

Prem-Raj Ruffin 00:15

Hello everybody, let's get started on another great physics problem. This time we're going to talk about Romeo and Juliet one more time. So we have a question here. Romeo is at  $x$  equals zero at  $t$  equals zero.

Prem-Raj Ruffin 00:33

So we're saying he's at position zero and time is zero when he sees Juliet six meters ahead. He begins to run towards her at speed of five meters per second. She in turn begins to accelerate towards him at minus two meters per second squared.

Prem-Raj Ruffin 00:55

When and where will they cross? Suppose she moves away from him with positive acceleration. Find the maximum acceleration for which he will catch up with her. Okay, so I started with two graphs. On this side here we have the graph of Romeo and over here the graph of Juliet.

Prem-Raj Ruffin 01:23

So let's talk about this. So Romeo is running, currently running at five meters per second. Juliet is, while Romeo is running towards her, she begins to accelerate towards him at minus two meters per second squared.

Prem-Raj Ruffin 01:56

So in the graph, I drew a constant acceleration of mine. for a certain amount of time. And then it says, when and where will they cross? Suppose she moves away with positive acceleration. So at this point here, she starts to run away from him with positive acceleration.

Prem-Raj Ruffin 02:23

Alright. So Romeo and Juliet will meet when they have the same velocity. This is a very important concept to remember. That Romeo and Juliet, at the time of their meeting, they will have the same velocity.

Prem-Raj Ruffin 02:46

So that would make us have, or an equation here,  $5 = 18$ . So if they have the same velocity, this information right here, comes from this part of the graph all right so if I want to find the change in the velocity I would multiply acceleration times the time because it's in the shape of a rectangle and I equated that to the current velocity of Romeo meaning that Juliet will have the same velocity as Romeo now in the problem Juliet was running from at the beginning of the problem Juliet was running with a negative 2 meters per second square the acceleration so on my velocity graph I start out with a minus 2 so my position can be expressed by one half  $vt$  because it's in the shape of a triangle going back to my acceleration graph my  $\Delta B$  for the first part is going to be minus  $2t$  I take this information and I substitute it into the velocity so my position for Juliet so far is minus  $T$  squared but remember that Romeo saw Juliet at 6 meters ahead of him so you have to put 6 at the beginning so I have an expression for Juliet as  $6 - t^2$  I equate that to Romeo on this side I have Romeo's position and on this side I have Juliet's position solving for  $t$  so once I equate get my information collected on one side here I factored out this minus sign which means I change the signs on all of these terms and I factor and I come out with two times so here I have a time of minus six and a time of one I'm going to ignore the minus six because we can't have a negative time so I go with my positive time that's the time when they meet they're going to meet at one second.

Prem-Raj Ruffin 06:04

Let's write that down. One second. So where do they meet? Well, I plug one into my position equation for Romeo and I get five. It equals five. So to help out, here's a short position graph of Romeo and Juliet and the time notice that Romeo's velocity is increasing, increasing and Juliet's is decreasing.

Prem-Raj Ruffin 06:56

All right. Now one thing interesting about these graphs is that notice that the green curve right here is above the blue, blue curve. This means Juliet is above Romeo. But then at one second, Juliet starts to run away.

Prem-Raj Ruffin 07:25

But Romeo is now farther away from Juliet. All right. So let's start to calculate here. We found the position in the time they met. Now we need to find out what maximum acceleration did she run? So I have a kinematics equation here and I want you to notice that I wrote it without the  $\Delta x$ .

Prem-Raj Ruffin 07:55

So I have an  $x_i$  on this side. An initial position and a final position. And I included a short graph here to illustrate a point about a constant acceleration, what the graph would look like. So, my  $\Delta v$ , now, is  $a \times t$ .

Prem-Raj Ruffin 08:38

I'm going to take this information from here, and I'm going to substitute it into my velocity equation, and I get  $1 \frac{1}{2} a t^2$ . Now, remember, we have to add 6. for Juliet because she's ahead of him and we're going to equate this position now to Romeo on the left Juliet on the right here I have two unknowns so I want to get rid of this  $A$  with a simple substitution of  $\frac{5}{t}$  I substitute that in I end up with  $5t$  equals  $6 + \frac{5}{2}t$  notice that this  $t$  cancels with that two in this expression with the five halves I multiply both sides of this equation by two and I end up with  $10t$  equals  $12 + 5t$  which gives me a time of  $\frac{12}{5}$  once again I'm going to find I'm looking for my maximum acceleration so I'm going to substitute  $\frac{12}{5}$  in for  $t$  solve for  $a$  and I get  $\frac{25}{12}$  over 12 which means Juliet's maximum acceleration was 2.08 meters per second square what a fantastic problem using pure logic in some graphs to help explain something that some would consider to be extremely difficult Now I want you to go back over this problem again and look and See if you can identify and come up with reasons why I did the substitutions that I did It's very important for you to understand all of that Because when you end up doing further problems These same ideas you can use over and over again.

Prem-Raj Ruffin 11:36

Thanks for listening