SANDEEP KAUR SEKHON (MAT/19/112)

Assignment(Chapter-3)

SECTION-3.2

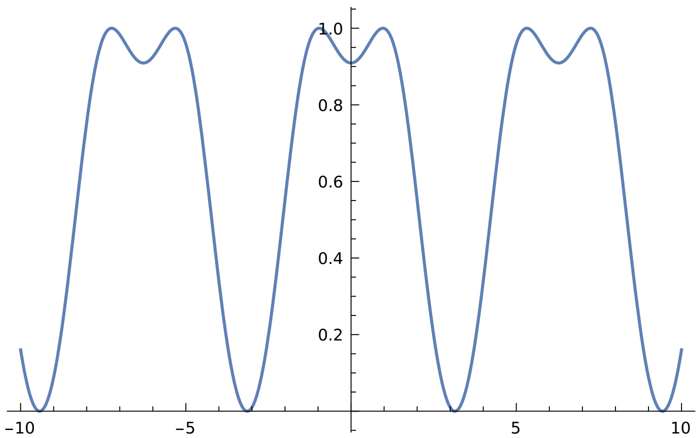
Q1.) Plot the following functions on the domain -10 ≤ x ≤ 10.

- sin(1+cos(x))

In[1]:=

```
Plot[Sin[1 + Cos[x]], {x, -10, 10}]
```

Out[1]=

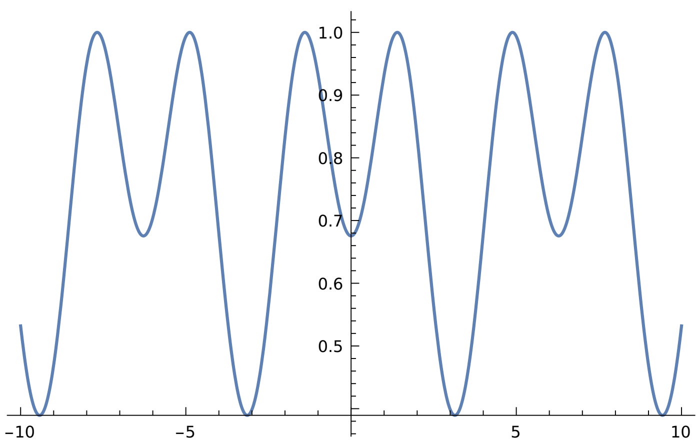


- sin(1.4+cos(x))

In[2]:=

```
Plot[Sin[1.4 + Cos[x]], {x, -10, 10}]
```

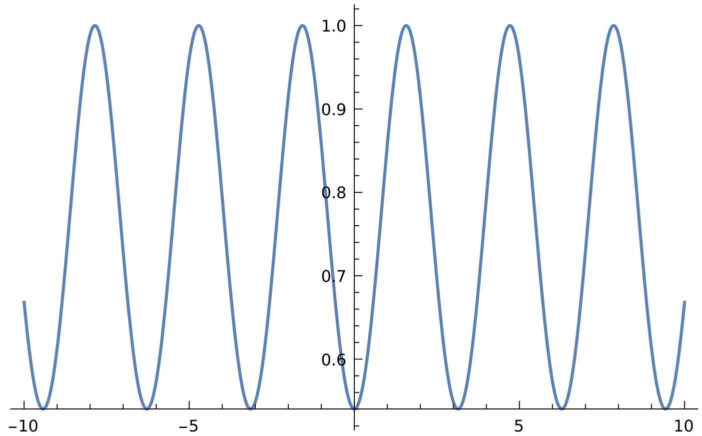
Out[2]=



- sin(π/2+cos(x))

In[3]:= `Plot[Sin[(Pi / 2) + Cos[x]], {x, -10, 10}]`

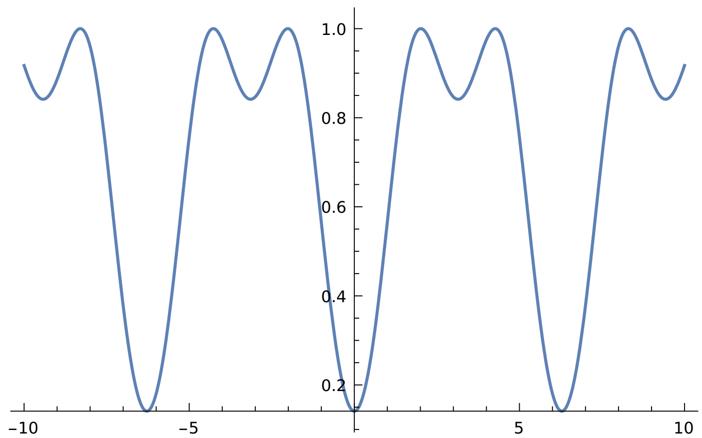
Out[3]=



- sin(2+cos(x))

In[4]:= `Plot[Sin[2 + Cos[x]], {x, -10, 10}]`

Out[4]=



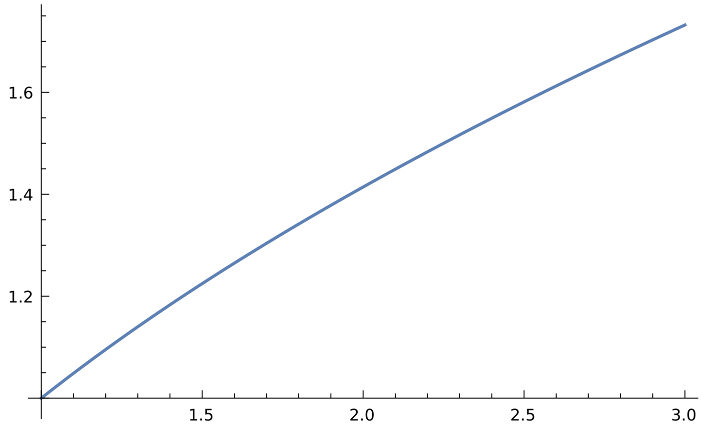
Q2.) One can zoom in toward a particular point in the domain of a function and see how the graph appears at different zoom levels. For instance, consider the sqaure root function f(x)=$\sqrt{x}$ when x is near 2.

- Enter the input below to see the graph of f as x goes from 1 to 3.

With[{δ=10^0},Plot[$\sqrt{x}$,{x,2-δ,2+δ}]]

In[5]:=
```
With[{δ = 10 ^ 0}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

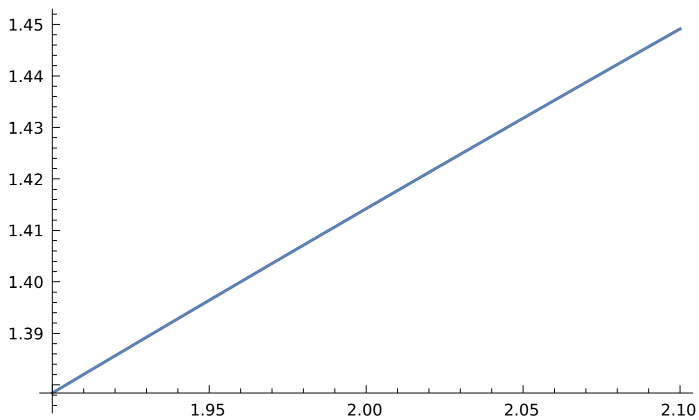
Out[5]=



- Now zoom; change the value of δ to be 10^-1 and re-enter the input above to see the graph of f as x goes from 1.9 to 2.1 . Do this again for δ= 10^-2, 10^-3, 10^-4, and 10^-5 .

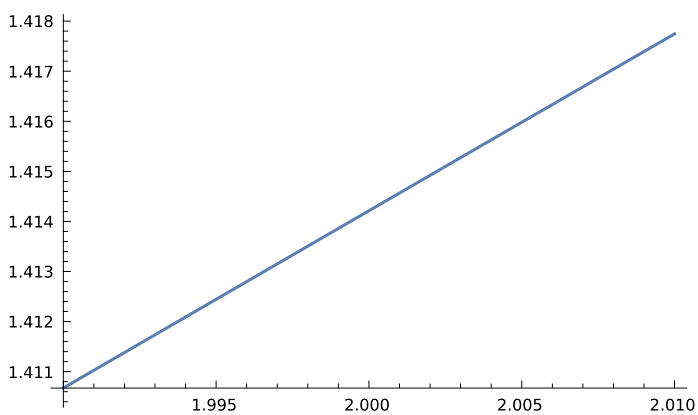
In[6]:=
```
With[{δ = 10 ^ - 1}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[6]=



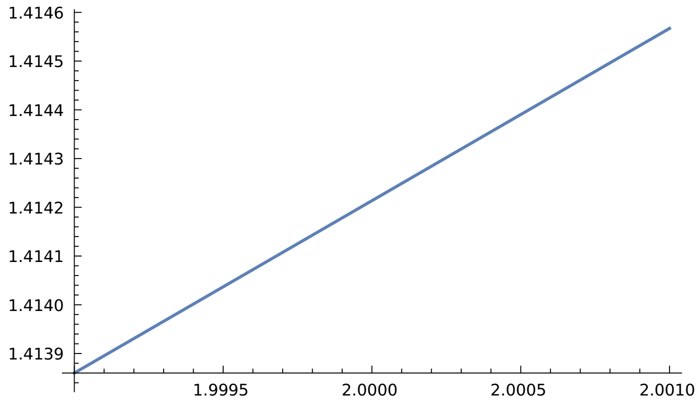
In[7]:=
```
With[{δ = 10 ^ - 2}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[7]=



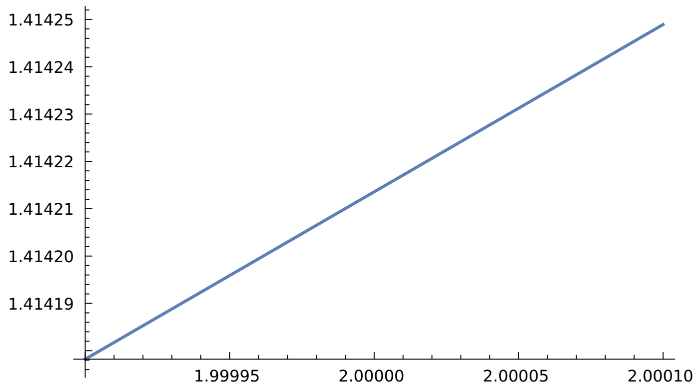
In[8]:=
```
With[{δ = 10^-3}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[8]=



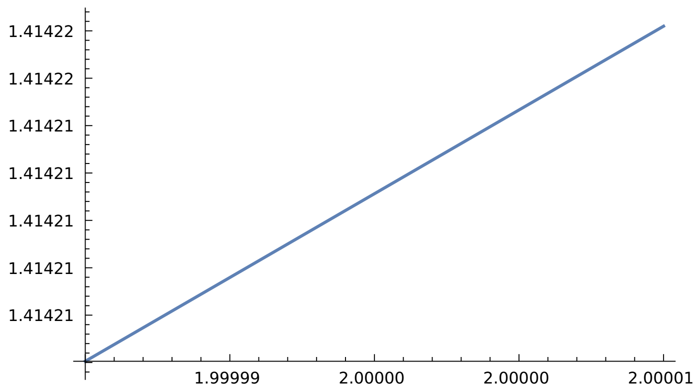
In[9]:=
```
With[{δ = 10^-4}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[9]=



In[10]:=
```
With[{δ = 10^-5}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

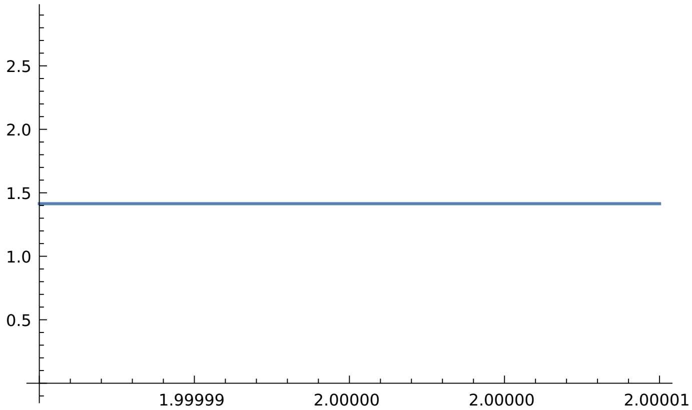
Out[10]=



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

In[1]:= `With[{δ = 10^-5}, Plot[√2, {x, 2 - δ, 2 + δ}]]`

Out[1]=



In[5]:= `N[√2, 6]`

Out[5]= `1.41421`

- When making a Plot, the lower and the upper bounds on the iterator must be distinct when rounded to machine precision. Enter the previous Plot command with $\delta = 10$^-20. An error message results. Read the error message and speculate as to what is happening. The bottom line is that zooming has its limits.

In[4]:= `With[{δ = 10^-20}, Plot[√x, {x, 2 - δ, 2 + δ}]]`

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

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

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{199999999999999999999}{100000000000000000000}, \frac{200000000000000000001}{100000000000000000000}\right\}$ must have distinct machine −precision numerical values .

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

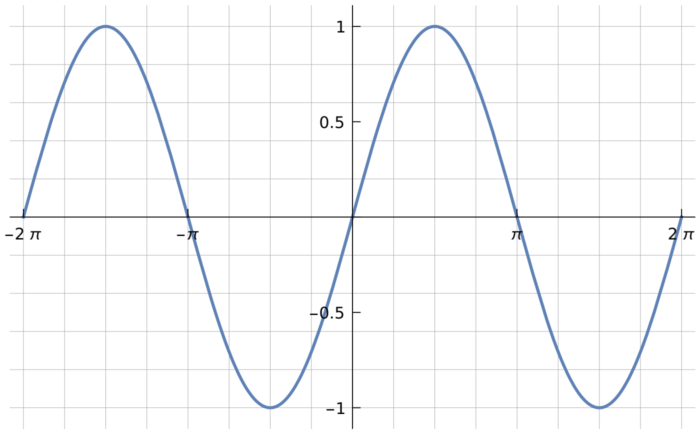
Out[4]= $\text{Plot}\left[\sqrt{x}, \left\{x, 2 - \frac{1}{100\,000\,000\,000\,000\,000\,000}, 2 + \frac{1}{100\,000\,000\,000\,000\,000\,000}\right\}\right]$

SECTION-3.3

Q1.) Use the GridLines and Ticks options, as well as the setting GridLinesStyle→Lighter[Gray], to produce the following Plot of the sine functions.

In[17]:=
```
Plot[Sin[x], {x, -2 Pi, 2 Pi}, GridLines → {Range[-2 Pi, 2 Pi, Pi / 4], Range[-1, 1, 0.2]},
 Ticks → {{-2 Pi, -Pi, Pi, 2 Pi}, {-1, -0.5, 0, 0.5, 1}}, GridLinesStyle → Lighter[Gray]]
```

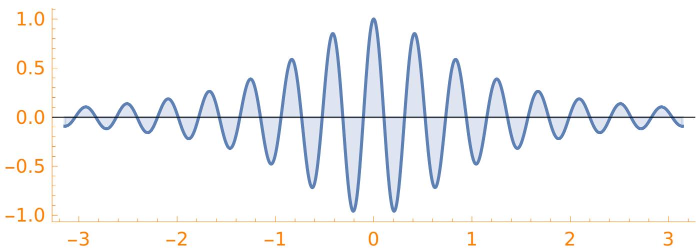
Out[17]=



Q2.) Use the Axes, Frame, Filling, Framestyle, PlotRange, and AspectRatio options to produce the following plot of the function y = cos(15x)/(1+x^2).

In[10]:=
```
Plot[Cos[15 x] / (1 + x ^ 2), {x, -Pi, Pi}, AspectRatio → Automatic,
 Axes → {True, False}, Frame → {{True, False}, {True, False}},
 PlotRange → Full, FrameStyle → Directive[Orange, 10], Filling → Axis]
```

Out[10]=

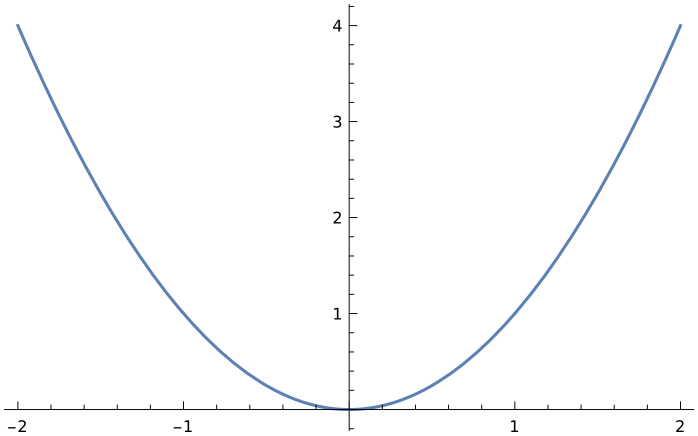


Q4.) Plot the function f(x) = x^2 on the domain -2 ≤ x ≤ 2, and set Exclusions to {x=1}. Note that f has no vertical asymptote at x=1. What happens?

In[13]:=

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

Out[13]=



Nothing happens

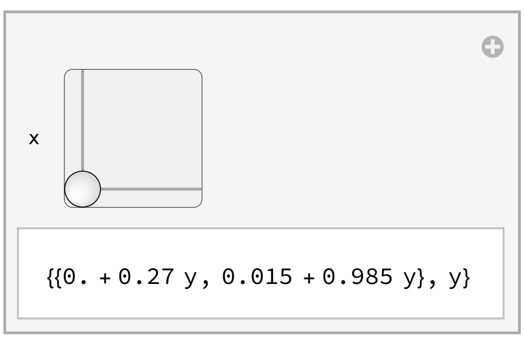
SECTION-3.4

Q1.) The following simple Manipulate has two sliders: one for x and one for y. Make a Manipulate that also has output {x,y}, but that has a single Slider2D controller.

In[6]:=

```
Manipulate[{x, y}, {x, y, {0, 1}}]
```

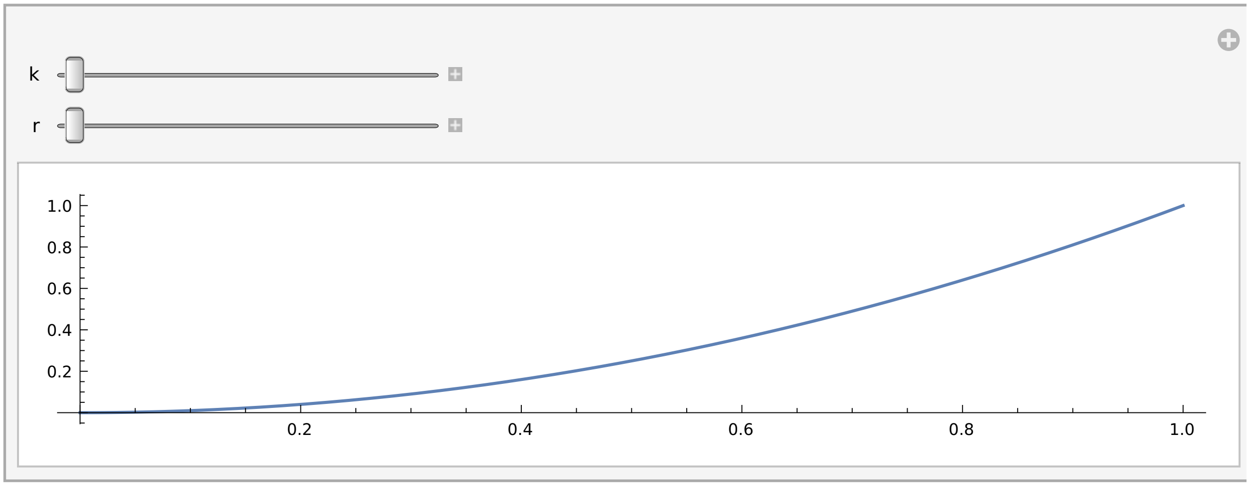
Out[6]=



Q2.) Make a Manipulate of a Plot where the user can adjust the AspectRatio in real time,from a starting value of 1/5 (five times as wide as it is tall) to an ending value of 5 (five times as tall as it is wide). Set ImageSize to {Automatic,128} so the height remains constant as the slider is moved.

In[17]:=
```
Manipulate [Plot[x ^ 2, {x, 0, r}, ImageSize → {Automatic , 128}, AspectRatio → k],
 {k, 1 / 5, 5}, {r, 1, 2}]
```

Out[17]=



SECTION-3.5

Q1.) The Partition command is used to break a single list into sublists of equal length. It is useful for breaking up a list into rows for display within a Grid.

- Enter the following inputs and discuss the outputs.

Range[100]

Partition[Range[100],10]

In[1]:=
```
Range[100]
```

Out[1]=
```
{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[2]:=
```
Partition [Range[100], 10]
```

Out[2]=
```
{{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}}
```

- Format a table of the first 100 integers, with twenty digits per row. The first two rows, for example, should look like this:

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

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

In[9]:=
```
Table[f[x], {x, 1, 100}]
```

Out[9]=
```
{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[10]:=
```
Partition[Table[f[x], {x, 1, 100}], 20]
```

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}}
```

- Make the same table as above, but use only the Table and Range commands. Do not use Partition.

In[13]:=
```
Table[Range[100], 1]
```

Out[13]=
```
{{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}}
```

- Make the same table as above, but use only the Table command (twice) . Do not use Partition or Range.

In[9]:=
```
Table[Table[x, {x, 1, 100}], 1]
```

Out[9]=
```
{{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.) The Sum command has a syntax similar to that of Table.

- 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[7]:=
```
f[x_] := x ^ 3
```

In[8]:=
```
Sum[f[x], {x, 1, 20}]
```
Out[8]= 44 100

- Make the table of values for x = 1, 2, ... ,10 for the function:

  f(x) =

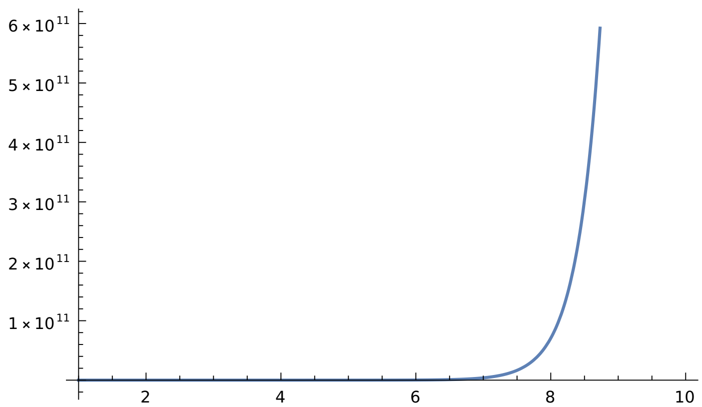
  1^x + 2^x +3^x +4^x +5^x + 6^x + 7^x + 8^x + 9^x + 10^x + 11^x + 12^x + 13^x + 14^x + 15^x + 16^x + 17^x + 18^x + 19^x + 20^x

In[9]:=
```
f[x_] := 1 ^ x + 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[12]:=
```
Table[f[x], {x, 1, 10}]
```
Out[12]= {210 , 2870 , 44 100 , 722 666 , 12 333 300 , 216 455 810 ,
 3 877 286 700 , 70 540 730 666 , 1 299 155 279 940 , 24 163 571 680 850 }

- Plot f(x) on the domain 1 ≤ x ≤ 10

In[13]:=
```
Plot[f[x], {x, 1, 10}]
```
Out[13]=



SECTION-3.6

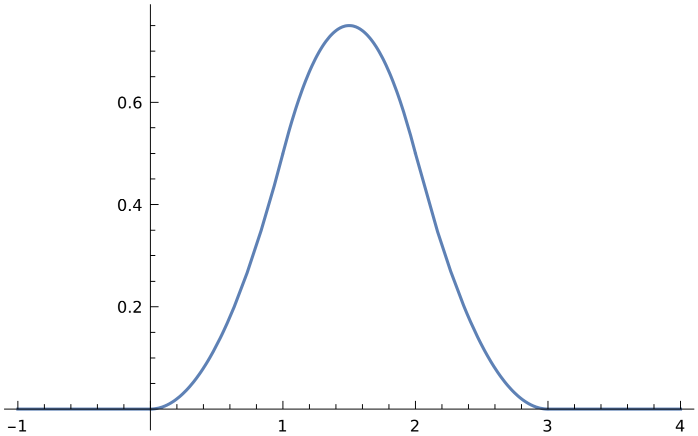
Q2.) Make a plot of the piecewise function below, and comment on its shape

$$f(x) = \begin{cases} 0 & x < 0 \\ \frac{x^2}{2} & 0 \le x \le 1 \\ -\frac{3}{2} + 3x - x^2 & 1 \le x \le 2 \\ \frac{1}{2}(3-x)^2 & 2 \le x \le 3 \\ 0 & \text{True} \end{cases}$$

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

In[2]:=
```
Plot[f[x], {x, -1, 4}]
```

Out[2]=



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 ≤ x ≤ n+1. Use the domain 0 ≤ x ≤ 20.

In[3]:=
```
ClearAll[f, x]
```

In[4]:=
```
f[x_] := Piecewise[{{n^2, n ≤ x ≤ n + 1}, {1, n ≤ x ≤ n + 1}}]
```

In[5]:=
```
Plot[f[x], {x, 0, 20}]
```

Out[5]=