

2018 SCORING GUIDELINES

Question 4

7 points total

Distribution
of points

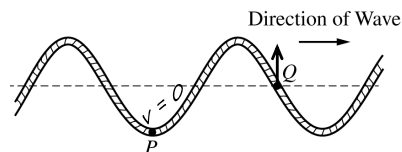
A transverse wave travels to the right along a string.

- (a) LO / SP: 3.A.1.1 / 1.5; 6.A.1.2 / 1.2
4 points

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

- i. 2 points

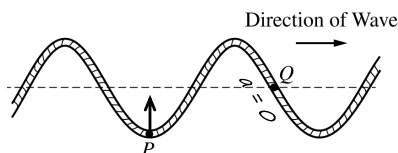
The figure below shows the string at an instant in time. At the instant shown, dot P has maximum displacement and dot Q has zero displacement from equilibrium. At each of the dots P and Q , draw an arrow indicating the direction of the instantaneous velocity of that dot. If either dot has zero velocity,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



For " $v = 0$ " at point P	1 point
For an upward arrow at point Q	1 point

- ii. 2 points

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.



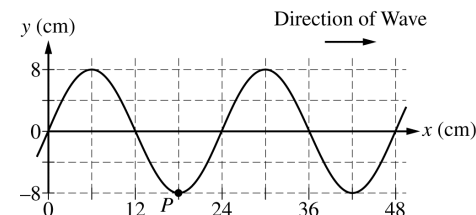
For an upward arrow at point P	1 point
For " $a = 0$ " at point Q	1 point

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Question 4 (continued)

Distribution
of points

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.

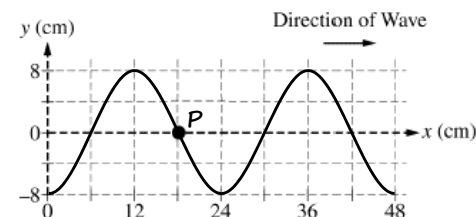


- (b) LO / SP: 3.A.1.1 / 1.5; 6.A.1.2 / 1.2
2 points

- i. 1 point

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.



For a curve shifted to the right by 1/4 of a wavelength (1 gridline) with the same wavelength as the original wave (for example, as indicated by a negative minimum at $x = 0$)	1 point
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- ii. 1 point

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 .

For point P on the string and at the dot's original x position, 3/4 of a wavelength (3 grid units) to right of origin	1 point
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2018 SCORING GUIDELINES**Question 4 (continued)****Distribution
of points**

(c) LO / SP: 6.A.3.1 / 1.4
1 point

Now consider the wave at time $t = T$. Determine the distance traveled (not the displacement) by dot P between times $t = 0$ and $t = T$.

For the correct numerical answer: 32 cm	1 point
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Learning Objectives (LO)

LO 3.A.1.1: The student is able to express the motion of an object using narrative, mathematical, and graphical representations. [See Science Practice 1.5]

LO 6.A.1.2: The student is able to describe representations of transverse and longitudinal waves. [See Science Practice 1.2]

LO 6.A.3.1: The student is able to use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. [See Science Practice 1.4]