Flipping Physics Lecture Notes:

Quantitative/Qualitative Translation (QQT) and
Paragraph Argument Short Answer (PASA) for AP Physics Explained!
http://www.flippingphysics.com/qqt-pasa.html

Links to my solutions to the Free Response Questions from publicly released, past AP Physics 1 exams and the category for each of those Free Response Questions:
https://www.flippingphysics.com/ap-physics-1-review.html

From page 206 of the 2020 AP Physics 1 Course and Exam Description (CED)[1]:
"Every exam includes one experimental design question, one quantitative/qualitative translation question, one paragraph short answer question, and two additional short answer questions. These questions may appear in any order on the AP Exam."

In summary, every AP Physics 1 exam will have five questions:[2]

1) Quantitative/Qualitative Translation or QQT (12 points)[3]
2) Paragraph Argument Short Answer or PASA (7 points)
3) Experimental Design Question or EDQ (12 points)
4) Two additional Short Answer questions or SA (7 points each)

Quantitative: relating to, measuring, or measured by the quantity of something rather than its quality.
Qualitative: relating to, measuring, or measured by the quality of something rather than its quantity.

Therefore, reasoning something quantitatively will involve algebraic manipulation of variables, however, reasoning something qualitatively will involve writing out words in paragraph form.

With regards to Quantitative/Qualitative Translation, from page 43 of the 2019 CED:
"The AP Physics 1 Exam requires students to be able to re-express key elements of natural phenomena across multiple representations in the domain. This skill appears in the Qualitative/Quantitative Translation (QQT), a long free-response question that requires students to go between words and mathematics in describing and analyzing a situation. A QQT question might ask students to work with multiple representations or to evaluate another student's words or representations. Representations include mathematical equations, narrative descriptions, graphs, diagrams, and data tables.

Students who have primarily been exposed to numerical problem solving often struggle with a QQT question because it requires students to have a more conceptual understanding of both content and representations. Opportunities to translate between different representations, including equations, diagrams, graphs, and written descriptions, will help students prepare for the QQT question."

In other words, you will need to be able to go back and forth between quantitative (equations) and qualitative (words). A QQT example from the Free Response Question #3 from the 2017 AP Physics 1 exam:

In part (a), you are asked to determine where a disk should strike a rod to maximize the final angular velocity of the rod. You are asked to "Briefly explain your reasoning without manipulating equations." This is a *qualitative explanation*. This explanation requires that you write out words to explain the physics behind your reasoning.

In parts (b) & (c), you are given equations which *might* describe the angular speed of the rod after the collision. You are then asked to take these quantitative student answers (equations) and translate them to

[1] https://apstudents.collegeboard.org/ap/pdf/ap-physics-1-course-and-exam-description.pdf
[2] Due to the coronavirus pandemic, the 2020 exam only had one QQT and one PASA.
[3] Point values are from page 206 of the 2020 AP Physics 1 Course and Exam Description (CED).

qualitatively reason if the equations make logical sense. Again, you are asked to “Briefly explain your reasoning without deriving an equation”.

In part (d) the described event changes slightly and you are asked to do your own quantitative analysis and derive an equation for the final angular of the rod.

In part (e) the described event is changed even further, and you are asked to qualitatively determine how the final angular velocity of the rod changes.

Hopefully you can see how this problem requires that you translate back and forth between the quantitative and the qualitative. Now, quantitative does not have to include equations. You could be given data collected by students and presented in a data table or a graph. You also could be given student qualitative arguments about physics phenomena and be expected to qualitatively explain what is correct or incorrect about the student’s qualitative argument. In other words, you have to be ready to look at data and arguments and be able to respond both quantitatively and qualitatively about the physics.

Now let’s look at Paragraph Argument Short Answer.

From page 61 of the 2019 CED:
“Students will be asked to give a paragraph-length response to demonstrate their ability to communicate their understanding of a physical situation in a reasoned, expository analysis. For full credit, the response should be a coherent, organized, and sequential description of the analysis of a situation that draws from evidence, cites physical principles, and clearly presents the student’s thinking. Full credit may not be earned if the response contains any of the following: principles not presented in a logical order, lengthy digressions within an argument, or a lack of linking prose between equations or diagrams.”

Expository: “intended to explain or describe something”

In other words, a Paragraph Argument Short Answer is not an equation derivation, it is a paragraph of sentences where you explain the physics. You are certainly going to use equations because equations are what the physics principles are based on, however, you need to not just write out equations. Instead you need to write a paragraph and use those equations to argue that your reasoning is correct. Be careful to present your argument in a logical order and, while you may include a few equations or diagrams, you need to make sure your answer is mostly words creating sentences which creates a paragraph.

A PASA example from Free Response Question #5 from the 2015 AP Physics 1 exam:

In part (a) the motion of two identical spheres is described. One is in projectile motion and one is in free fall only. After a full description of the motion, you are asked to draw free body diagrams of the force(s) acting on the spheres. No explanation is asked for.

In part (b) you are asked to draw a graph of the horizontal components of the velocities of each sphere as a function of time. Still no explanation is asked for.

Notice that this Paragraph Argument Short Answer question has yet to ask for any explanation. Please do not waste time writing out explanations when you are not asked to.

Part (c) begins with “In a clear, coherent, paragraph-length response …”

Hopefully you recognize that this is where the Paragraph Argument Short Answer goes. In every AP Physics 1 exam so far, there has been a free response question with this statement in it. So please, answer with mostly words in paragraph form.

The full question in part (c) is “In a clear, coherent, paragraph-length response, explain why the spheres reach the ground at the same time even though they travel different distances. Include references to your answers to parts (a) and (b).”

My answer to the question is “As shown in Part (a), the only force acting on each sphere is the force of gravity. Therefore, each sphere will have an acceleration in the y-direction which will equal –g. There is no force in the x-direction on either sphere, so, as shown in Part (b), both spheres will have zero acceleration in the x-direction. And any motion in the x-direction will not affect how long it takes the spheres to reach the ground. The initial velocity in the y-direction for both spheres is zero. The displacement in the y-direction for both spheres is –H. Therefore, we can

use the uniformly accelerated motion equation $\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y\Delta t^2$ to show that both spheres will

reach the ground at the same time. We have shown that, other than the change in time, all of the variables in this equation are the same for both spheres, therefore the remaining variable, change in time, must be the same.

Notice I did refer to my answers in parts (a) and (b), and, while I did refer to variables and an equation, I did not derive anything. Instead, I used words, to form sentences, to form a coherent paragraph argument which answers the question.

If you recall, I have been stressing that you need to let go of your numbers dependency. Hopefully you can see that because you will have to do Quantitative Qualitative Translation and Paragraph Argument Short Answer, you really do need to stop plugging in numbers so much and instead look at the equations and understand what they physically mean. When you are able to do that, you will be able to answer these questions more easily.