Physics in the classroom

Lecture 2
Distance

Speed

Acceleration
Strip Chart

Distance (m) vs. Time (s)

Physics 304
Strip Chart

Distance (m)

Time (s)

Physics 304
Strip Chart

Distance (m) vs. Time (s)

Physics 304
Strip Chart

Distance (m)

Time (s)

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Graph

Distance (m)

Time (s)

Physics 304
Graph of race

Time (s)

Distance (m)

Physics 304
Slope = rise over run
rise = distance in meters
run = time in seconds
slope = distance divided by time
slope = speed!
Units: meters divided by seconds
Units: meters per second
m/s
Graph

rise = 100 meters
run = 10 seconds

Lets do the numbers for the red one
slope = 100 meters divided by 10 seconds
slope = 10 meters per second
slope = speed = 10 m/s
Let's do the numbers for the blue one:
slope = \frac{50 \text{ meters}}{10 \text{ seconds}}
slope = 5 \text{ meters per second}
slope = \text{speed} = 5 \text{ m/s}
What does the race look like on this kind of graph?

Speed Graph of race

Time (s)

Speed (m/s)
Now what does the area under the line tell us? The area under the blue curve is just a square 5 m/s high and 10 seconds wide. Multiplying the height by the width we get $5 \times 10 = 50$ for the numeric part and meters per second times seconds for the units. The seconds cancel giving simply meters, so our answer is 50 meters, which is what we read from the distance graph!

A similar calculation for the red line gives 100 meters for the red line, which is again the same as what we read from the distance graph!
Now what does the area under this line tell us? The area of a triangle is $\frac{1}{2}$ height times base. Height - meters per second base - seconds area units - meters per second time seconds the seconds cancel leaving meters again The area under the curve is the distance traveled.
Let's do the math.
1/2 height times the base.
1/2 (10 m/s) × (5 s) = 25 m
Now let's take a look at the slope in this kind of graph.

Slope = rise over run
What are the units of this slope?
Rise - speed - meters per second
run - time - seconds
slope - meters per second per second
acceleration - m/s²
Let's do the math:
acceleration = slope = rise/run
= \frac{(10 \text{ m/s})}{5 \text{ s}}
= 2 \text{ m/s}^2
Recall that the area under the line is equal to the distance. Distance = $\frac{1}{2} \text{ (speed) x (time)}$
or in shorthand $d = \frac{1}{2} v t$ where $v$ is for velocity or speed. Also recall that acceleration = speed divided by time, or $a = \frac{v}{t}$
this can be rearranged algebraically to give $v = a t$
Substituting this back into our first equation, we have, $d = \frac{1}{2} (a t) t = \frac{1}{2} a t^2$
Finally this can be rearranged to give $a = \frac{(2d)}{t^2}$, which is the equation that appears in your lab write-up.