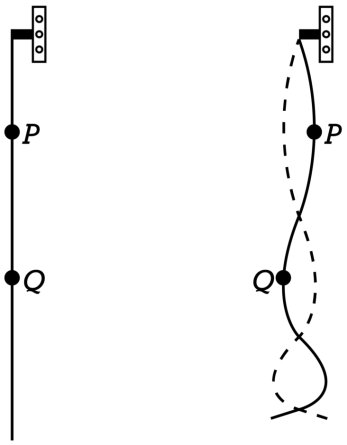
Flipping Physics Lecture Notes:

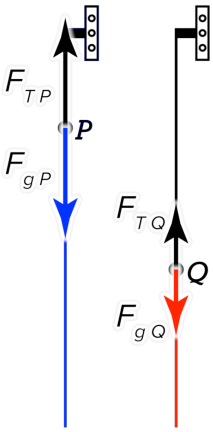
2016 #5 Free Response Question - AP Physics 1 - Exam Solution
http://www.flippingphysics.com/ap1-2016-frq5.html

This is a Paragraph Argument Short Answer question.

The figure shows a uniformly thick rope hanging vertically from an oscillator that is turned off. When the oscillator is turned on and set to a certain frequency, the rope forms the standing wave as shown. P and Q are two points on the rope.



(a) The tension at point P is greater than the tension at point Q. Briefly explain why.



Every bit of rope below each point pulls downward on that point with a force of gravity equal to the total mass below the point times the acceleration due to gravity. A force of tension acts upward on each point. Because the rope is not accelerating, the force of tension and force of gravity are equal in magnitude at each point on the rope. Because P has more mass below it than Q, P has a larger force of gravity, and therefore a larger force of tension.

(b) A student hypothesizes that increasing the tension in a rope increases the speed at which waves travel along the rope. In a clear, coherent paragraph-length response that may also contain figures and/or equations, explain why the standing wave shown above supports the student's hypothesis.

As we move up the rope, the distance between nodes increases, therefore the wavelength increases. The frequency of the oscillation of the rope is constant throughout the rope. Therefore, because wave speed equals wavelength times wave frequency, the wave speed must increase as we move up the rope. From part (a) we also know that the force of tension increases as we move up the rope. Therefore, an increase in force of tension in a rope increases the speed at which waves travel along the rope.

From the Scoring Guidelines, you gain 1 point out of 7 for this question for part (b):
"For a response that has sufficient paragraph structure, as described in the published requirements for the paragraph-length response."

Please make sure you have watched my video describing Qualitative/Quantitative Translation and Paragraph Argument Short Answer! https://www.flippingphysics.com/qqt-pasa.html