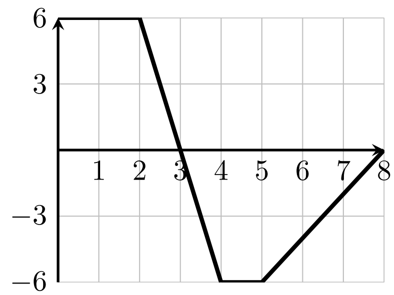
1. Review and Warm-up: The graph of f is shown below. Calculate exactly each of the definite integrals that follow.

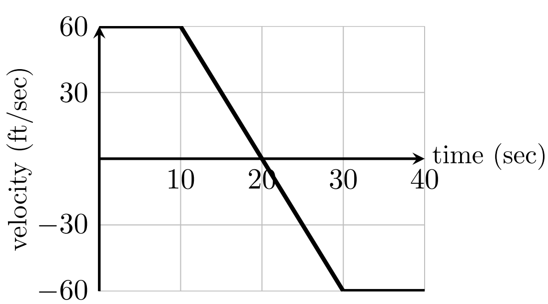


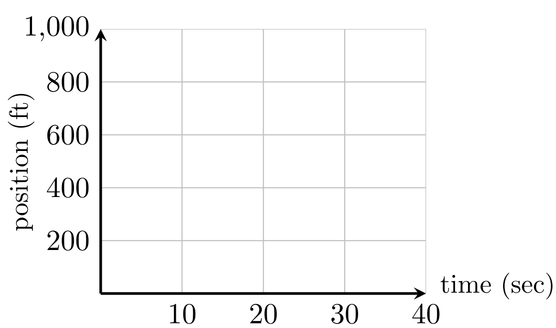
(a) $\int_0^2 f(x)\,dx =$ (d) $\int_5^8 f(x)\,dx =$

(b) $\int_0^3 f(x)\,dx =$ (e) $\int_2^4 f(x)\,dx =$

(c) $\int_4^5 f(x)\,dx =$ (f) $\int_0^8 f(x)\,dx =$

2. Let $s(t)$ be the position, in feet, of a car along a straight east/west highway at time t seconds. Positive values of s indicate eastward displacement of the car from home, and negative values indicate westward displacement. At $t = 0$ the car is at home. Let $v(t)$ represent the velocity of this same car, in feet per second, at time t seconds (see graph below).





(a) Write a definite integral representing each of the following:

$s(10) =$

$s(30) =$

$s(t) =$

Now use these integrals and the velocity graph to help you fill in the chart below:

t	0	10	20	30	40
$s(t)$	0				

(b) Use these values to help you plot the position function.

(c) Fill in the chart below:

Definite integral of velocity	Change in position
$\int_0^{10} v(t)dt =$	$s(10) - s(0) =$
$\int_{10}^{20} v(t)dt =$	$s(20) - s(10) =$
$\int_0^{40} v(t)dt =$	$s(40) - s(0) =$

(d) Why do these two columns give the same answers?

3. The following data is from the U.S. Bureau of Economic Analysis. It shows the rate of change $r(t)$ (in dollars per month) of per capita personal income, where t is the number of months after January 1, 2012.

t (months)	0	2	4	6	8	10	12
$r(t)$ (dollars per month)	154	17	10	79	278	-432	290

Use left-hand Riemann sums to estimate the total change in personal income during 2012.

4. A can of soda is put into a refrigerator to cool. The temperature of the soda is given by $F(t)$. The **rate** at which the temperature of the soda is changing is given by

$$F'(t) = f(t) = -25e^{-2t} \text{ (in degrees Fahrenheit per hour)}$$

(a) Find the rate at which the soda is cooling after 0, 1, and 2 hours. Then use this information to estimate the temperature of the soda after 3 hours if the soda was $60°F$ when it was placed in the refrigerator.

(b) Now we will find the exact temperature of the soda after three hours have passed.

i. Find an antiderivative of $f(t)$, that is, find a function $G(t)$ such that $F'(t) = f(t) = -25e^{-2t}$.
(Hint: take a couple of derivatives of $f(t)$ and try to find a pattern.)

ii. The Fundamental Theorem of Calculus (the Evaluation Theorem) tells us that $\int_a^b f(t)\,dt = F(b) - F(a)$. Use this theorem and the function you found in the last step to find the temperature of the soda after 3 hours have passed.

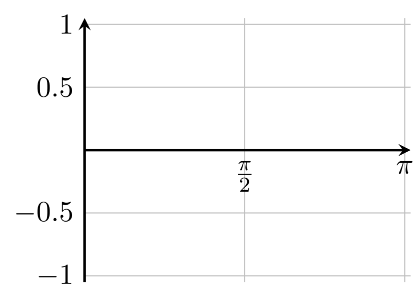
(c) Why do you think your estimate in part (a) is so far off?

5. (a) Write an integral which represents the area between $f(x) = x^4$ and the x-axis, between $x = 0$ and $x = 2$.

   (b) Evaluate this integral using the Fundamental Theorem of Calculus (the Evaluation Theorem).

6. (a) Using the Fundamental Theorem of Calculus (as in the last problem), evaluate $\int_0^{\pi} \cos(x)\,dx$.

   (b) Show the area represented by the integral in part (a) on the graph.



7. Evaluate $\int_0^1 \frac{1}{1+x^2}\,dx$ without using technology.