MATH 151 Lab 9

Jaeheon Kim, Vishwa Kumaravel,Alex Dao, Nico Bui

In [45]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
```

Question 1

1a

In [46]:
```
from sympy import symbols, ln, limit, oo
print('part a')
# Define the variable
x = symbols('x')
# Given expression for y
y = (1 + (16 / x)) **(2*x)
print(f'f(x) is 2ln(1+16/x) g(x) is x**-1 ')
f = 2*ln(1+16/x)
g = x**-1
```

```
part a
f(x) is 2ln(1+16/x) g(x) is x**-1
```

1b

In [47]:
```
# Find the limits of f and g as x → ∞
limit_f = limit(f, x, oo)
limit_g = limit(g, x, oo)
print(f'limit f: {limit_f}, limit g: {limit_g}')
```

```
limit f: 0, limit g: 0
```

1c

In [48]:
```
from sympy import diff
# Apply L'Hopital's Rule
f_prime = diff(f, x)
g_prime = diff(g, x)
limit_lhopital = E**limit(f_prime/g_prime, x, oo)
print('f prime is:',f_prime, 'g prime is:',g_prime, ',and lim y:',limit_lhopital)
```

```
f prime is: -32/(x**2*(1 + 16/x)) g prime is: -1/x**2 ,and lim y: exp(32)
```

1d

In [49]:
```
# Evaluate the limit directly
limit_direct = limit(y, x, oo)
limit_direct
print(f'{exp(32)} from 1(c) and {limit_direct} from 1(d) are the same')
```

```
exp(32) from 1(c) and exp(32) from 1(d) are the same
```

Question 2

2a

In [50]:
```
x = symbols('x')# x is theta
f = (20+20*cos(x))*10*sin(x)/2
ans =solve(diff(f))
print(f'possible theta values: {ans}')
print(f'volume when theta is {ans[0]}: {f.subs(x,ans[0])}')
print(f'volume when theta is {ans[1]}: {f.subs(x,ans[1])}')
print('Volume is maximum when thetat is ',ans[1], 'which is',float(ans[1]))
```

```
possible theta values: [-pi/3, pi/3]
volume when theta is -pi/3: -75*sqrt(3)
volume when theta is pi/3: 75*sqrt(3)
Volume is maximum when thetat is  pi/3 which is 1.0471975511965979
```

2b

In [51]:
```
ddf = diff(f,x,2)
maxi = ddf.subs(x,ans[1])
print(f'You can verify the maximum by checking if the f double prime becomes negative
```

```
You can verify the maximum by checking if the f double prime becomes negative when p
i/3 is substituted. When pi/3 is substituted, d double prime is -150*sqrt(3),which is
negative, so we can say pi/3 is the maximum
```

Question 3

3a

In [52]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
x = symbols('x')
c = symbols('c')
d = symbols('d')
fx_2_prime = 4 / (x + 1)**2
fx_prime = integrate(fx_2_prime, x)
c = 3 - fx_prime.subs(x, 0)
fx_prime = fx_prime + c
fx = integrate(fx_prime, x)
d = 9 - fx.subs(x, 0)
fx = fx + d
print(f"f'(x) = {fx_prime}")
print(f"f(x) = {fx}")
```

```
f'(x) = 7 - 4/(x + 1)
f(x) = 7*x - 4*log(x + 1) + 9
```

3b

In [53]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
x = symbols('x')
c = symbols('c')
```

```
d = symbols('d')
fx_2_prime = 4 / (x + 1)**2
fx_prime = integrate(fx_2_prime, x)
fx = integrate(fx_prime, x)
print(f"f(x) = {fx} + cx + d")
print(f"c + d = {10 - fx.subs(x, 1)}")
print(f"4c + d = {10 - fx.subs(x, 4)}")
print("Solve the Systems of Equations")
c = -(4*(log(2)-log(5)))/3
d = 10 + ((16*log(2)-4*log(5))/3)
print("Plug vals into fx equation")
fx = fx + c*x + d
print(f"f(x) = {fx}")
```

```
f(x) = -4*log(x + 1) + cx + d
c + d = 4*log(2) + 10
4c + d = 4*log(5) + 10
Solve the Systems of Equations
Plug vals into fx equation
f(x) = x*(-4*log(2)/3 + 4*log(5)/3) - 4*log(x + 1) - 4*log(5)/3 + 16*log(2)/3 + 10
```

In [ ]:

```
```