MAT/19/83 SUHANI SHARMA.

CHAPTER 3 - FUNCTIONS AND THEIR PLOT.

EXERCISE

SECTION 3.2 - EXERCISE .

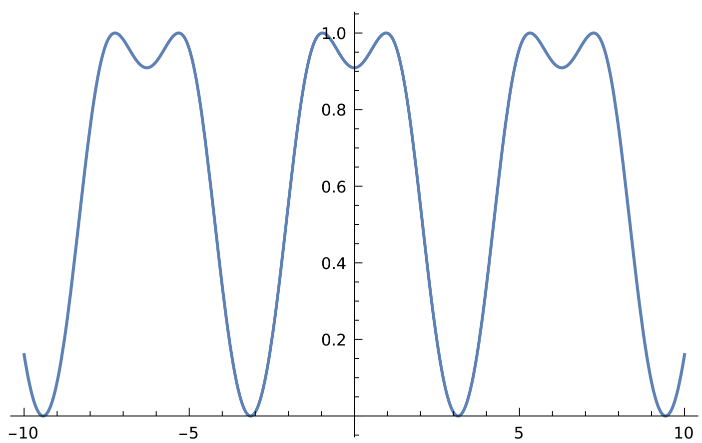
1) Plot the following functions on the domain 10 ≤ x ≤ 10.

a. sin (1+ cos (x))

In[2]:=
```
f[x_] := Sin[1 + Cos[x]];
```

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

Out[2]=

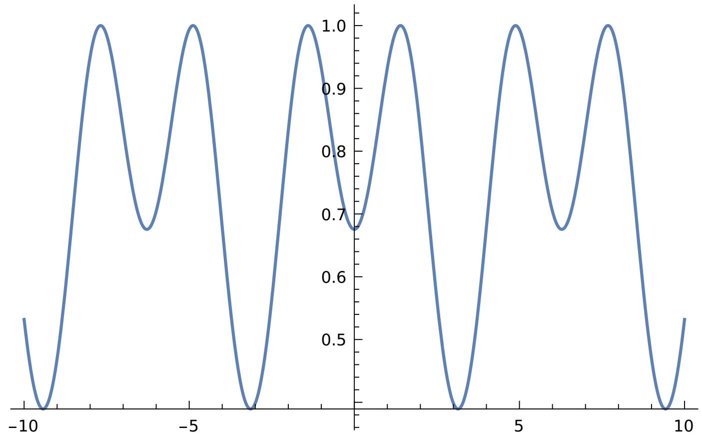


b. sin(1.4 + cos(x))

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

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

Out[6]=

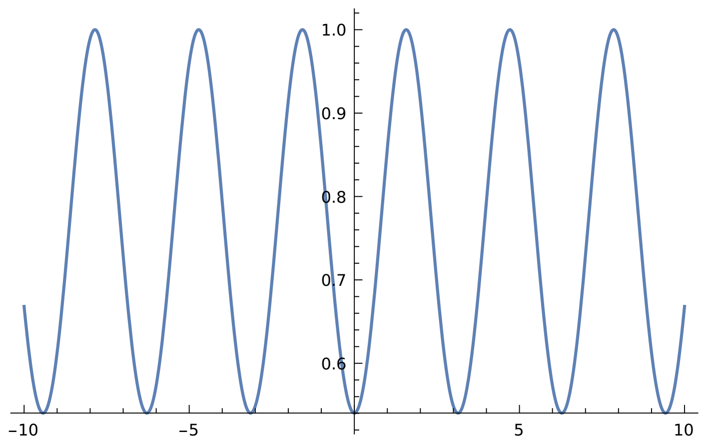


c. sin(π/2 + cos(x))

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

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

Out[8]=

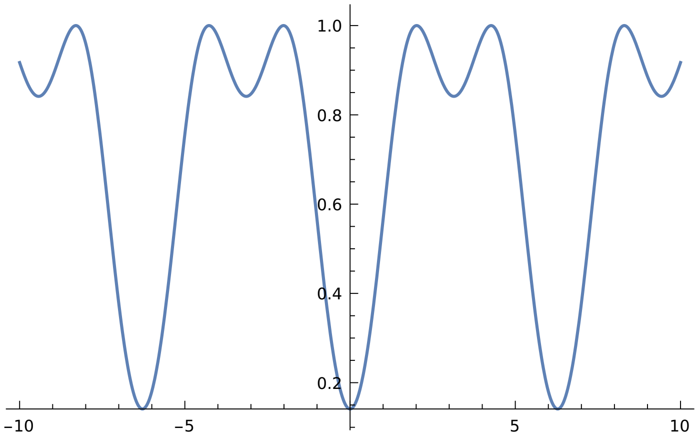


d. sin(2+ cos(x))

In[9]:=
```
s[x_] := Sin[2 + Cos[x]];
```

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

Out[10]=

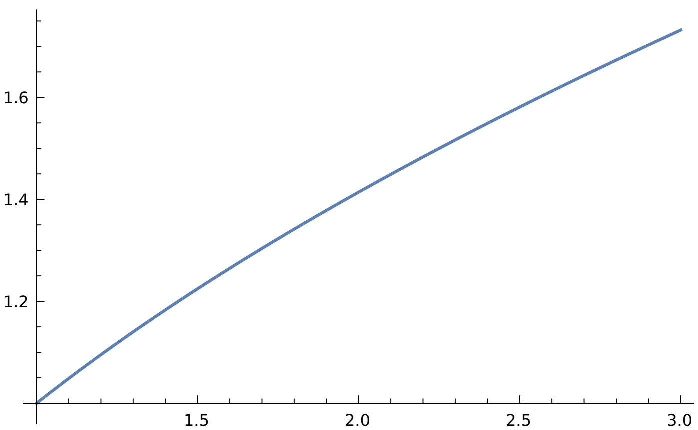


2) One can zoom in toward a particular point in the domain of a function and see how the graph appears at different zoom levels. For instance, consider the square root function f +x/ x when x is near 2.

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

In[31]:=
```
With[{δ = 10 ^ 0}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

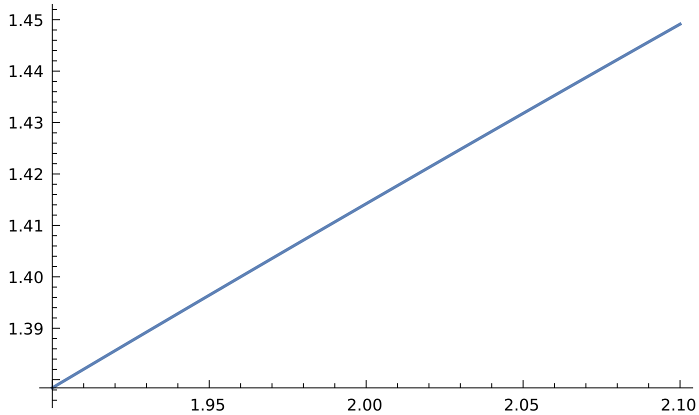
Out[31]=



b. Change the value of δ to be 10^-1 , 10^-2 , 10^-3, 10^-4, 10^-5 and see the graph of f as x goes from 1.9 to 2.1 .

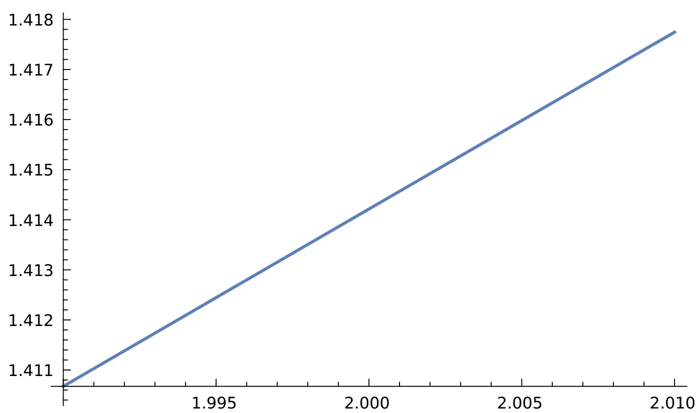
In[32]:=
```
With[{δ = 10 ^- 1}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[32]=



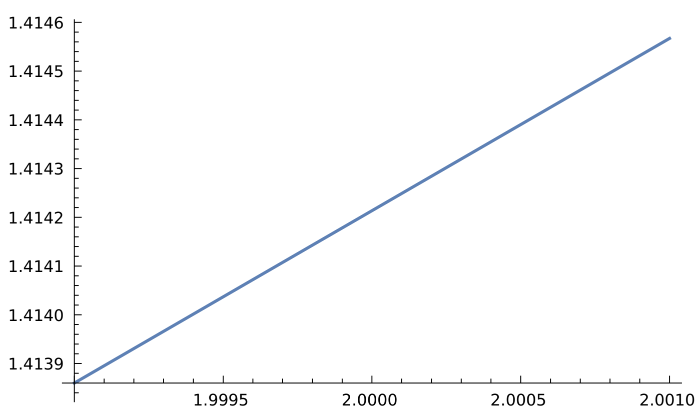
In[33]:=
```
With[{δ = 10 ^- 2}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[33]=



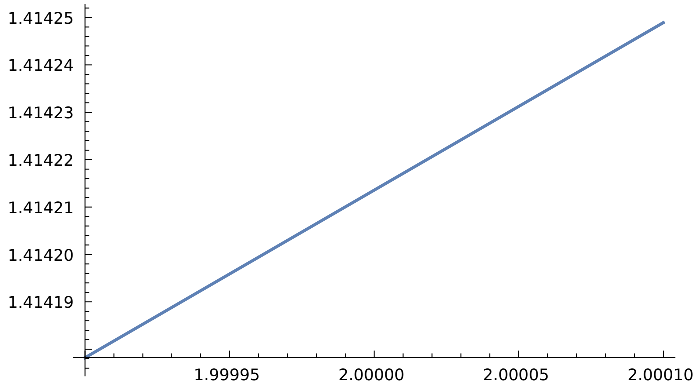
In[34]:=
```
With[{δ = 10 ^- 3}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[34]=



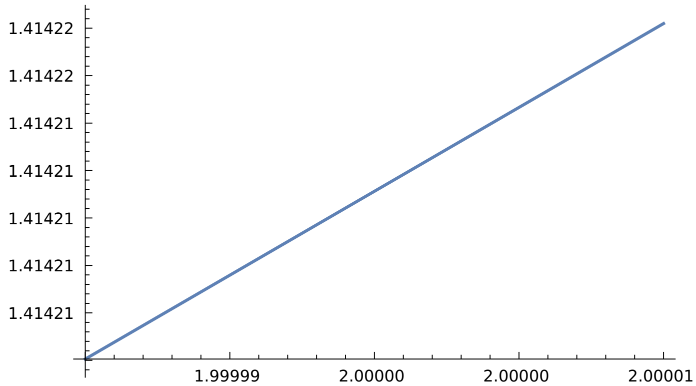
In[35]:=
```
With[{δ = 10 ^- 4}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[35]=



In[37]:=
```
With[{δ = 10 ^- 5}, Plot[Sqrt[x], {x, 2 - δ, 2 + δ}]]
```

Out[37]=



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

- By the above plots we can approximate that $\sqrt{2} = 1.41421$

In[36]:=
```
N[Sqrt[2], 6]
```

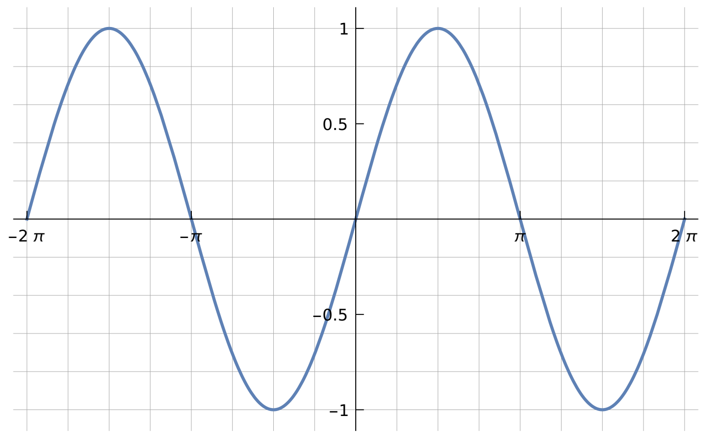
Out[36]=
```
1.41421
```

SECTION 3.3 - EXERCISE

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[14]:= 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}, {-0.5, -1, 0.5, 1}}, GridLinesStyle → Lighter[Gray]]
```

Out[14]=

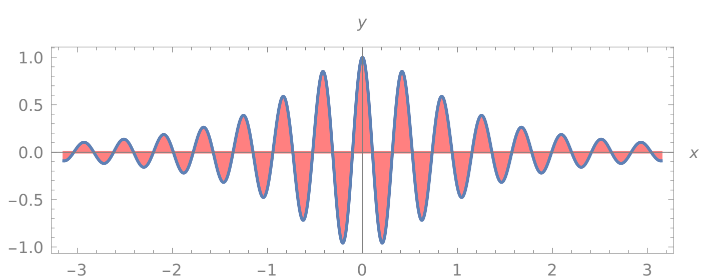


2) Use the Axes, Frame, Filling, FrameStyle, PlotRange, and AspectRatio options to produce the following plot of the function y cos+15 x

```
In[1]:= f[x_] := Cos[15 * x] / (1 + x ^ 2);

In[3]:= Plot[ f[x], {x, -Pi, Pi}, Axes → True , AxesLabel → {x, y},
  AxesStyle → Directive[Gray], Frame → True, Filling → Axis, FillingStyle → Pink,
  FrameStyle → Gray, PlotRange → Full, AspectRatio → Automatic]
```

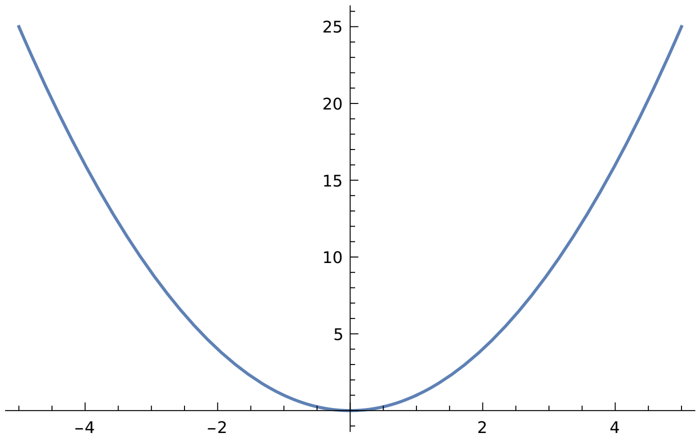
Out[3]=



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[8]:=
```
Plot[x^2, {x, -5, 5}, Exclusions → {x == 1}]
```

Out[8]=



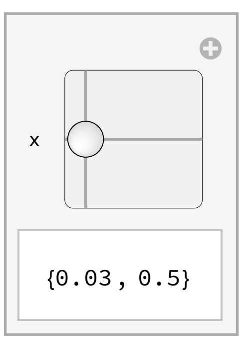
f has no vertical asymptote at x = 1 which shows that f is continuous.

SECTION 3.4 - EXERCISE

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 that has a single Slider2D controller.

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

Out[1]=

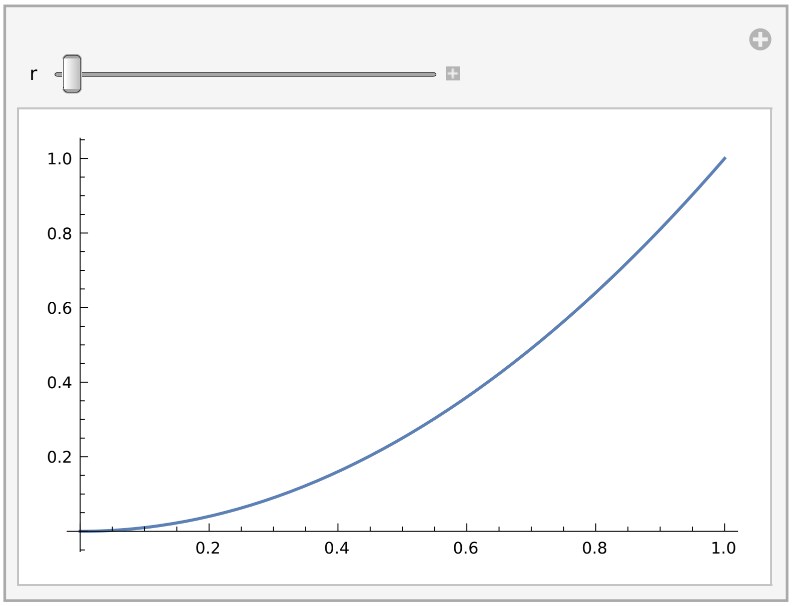


2) Make a Manipulate of a Plot where the user can adjust the AspectRatio in real time, from a starting value of 1/5 (five times as wide as it is tall) to an ending value of 5

(five times as tall as it
is wide). Set ImageSize to Automatic, 128 so the height remains constant as the slider is
moved.

In[7]:=
```
Manipulate[Plot[x^2, {x, 0, r}], {r, 1, 3},
 AspectRatio → 5/6, ImageSize → {Automatic, 128}]
```

Out[7]=



SECTION 3.5 - EXERCISE

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[4]:=
```
Range[100]
```

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}
```

In[5]:=
```
Partition [Range[100], 10]
```

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}}
```

b. Form a table of the first 100 integers , with twenty digits per row. he 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[6]:=
```
Table[x, {x, 1, 100}]
```

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}
```

In[7]:=
```
Partition [Table[x, {x, 1, 100}], 20]
```

Out[7]=
```
{{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 command.

In[8]:=
```
Table[Range[10], 10]
```

Out[8]=
```
{{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 twice . do not use partition or range .

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

4) 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+1
5^3
+16^3+17^3+18^3+19^3+20^3**

In[11]:=
```
f[x_] := x^3

Sum[f[x], {x, 1, 20}]
```

Out[12]=
```
44 100
```

**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 10 +16^x+17^x+18^x+19^x+20^x**

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

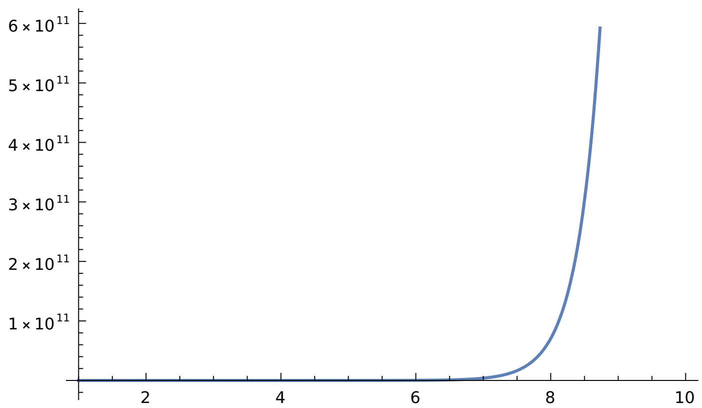
Out[14]=
```
{210, 2870, 44 100, 722 666, 12 333 300, 216 455 810,
 3 877 286 700, 70 540 730 666, 1 299 155 279 940, 24 163 571 680 850}
```

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

In[5]:=
```
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[6]:=
```
Plot[f[x], {x, 1, 10}]
```

Out[6]=



SECTION 3.6 - EXERCISE

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

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[1]:=
```
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[2]:=
```
Plot[f[x], {x, - 3, 3}]
```

Out[2]=