7.1 Integral as Net Change

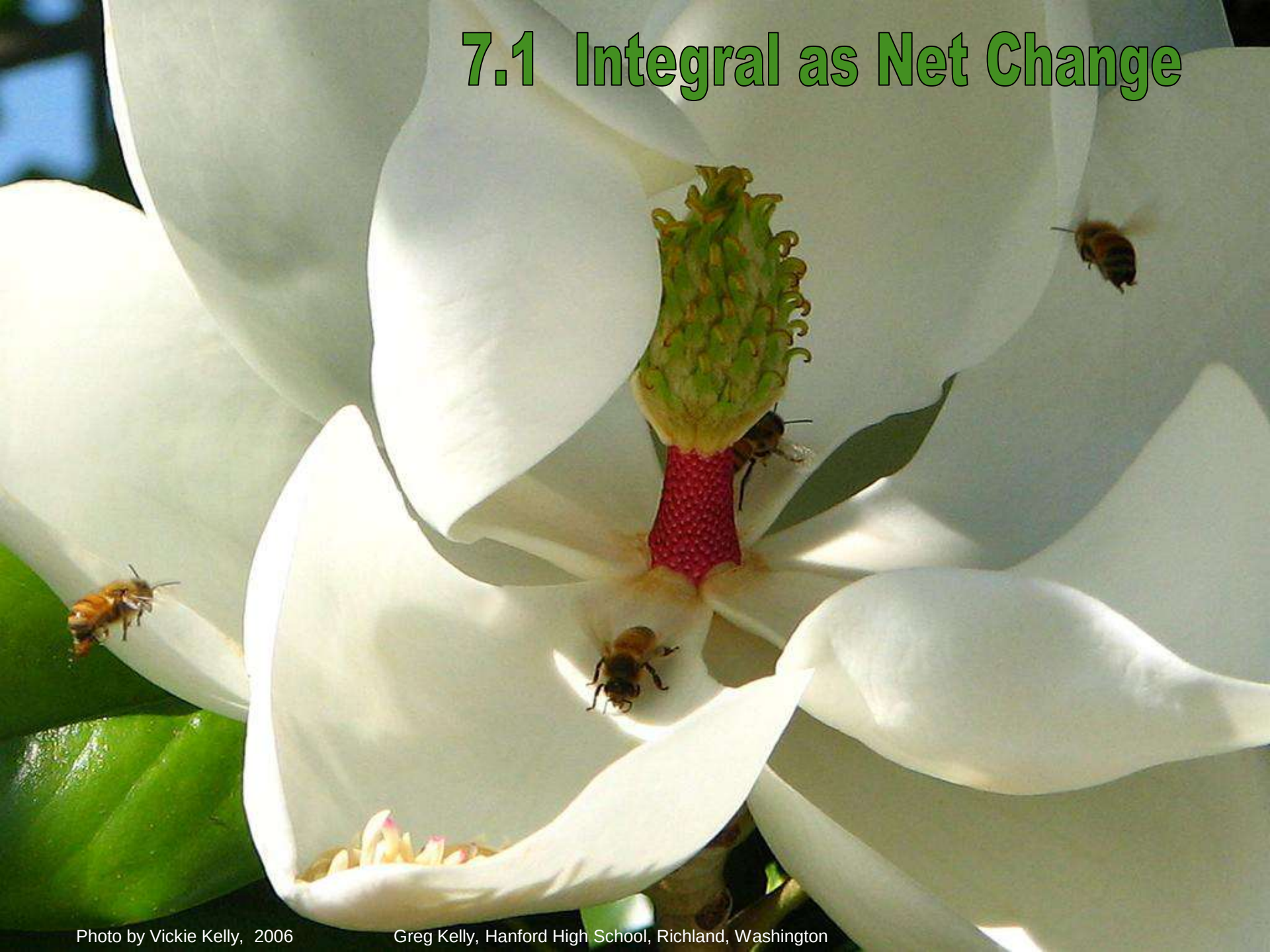


Photo by Vickie Kelly, 2006

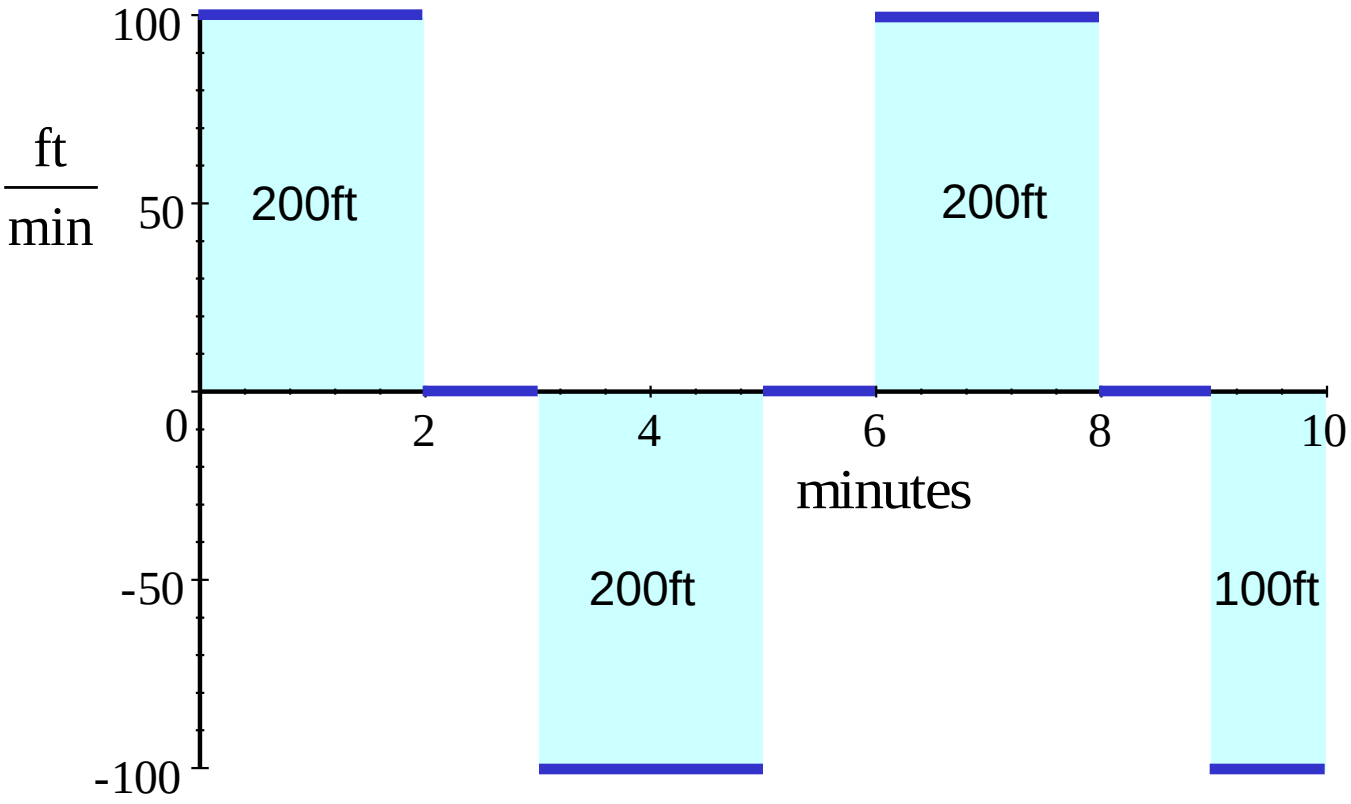
Greg Kelly, Hanford High School, Richland, Washington

A honey bee makes several trips from the hive to a flower garden. The velocity graph is shown below.

What is the total distance traveled by the bee?

$$200+200+200+100=700$$

700 feet



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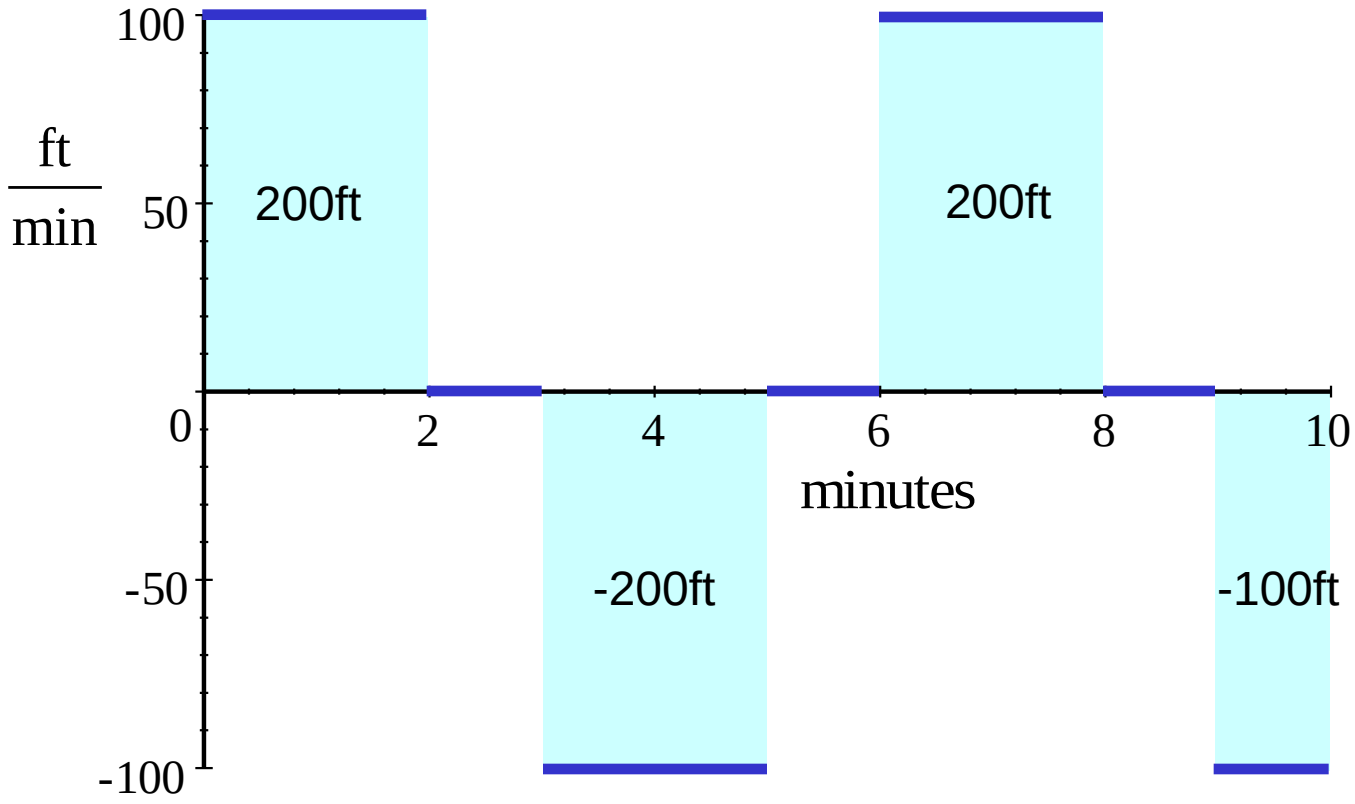
What is the displacement of the bee?

$$200 - 200 + 200 - 100 = 100$$

100 feet towards the hive



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To find the displacement (position shift) from the velocity function, we just integrate the function. The negative areas below the x-axis subtract from the total displacement.

$$\text{Displacement} = \int_a^b V\ \ t\ \ dt$$

To find distance traveled we have to use absolute value.

$$\text{Distance Traveled} = \int_a^b \left| V\ \ t\ \right| dt$$

Find the roots of the velocity equation and integrate in pieces, just like when we found the area between a curve and the x-axis. (Take the absolute value of each integral.)

Or you can use your calculator to integrate the absolute value of the velocity function.

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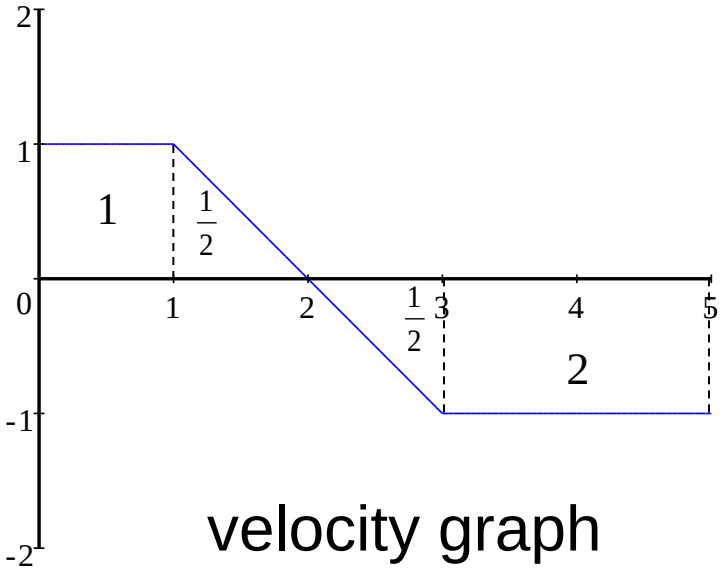
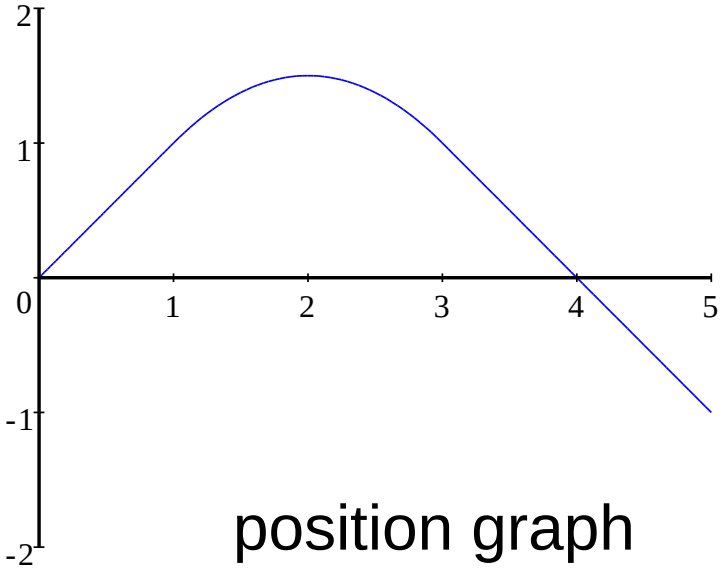


velocity graph



position graph

Displacement:

$$1+\frac{1}{2}-\frac{1}{2}-2=-1$$

Distance Traveled:

$$1+\frac{1}{2}+\frac{1}{2}+2=4$$

Every AP exam I have seen has had at least one problem requiring students to interpret velocity and position graphs.

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