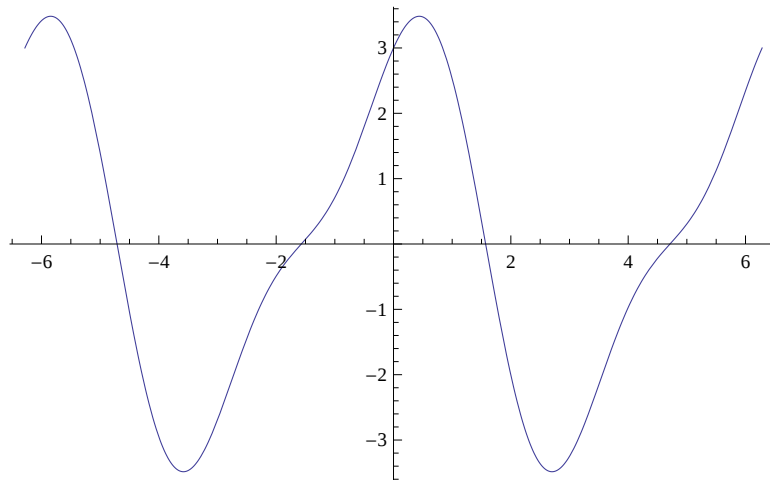


Definition of function, function value, graph, derivative

f[x_] = 3 Cos[x] + Sin[2 x]

3 Cos[x] + Sin[2 x]

Plot[f[x], {x, -2 * Pi, 2 Pi}]



f[Pi / 2]

0

f[3 * Pi]

-3

f[7 * Pi / 3]

$\frac{3}{2} + \frac{\sqrt{3}}{2}$

f[7 * Pi / 3] // N

2.36603

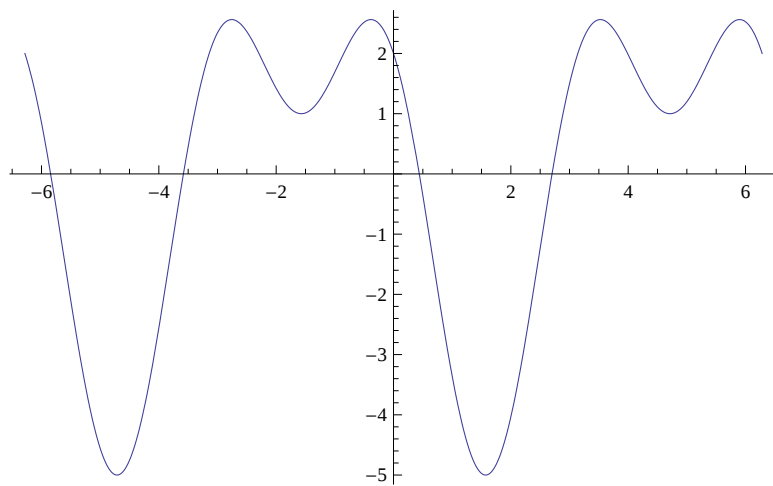
f' [x]

2 Cos[2 x] - 3 Sin[x]

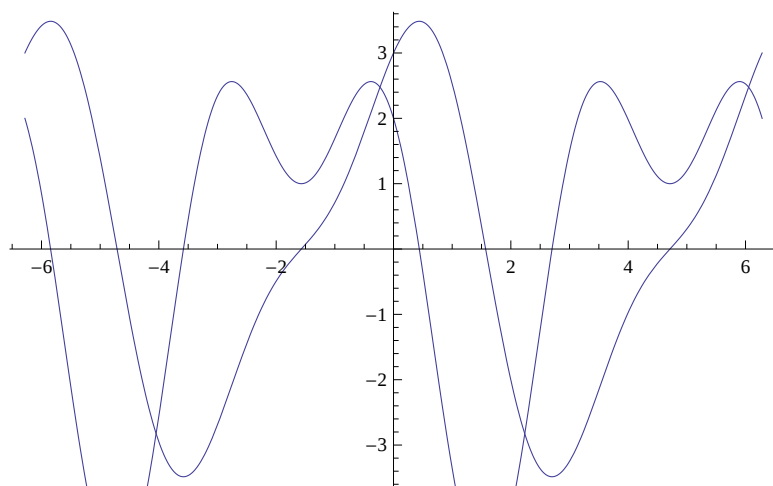
f' [Pi / 2]

-5

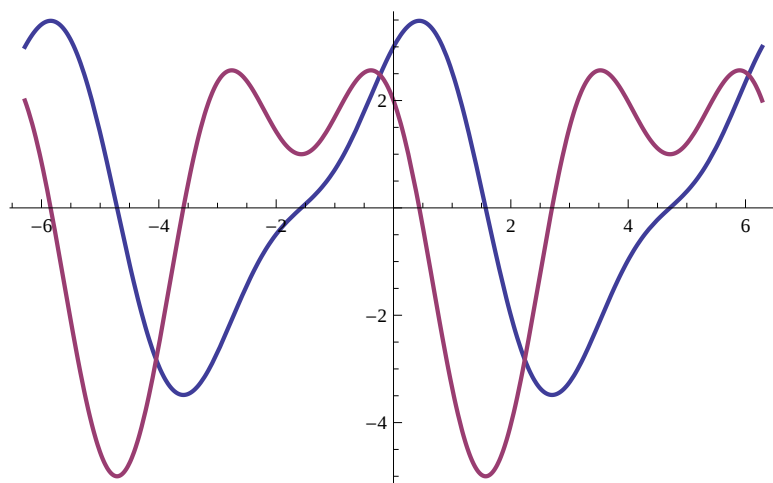
```
Plot[f'[x], {x, -2 * Pi, 2 Pi}]
```



```
Show[%10, %17]
```



```
Plot[{f[x], f'[x]}, {x, -2 * Pi, 2 Pi}, PlotStyle -> Thick]
```



Function extrema, limit, range of values

```
Clear[f]
```

f[x_] = 3 x^2 / 2 Exp[-x^2]

$$\frac{3}{2} e^{-x^2} x^2$$

f'[x]

$$3 e^{-x^2} x - 3 e^{-x^2} x^3$$

Solve[f'[x] == 0, x]

{x → -1}, {x → 0}, {x → 1}

Reduce[f'[x] == 0, x] // N

x == -1. || x == 0. || x == 1.

FindRoot[f'[x] == 0, {x, 0}]

{x → 0.}

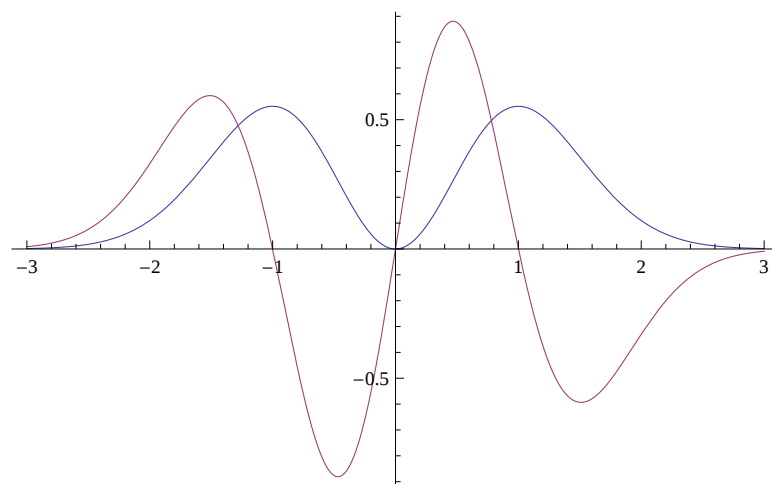
FindRoot[f'[x] == 0, {x, 1}]

{x → 1.}

FindRoot[f'[x] == 0, {x, -1}]

{x → -1.}

Plot[{f[x], f'[x]}, {x, -3, 3}]



ddf[x_] = D[f[x], {x, 2}] // Simplify

$$3 e^{-x^2} (1 - 5 x^2 + 2 x^4)$$

ddf[-1]

$$-\frac{6}{e}$$

ddf[0]

$$3$$

ddf[1]

$$-\frac{6}{e}$$

f[-1]

$$\frac{3}{2 e}$$

f[0]

0

f[1]

$$\frac{3}{2 e}$$

Limit[f[x], x → 0]

0

Limit[f[x], x → Infinity]

0

Limit[f[x], x → -Infinity]

0

Solve[f[x] == 0, x]

Solve::ifun: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information. >>

{ {x → 0} }

Reduce[f[x] == 0, x]

x == 0

f[2]

$$\frac{6}{e^4}$$

Integration

Integrate[x^n, x]

$$\frac{x^{1+n}}{1+n}$$

$$\int_{-1}^{10} \text{Log}[x+1] \, dx$$

11 (-1 + Log[11])

$$\int_{-1}^{\infty} \text{Log}[x+1] \, dx$$

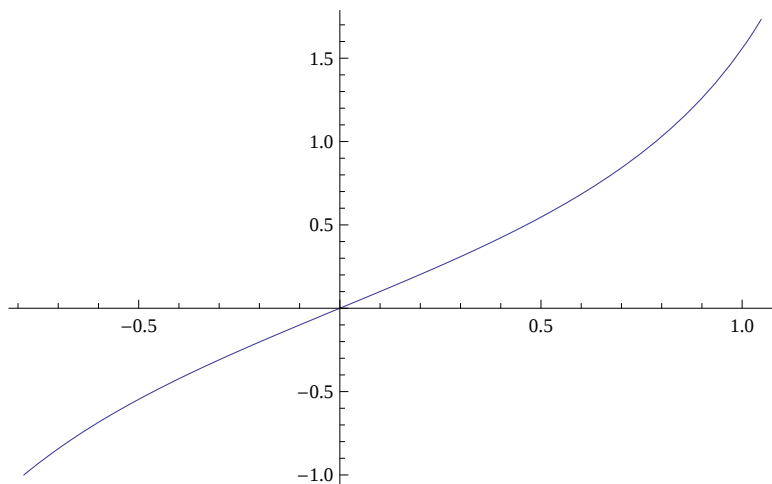
Integrate::idiv: Integral of Log[1+x] does not converge on {-1, ∞}. >>

$$\int_{-1}^{\infty} \text{Log}[1+x] \, dx$$

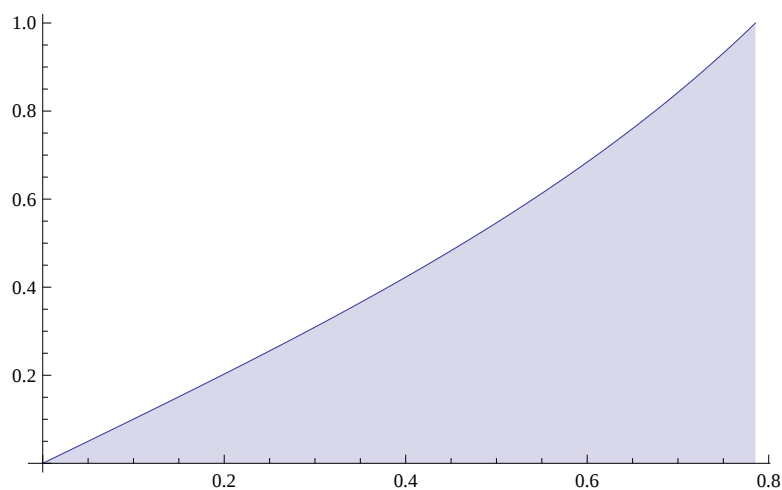
```
Integrate[Tan[x], {x, 0,  $\frac{\pi}{4}$ }] // N
```

```
0.346574
```

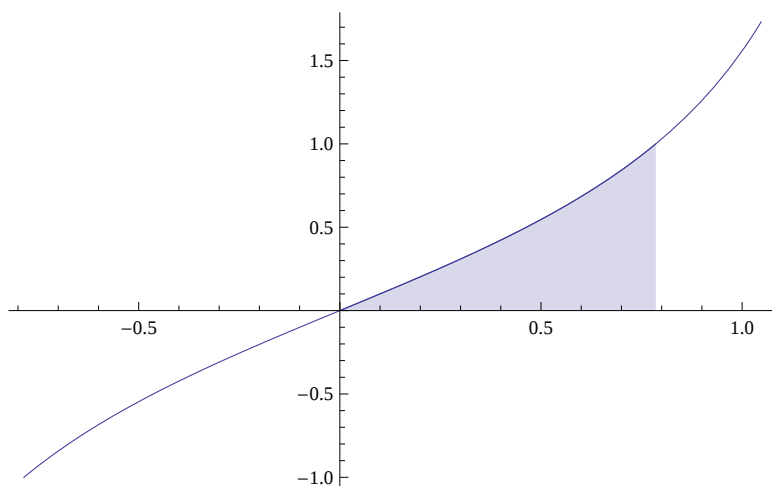
```
g1 = Plot[Tan[x], {x, - $\frac{\pi}{4}$ ,  $\frac{\pi}{3}$ }]
```



```
g2 = Plot[Tan[x], {x, 0,  $\frac{\pi}{4}$ }, Filling -> Axis]
```



```
Show[g1, g2]
```



Area of a region

```
Clear[f, g1, g2]
```

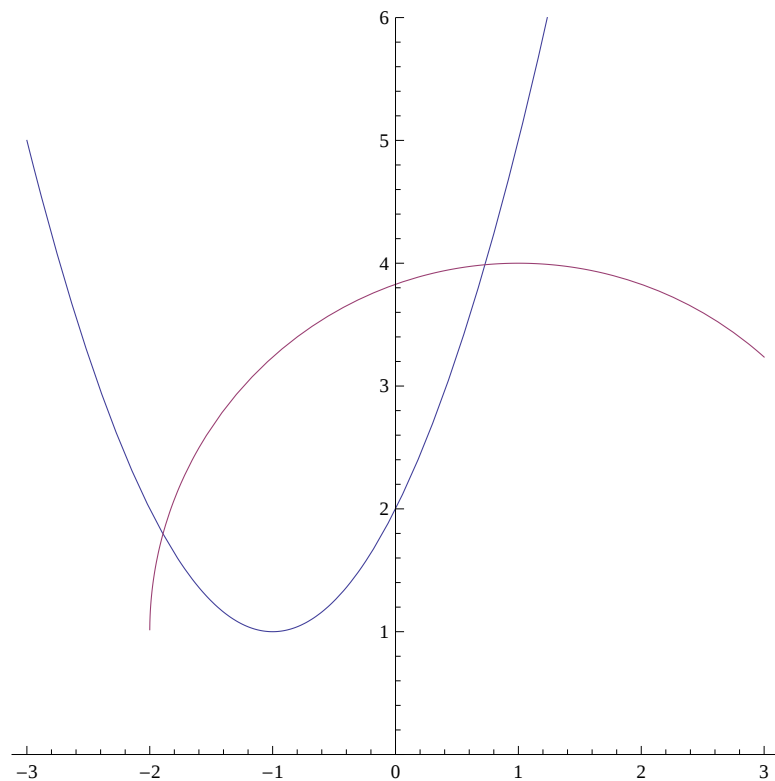
```
f[x_] = x^2 + 2 * x + 2
```

$$2 + 2x + x^2$$

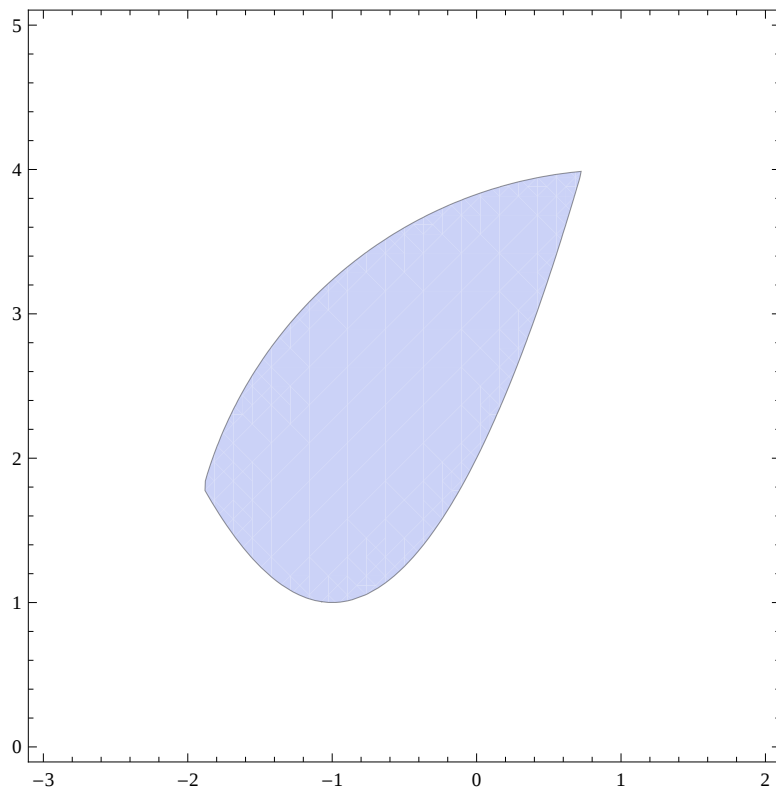
```
g[x_] = 1 + Sqrt[9 - (x - 1)^2]
```

$$1 + \sqrt{9 - (-1 + x)^2}$$

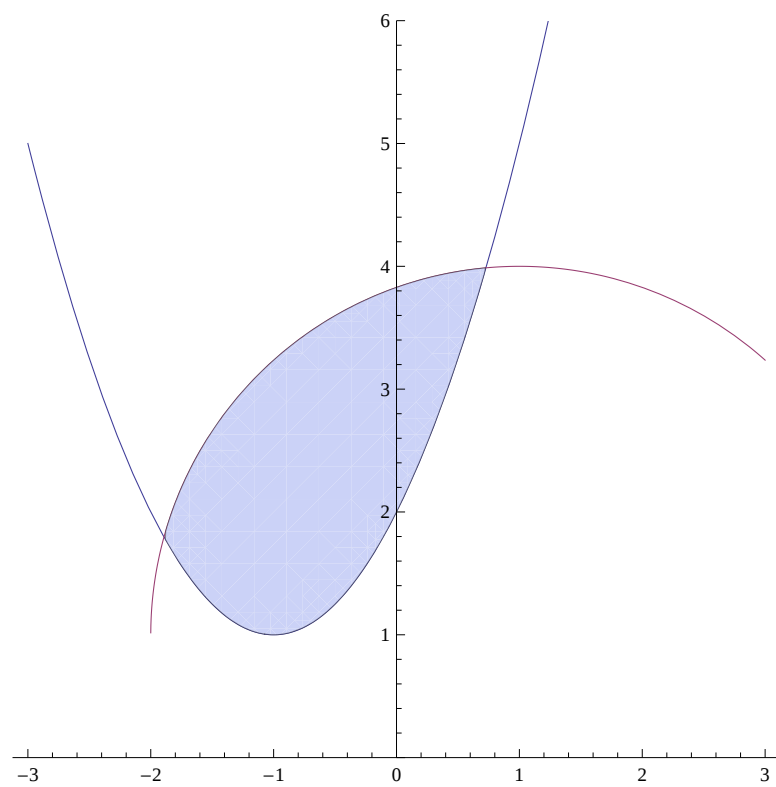
```
g1 = Plot[{f[x], g[x]}, {x, -3, 3}, AspectRatio -> Automatic, PlotRange -> {0, 6}]
```



```
g2 = RegionPlot[f[x] ≤ y ≤ g[x], {x, -3, 2}, {y, 0, 5}, AspectRatio → Automatic]
```



```
Show[g1, g2]
```



```
r = Solve[f[x] == g[x], x] // N
```

```
{{x → -1.89238}, {x → 0.728493}}
```

```
a = x /. r[[1]]
```

```
-1.89238
```

```
b = x /. r[[2]]
```

```
0.728493
```

```
P = Integrate[g[x] - f[x], {x, a, b}]
```

```
4.23955
```

Matrices, determinants

```
Clear[f, g]
```

```
A = {{f[x], g[x]}, {f'[x], g'[x]}}
```

```
{{f[x], g[x]}, {f'[x], g'[x]}}
```

```
MatrixForm[A]
```

$$\begin{pmatrix} f[x] & g[x] \\ f'[x] & g'[x] \end{pmatrix}$$

```
MatrixForm[{{f[x], g[x]}, {f'[x], g'[x]}}
```

$$\begin{pmatrix} f[x] & g[x] \\ f'[x] & g'[x] \end{pmatrix}$$

```
W = Det[A]
```

```
-g[x] f'[x] + f[x] g'[x]
```

```
f[x_] = Sin[4 x]; g[x_] = Cos[4 x];
```

```
Det[A]
```

```
-4 Cos[4 x]^2 - 4 Sin[4 x]^2
```

```
Det[A] // Simplify
```

```
-4
```

```
Clear[f, g]
```

```
f[x_] = E^(2 x) * Cos[3 x]; g[x_] = E^(2 x) * Sin[3 x];
```

```
MatrixForm[A] // Simplify
```

$$\begin{pmatrix} e^{2x} \cos[3x] & e^{2x} \sin[3x] \\ e^{2x} (2 \cos[3x] - 3 \sin[3x]) & e^{2x} (3 \cos[3x] + 2 \sin[3x]) \end{pmatrix}$$

```
W // Simplify
```

```
3 e^{4x}
```