Chapter: 3

Section 3.2

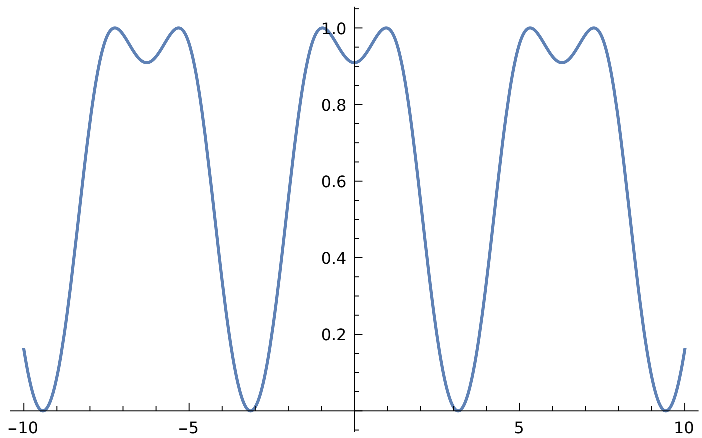
Ques 1. Plot the following functions on the domain -10≤ x ≤10.

a. sin(1+cos(x))

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

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

Out[2]=



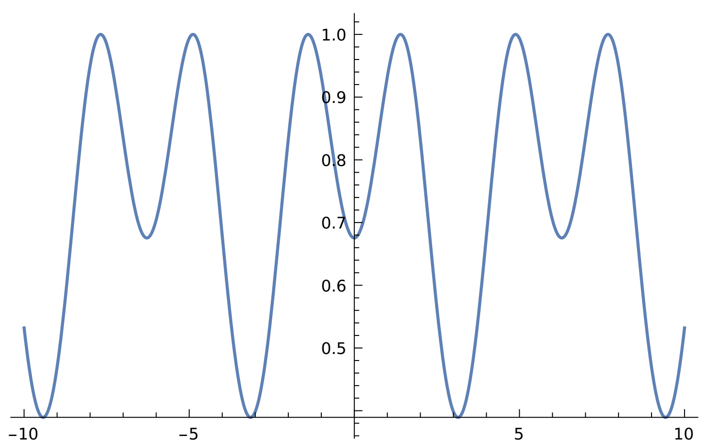
b. sin(1.4+cos(x))

In[3]:=
```
Clear[f]
```

In[4]:=
```
f[x_] := Sin[1.4 + Cos[x]]
```

In[5]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[5]=



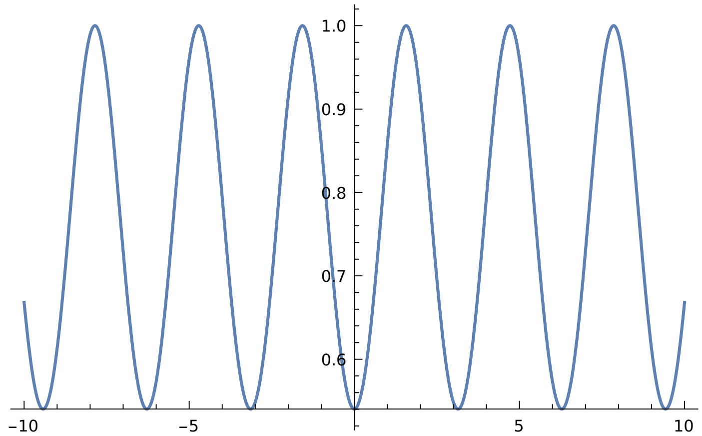
c. sin(π/2+cos(x))

In[6]:=
```
Clear[f]
```

In[7]:=
```
f[x_] := Sin[Pi / 2 + Cos[x]]
```

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

Out[8]=



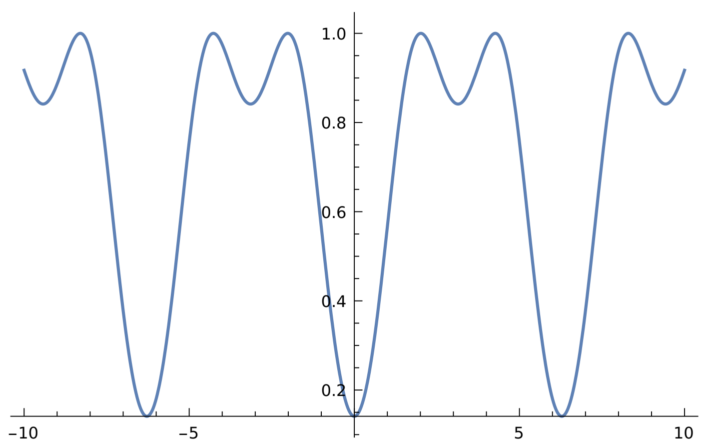
d. sin(2+cos(x))

In[9]:=
```
Clear[f]
```

In[10]:=
```
f[x_] := Sin[2 + Cos[x]]
```

In[11]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[11]=

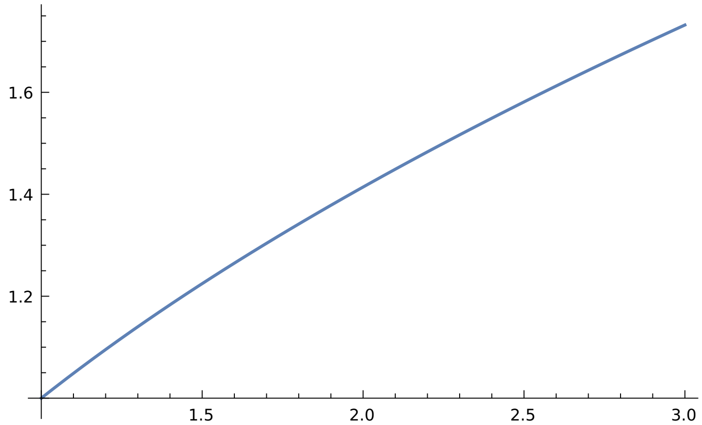


Ques 2. One can zoom in toward a particular point in the domain of a function and see how the graph appears at different zoom levels. For instance, consider the square root function f(x)=√x when x is near 2.

a. Enter the input below to see the graph of f as x goes from 1 to 3. With[{δ = 10^0},Plot[√x,{x,2-δ,2+δ}]]

In[12]:=
```
With[{δ = 10^0}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

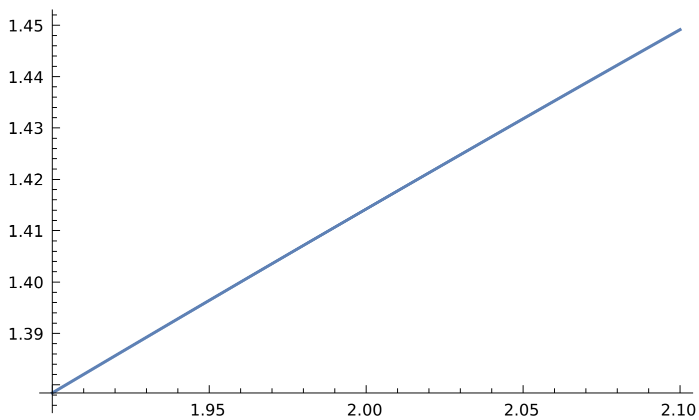
Out[12]=



b. 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).

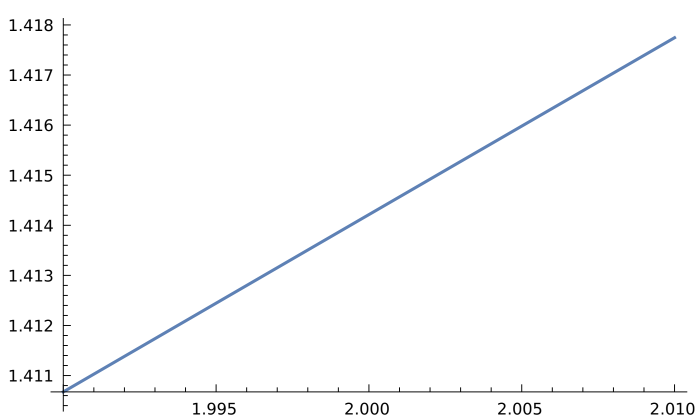
In[13]:=
```
With[{δ = 10^(-1)}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[13]=



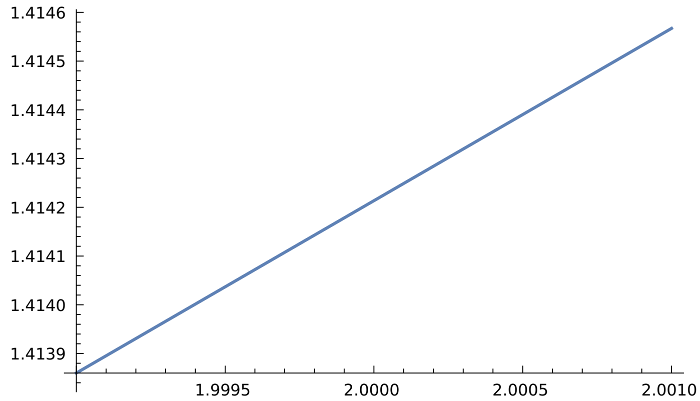
In[14]:=
```
With[{δ = 10^(-2)}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[14]=



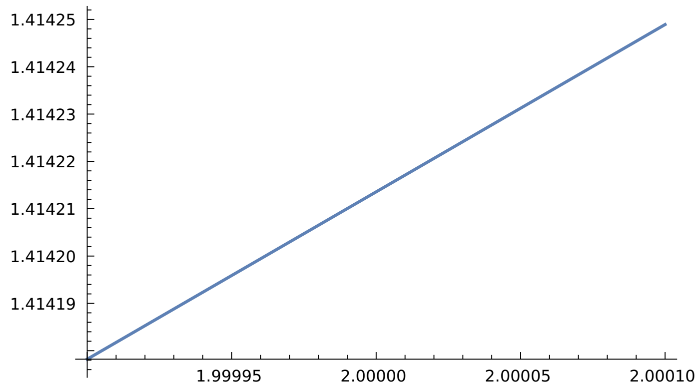
In[15]:=
```
With[{δ = 10^(-3)}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[15]=



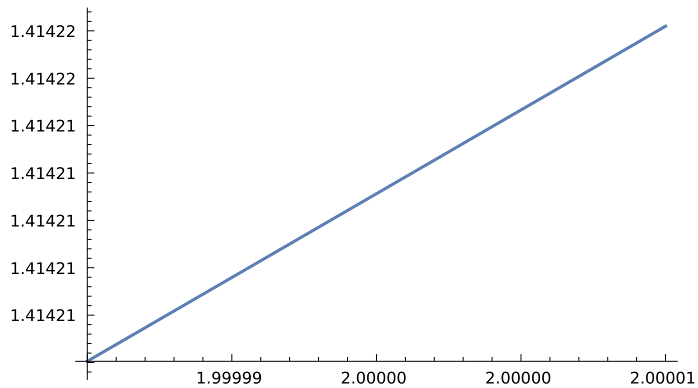
In[16]:=
```
With[{δ = 10^(-4)}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[16]=



In[17]:=
```
With[{δ = 10^(-5)}, Plot[√x, {x, 2 - δ, 2 + δ}]]
```

Out[17]=

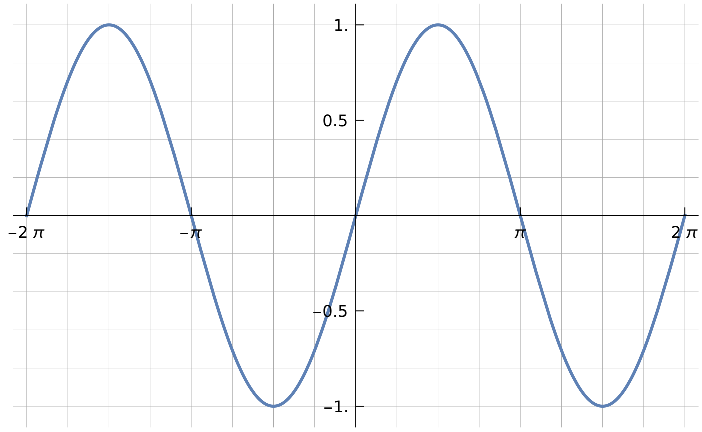


Section 3.3

Ques 1. Use the GridLines and Ticks options, as well as the setting GridLinesStyle ⟶ Lighter[Gray], to produce the following Plot of the sine function:

In[21]:=
```
Plot[Sin[x] , {x, -2 Pi, 2 Pi}, GridLines → {Range[-2 Pi, 2 Pi, Pi / 4], Range[-1, 1, 0.2]},
 Ticks → {Range[-2 Pi, 2 Pi, Pi], Range[-1, 1, 0.5]}, GridLinesStyle → Lighter[Gray]]
```

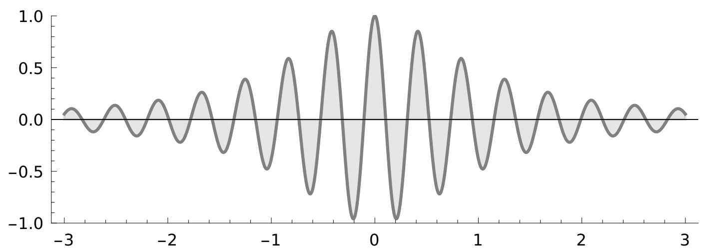
Out[21]=



Ques 2. 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[43]:=
```
Plot[Cos[15 x] / (1 + x ^ 2), {x, -3, 3},
 Axes → {True, False}, AspectRatio → Automatic, Filling → Axis
, Frame → {{True, False}, {True, False}}, FrameStyle → {Gray},
 PlotStyle → {Gray}, PlotRange → {-1, 1}]
```

Out[43]=



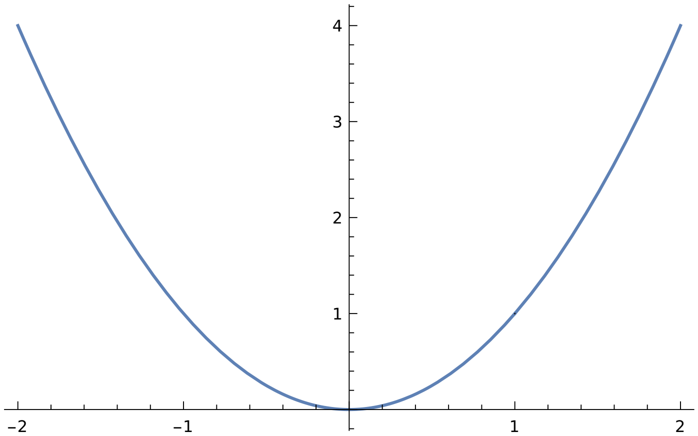
Ques 4. Plot the function f(x)=x^2 on the domain -2≤ x ≤2, and set Exclusions to {x=1}. Note that f has no vertical asymptote at x=1. What happens?

In[1]:=
```
Clear[f]
```

In[2]:=
```
f[x_] := x ^ 2
```

In[3]:=
```
Plot[x^2, {x, -2, 2}, Exclusions → {x == 1}, ExclusionsStyle → Dashed]
```

Out[3]=



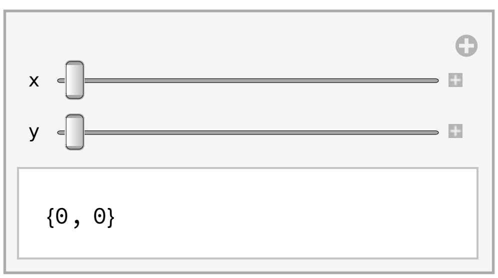
Conclusion: As the function x^2 is continuous on the whole real line, thus Exclusions has little visible effect as function is continuous at the specified point and has no vertical asymptote at x=1.

Section 3.4

Ques 1. The following simple Manipulate has two sliders: one for x and one for y. Make a Manipulate that also has output [x,y] but has a single Slider2D controller.

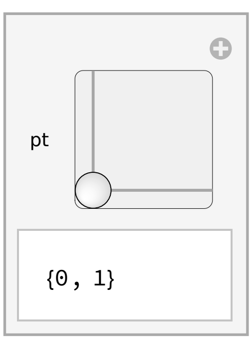
In[31]:=
```
Manipulate[{x, y}, {x, 0, 1}, {y, 0, 1}]
```

Out[31]=




```
Manipulate[pt, {pt, {0, 1}, {0, 1}}]
```

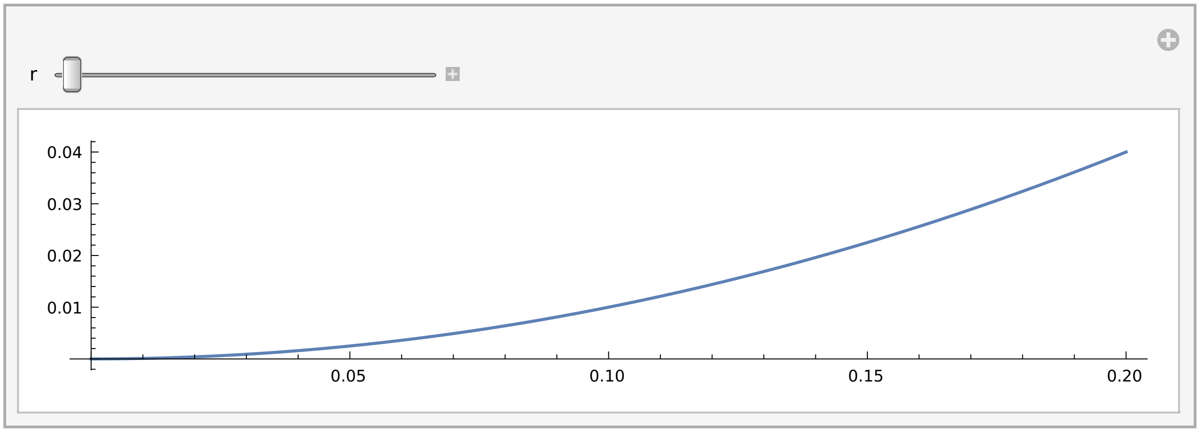
Out[54]=



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

Out[2]=



Section 3.5

Ques 1. 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 and discuss the outputs.

```
In[3]:= Range[100]

Out[3]= {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[4]:= Partition[Range[100], 10]

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}}
```

Conclusion: Range[100] gives a list of 100 elements whereas Partition[Range[100],10] gives us sublists of the main list containing 100 elements such that each sublist contains equal number of elements i.e. 10.

b. Format a table of the first 100 integers, with twenty digits per row.

In[5]:=
```
data = Partition[Range[100], 20]
```

Out[5]=
```
{{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[6]:=
```
Grid[data]
```

Out[6]=

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.

In[3]:=
```
Grid[Table[Range[x, x + 19], {x, {1, 21, 41, 61, 81}}]]
```

Out[3]=

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 Table command (twice).

In[4]:=
```
Clear[f]
```

In[5]:=
```
f[x_] := x
```

In[6]:=
```
Grid[Table[Table[f[x], {x, x, x + 19}], {x, {1, 21, 41, 61, 81}}]]
```

Out[6]=

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

Ques 4. The Sum command has syntax similar to that of Table.

a. Use the Sum command to evaluate the following expression: 1^3+2^3+3^3+............+20^3

In[2]:=
```
Sum[x ^ 3, {x, 1, 20}]
```

Out[2]=
```
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[16]:=
```
Clear[f]
```

In[17]:=
```
f[x_] := Sum[r ^ x, {r, 1, 20}]
```

In[19]:=
```
data = Table[{x, f[x]}, {x, 1, 10}]
```

Out[19]=
```
{{1, 210}, {2, 2870}, {3, 44 100}, {4, 722 666}, {5, 12 333 300}, {6, 216 455 810},
 {7, 3 877 286 700}, {8, 70 540 730 666}, {9, 1 299 155 279 940}, {10, 24 163 571 680 850}}
```

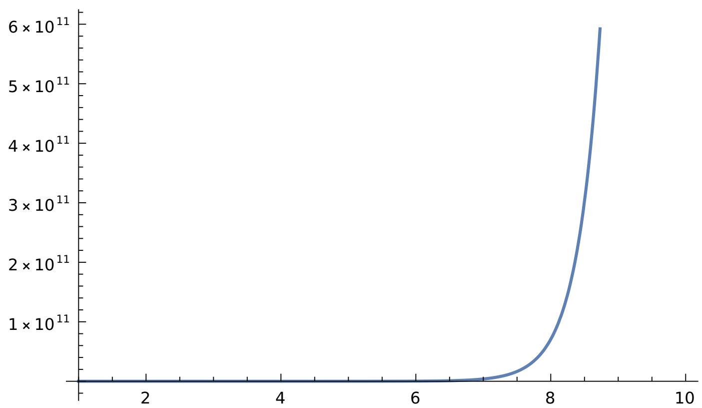
In[20]:=
```
Grid[data]
```

Out[20]=

1	210
2	2870
3	44 100
4	722 666
5	12 333 300
6	216 455 810
7	3 877 286 700
8	70 540 730 666
9	1 299 155 279 940
10	24 163 571 680 850

c. Plot f(x) on the domain 1≤x≤10.

In[22]:=
```
Plot[f[x], {x, 1, 10}]
```

Out[22]=


Section 3.6

Ques 2. Make a plot of the piecewise function below, and comment on its shape

In[23]:=
```
Clear[f]
```

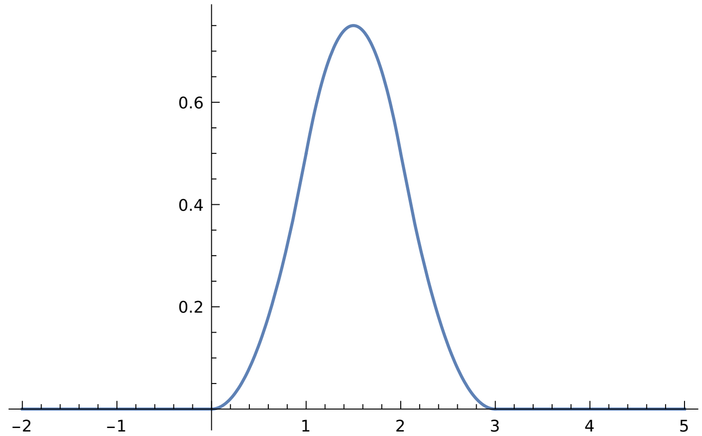
In[32]:=
```
f[x_] = Piecewise[{{0, x < 0}, {x ^ 2 / 2, 0 ≤ x < 1},
   {-x ^ 2 + 3 x - 3 / 2, 1 ≤ x < 2}, {((3 - x) ^ 2) / 2, 2 ≤ x < 3}, {0, x ≥ 3}}]
```

Out[32]=

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

In[38]:=
```
Plot[f[x], {x, -2, 5}]
```

Out[38]=



Ques 3. 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[1]:=
```
Clear[f]
```

In[32]:=
```
f[x_] := Piecewise[{{1^2, 1 ≤ x < 2}, {2^2, 2 ≤ x < 3}, {3^2, 3 ≤ x < 4}}]
```

In[33]:=
```
Plot[f[x], {x, 0, 19}]
```

Out[33]=