(1.) Suppose the velocity of a car traveling along a straight road is given by \( v(t) = -(t - 2)^2 + 4 \). Answer the following questions. (Note that the horizontal intercepts or zeroes of this function are at \( t = 0 \) and \( t = 4 \))

(a) At which positive time does the car begin traveling backwards?

Since the velocity changes from positive to negative at \( t = 4 \), it is traveling backwards for all \( t > 4 \).

(b) Sketch \( v(t) \) for the times between \( t = 0 \) and \( t = 6 \). (Hint: it is an upside down parabola shifted to the right by 2 and up by 4 and crosses the \( t \)-axis at \( t = 0 \) and \( t = 4 \)). On this sketch, draw the rectangles with \( n = 6 \) and that give the RHS (right hand sum) approximation to the integral (or signed area) of \( v(t) \) between \( t = 0 \) and \( t = 6 \). That is, approximate \( \int_0^6 v(t) \, dt \) using \( n = 6 \) with right hand endpoints.

\[
\text{RHS} = 1(3) + 1(4) + 1(3) + 1(0) + 1(-5) + 1(-12) = -7
\]
(c) Interpret the integral you approximated in part (b) as a statement about the car. Be sure to be very clear and differentiate between total distance traveled and displacement (change in position).

The previous part says that between $t = 0$ and $t = 6$ the total change in the car's position is approximately $-7$. Therefore the car ended up 7 before the start.

(d) Use your calculator to find the exact value of $\int_{0}^{6} v(t) \, dt$. Did the car end up ahead of where it started, or behind?

$$\int_{0}^{6} -(t - 2)^2 + 4 \, dt = 0$$

(2.)
Write down the definite integral that gives the area (meaning a positive number) between the graphs of $y = x$ and $y = x^2$. (You will need to figure out the limits of integration from a graph/algebra/calculator). Use your calculator to evaluate this integral.

$$\text{Area} = \int_{0}^{1} x - x^2 \, dx = \frac{1}{6}$$