

(\*Brady Metherall\*)

(\*1. Functions\*)

`f[x_] := Sin[x]`

`f'[x]`

`(f[x])2 + (f'[x])2`

`Integrate[f[x], x]`

`Cos[x]`

`Cos[x]2 + Sin[x]2`

`-Cos[x]`

(\*2. Simplify\*)

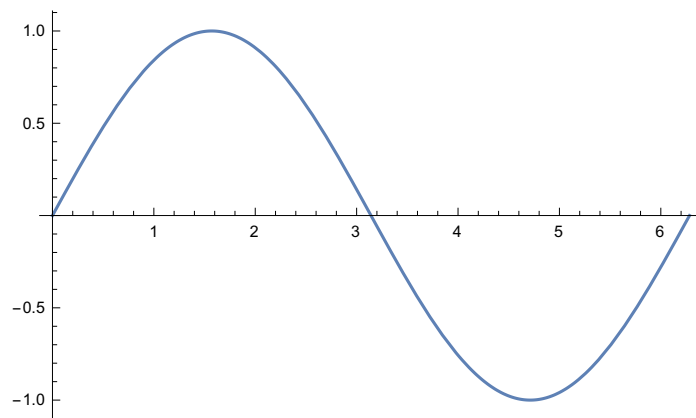
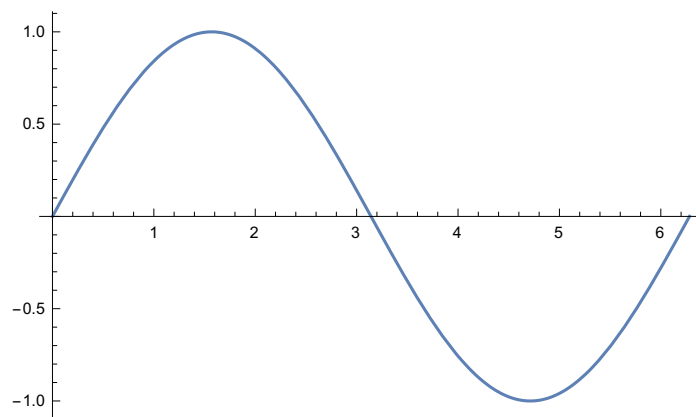
`Simplify[%3]`

1

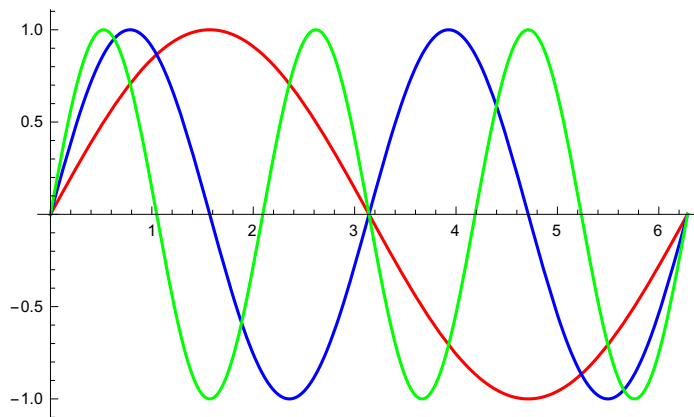
(\*3. Plotting Functions\*)

`Plot[Sin[x], {x, 0, 2  $\pi$ }]`

`Plot[f[x], {x, 0, 2  $\pi$ }]`

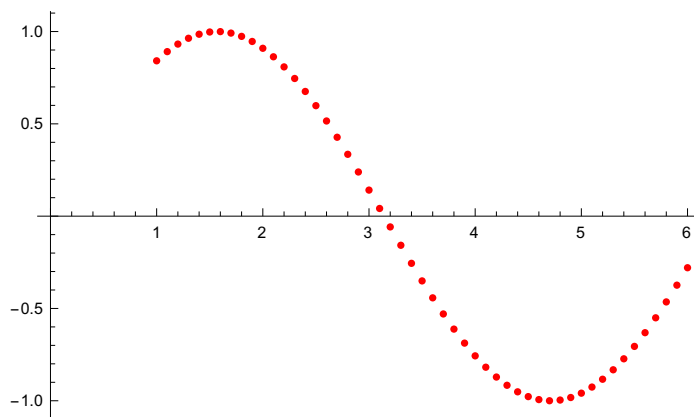


```
Plot[{f[x], f[2 x], f[3 x]}, {x, 0, 2  $\pi$ }, PlotStyle -> {Red, Blue, Green}]
```

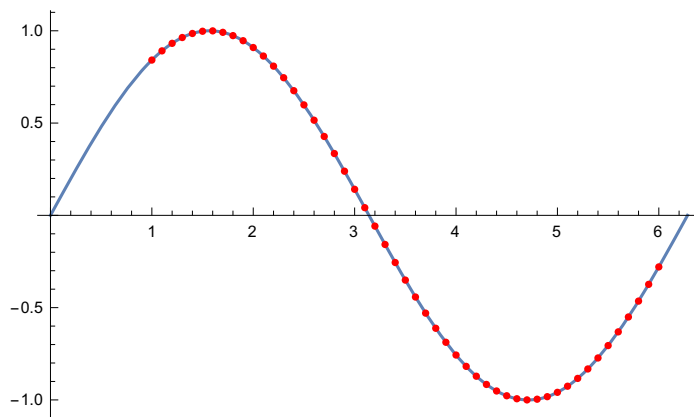


```
Table[{i, Sin[i]}, {i, 1, 6, 0.1}];
```

```
ListPlot[%, PlotStyle -> Red]
```



```
Show[{Plot[f[x], {x, 0, 2  $\pi$ }], %10}]
```

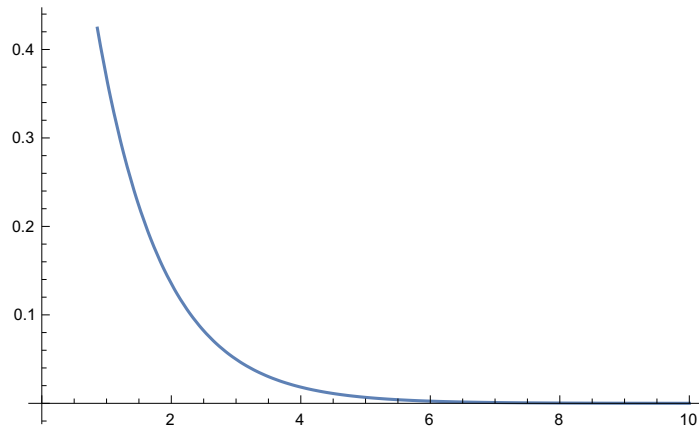


(\*4. Solving Differential Equations\*)

```
DSolve[{y'[x] == -y[x], y[0] == 1}, y[x], x]
```

```
Plot[y[x] /. %13, {x, 0, 10}]
```

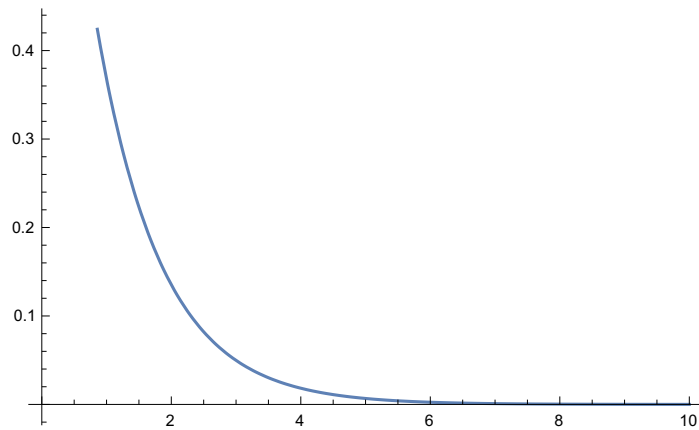
```
{{y[x] → e-x}}
```



```
NDSolve[{y'[x] == -y[x], y[0] == 1}, y[x], {x, 0, 10}]
```

```
Plot[y[x] /. %15, {x, 0, 10}]
```

```
{{y[x] → InterpolatingFunction[ Domain: {{0., 10.}} Output: scalar][x]}}
```



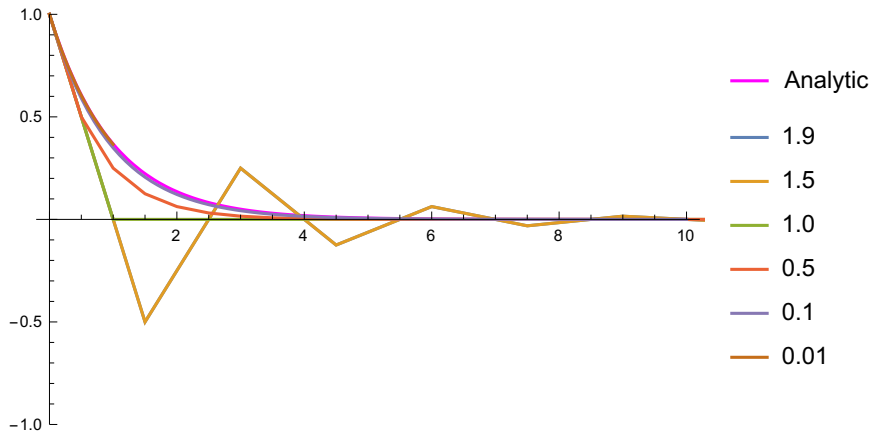
```
RSolve[{y[n + 1] == (1 - h) y[n], y[0] == 1}, y[n], n]
```

```
{{y[n] → (1 - h)n}}
```

```
Table[{h n, y[n] /. %17[[1]][[1]]}, {n, 0, 100}];
```

```
R[t_] := %23 /. h → t
```

```
ListPlot[{R[1.5], R[1.5], R[1.0], R[0.5], R[0.1], R[0.01]},
  Joined → True, PlotLegends → {"1.9", "1.5", "1.0", "0.5", "0.1", "0.01"}];
Show[Plot[y[x] /. %13, {x, 0, 10}, PlotRange → {-1, 1},
  PlotLegends → {"Analytic"}, PlotStyle → {Magenta}], %29]
```



```
sol1 = DSolve[{y'[x] + 3 y[x] + 2 y[x] == 0, y[0] == 1, y'[0] == 1}, y[x], x][[1]][[1]];
sol2 = NDSolve[{y'[x] + 3 y[x] + 2 y[x] == 0, y[0] == 1, y'[0] == 1}, y[x], {x, 0, 10}][[1]][[1]];
sol3 = RSolve[{y[n + 1] (2 + 3 h) + y[n] 4 (h + 1) (h - 1) + y[n - 1] (2 - 3 h) == 0,
  y[0] == 1, y[1] -  $\frac{4 (1 - h) (1 + h) - y[1] (2 + 3 h)}{2 - 3 h} == 2 h$ }, y[n], n][[1]][[1]];
tab = Table[{h n, y[n] /. sol3}, {n, 0, 1000}];
R2[t_] := tab /. h → t;
```

```
Show[{Plot[{y[x] /. sol1, y[x] /. sol2}, {x, 0, 10},
  PlotLegends → {"Analytic", "Numeric"}, PlotStyle → {Magenta, {Black, Dashed}}],
  ListPlot[{R2[0.3], R2[0.2], R2[0.1]}, PlotRange → {0, 1.5},
  PlotLegends → {"0.3", "0.2", "0.1"}, Joined → True, PlotStyle → {Red, Green, Blue}]]]
```

