MATH 151 Lab 5

Put team members' names and section number here.

In [2]:
```
from sympy import *
from sympy import Symbol, N
from sympy.plotting import (plot,plot_parametric)
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```

Question 1

1a

In [16]:
```
#8 derivatives
x = symbols('x')
f = exp(x)*(1+x**2)

for i in range(1,9):
    print(f"the {i}th derrivative of {f} with respect to x is {diff(f,x,i)}")
```

```
the 1th derrivative of (x**2 + 1)*exp(x) with respect to x is 2*x*exp(x) + (x**2 + 1)
*exp(x)
the 2th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 4*x + 3)*exp(x)
the 3th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 6*x + 7)*exp(x)
the 4th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 8*x + 13)*exp
(x)
the 5th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 10*x + 21)*exp
(x)
the 6th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 12*x + 31)*exp
(x)
the 7th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 14*x + 43)*exp
(x)
the 8th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 16*x + 57)*exp
(x)
```

1b

In [6]:
```
n = symbols('n')
eq = (x**2 + 2*n*x + (n**2-(n-1)))*exp(x)
print(f"the formula for the derrivative of {f} to the nth is: {eq}")
```

```
the formula for the derrivative of (x**2 + 1)*exp(x) to the nth is: (n**2 + 2*n*x - n
+ x**2 + 1)*exp(x)
```

1c

In [7]:
```
#50th
print(f"the {50}th derrivative of {f} with respect to x is {diff(f,x,50)}")
print(f"{eq} where n is substituted for 50 is {eq.subs(n,50)}")
```

```
the 50th derrivative of (x**2 + 1)*exp(x) with respect to x is (x**2 + 100*x + 2451)*
exp(x)
(n**2 + 2*n*x - n + x**2 + 1)*exp(x) where n is substituted for 50 is (x**2 + 100*x +
2451)*exp(x)
```

Question 2

2a

In [21]:
```
#C values 4y’’ + 25y = 0.
k = symbols('k')

y = cos(k*x)

eq = 4 * diff(y,x,2) + 25 * y


print("solutions for the equation 4y’’ + 25y = 0 where y is y = cos(k*x) are:", solve(
solutions = solve(eq, k)
```

```
solutions for the equation 4y’’ + 25y = 0 where y is y = cos(k*x) are: [-5/2, 5/2, p
i/(2*x), 3*pi/(2*x)]
```

2b

In [22]:
```
a = symbols('a')
b = symbols('b')

y = a * sin(k*x) + b * cos(k*x)

eq = 4 * diff(y,x,2) + 25 * y

for i in solutions:
    if eq.subs(k,i) != 0:
        print(f"roots or solutions to the differential 4y’’ + 25y = 0 where y is {y} a
    else:
        print(f"roots or solutions to the differential 4y’’ + 25y = 0 where y is {y} a
```

```
roots or solutions to the differential 4y’’ + 25y = 0 where y is a*sin(k*x) + b*cos(k
*x) and k is -5/2 is 0
roots or solutions to the differential 4y’’ + 25y = 0 where y is a*sin(k*x) + b*cos(k
*x) and k is 5/2 is 0
roots or solutions to the differential 4y’’ + 25y = 0 where y is a*sin(k*x) + b*cos(k
*x) and k is pi/(2*x) is not 0
roots or solutions to the differential 4y’’ + 25y = 0 where y is a*sin(k*x) + b*cos(k
*x) and k is 3*pi/(2*x) is not 0
```

Question 3

3a

In [24]:
```
#derivative
t = symbols('t')

y = ((t - 2)/((2 * t) - 1)) ** 9
```

```
print(f"the derrivative of {y} is {diff(y,t)}")
```

```
the derrivative of (t - 2)**9/(2*t - 1)**9 is -18*(t - 2)**9/(2*t - 1)**10 + 9*(t -
2)**8/(2*t - 1)**9
```

3b

In [25]:
```
#simplify

y = ((t - 2)/((2 * t) - 1)) ** 9
yPrime = (27 * (t - 2)**8/((2 * t) - 1)**10)

print(f"the simplified derrivative of {y} is {yPrime}")
```

```
the simplified derrivative of (t - 2)**9/(2*t - 1)**9 is 27*(t - 2)**8/(2*t - 1)**10
```

3c

In [54]:
```
#derivative

t = symbols('t')

y = (2*t + 1)**5 * (t**2 - t + 2)**4

print(f"the derrivative of {y} is {diff(y,t)}")

print(f"the horizontal tangent of {d} is {solve(d,t)[0]}")
```

```
the derrivative of (2*t + 1)**5*(t**2 - t + 2)**4 is (2*t + 1)**5*(8*t - 4)*(t**2 - t
+ 2)**3 + 10*(2*t + 1)**4*(t**2 - t + 2)**4
the horizontal tangent of (2*t + 1)**5*(8*t - 4)*(t**2 - t + 2)**3 + 10*(2*t + 1)**4*
(t**2 - t + 2)**4 is -1/2
```

3d

In [53]:
```
#simplify
t = symbols('t')

y = (2*t + 1)**5 * (t**2 - t + 2)**4

d = diff(y,t)

print(f"the simplified derrivative of {y} is {simplify(d)}")
```

```
the simplified derrivative of (2*t + 1)**5*(t**2 - t + 2)**4 is (2*t + 1)**4*(t**2 -
t + 2)**3*(10*t**2 - 10*t + 4*(2*t - 1)*(2*t + 1) + 20)
```

3e

In [55]:
```
#factor
t = symbols('t')

y = (2*t + 1)**5 * (t**2 - t + 2)**4

f =factor(diff(y,t))

print(f"the factored derrivative of {y} is {f}")
```

```
the factored derrivative of (2*t + 1)**5*(t**2 - t + 2)**4 is 2*(2*t + 1)**4*(t**2 -
t + 2)**3*(13*t**2 - 5*t + 8)
[-1/2, 5/26 - sqrt(391)*I/26, 5/26 + sqrt(391)*I/26, 1/2 - sqrt(7)*I/2, 1/2 + sqrt(7)
*I/2]
```

3f

In [56]:
```
print("it would be easiest to use the factored form since each factor provides a zero-
```

```
it would be easiest to use the factored form since each factor provides a zero-able s
olution, in this case again the only zero would be -1/2
```

Question 4

4a

In [4]:
```
#ROC

u = symbols('u')
W = symbols('W')
theta = symbols('theta')

F = (u*W)/(u*sin(theta) + cos(theta))

Fprime = diff(F,theta)

print(f"the rate of change of F with respect to theta is {Fprime}")
```

```
the rate of change of F with respect to theta is W*u*(-u*cos(theta) + sin(theta))/(u*
sin(theta) + cos(theta))**2
```

4b

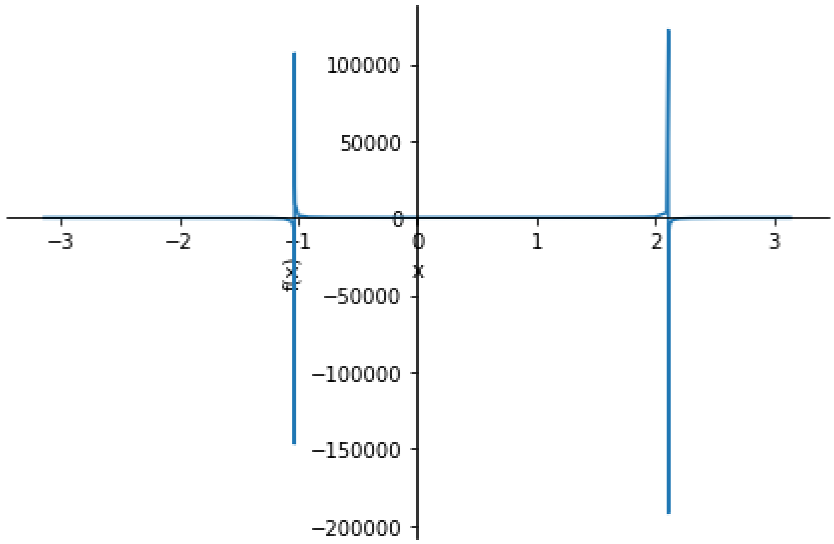
In [63]:
```
#ROC = 0

print(f"the rate of change of F with respect to theta is at theta = 0 is {Fprime.subs(
```

```
the rate of change of F with respect to theta is at theta = 0 is -W*u**2
```

4c

In [9]:
```
#graph

u = symbols('u')
W = symbols('W')
theta = symbols('theta')

F = (.6*100)/(.6*sin(theta) + cos(theta))

print("estimate that force is equal to zero just somewhere just over 2")

plot((F,(theta,-3.14,3.14)))
```

```
estimate that force is equal to zero just somewhere just over 2
```



Out[9]:
```
<sympy.plotting.plot.Plot at 0x1ce77ac0ca0>
```

4d

In [8]:
```python
#verify (c)
theta = symbols('theta')

F = (.6*100)/(.6*sin(theta) + cos(theta))
Fprime = diff(F,theta)

print("the areas where the slope is equal to zero are where theata equals", solve(Fpri
```

```
the areas where the slope is equal to zero are where theata equals [0.54041950027058
4]
```

In [ ]: