## Luke Takes a Trip (Section 5.3)

The figure shows the velocity of Luke's trip from Beggar's Canyon.
Positive velocities take him **away** from Beggar's Canyon and
negative velocities take him **toward** Beggar's Canyon.

The formula of the velocity, in km/hr, is given by
$$v(t) = 6(t-3)(t-6)(t+1) = 6t^3 - 48t^2 + 54t + 108,$$
where t is in hours.
Recall $v(t) = s'(t)$, where $s(t)$ is his position from Beggar's Canyon.

v(t) (km per hour)

108

1   2   3   4   5   6   t (hrs)
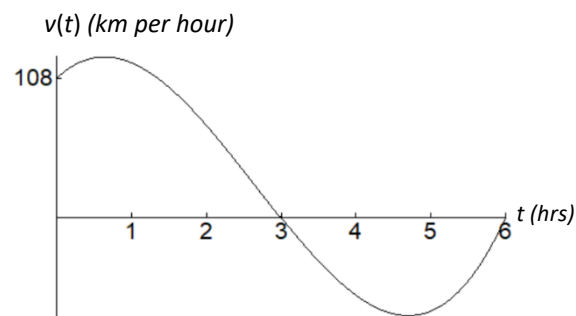
Complete the blanks. Use the word bank where provided.

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Plot1   Plot2   Plot3
∎\Y₁⊟6(X−3)(X−6)(X+1)

a. How many km is Luke away from Beggar's Canyon at the end of the 6 hours?

At the end of 6 hours Luke is a distance of ____**108**____ km from Beggar's Canyon.
Represent this as an integral:

$$\int_0^6 \left(\boxed{s'(t)} \right) dx = \boxed{108}$$

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$\int_0^6 (Y_1)dX$
108

b When is Luke farthest from Beggar's Canyon? How far away was he at that time?

At $t =$ __**3**__ hours Luke is the maximum distance of __**256.5**__ km from Beggar's Canyon.
When the velocity changes from positive to negative Luke turns direction and he moves toward the canyon.
Represent this as an integral:

$$\int_0^3 \left(\boxed{s'(t)} \right) dx = \boxed{256.5}$$

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$\int_0^3 (Y_1)dX$
256.5

c. At the start of the trip, Luke had set his "trip odometer," which records km traveled, to 0 km.
Report the total number of kilometers the odometer reads at the end of the trip, i.e., after 6 hours.
____**405**____ km. The following graph of Luke's speed may be helpful.

Method 1:
The total odometer distance is the area under the speed $y = |v(t)|$.

Represent this as an integral:

$$\int_0^6 \left(\boxed{|s'(t)|} \right) dx = \boxed{405}$$

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$\int_0^6 (|Y_1|)dX$
405
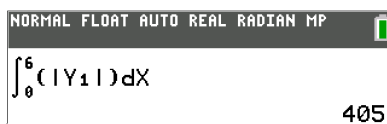
Method 2:
The area under the velocity $y = v(t)$ from $t = 0$ to $t = 3$ is the distance Luke moved **away from** Beggar's Canyon, 256.5 km
The area under the velocity $y = v(t)$ from $t = 3$ to $t = 6$ is the distance Luke moved **toward** Beggar's Canyon, 148.5 km

v(t) (km per hour)

108

256.5

1   2   3   4   5   6   t (hrs)

−148.5

Velocity

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$\int_3^6 (Y_1)dX$
−148.5
256.5+148.5
405

|v(t)| (km per hour)

108

256.5

148.5

1   2   3   4   5   6   t (hrs)

Speed
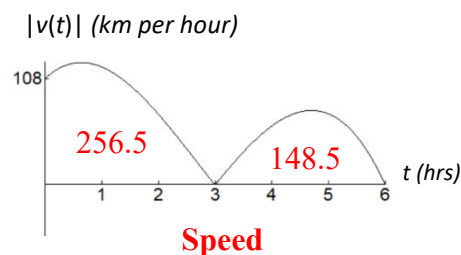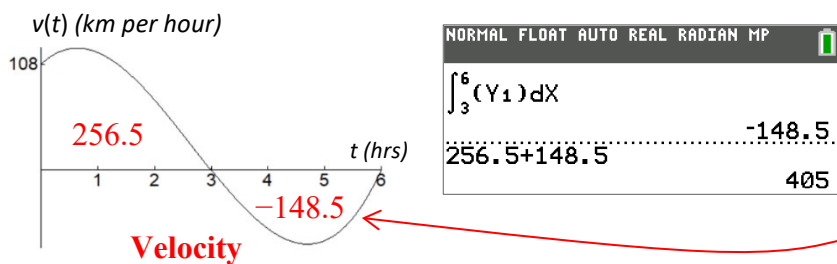
Luke initially travels away from Beggar's Canyon. He slows down and at $t = 3$ he stops.
At this point he is the farthest away (256.5 km).
He turns in the opposite direction and travels 148.5 km toward Beggar's Canyon for 3 more hours.
At $t = 6$ his *total displacement* is 256.5 − 148.5 = 108 km away from Beggar's Canyon,
but his odometer reads a *total distance* traveled of 256.5 + 148.5 = 405 km.

Click *HERE* to see his trip animated on the TI-84 Plus CE.

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X₁ᴛ=6∕4T^4−(48∕... Y₁ᴛ=3

T=6
X=108   Y=3