

Using CoCalc to calculate definite integrals

The homework assignment for section 5.2 asks you to "use a calculator" to calculate several of those definite integrals. The point of this notebook is to show you how to use CoCalc / Sagemath as your "calculator".

For example, the shaded area below represents the definite integral

$$\int_1^5 (1+x) dx$$

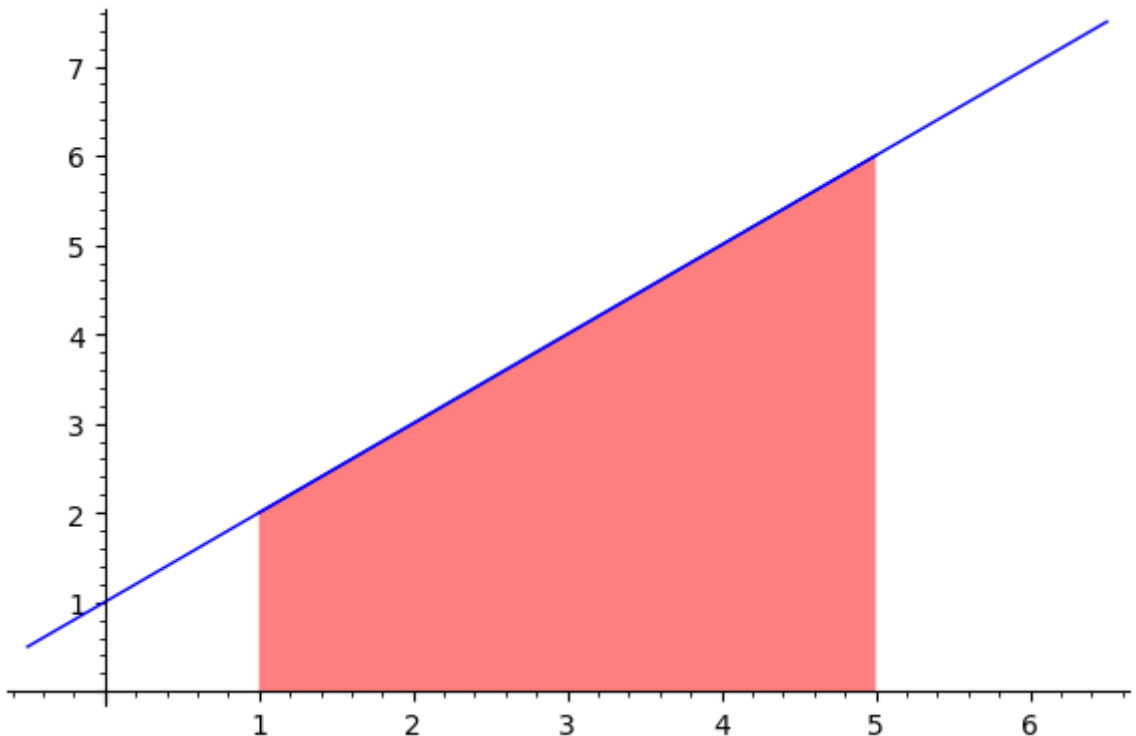
Where:

- The function in blue is given by $f(x) = 1 + x$, and is called the **integrand**.
- The integration variable is x .
- The lower limit of integration is 1, and
- The upper limit of integration is 5.

In [23]:

```
show( plot(1+x,(x,-.5, 6.5))+  
      plot(1+x,(x,1,5),fill=True, fillcolor="red"))
```

Out[23]:



You should be able to calculate the answer: Add the area of a (4×2) rectangle to the area for a triangle with a base of 4, and a height of 4, to get $\text{Area} = (4 \times 2) + (4 \times 4)/2 = 8 + 8 = 16$.

The way to code the integral in CoCalc is with the `integrate` command, shown below.

- The first argument is the function, the integrand,

- the second argument is the integration variable,
- the 3rd and 4th arguments are the lower and upper bound.

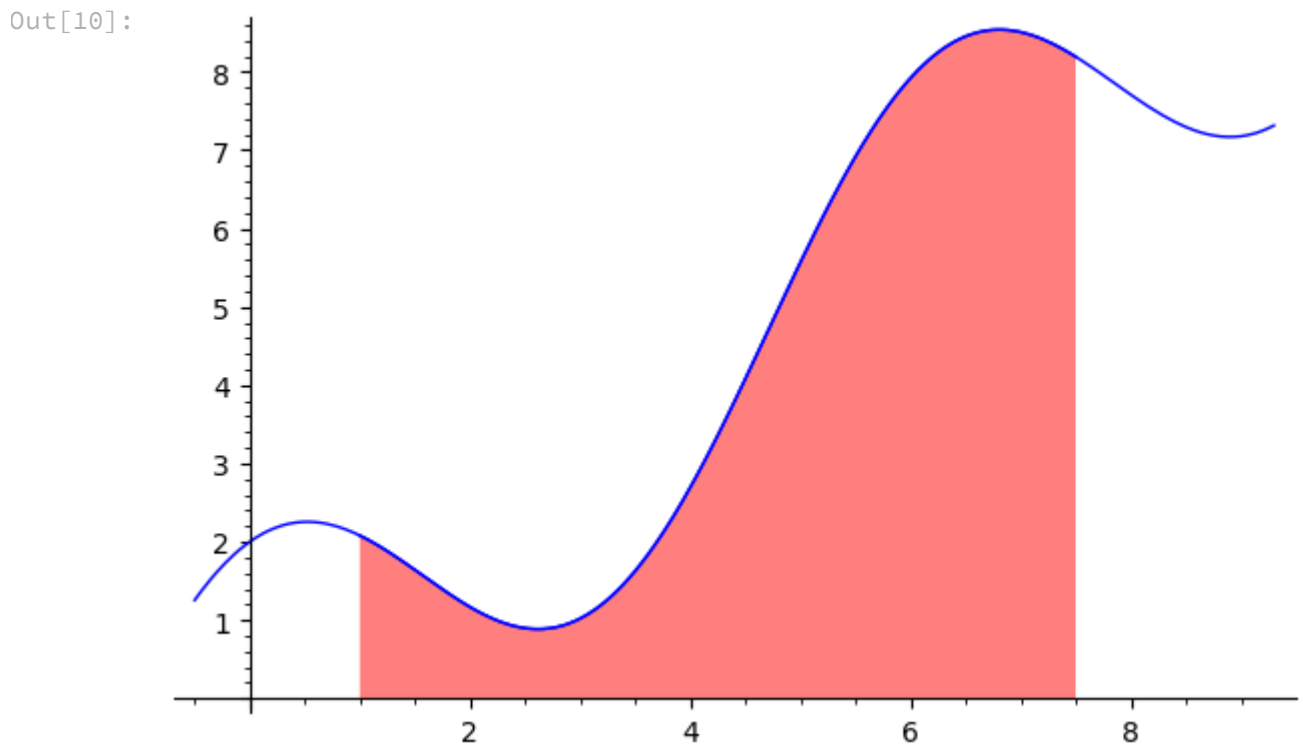
In [24]: `N(integrate(1+x, x, 1, 5))`

Out[24]: 16.000000000000000

Another example: The shaded area below represents the definite integral

$$\int_1^{7.5} (1 + 2 \cos(x)) dx$$

In [10]: `show(
 plot(x+2*cos(x),(x,-0.5,9.3))+
 plot(x+2*cos(x),(x,1,7.5),fill=True, fillcolor="red")
)`



Pause for a moment, and make a rough estimate for the red area.

See if your estimate is close to the answer you get when you execute the following cell:

In [25]: `N(integrate(x + 2*cos(x), x, 1, 7.5))`

Out[25]: 27.8180579839337

One more example Below: The shaded areas are:

$$\text{red: } \int_0^{\pi/2} \cos(x) dx$$

and

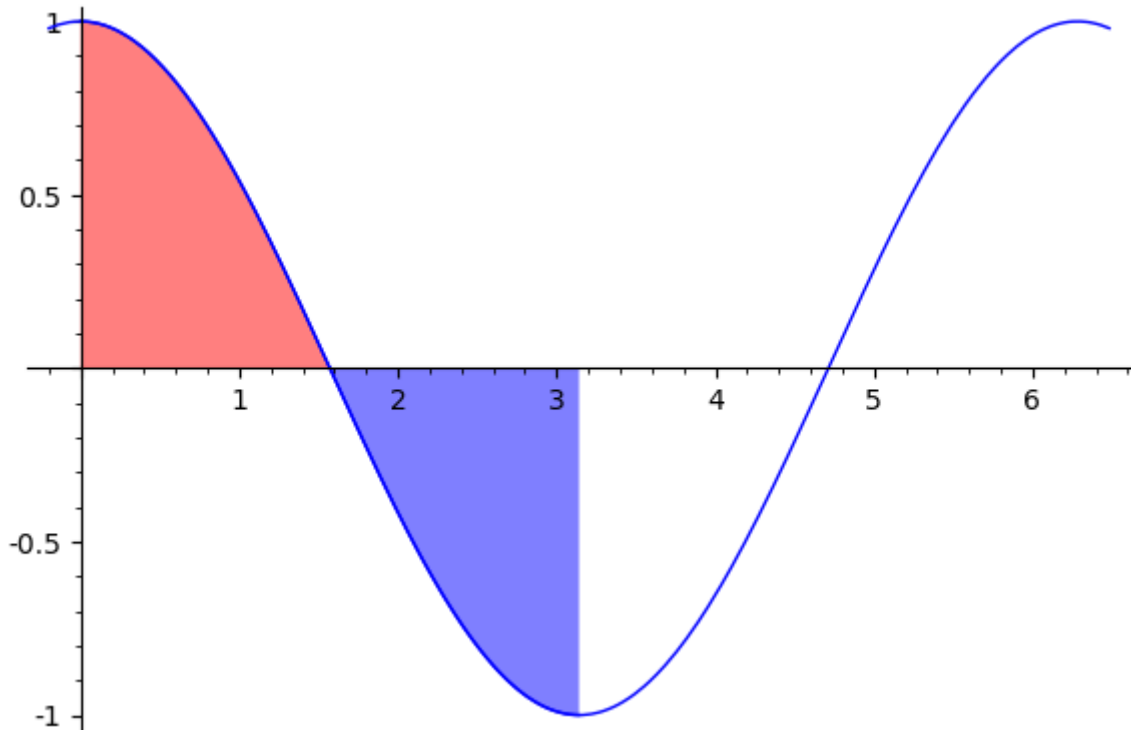
$$\text{blue: } \int_{\pi/2}^{\pi} \cos(x) dx$$

They kind of look the same?

In [15]:

```
# It sure *looks* as if the red area is equal to the blue area
show(
  plot(cos(x),(x, -.2, 2*pi+0.2)) +
  plot(cos(x), (x,0,pi/2),fill=True, fillcolor="red")+
  plot(cos(x),(x,pi/2, pi),fill=True, fillcolor="blue")
)
```

Out[15]:



Below, we calculate the two areas, and find that the definite integral of the blue region is -1 and of the red region is +1

In [16]:

```
[
  # the red area:
  N(integrate(cos(x),x,0,pi/2)),

  # the blue area
  N(integrate(cos(x),x,pi/2,pi))
]
```

Out[16]: [1.0000000000000000, -1.0000000000000000]

About Edfinity HW 5.2

Problem 9

The definite integral is the sum of +(areas above the x axis, and below $f(x)$) - (areas below the x axis, and above $f(x)$).

But the first part of Problem 9 asks for the "total area" between the x axis and the function on some interval. This is the sum of the *absolute values* of the areas.

In [0]: