TORRENCE
MAT / 19 / 75

Exercise 3.2 Qns

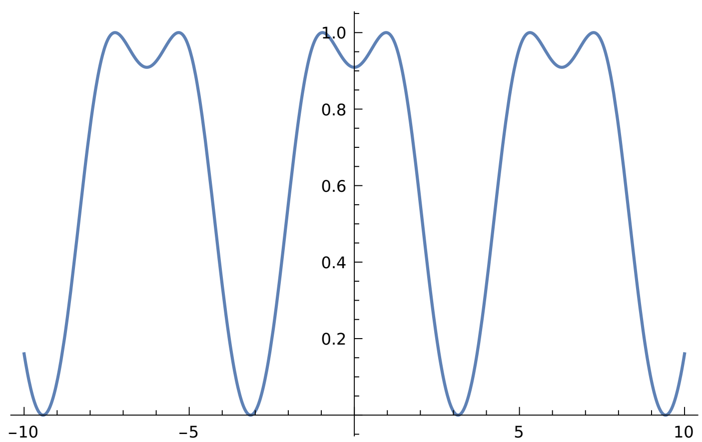
Ques1 – Plot the following functions on the domain $-10 \leq x \leq 10$.

(a) Sin[1+Cos[x]]

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

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

Out[2]=

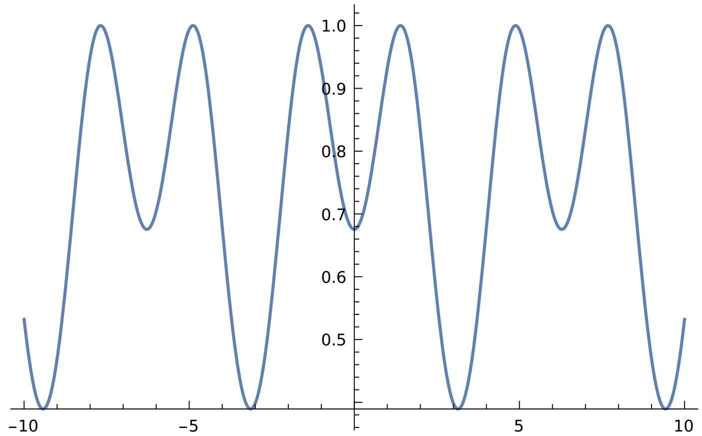


(b) Sin[1.4+Cos[x]]

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

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

Out[4]=

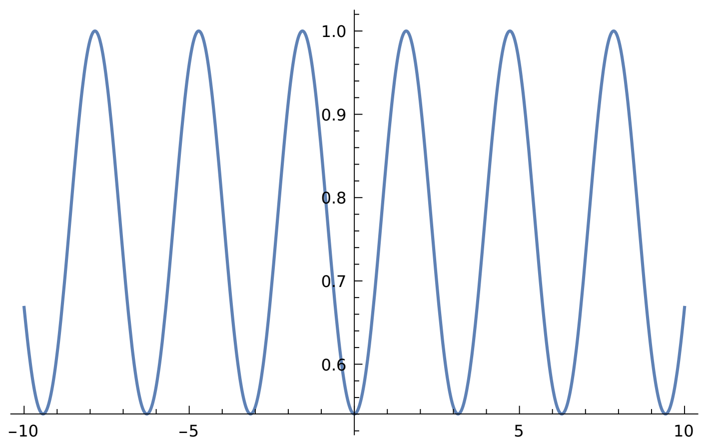


(c) Sin[Pi/2+Cos[x]]

In[5]:=
```
h[x_] := Sin[Pi / 2 + Cos[x]]
```

In[6]:=
```
Plot[h[x], {x, -10, 10}]
```

Out[6]=

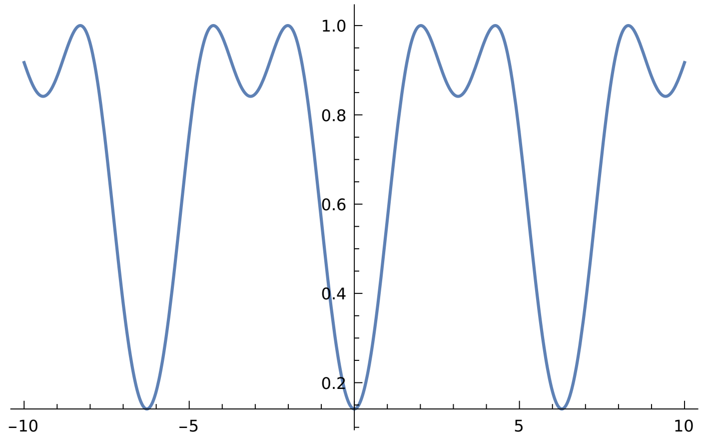


(d) Sin[2+Cos[x]]

In[7]:=
```
z[x_] := Sin[2 + Cos[x]]
```

In[8]:=
```
Plot[z[x], {x, -10, 10}]
```

Out[8]=

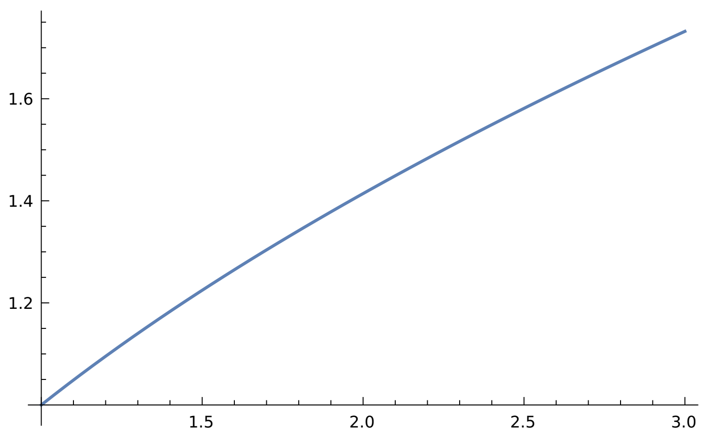


<u>Ques2</u> – Consider the square root function f (x) = $\sqrt{x}$ when a is near 2.

(a) Enter the input below to see the grapf of f as x goes from 1 to 3.

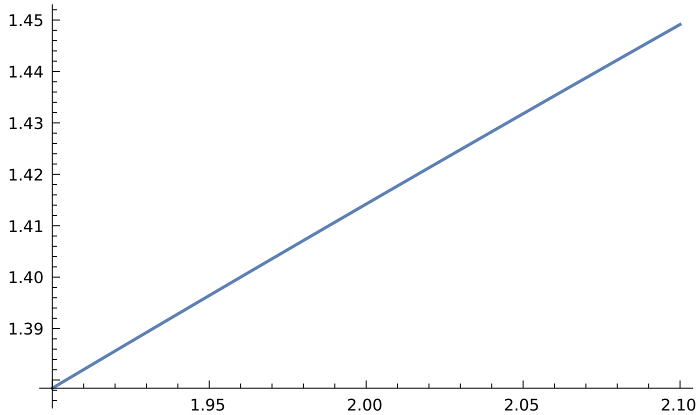
In[9]:=
```
With[{δ = 10^0}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[9]=



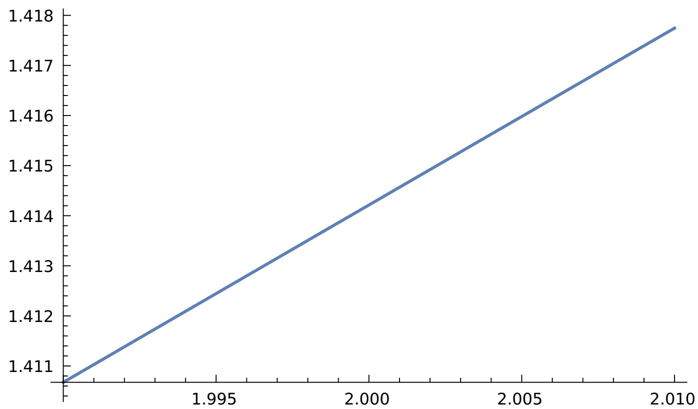
(b) Change the value of δ to be 10^(−1) and do this again for δ = 10^(−2), 10^(−3), 10^(−4) and 10^(−5).

In[10]:= `With[{δ = 10^(-1)}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]`

Out[10]=


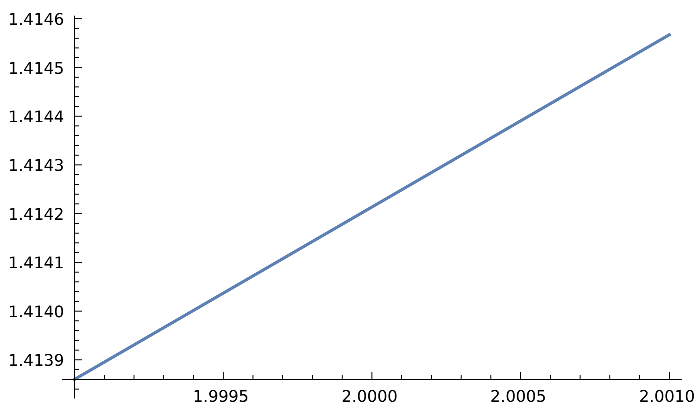
For 10^(-2)

In[11]:= `With[{δ = 10^(-2)}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]`

Out[11]=


For 10^(-3)

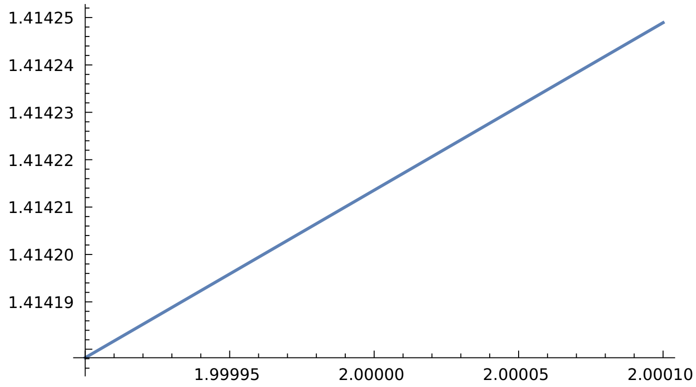
In[12]:= `With[{δ = 10^(-3)}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]`

Out[12]=


For 10^(-4)

In[13]:=
```
With[{δ = 10 ^ (- 4)}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

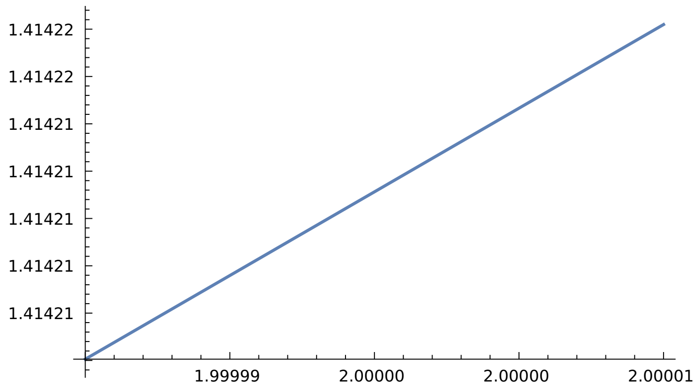
Out[13]=



For 10^(-5)

In[14]:=
```
With[{δ = 10 ^ (- 5)}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

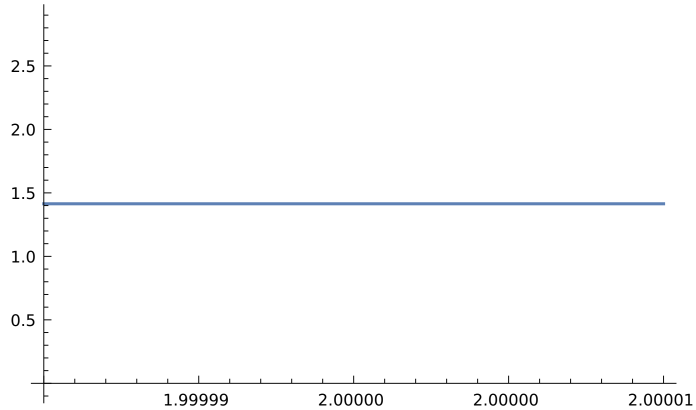
Out[14]=



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

In[15]:=
```
With[{δ = 10^(-5)}, Plot[Sqrt[2], {x, 2 - δ, 2 + δ}]]
```

Out[15]=



In[16]:=
```
N[Sqrt[2], 6]
```

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

(d) When making a Plot, the lower and 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[17]:=
```
With[{δ = 10^(-20)}, Plot[Sqrt[2], {x, 2 - δ, 2 + δ}]]
```

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

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

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

Plot : Endpoints for x in $\left\{x, \frac{19999999999999999999}{10000000000000000000}, \frac{20000000000000000001}{10000000000000000000}\right\}$ must have distinct machine -precision numerical values .

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

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

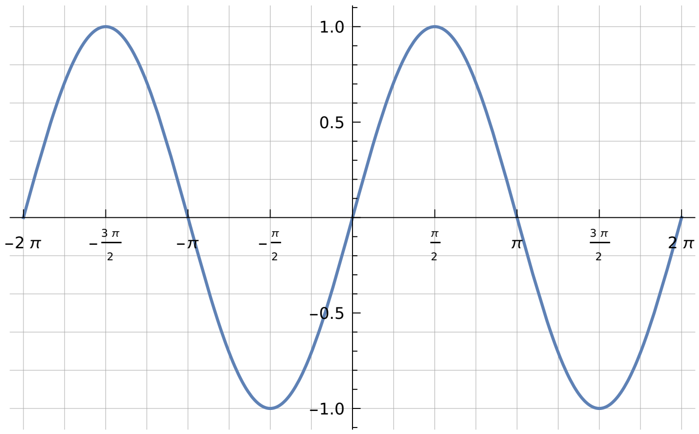
CONCLUSION: The difference and addition of two values are so small that it cannot read by the computer, thus, the mathematica is showing error.

Exercise 3.3 Qns

Ques1 – Use the GridLines and ticks option ,
as well as the setting GridLinesStyle →
Lighter[Gray],
to produce the following Plot of the sine function.

In[28]:=
```
Plot[Sin[x] , {x, -2 π, 2 π}, GridLinesStyle → Lighter[Gray],
 GridLines → {Range[-2 π, 2 π, π / 4], Range[-1, 1, 0.2]},
 Ticks → {Range[-2 π, 2 Pi, Pi / 2], Automatic}]
```

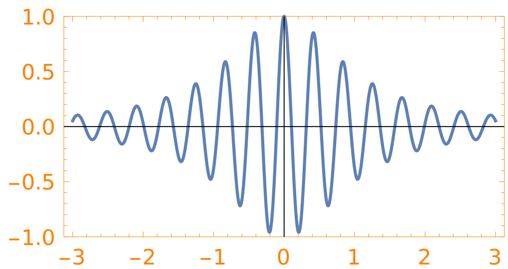
Out[28]=



<u>Ques2</u> – Use the Axes, Frame, Filling , FrameStyle, PlotRange and AspectRatio options to produce the following plot of the function y = Cos[15 x] / 1 + x ^ 2

In[11]:=
```
Plot[Cos[15 x] / (1 + x ^ 2), {x, -3, 3}, AspectRatio → 1 / 2, PlotRange → {-1, 1},
 Axes → True, Frame → True, FrameStyle → Directive[Orange, 12]]
```

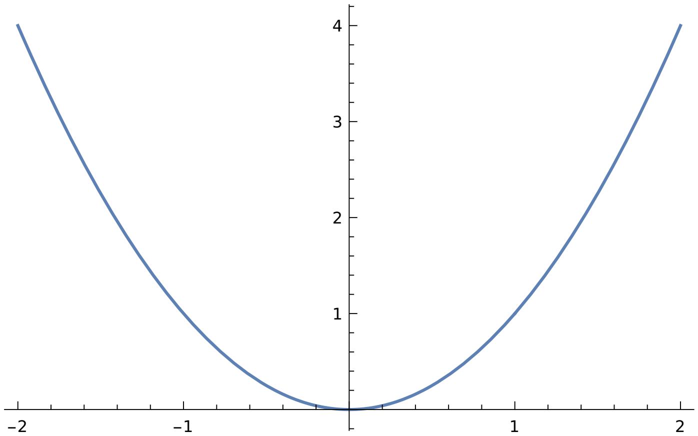
Out[11]=



<u>Ques4</u> – Plot the function f (x) = x ^ 2 on the domain – 2 ≤ x ≤ 2 and set Exclusions to {x == 1}.

In[13]:=
```
Plot[x^2, {x, -2, 2}, Exclusions → {x == 1}]
```

Out[13]=

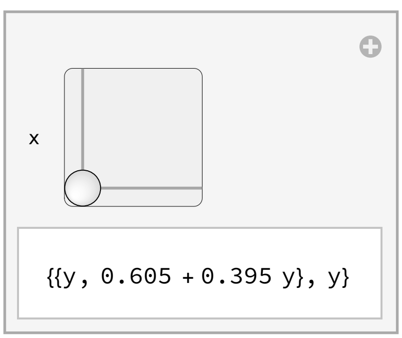


Exercise 3.4 Qns

Ques1 – Make a manipulate that has output {x, y}, but that has a single Slider2D controller.

In[12]:=
```
Manipulate[{x, y}, {x, y, {0, 1}}]
```

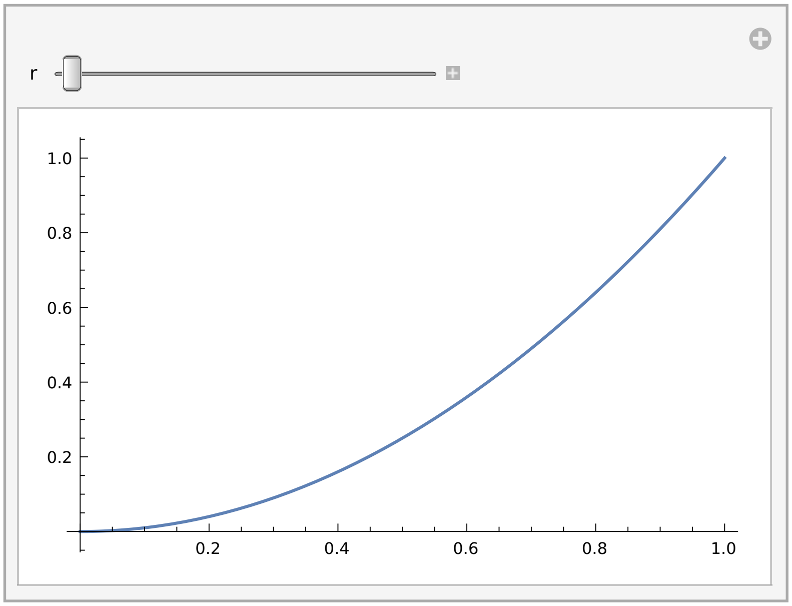
Out[12]=



Ques2 – 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[13]:=
```
Manipulate[Plot[x^2, {x, 0, r}], {r, 1, 3},
 ImageSize → {Automatic, 128}, AspectRatio → 5/6]
```

Out[13]=



Exercise 3.5 Qns

Ques1 – 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.

(a) Enter the following inputs.

In[14]:=
```
Range[100]
```

Out[14]=
```
{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[15]:= Partition[Range[100], 10]

Out[15]= {{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 twenty digits per row.

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

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

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

```
In[2]:= Grid[Table[Range[x, x + 19], {x, {1, 21, 41, 61, 81}}]]
```

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

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

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

In[4]:= Grid[Table[Table[f[x], {x, x, x + 19}], {x, {1, 21, 41, 61, 81}}]]
```

Out[4]=

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

Ques4 − The Sum command has a syntax similar to that of Table.

(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[28]:= f[x_] := x ^ 3

In[29]:= Sum[f[x], {x, 1, 20}]

Out[29]= 44 100
```

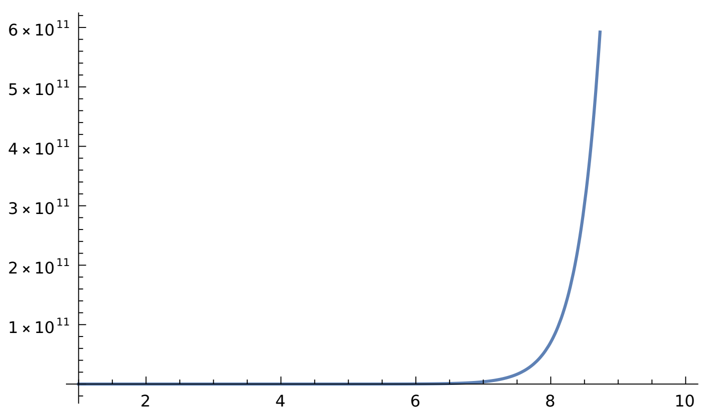
(b) Make a table of values for x = 1, 2, … …, 10 for the function f[x] = 1 + 2 ^ x + 3 ^ x + … … .. + 20 ^ x

```
In[30]:= 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[31]:= Table[f[x], {x, 1, 10}]

Out[31]= {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 }
```

(c) Plot f[x] on the domain 1 ≤ x ≤ 10

```
In[32]:= 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[33]:= Plot[f[x], {x, 1, 10}]
```

Out[33]=



In[3]:=
```
ClearAll[f, g, h, z]
```

Exercise 3.6 Qns

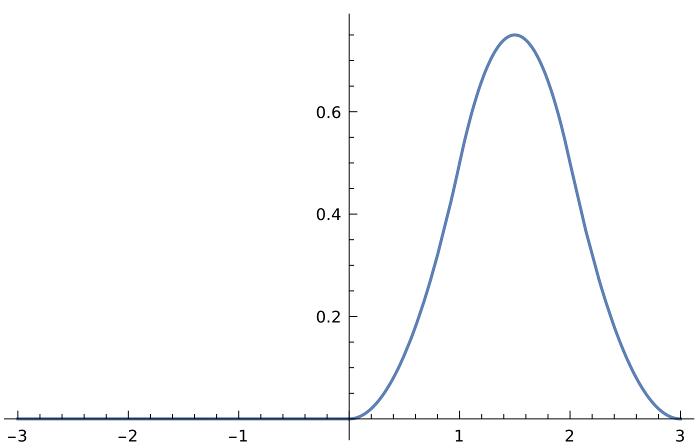
Ques2 – Make a plot of the piecewise function below.

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

In[6]:=
```
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, 3 ≤ x}}]
```

In[7]:=
```
Plot[f[x], {x, -3, 3}]
```

Out[7]=



In[10]:=
```
ClearAll[f]
```

Ques3 – 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[19]:=
```
f[x_] := Piecewise[{{n^2, n ≤ x < n + 1}, {1, n ≤ x ≤ n + 1}}]
```

In[20]:=

```
Plot[f[x], {x, 0, 20}]
```

Out[20]=