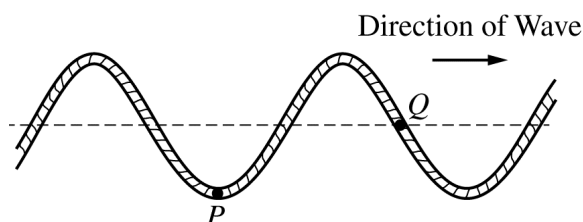


4. (7 points, suggested time 13 minutes)

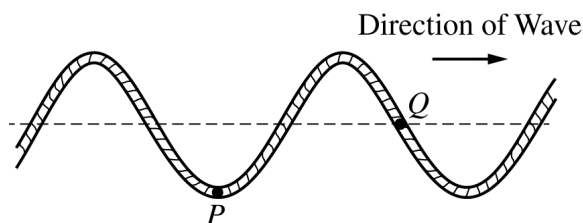
A transverse wave travels to the right along a string.

(a) Two dots have been painted on the string. In the diagrams below, those dots are labeled P and Q .

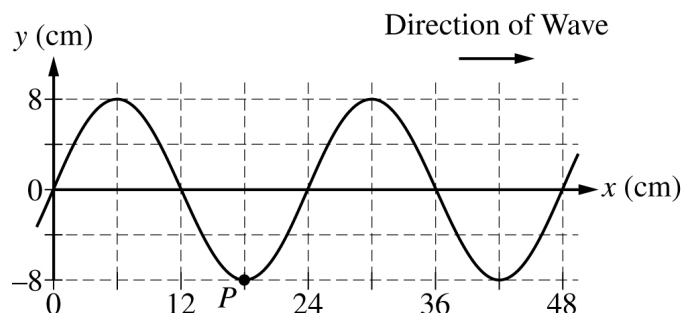
- i. The figure below shows the string at an instant in time. At the instant shown, dot P has maximum displacement and dot Q has zero displacement from equilibrium. At each of the dots P and Q , draw an arrow indicating the direction of the instantaneous velocity of that dot. If either dot has zero velocity, write " $v = 0$ " next to the dot.



- ii. The figure below shows the string at the same instant as shown in part (a)i. At each of the dots P and Q , draw an arrow indicating the direction of the instantaneous acceleration of that dot. If either dot has zero acceleration, write " $a = 0$ " next to the dot.



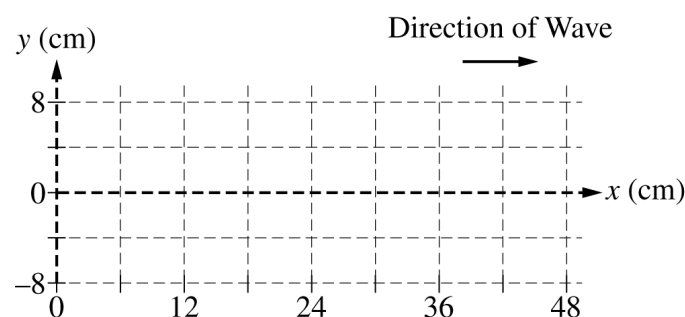
The figure below represents the string at time $t = 0$, the same instant as shown in part (a) when dot P is at its maximum displacement from equilibrium. For simplicity, dot Q is not shown.



(b)

- i. On the grid below, draw the string at a later time $t = T/4$, where T is the period of the wave.

Note: Do any scratch (practice) work on the grid at the bottom of the page. Only the sketch made on the grid immediately below will be graded.



- ii. On your drawing above, draw a dot to indicate the position of dot P on the string at time $t = T/4$ and clearly label the dot with the letter P .
- (c) Now consider the wave at time $t = T$. Determine the distance traveled (not the displacement) by dot P between times $t = 0$ and $t = T$.

The grid below is provided for scratch work only. Sketches made below will not be graded.

