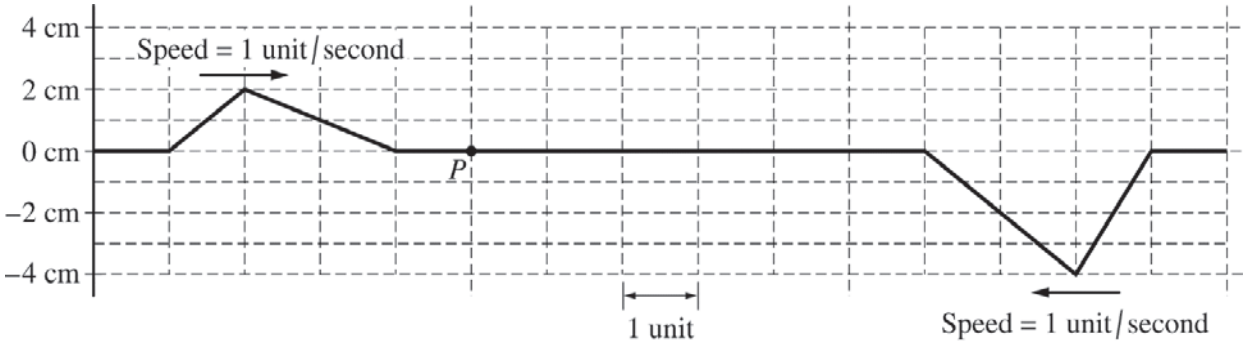
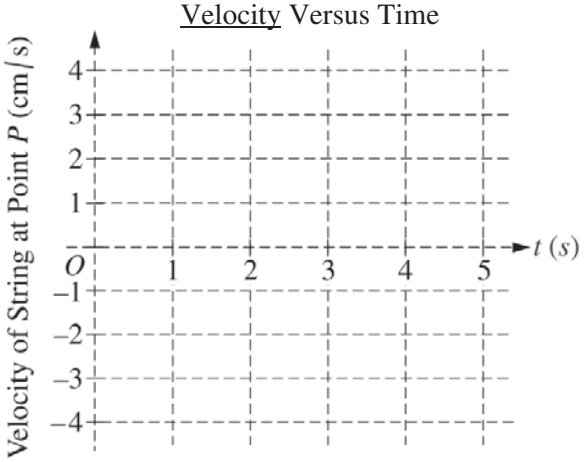


5. (7 points, suggested time 13 minutes)

Two wave pulses are traveling in opposite directions on a string. The shape of the string at $t = 0$ is shown above. Each pulse is moving with a speed of one unit per second in the direction indicated.

(a) Between time $t = 0$ and $t = 5$ seconds, the entire left-hand pulse approaches and moves beyond point P on the string. On the coordinate axes below, plot the velocity of the piece of string located at point P as a function of time between $t = 0$ and $t = 5$ seconds.



(b) At $t = 5$ s, the pulses completely overlap. On the grid provided below, sketch the shape of the entire string at $t = 5$ s.

Note: Do any scratch (practice) work on the grids on the following page. You will only be graded for the sketch made on the grid on this page.

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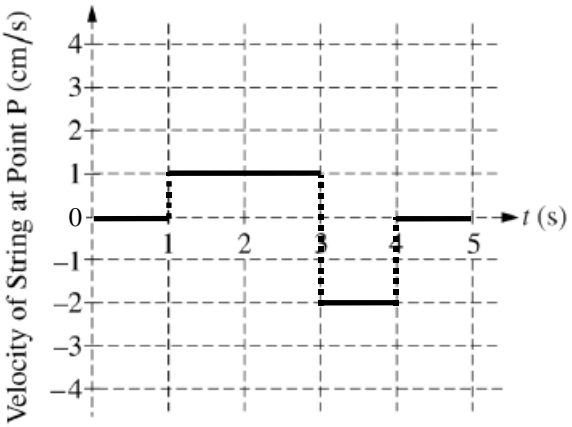
Question 5

7 points total **Distribution of points**

(a) 3 points

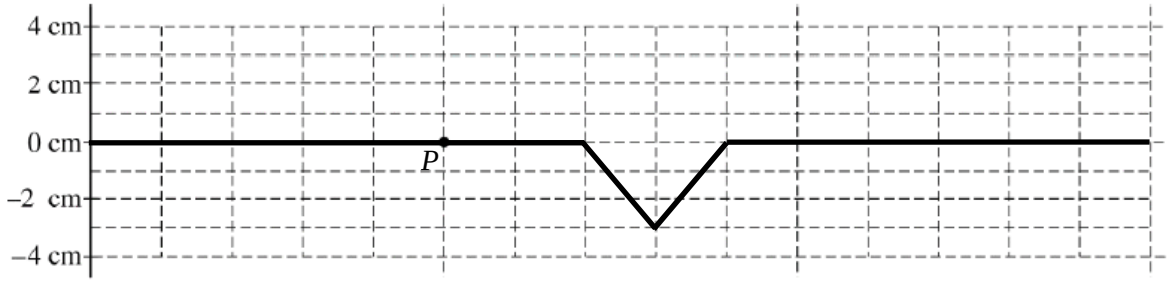


For indicating zero velocity for $0 < t < 1$ s and 4 s $< t < 5$ s — 1 point

For indicating two different non-zero constant velocities, one at the interval 1 s $< t < 3$ s and the other at the interval 3 s $< t < 4$ s — 1 point

For indicating a maximum velocity of $+1$ cm/s and a minimum velocity of -2 cm/s — 1 point

(b) 4 points



For drawing a single pulse and zero elsewhere — 1 point

For drawing a single pulse that is triangular (need not be isosceles or of two-unit extent) — 1 point

For drawing a single pulse with the correct maximum displacement from equilibrium of -3 cm — 1 point

For drawing a single pulse at the correct location that is two units wide between the 7th and 9th grid lines (i.e., 2 grid lines to the right of *P* to 4 grid lines to the right of *P*) and zero elsewhere — 1 point