MAT/19/110
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Exercise 3.2

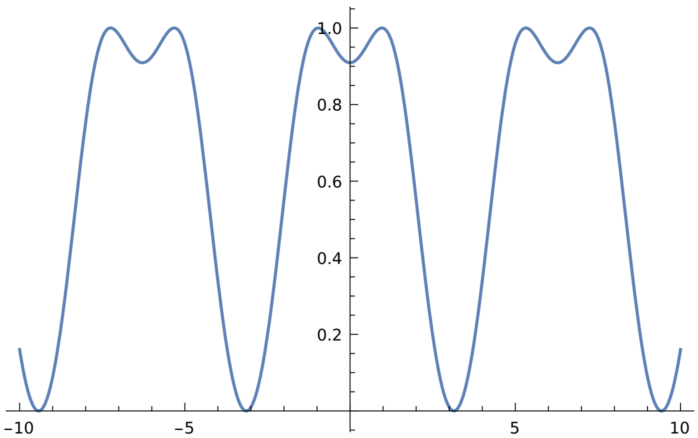
Q1. Plot the following functions on the domain -10 ≤ x ≤ 10.

a) Sin(1+Cos(x))

In[1]:=
```
f[x_] := Sin[1 + Cos[x]]
```

In[2]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[2]=

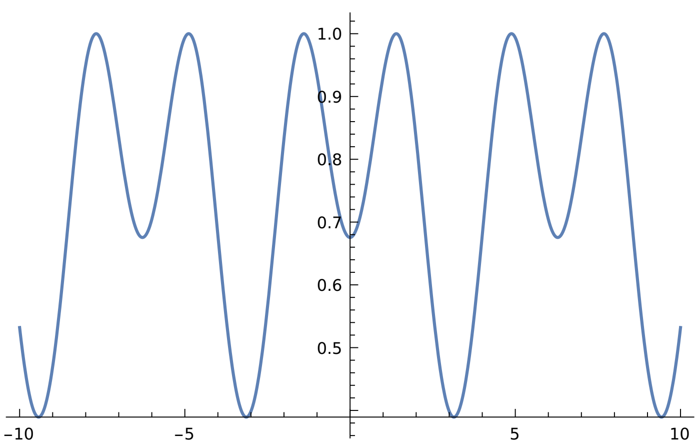


b) Sin(1.4+Cos(x))

In[3]:=
```
g[x_] := Sin[1.4 + Cos[x]]
```

In[4]:=
```
Plot[g[x], {x, -10, 10}]
```

Out[4]=

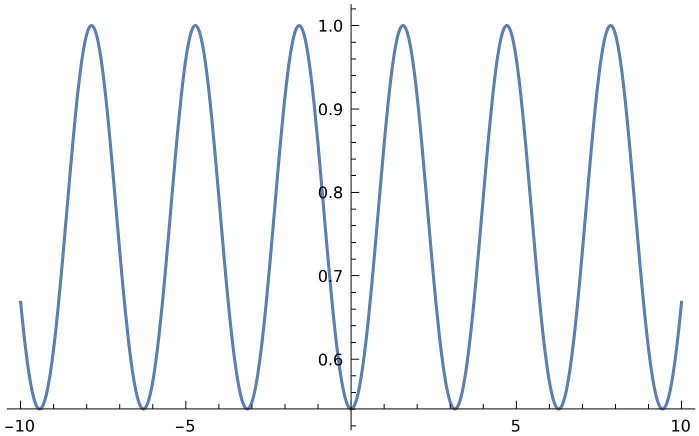


c) Sin(π/2 + Cos(x))

In[6]:=
```
h[x_] := Sin[π / 2 + Cos[x]]
```

In[7]:=
```
Plot[h[x], {x, -10, 10}]
```

Out[7]=

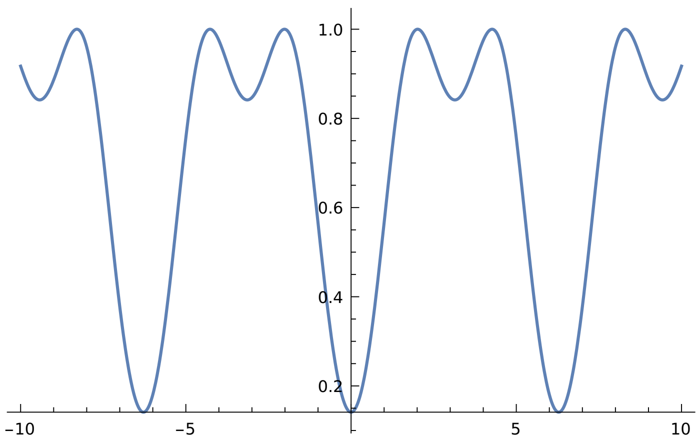


d) Sin(2 + Cos(x))

In[8]:=
```
f[x_] := Sin[2 + Cos[x]]
```

In[9]:=
```
Plot[f[x], {x, -10, 10}]
```

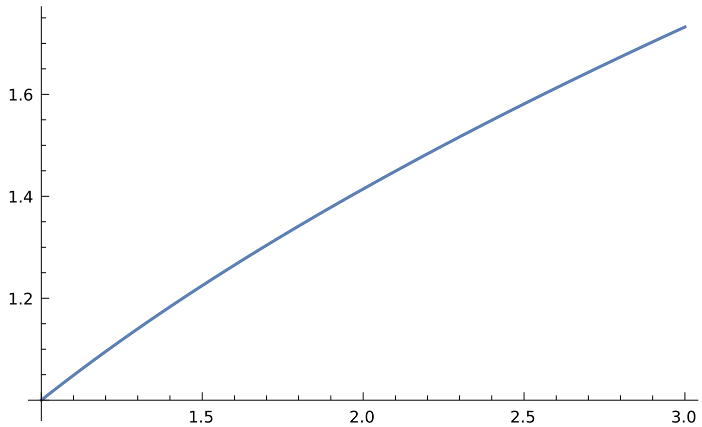
Out[9]=



Q2. Consider the square root function f(x)= $\sqrt{x}$ when x is near 2.

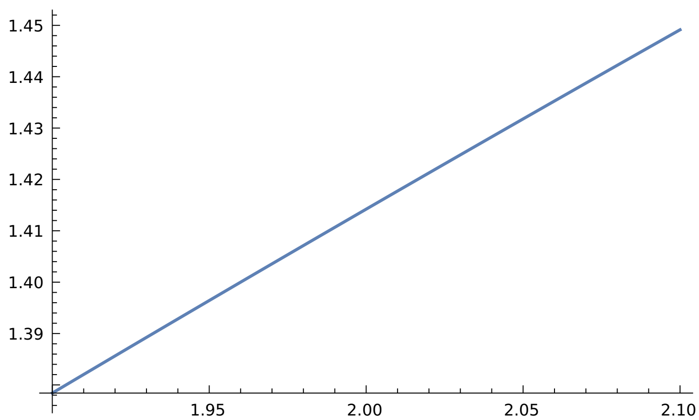
a) Graph of f as x goes from 1 to 3.

In[10]:=
```
With[{δ = 10 ^ 0}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

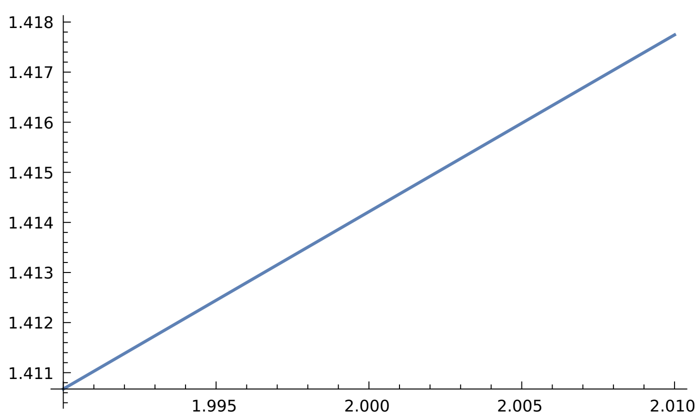
Out[10]=


b) Change the value of δ to be 10^(-1) , 10^(-2) , 10^(-3) and see the graph of f as x goes from 1.9 to 2.1 .

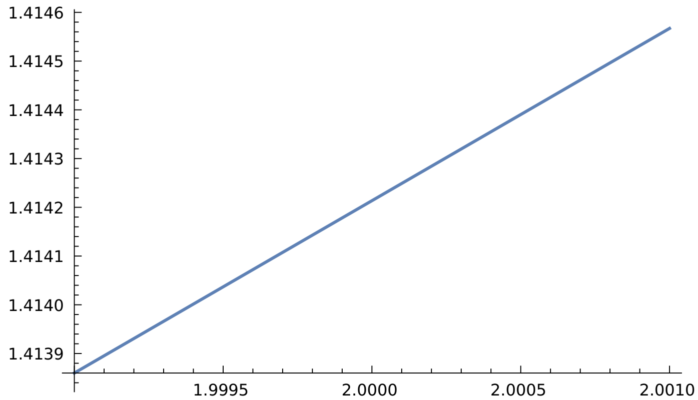
In[11]:=
```
With[{δ = 10 ^ -1}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[11]=


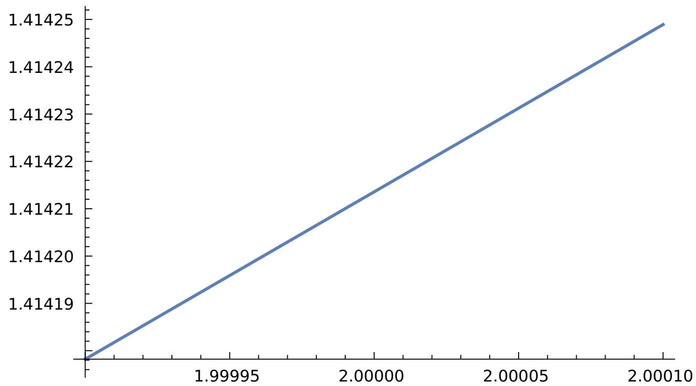
In[13]:=
```
With[{δ = 10 ^ -2}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[13]=


In[14]:=
```
With[{δ = 10^-3}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[14]=


In[15]:=
```
With[{δ = 10^-4}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[15]=


c) Use the last plot to approximate $\sqrt{2}$ ti six significant digits. Check your answer using N.

By the above plot we can approximate $\sqrt{2} = 1.41421$

In[16]:=
```
N[√2, 6]
```

Out[16]=
```
1.41421
```

In[17]:=
```
With[{δ = 10^-20}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Plot : Endpoints for x in $\left\{x, \frac{1999999999999999999999}{1000000000000000000000}, \frac{2000000000000000000001}{1000000000000000000000}\right\}$ must have distinct machine −precision numerical values .

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General : Further output of Plot::plld will be suppressed during this calculation .

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General : Further output of Plot::plld will be suppressed during this calculation .

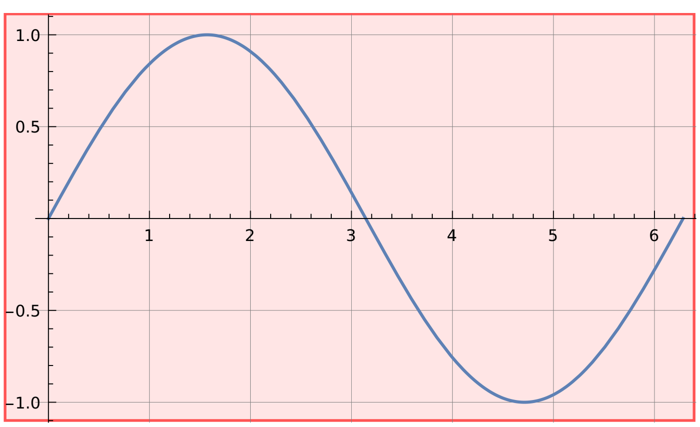
Out[17]= Plot$\left[\sqrt{x}, \left\{x, 2 - \frac{1}{100\,000\,000\,000\,000\,000\,000}, 2 + \frac{1}{100\,000\,000\,000\,000\,000\,000}\right\}\right]$

Exercise 3.3

Q1. Use the Gridlines and Ticks options, as well as the setting Gridlines Style → Lighter[Gray] to plot the sine function.

In[18]:=
```
Plot[Sin[x], {x, 0, 2 π}, GridLines → Automatic ,
 Ticks → Automatic , GridLinesStyle → Light[Gray]]
```

Out[18]=

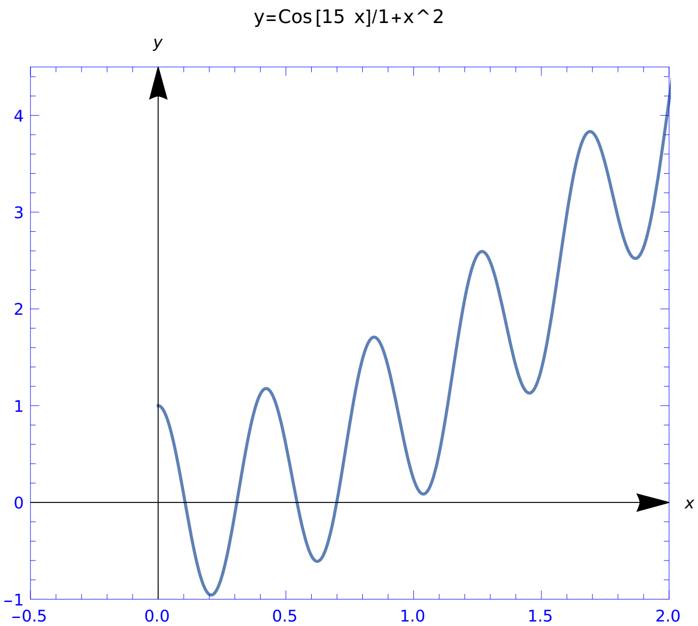


Q2. Use the Axes, Frame, Filling, FrameStyle, PlotRange and AspectRatio options to plot y = Cos(15 x)/1 + x^2.

In[19]:=

```
Plot[Cos[15 x] / 1 + x ^ 2, {x, 0, π}, PlotRange → {{-0.5, 2}, {-1, 4.5}},
 Frame → True, AxesStyle → Arrowheads[00.05], AspectRatio → 5 / 6, Axes → True,
 AxesLabel → {x, y}, PlotLabel → "y=Cos[15 x]/1+x^2", FrameStyle → Blue]
```

Out[19]=

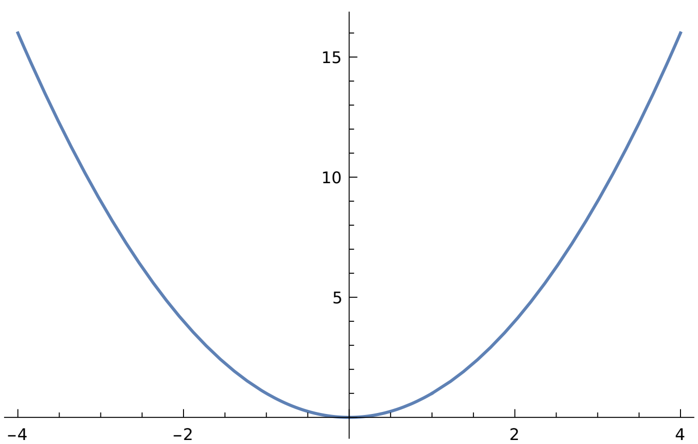


Q4. Plot the function f(x) = x^2 on the domain -2 ≤ x ≤ 2 and set exclusions to x = 1.

In[20]:=

```
Plot[x ^ 2, {x, -4, 4}, Exclusions → {x == 1}]
```

Out[20]=

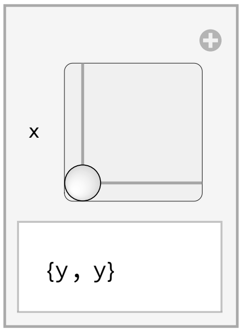


Exercise 3.4

Q1. Make a manipulate has output {x,y}, but has a single Slider2D controller.

In[22]:=
```
Manipulate[{x, y}, {x, y, {0, 1}}]
```

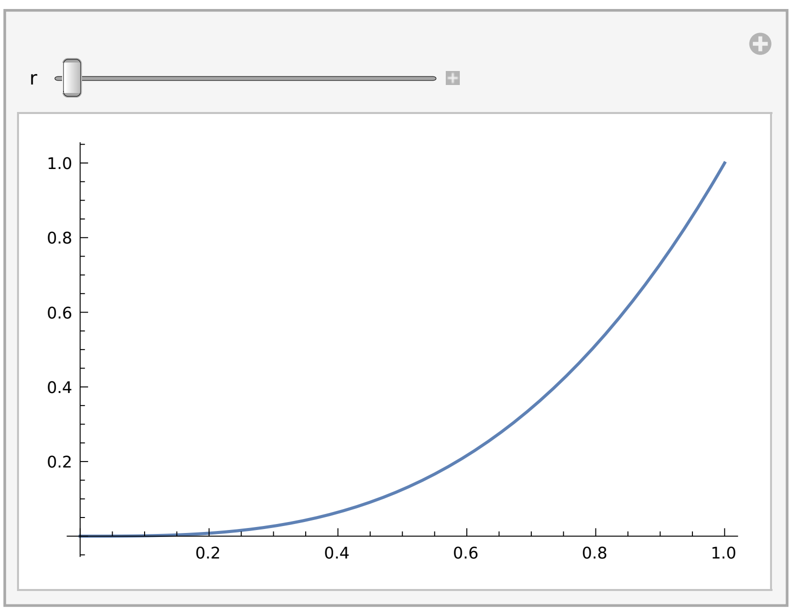
Out[22]=



Q2. Make a manipulate of a plot where the user can adjust the AspectRatio in real time from a starting value of 1/5 to an ending value of 5. Set ImageSize to {Automatic 128} so the height remains constant as the slider is moved.

In[23]:=
```
Manipulate[Plot[x^3, {x, 0, r}], {r, 1, 2}, ImageSize → {Automatic 128}, AspectRatio → 5/6]
```

Out[23]=



Exercise 3.5

Q1.

a) Enter the following inputs and discuss the outputs.

In[24]:=
```
Range[100]
```

Out[24]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41,
 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61,
 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100}
```

In[25]:=
```
Partition[Range[100], 10]
```

Out[25]=
```
{{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {11, 12, 13, 14, 15, 16, 17, 18, 19, 20},
 {21, 22, 23, 24, 25, 26, 27, 28, 29, 30}, {31, 32, 33, 34, 35, 36, 37, 38, 39, 40},
 {41, 42, 43, 44, 45, 46, 47, 48, 49, 50}, {51, 52, 53, 54, 55, 56, 57, 58, 59, 60},
 {61, 62, 63, 64, 65, 66, 67, 68, 69, 70}, {71, 72, 73, 74, 75, 76, 77, 78, 79, 80},
 {81, 82, 83, 84, 85, 86, 87, 88, 89, 90}, {91, 92, 93, 94, 95, 96, 97, 98, 99, 100}}
```

b) Format a Table of the first 100 integers , with 20 digits per row.

In[8]:=
```
Partition[Table[x, {x, 1, 100}], 20]
```

Out[8]=
```
{{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20},
 {21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40},
 {41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60},
 {61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80},
 {81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100}}
```

c) Make the same table above , but use only the Table and Range commands.

In[9]:=
```
Table[Range[10], 10]
```

Out[9]=
```
{{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10},
 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10},
 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10},
 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}}
```

d) Make the same table as above, but use only the Table command .

In[10]:=
```
Table[Table[x, {x, 1, 100}]]
```

Out[10]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41,
 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61,
 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100}
```

Q4.

a) Use the Sum command to evaluate the following expression :

$$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3 + 10^3 + 11^3 + 12^3 + 13^3 + 14^3 + 15^3 + 16^3 + 17^3 + 18^3 + 19^3 + 20^3$$

In[31]:=
```
f[x_] := x^3
```

In[32]:=
```
Sum[f[x], {x, 1, 20}]
```

Out[32]=
```
44100
```

b) Make a table of values for x = 1, 2,.......,10 for the function
$f(x) = 1+2^x+3^x+4^x+5^x+6^x+7^x+8^x+9^x+10^x+11^x+12^x+13^x+14^x+15^x+16^x+17^x+18^x+19^x+20^x$

In[19]:=
```
Table[x^3, {x, 1, 10}]
```

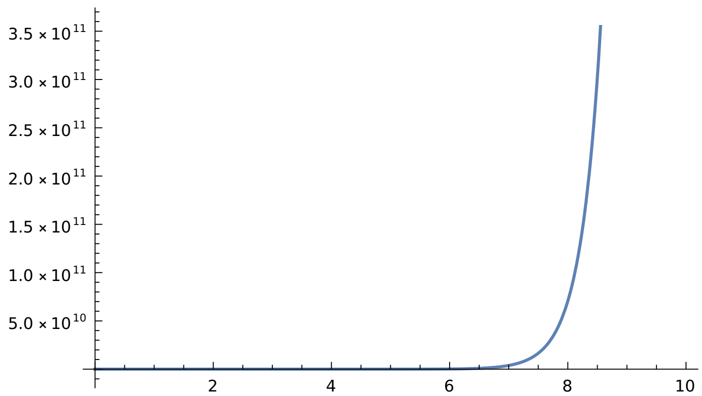
Out[19]=
```
{1, 8, 27, 64, 125, 216, 343, 512, 729, 1000}
```

c) Plot f(x) on the domain $1 \le x \le 10$.

In[13]:=
```
f[x_] := 1 + 2^x + 3^x + 4^x + 5^x + 6^x + 7^x + 8^x + 9^x + 10^x +
  11^x + 12^x + 13^x + 14^x + 15^x + 16^x + 17^x + 18^x + 19^x + 20^x
```

In[14]:=
```
Plot[f[x], {x, 0, 10}]
```

Out[14]=

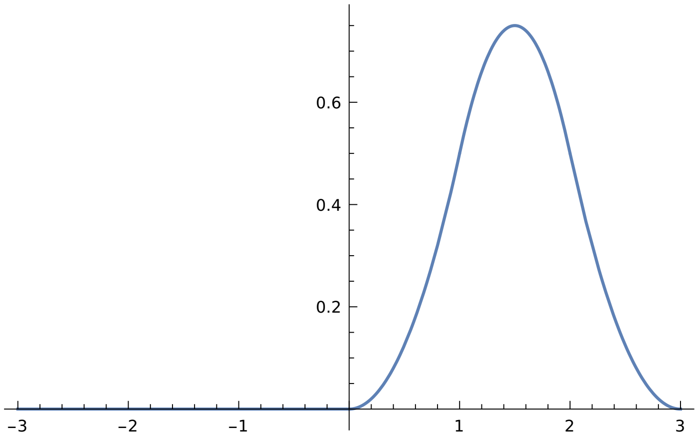


Exercise 3.6
Q2. Make a plot of a piecewise function.

In[29]:=
```
f[x_] := Piecewise[{{0, x < 0}, {x^2/2, 0 ≤ x < 1},
   {-x^2 + 3 x - 3/2, 1 ≤ x < 2}, {(1/2) (3 - x)^2, 2 ≤ x < 3}, {0, x ≤ 3}}]
```

In[30]:=
```
Plot[f[x], {x, -3, 3}]
```

Out[30]=



Q3. A step function assumes a constant value between consecutive integers n and n+1 . Make a plot of the step function f(x) whose value is n^2 when $n \le x < n+1$. Use the domain $0 \le x < 20$.

In[15]:=
```
f[x_] := n^2
```

In[16]:=
```
Plot[n^2, {x, n, n + 1}, {x, 0, 20}]
```

Plot : Options expected (instead of {x, 0, 20}) beyond position 2 in Plot[n^2, {x, n, n + 1}, {x, 0, 20}]. An option must be a rule or a list of rules .

Out[16]=
```
Plot[n^2, {x, n, n + 1}, {x, 0, 20}]
```