

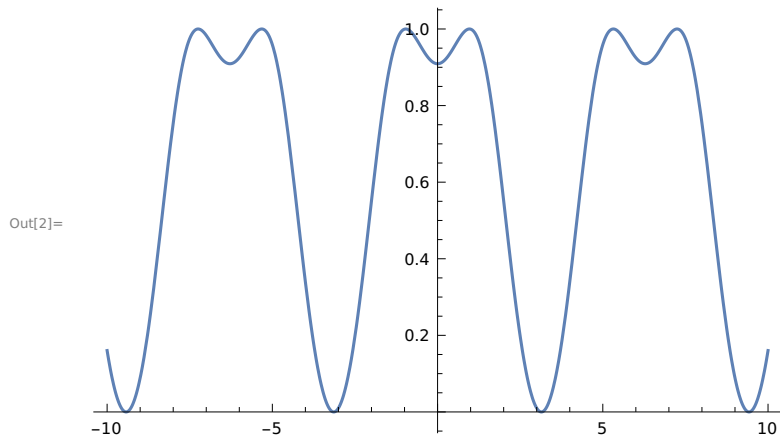
## Exercise 3.2

Q1. Plot the following functions on the domain  $-10 \leq x \leq 10$ .

a)  $\text{Sin}(1+\text{Cos}(x))$

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

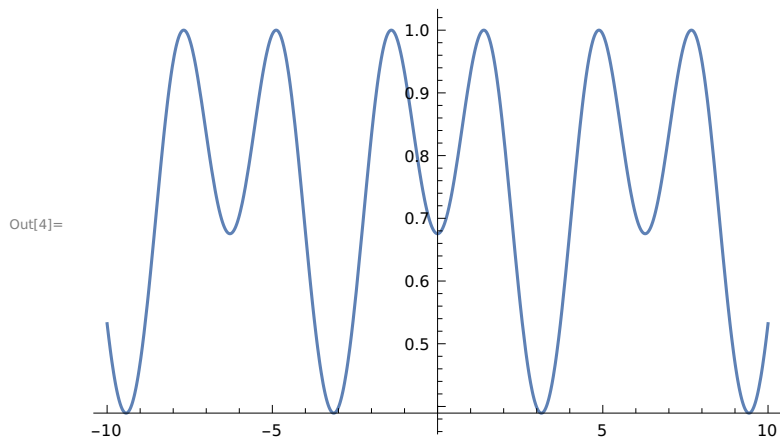
```
In[2]:= Plot[f[x], {x, -10, 10}]
```



b)  $\text{Sin}(1.4+\text{Cos}(x))$

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

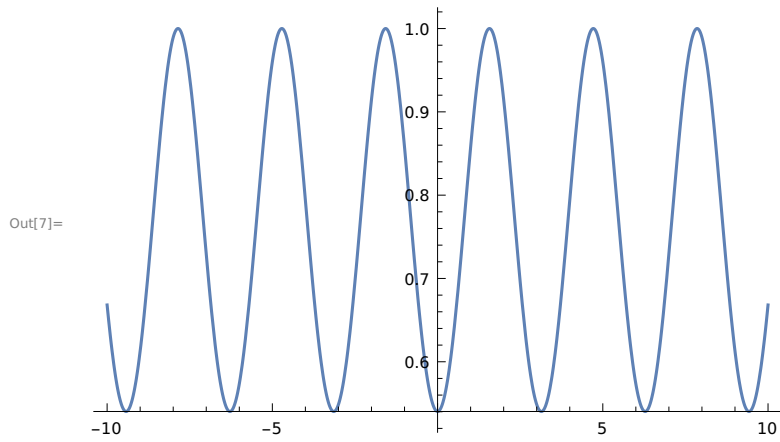
```
In[4]:= Plot[g[x], {x, -10, 10}]
```



c)  $\text{Sin}(\pi/2 + \text{Cos}(x))$

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

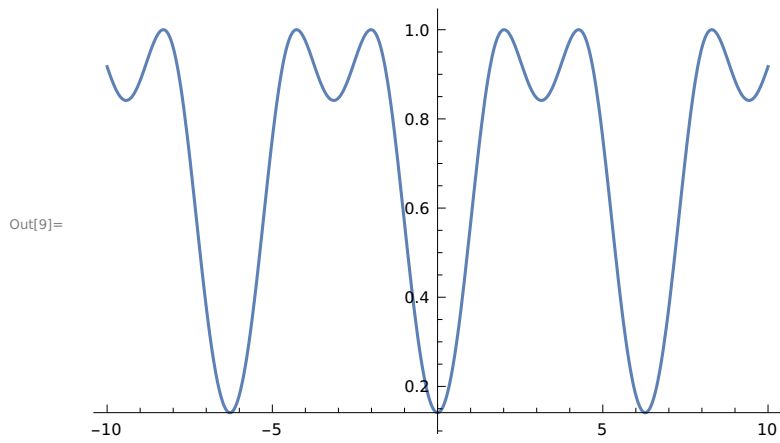
In[7]:= `Plot[h[x], {x, -10, 10}]`



d)  $\text{Sin}(2 + \text{Cos}(x))$

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

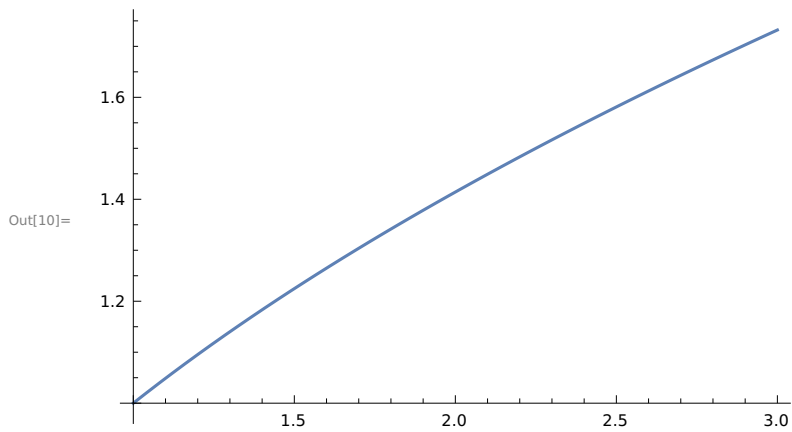
In[9]:= `Plot[f[x], {x, -10, 10}]`



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

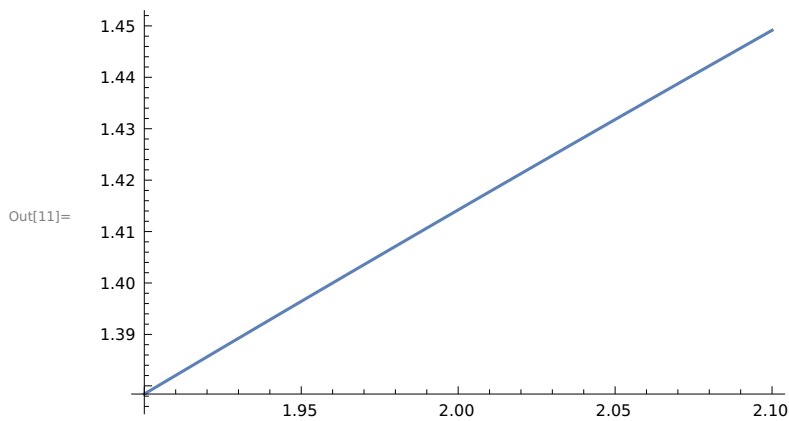
a) Graph of  $f$  as  $x$  goes from 1 to 3.

In[10]:= **With[{ $\delta = 10^0$ }, Plot[ $\sqrt{x}$ , {x, 2 -  $\delta$ , 2 +  $\delta$ }]]**

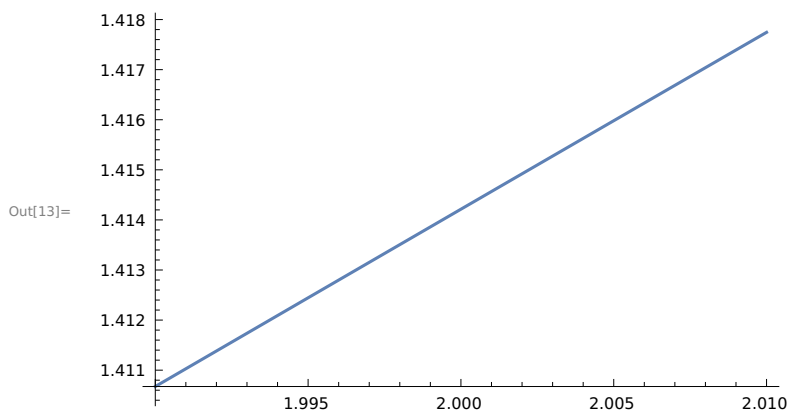


b) Change the value of  $\delta$  to be  $10^{-1}$ ,  $10^{-2}$ ,  $10^{-3}$  and see the graph of  $f$  as  $x$  goes from 1.9 to 2.1.

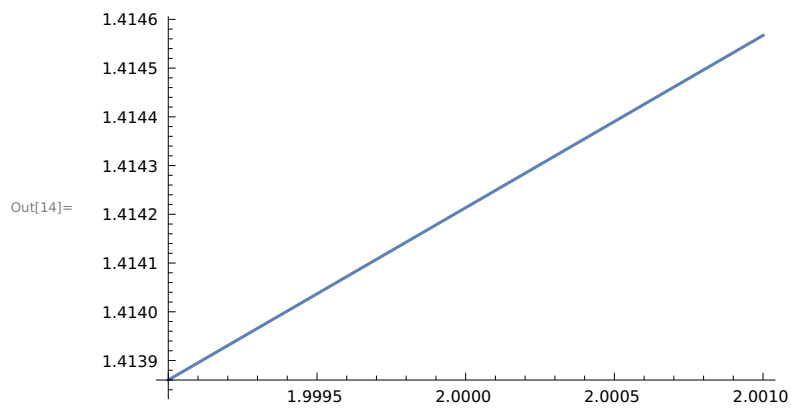
In[11]:= **With[{ $\delta = 10^{-1}$ }, Plot[ $\sqrt{x}$ , {x, 2 -  $\delta$ , 2 +  $\delta$ }]]**



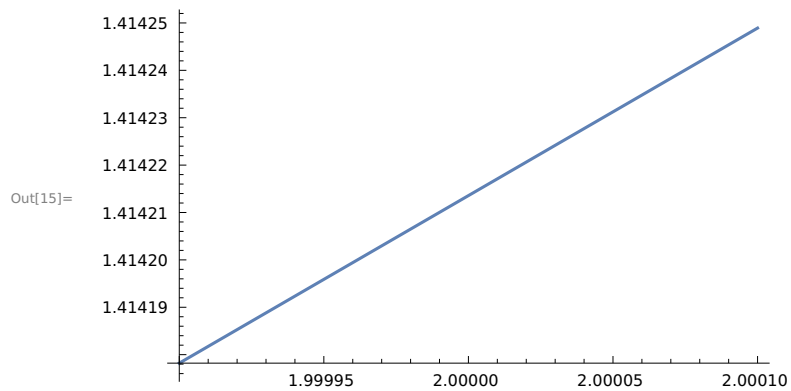
In[13]:= **With[{ $\delta = 10^{-2}$ }, Plot[ $\sqrt{x}$ , {x, 2 -  $\delta$ , 2 +  $\delta$ }]]**



In[14]:= `With[{ $\delta = 10^{-3}$ }, Plot[ $\sqrt{x}$ , {x,  $2 - \delta$ ,  $2 + \delta$ }]`



In[15]:= `With[{ $\delta = 10^{-4}$ }, Plot[ $\sqrt{x}$ , {x,  $2 - \delta$ ,  $2 + \delta$ }]`



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

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

In[16]:= `N[ $\sqrt{2}$ , 6]`

Out[16]= 1.41421

In[17]:= **With**[[ $\delta = 10^{-20}$ ], **Plot**[ $\sqrt{x}$ , {x, 2 -  $\delta$ , 2 +  $\delta$ }]

**Plot** : Endpoints for x in  $\left\{x, \frac{19999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$  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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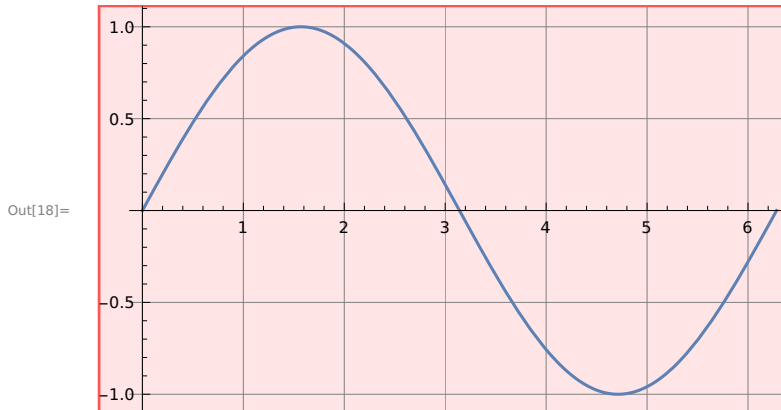
**General** : Further output of Plot::plld will be suppressed during this calculation .

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

### Exercise 3.3

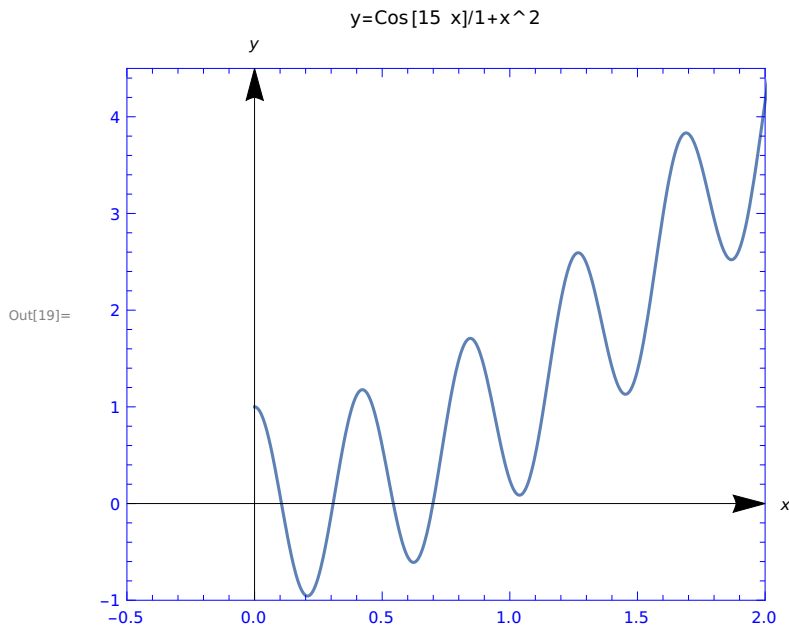
Q1. Use the Gridlines and Ticks options, as well as the setting Gridlines Style  $\rightarrow$  Lighter[Gray] to plot the sine function.

In[18]:= **Plot**[Sin[x], {x, 0, 2  $\pi$ }, **GridLines**  $\rightarrow$  Automatic ,  
**Ticks**  $\rightarrow$  Automatic , **GridLinesStyle**  $\rightarrow$  Light[Gray]]



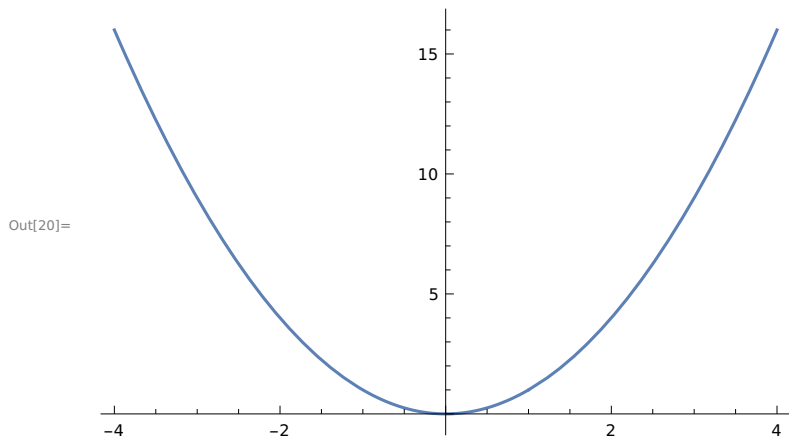
Q2. Use the Axes, Frame, Filling, FrameStyle, PlotRange and AspectRatio options to plot  $y = \text{Cos}(15x)/1 + x^2$ .

```
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]
```



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

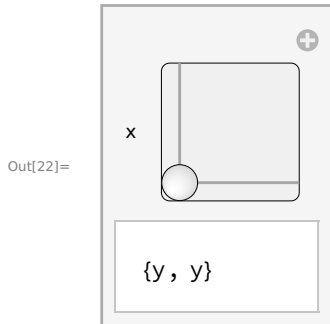
```
In[20]:= Plot[x^2, {x, -4, 4}, Exclusions → {x == 1}]
```



### Exercise 3.4

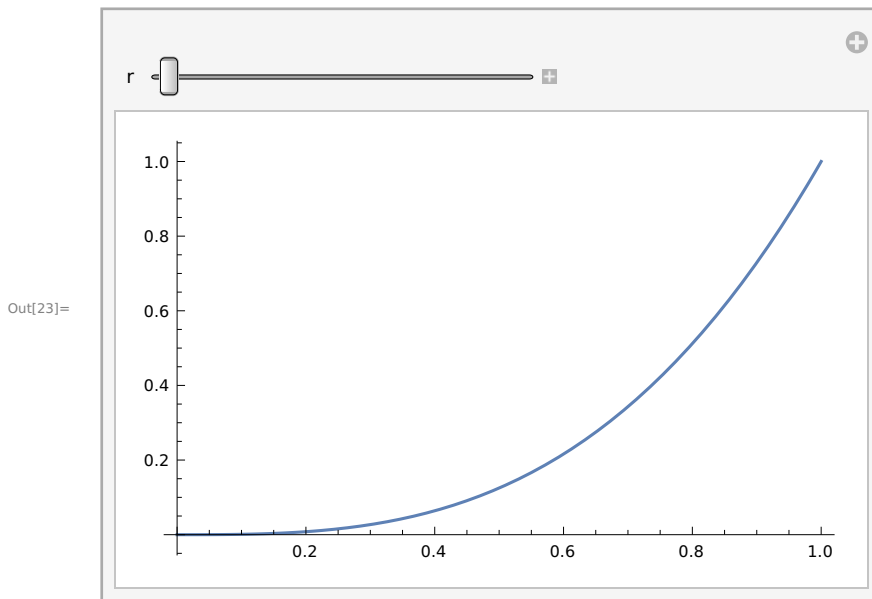
Q1. Make a manipulate has output  $\{x,y\}$ , but has a single Slider2D controller.

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



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]`



### 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]= 44 100

b) Make a table of values for  $x = 1, 2, \dots, 10$  for the function

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

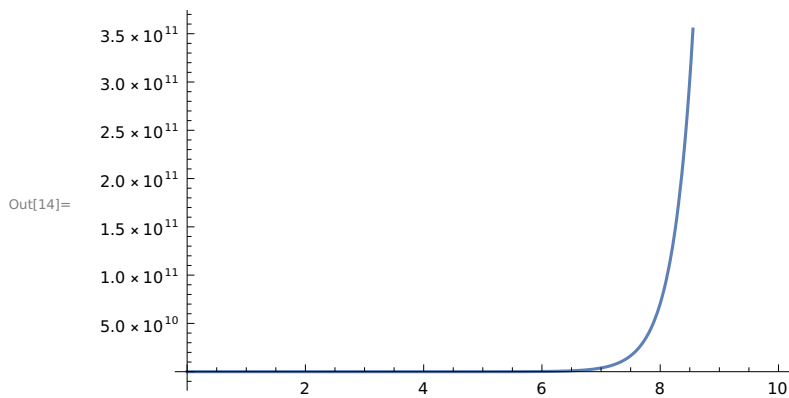
In[19]:= **Table[x ^ 3, {x, 1, 10}]**

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

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

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}]**

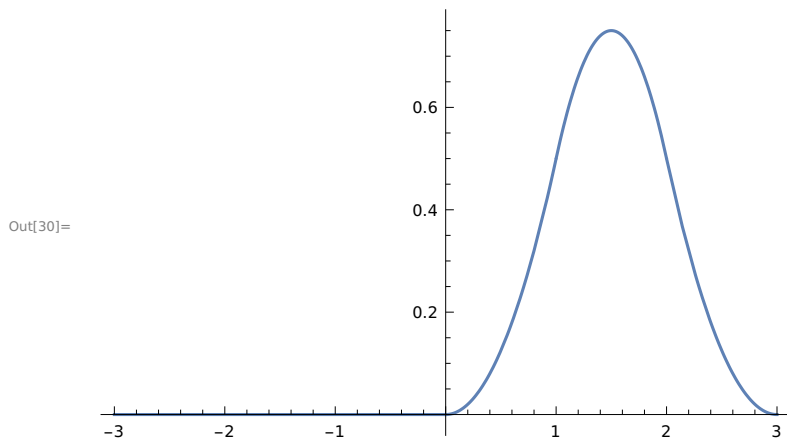


## Exercise 3.6

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}]`



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  $n \leq x < n+1$ . Use the domain  $0 \leq x < 20$ .

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}]`