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MATH 151-557

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In [2]:

```
from sympy import *
from sympy.plotting import (plot, plot_parametric)
```

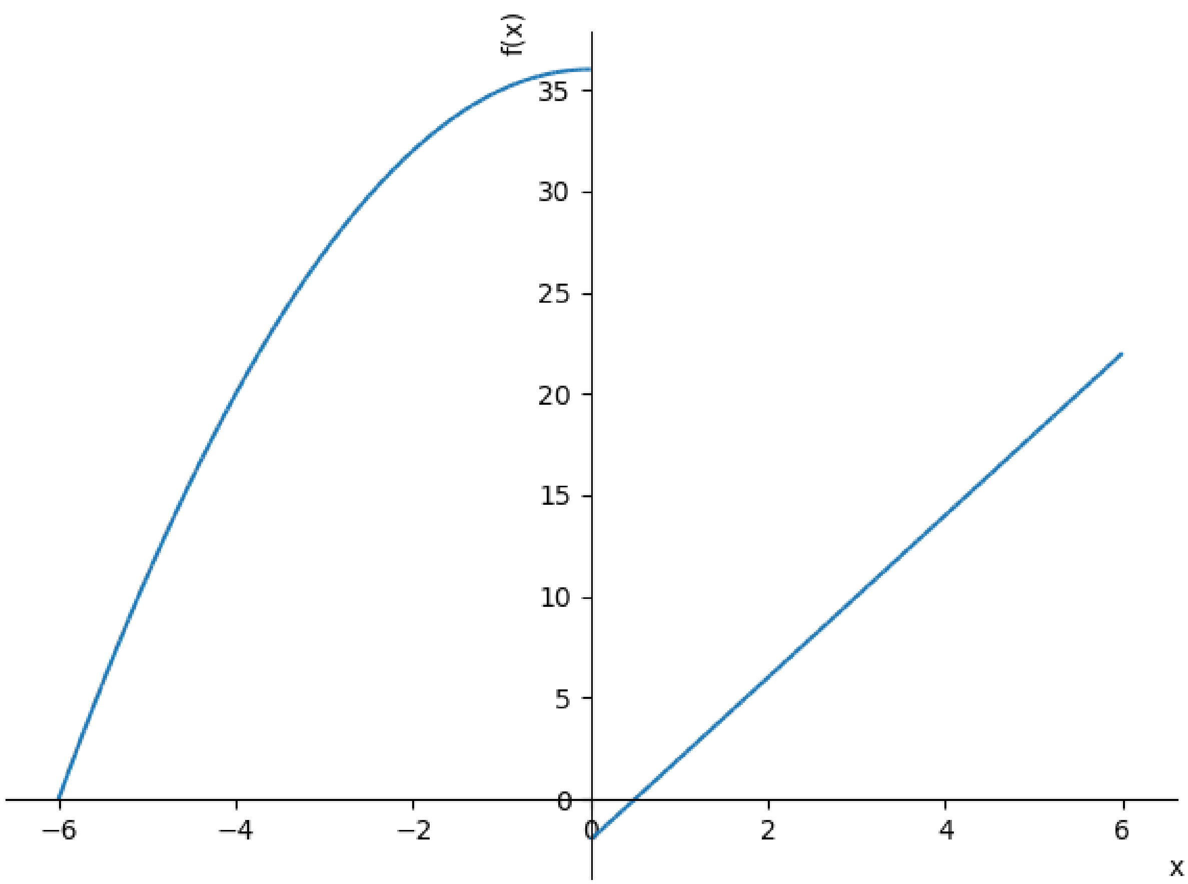
1a Graph of piecewise function

In [3]:

```
matplotlib notebook
```

In [4]:

```
x = symbols('x')
f1 = 36 - x ** 2
f2 = 4 * x - 2
plot((f1, (x, -6, 0)), (f2, (x, 0, 6)))
```



Out[4]: <sympy.plotting.plot.Plot at 0x2a20efc5070>

1b Absolute max and min based on graph

In [75]:
```
print("The absolute maximum of f on [-6,6] is 22, which occurs at x=6")
print("The absolute minimum of f on [-6,6] is -2, which occurs at x=0")
```

```
The absolute maximum of f on [-6,6] is 22, which occurs at x=6
The absolute minimum of f on [-6,6] is -2, which occurs at x=0
```

2a Critical values of f

In [12]:
```
x = symbols('x', real=True)
f = exp(x) + exp(-3 * x)
cvals = solve(f.diff(), x)
print(cvals)
print([i.evalf() for i in cvals])
```

```
[log(3**(1/4))]
[0.274653072167027]
```

2b absolute max and min on [0,1]

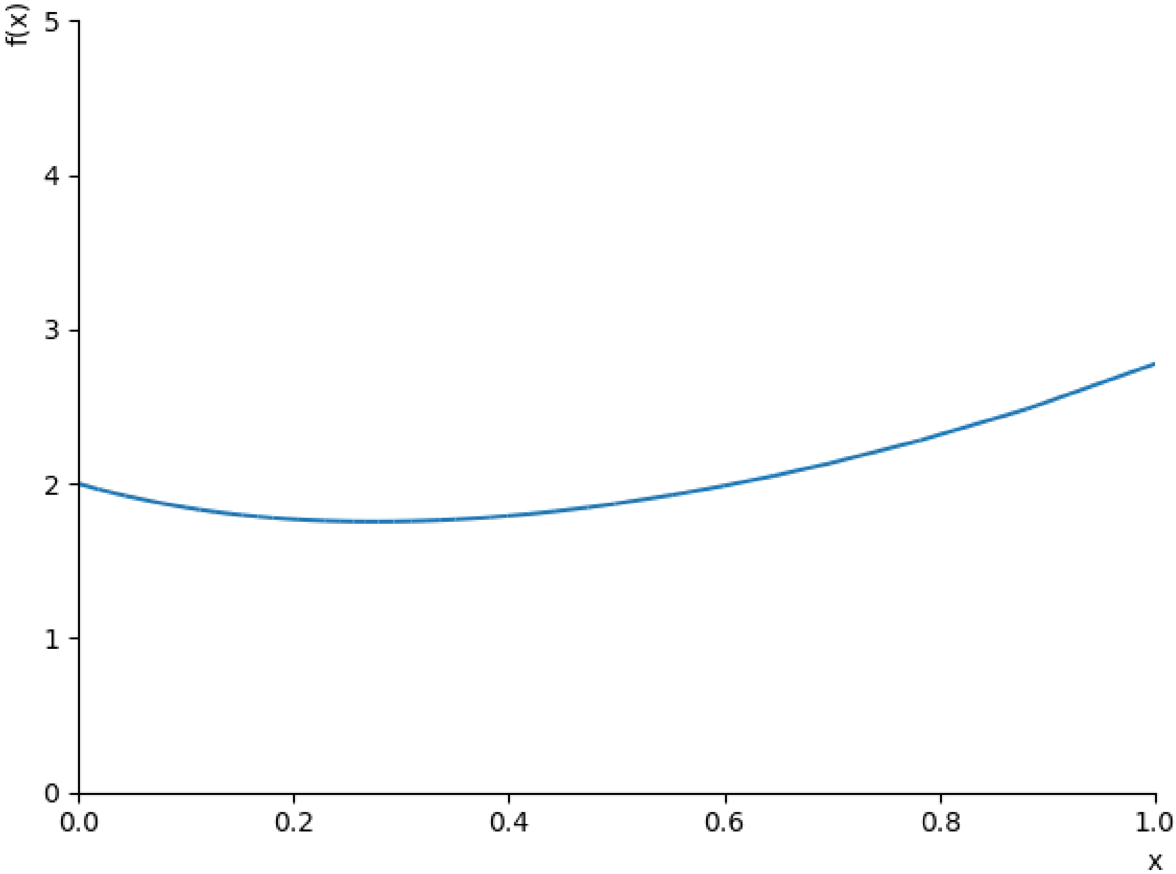
In [21]:
```
candidates = [0, 1]
for val in cvals:
    if 0 <= val <= 1:
        candidates.append(val)

vals = []
for val in candidates:
    vals.append(f.subs(x, val))
print(max(vals).evalf())
print(min(vals).evalf())
```

```
2.76806889682691
1.75476535060332
```

2c graphical confirmation of part b)

In [17]:
```
matplotlib notebook
```

In [20]:
```
plot(f, xlim=[0, 1], ylim=[0, 5])
```



Out[20]: <sympy.plotting.plot.Plot at 0x2a210140a60>

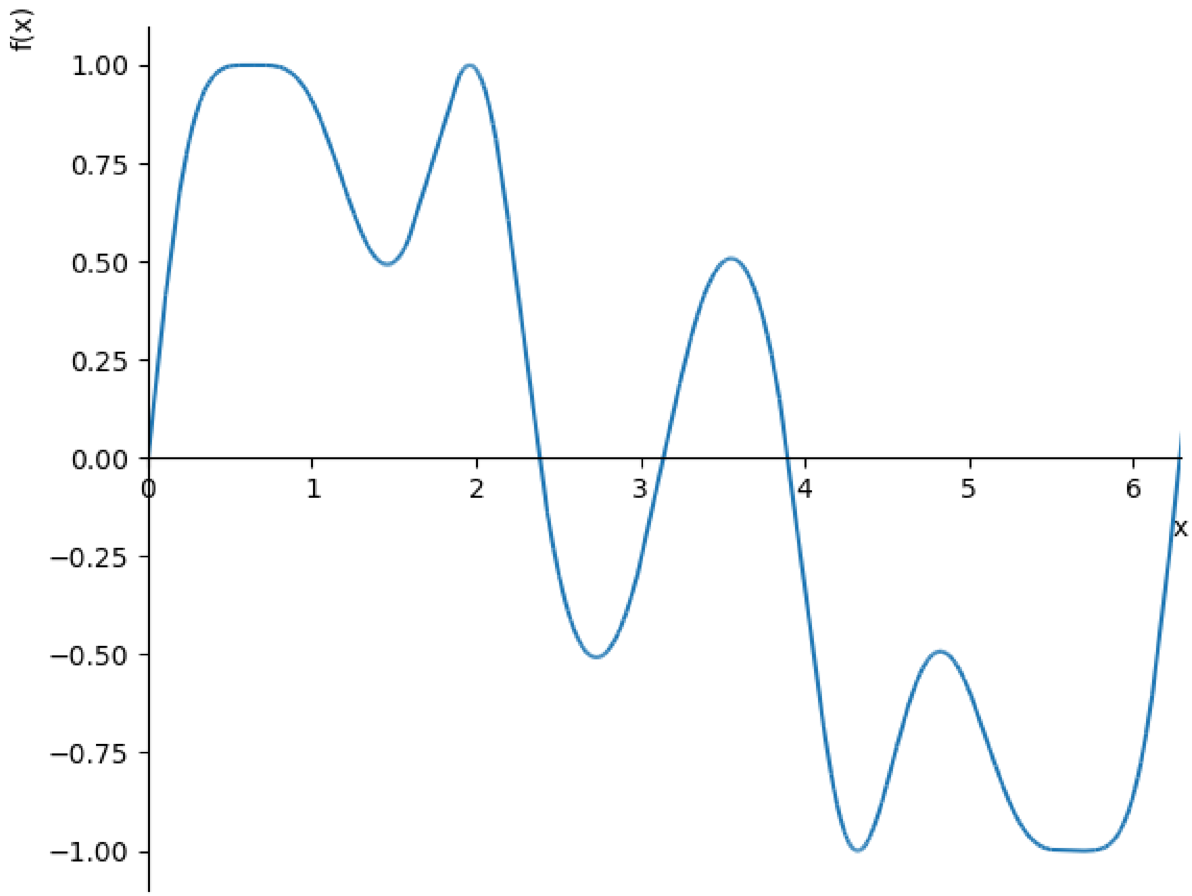
3a Plot of f and apparent number of local extrema

In [22]:

```
matplotlib notebook
```

In [26]:

```
x = symbols('x')
f = sin(x + sin(3 * x))
plot(f, xlim=[0,2 * pi])
print("There are 7 local extrema")
```




```
There are 7 local extrema
```

3b Derivative

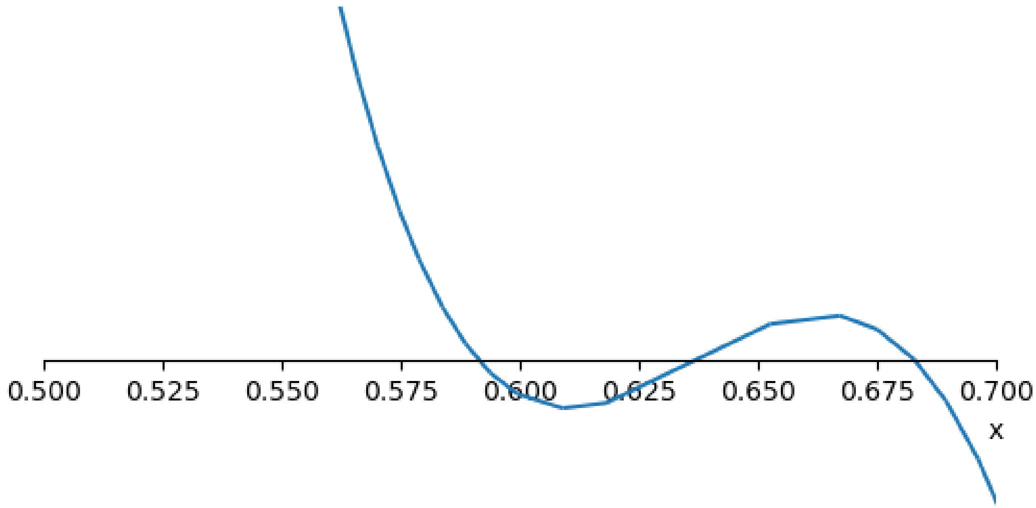
In [27]:
```
fPrime = f.diff()
fPrime
```

Out[27]: $(3\cos(3x)+1)\cos(x+\sin(3x))$

3c Plot f' in [0.5, 0.7]

In [ ]:
```
matplotlib notebook
```

In [30]:
```
plot(fPrime, xlim=[0.5,0.7], ylim=[-0.01,0.01])
```



Out[30]: <sympy.plotting.plot.Plot at 0x2a2100e4220>

3d Critical values in [0.5, 0.7]

In [34]:

```
point1 = nsolve(fPrime, .59)
point2 = nsolve(fPrime, .63)
point3 = nsolve(fPrime, .68)
print('The critical values are x =',point1,'x =', point2, 'x =',point3)
```

```
The critical values are x = 0.591429528804626 x = 0.636877745416340 x = 0.68307003234030
4
```

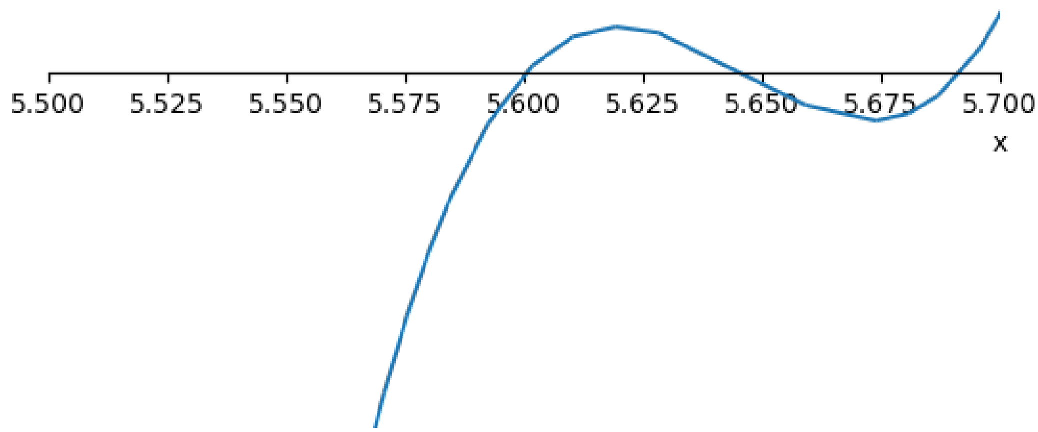
3e repeat parts (c) and (d) for the interval [5.5, 5.7]

In [ ]:

```
matplotlib notebook
```

In [37]:

```
plot(fPrime, xlim=[5.5,5.7], ylim=[-0.01,0.01])
point1 = nsolve(fPrime, 5.59)
point2 = nsolve(fPrime, 5.63)
point3 = nsolve(fPrime, 5.68)
print('The critical values are x =',point1,'x =', point2, 'x =',point3)
```




```
The critical values are x = 5.60011527483928 x = 5.64630756176325 x = 5.69175577837496
```

3f Actual number of local extrema

In [38]:

```
print("Actually there are 12 local extrema because the regions at (.5 , .7) and (5.5, 5
```

```
Actually there are 12 local extrema because the regions at (.5 , .7) and (5.5, 5.7) have
3 local extrema not 1
```

4a Two-variable function to be maximized and equation relating the two variables

In [56]:

```
s = symbols('s')
h= symbols('h')
SA = symbols('SA')
A = (s ** 2) + 4 * (h * s)
V = s * s * h
print(V)
print(A)
A = (s ** 2) + 4 * (h * s) - SA
```

```
h*s**2
4*h*s + s**2
```

4b Solve equation and substitute into function

In [59]:
```
height = solve(A, h)
V = V.subs(h, height[0])
print(V)
```

```
s*(SA - s**2)/4
```

4c practical domain

In [64]:
```
domains = solve(V, s)
print("The upper bound of the domain is",domains[2])
```

```
The upper bound of the domain is sqrt(SA)
```

4d Absolute maximum of function from part (b) on domain from part (c)

In [74]:
```
maxium = solve(V.diff(s), s)
print('The maxium side length is', V.subs(s, maxium[1]))
A = A.subs(s, maxium[1])
max_Height = solve(A, h)
print('The maxium height is', max_Height[0])
```

```
The maxium side length is sqrt(3)*SA**(3/2)/18
The maxium height is sqrt(3)*sqrt(SA)/6
```

In [ ]:
```

```