Lab 6
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Section 32
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1a: Consider the function f(x). For what x values is f(x) defined and then plot over that interval.

```
Quit[]
```

```
f[x_] = (x^2) * Sqrt[(2 - x - x^2)]
```

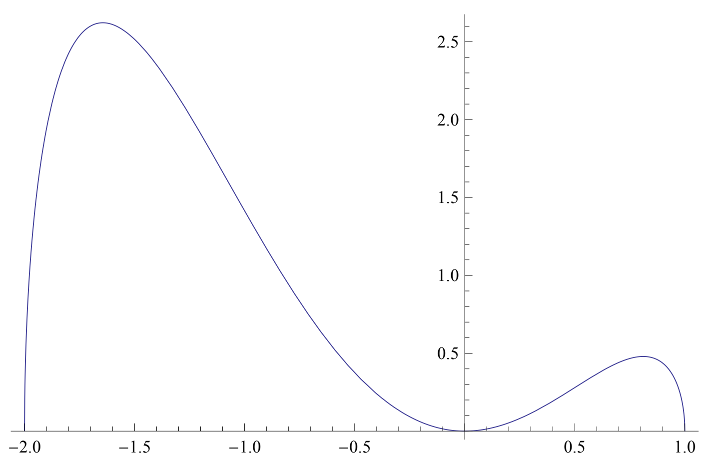
$x^2 \sqrt{2 - x - x^2}$

```
Solve[Sqrt[(2 - x - x^2)] == 0, x]
```

{{x → -2}, {x → 1}}

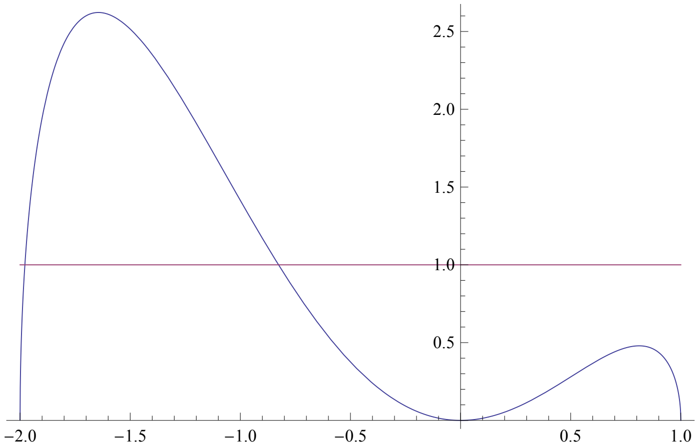
Therefore the function is defined on the interval [-2,1].

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



1b: Find all x values when f(x)=1 and use the graph to demonstrate how you found them.

```
Plot[{f[x], 1}, {x, -2., 1.}]
```




```
NSolve[f[x] == 1, x, Reals]
```

```
{{x → -1.97807}, {x → -0.826462}}
```

Therefore, since the horizantal line y=1, is intercepted by f(x) at x=-1.978, and x=-0.826, one can conclude that these are the x values for which f(x)=1.

2a:Find the length of the curve y=e^x on the interval [0,ln2] accurate to the nearist thousands.

```
g[x_] = Exp[x]
```

e^x

```
h[x_] = Sqrt[1 + (g'[x])^2]
```

$\sqrt{1 + e^{2x}}$

```
NIntegrate[h[x], {x, 0, Log[2]}]
```

```
1.2220161770866356``4
```

```
1.222
```

Therefore, the length of the curve is 1.222 units.

```
? Log
```

Log[z] gives the natural logarithm of z (logarithm to base e).
Log[b, z] gives the logarithm to base b. ≫

2b: Find an exact expression of the length from 2a.

```
Integrate[h[x], {x, 0, Log[2]}]
```

$-\sqrt{2} + \sqrt{5} + \text{ArcTanh}\left[\sqrt{2}\right] - \text{ArcTanh}\left[\sqrt{5}\right]$

3: Evaluate the sumation from n=1 to M of 1/n, for M values of 2,4,8,16,32,64,128,256,512,1024. Express answers to the thousands place. What do you notice about these numbers? Is this consistant with the divergence of the harmonic series?

```
Sum[1 / n, {n, 1., 2.}]
```

```
1.5``4
```

1.500

```
Sum[1 / n, {n, 1., 4.}]
```

```
2.083333333333333``4
```

2.083

```
Sum[1 / n, {n, 1., 8.}]
```

```
2.7178571428571425``4
```

2.718

```
Sum[1 / n, {n, 1., 16.}]
```

```
3.3807289932289937``4
```

3.381

```
Sum[1 / n, {n, 1., 32.}]
```

```
4.05849519543652``4
```

4.058

```
Sum[1 / n, {n, 1., 64.}]
```

```
4.7438909037057675``4
```

4.744

```
Sum[1 / n, {n, 1., 128.}]
```

```
5.433147092589174``4
```

5.433

```
Sum[1 / n, {n, 1., 256.}]
```

```
6.124344962817281``4
```

6.124

```
Sum[1 / n, {n, 1., 512.}]
```

```
6.81651653454972``4
```

6.817

```
Sum[1 / n, {n, 1., 1024.}]
```

```
7.509175672278132``4
```

7.509

One notices that as the values for M increase, the values of the sumation also increase. This would imply that as M->Infinity, so does the value of the sumation approach infinity. Therefore, the series diverges. This controdicts the limit test, but is consistant with a p-series where p=1, and with the harmonic series as was taught in class. The below work was done to check for coreectness.

```
Limit[(1 / x), x → Infinity]
```

0

```
Sum[1 / n, {n, 1, Infinity}]
```

Sum::div : Sum does not converge. ≫

$$\sum_{n=1}^{\infty} \frac{1}{n}$$