MATH 151 Lab 4

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In [20]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
```

Question 1

1a

In [21]:
```
#tangent line
#Part 1A
from sympy import *
from sympy.plotting import (plot,plot_parametric)
# Define x and f
x = symbols('x')
f = 8 / (x**2 + 4)
#Calc y1 with original func
y1 = f.subs(x, 2)
# Calc the derivative
m = diff(f, x, 1)
print("The derivative is", m)
x1 = 2
slope = m.subs(x, x1)
print("y1 is", y1)
print("x1 is", x1)
print("slope is", slope)
# Equation of the tangent line
tanl = y1 + slope * (x - x1)
print('The equation of the tangent line is y =', tanl)
```

```
The derivative is -16*x/(x**2 + 4)**2
y1 is 1
x1 is 2
slope is -1/2
The equation of the tangent line is y = 2 - x/2
```

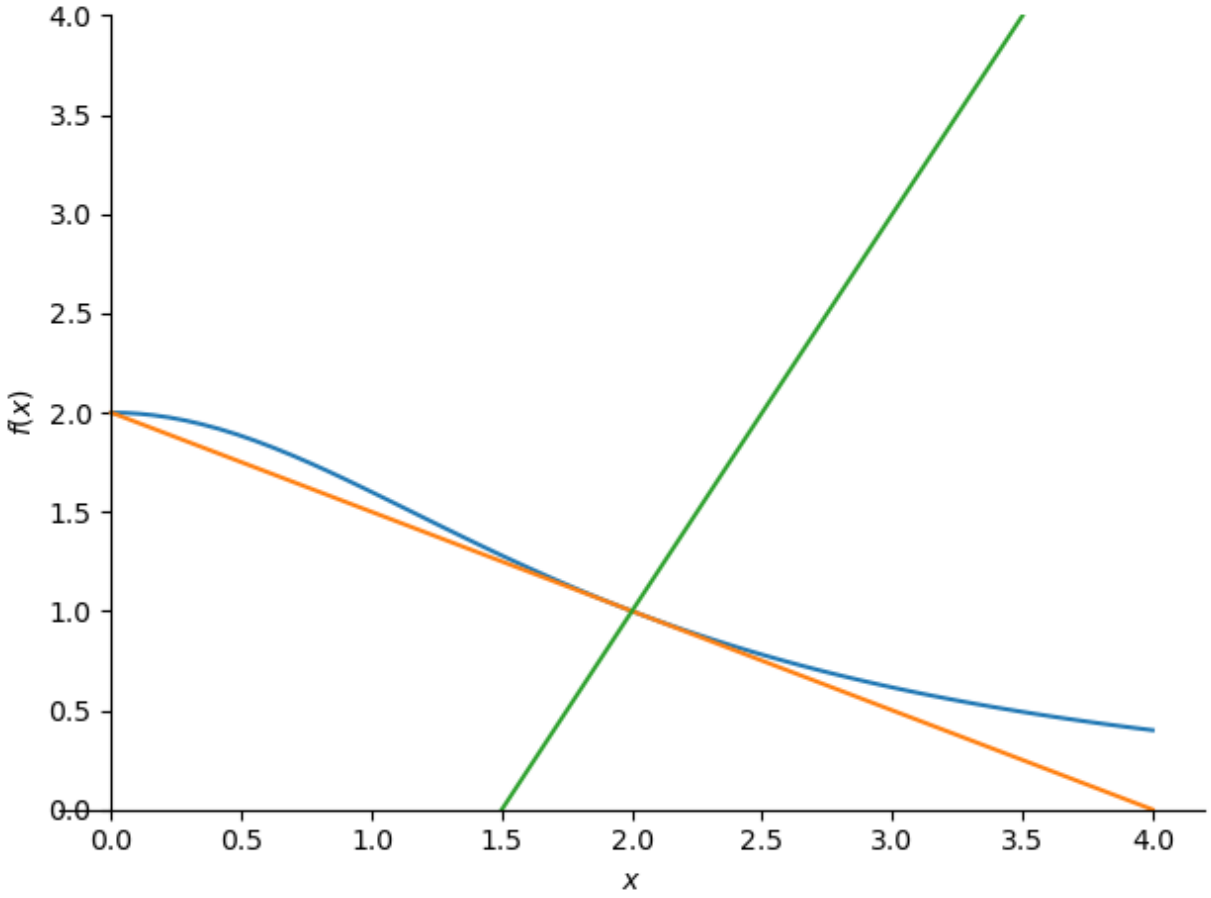
1b

In [22]:
```
#Part 1B
#The normal is a straight line which is perpendicular to the tangent so we need to
perp_slope = -1/slope
# Equation of the norm line
norml = y1 + perp_slope * (x - x1)
print('The equation of the normal line is y =', norml)
```

```
The equation of the normal line is y = 2*x - 3
```

1c

In [23]:
```
#graph
plot((f,(x,0,4)),(tanl,(x,0,4)),(norml,(x,0,4)),ylim=[0,4])
```



Out[23]: <sympy.plotting.plot.Plot at 0x21cb5fbc5d0>

Question 2

2a

In [24]:
```
# derivatives
num_list = [1 ,2 ,3 ,4 ,5 ,6 ,7 ,8]
x = symbols('x')
f = 2 * x * cos(x)
print('question 2a')
list_of_derivatives = [ diff (f ,x , n ) for n in num_list ]
print(list_of_derivatives)
```

```
question 2a
[-2*x*sin(x) + 2*cos(x), -2*(x*cos(x) + 2*sin(x)), 2*(x*sin(x) - 3*cos(x)), 2*(x*cos
(x) + 4*sin(x)), 2*(-x*sin(x) + 5*cos(x)), -2*(x*cos(x) + 6*sin(x)), 2*(x*sin(x) - 7*
cos(x)), 2*(x*cos(x) + 8*sin(x))]
```

2b

In [25]:
```
# formulas
print('question 2b')
print("\nFor n divisible by 4:")
print("nth derivative: 2xcos(x) + 2nxsin(x) ")
print("(n+1)th derivative: 2(n+1)cos(x) - 2xsin(x)")
print("(n+2)th derivative: -4(n+2)sin(x) - 2xcos(x)")
print("(n+3)th derivative: -2(n+3)cos(x) + 2xsin(x)")
```

question 2b

For n divisible by 4:
nth derivative: 2xcos(x) + 2nxsin(x)
(n+1)th derivative: 2(n+1)cos(x) - 2xsin(x)
(n+2)th derivative: -4(n+2)sin(x) - 2xcos(x)
(n+3)th derivative: -2(n+3)cos(x) + 2xsin(x)

Question 3

3a

In [26]:
```
# curvature A
from sympy import *
x = symbols('x')

h = [x**2+3*x+5,tan(x),7*x-1,sqrt(25-x**2)]
list_of_numbers = [2,pi/3,5,1]

k = [(Abs((diff(h[i],x,2)))/(1+diff(h[i],x,1)**2)**Rational(3,2)).subs(x,list_of_numbe
print('3(a)',k[0])
```

3(a) sqrt(2)/250

3b

In [27]:
```
# curvature B
print('3(b)',k[1])
```

3(b) 8*sqrt(51)/289

3c

In [28]:
```
# curvature C
print('3(c)',k[2])
```

3(c) 0

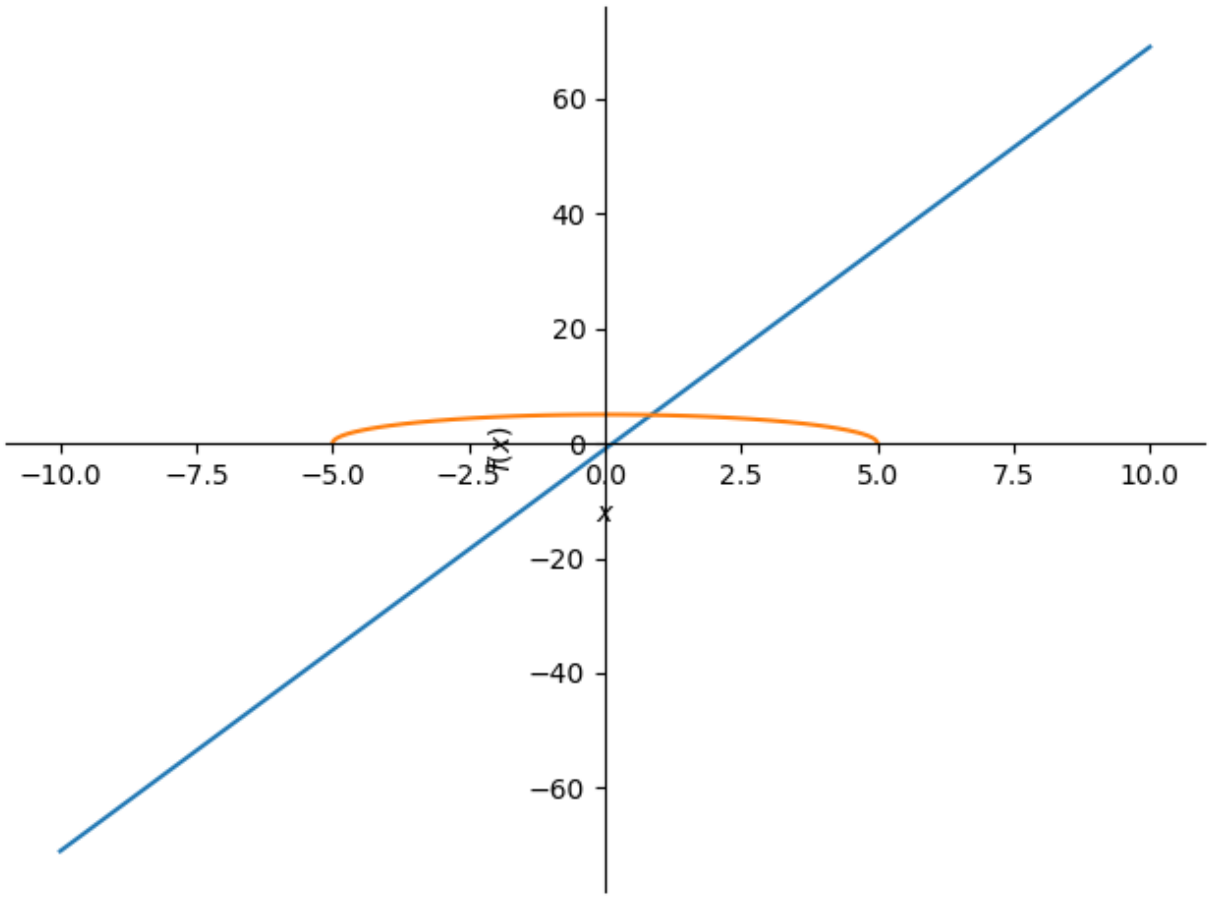
3d

In [29]:
```
# curvature D
print('3(d)',k[3])
```

3(d) 1/5

3e

In [30]:
```
# Write your answer in either comments or a print statement
plot(h[2],h[3])
print('3(e) 7x-1 is a linear line that it has no curvature, so curvature is 0.However
```



3(e) 7x-1 is a linear line that it has no curvature, so curvature is 0.However sqrt(25-x^2) is a half circle that it has curvautre of 1/5

In [ ]: