

Directions: Complete each Free Response Question on the FRQ Planning/Solution Template.

1)

$t$ (seconds)	0	10	40	60
$B(t)$ (meters)	100	136	9	49
$v(t)$ (meters per second)	2.0	2.3	2.5	4.6

Ben rides a unicycle back and forth along a straight east-west track. The twice-differentiable function  $B$  models Ben's position on the track, measured in meters from the western end of the track, at time  $t$ , measured in seconds from the start of the ride. The table above gives values for  $B(t)$  and Ben's velocity,  $v(t)$ , measured in meters per second, at selected times  $t$ .

- Use the data in the table to approximate Ben's acceleration at time  $t = 5$  seconds. Indicate units of measure.
- Using correct units, interpret the meaning of  $\int_0^{60} |v(t)| dt$  in the context of this problem. Approximate  $\int_0^{60} |v(t)| dt$  using a left Riemann sum with the subintervals indicated by the data in the table.
- For  $40 \leq t \leq 60$ , must there be a time  $t$  when Ben's velocity is 2 meters per second? Justify your answer.
- A light is directly above the western end of the track. Ben rides so that at time  $t$ , the distance  $L(t)$  between Ben and the light satisfies  $(L(t))^2 = 12^2 + (B(t))^2$ . At what rate is the distance between Ben and the light changing at time  $t = 40$ ?

2)

Let  $R$  be the region in the first quadrant enclosed by the graphs of  $y = 2x$  and  $y = x^2$ , as shown in the figure above.

- Find the area of  $R$ .
- The region  $R$  is the base of a solid. For this solid, at each  $x$  the cross section perpendicular to the  $x$ -axis has area  $A(x) = \sin\left(\frac{\pi}{2}x\right)$ . Find the volume of the solid.
- Another solid has the same base  $R$ . For this solid, the cross sections perpendicular to the  $y$ -axis are squares. Write, but do not evaluate, an integral expression for the volume of the solid.

