m/s)	0.0	0.6	1.0	0.0	-0.2	-0.8

   A. Calculate an approximate value for the acceleration of the person at $t = 0.6$ s. Show your work and justify your methodology.
   The instantaneous rate of change in the velocity with respect to time at $t = 0.6$ s can be approximated by calculating slope of velocity vs. time for the interval from $t = 0.4$ s to $t = 0.8$ s:

$$a \approx \frac{-0.2m/s - 1.0m/s}{0.8s - 0.4s} = -3m/s^2$$

   B. Calculate an approximate value for the change in position of the person during the time interval from $t = 0.0$ s to $t = 1.0$ s. Show your work and justify your methodology.
   The change in the position can be approximated by calculating the sum of the trapezoidal areas under velocity vs. time for each interval from $t = 0.0$ s to $t = 1.0$ s:

$$\Delta x \approx \left(\frac{0.0m/s + 0.6m/s}{2}\right)(0.2s - 0.0s) + \left(\frac{0.6m/s + 1.0m/s}{2}\right)(0.4s - 0.2s)$$
$$+ \left(\frac{1.0m/s + 0.0m/s}{2}\right)(0.6s - 0.4s) + \left(\frac{0.0m/s - 0.2m/s}{2}\right)(0.8s - 0.6s)$$
$$+ \left(\frac{-0.2m/s - 0.8m/s}{2}\right)(1.0s - 0.8s) = 0.2m$$