MATH 151 Lab 7

Put team members' names and section number here.

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Section number 576

In [1]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
```

Question 1

1a

In [2]:
```
x = symbols("x")

piece1 = 8 - x**2
piece2 = 5 * E**(-1 * ((x - 2) / 2)**2) + x

newton = x - diff(piece2, x) / diff(piece2, x, 2)
print(f"The critical values are {solve(diff(piece1, x), x)[0]}, {newton.subs(x, 2.4)},
```

```
The critical values are 0, 2.41774381486626, 4.78509528935372
```

1b

In [3]:
```
wholeFunction = Piecewise((8 - x**2, x < 0), (5 * E**(-1 * ((x - 2) / 2)**2) + x, x >=
candidates = [-5, solve(diff(piece1, x), x)[0], newton.subs(x, 2.4), newton.subs(x, 4.
minimum = 0
maximum = 0
for i in candidates:
    if wholeFunction.subs(x, i) > maximum:
        maximum = wholeFunction.subs(x, i)
    if wholeFunction.subs(x, i) < minimum:
        minimum = wholeFunction.subs(x, i)
i = -5
while i <= 5:
    if wholeFunction.subs(x, i) > maximum:
        maximum = "DNE"
        break
    i += 0.01
i = -5
while i <= 5:
    if wholeFunction.subs(x, i) < minimum:
        minimum = "DNE"
        break
    i += 0.01

print(f"The absolute maximum for f(x) is {maximum} and the absolute minimum is {minimu
```

```
The absolute maximum for f(x) is DNE and the absolute minimum is -17 in the domain of
[-5, 5]
```

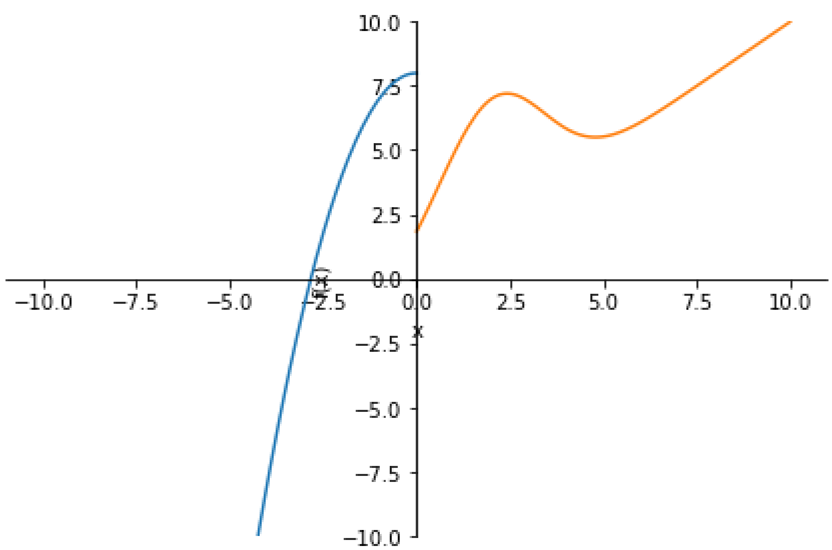
1c

In [4]:
```
candidates = [-10, solve(diff(piece1, x), x)[0], newton.subs(x, 2.4), newton.subs(x, 4
minimum = 0
maximum = 0
for i in candidates:
    if wholeFunction.subs(x, i) > maximum:
        maximum = wholeFunction.subs(x, i)
    if wholeFunction.subs(x, i) < minimum:
        minimum = wholeFunction.subs(x, i)
i = -10
while i <= 10:
    if wholeFunction.subs(x, i) > maximum:
        maximum = "DNE"
        break
    i += 0.01
i = -10
while i <= 10:
    if wholeFunction.subs(x, i) < minimum:
        minimum = "DNE"
        break
    i += 0.01
print(f"The absolute maximum for f(x) is {maximum.evalf()} and the absolute minimum is
```

```
The absolute maximum for f(x) is 10.0000005626759 and the absolute minimum is -92.000
0000000000 in the domain of [-10, 10]
```

1d

In [5]:
```
plot((piece1, (x, -10, 0)), (piece2, (x, 0, 10)), ylim = [-10, 10])
```



Out[5]:
```
<sympy.plotting.plot.Plot at 0x216dcb5e730>
```

Question 2

2a

In [6]:
```
k, r0, r = symbols('k r0 r')
v = k*r0*r**2 - k*r**3
```

```
half_r0 = v.subs(r, .5*r0)
twothirds_r0 = v.subs(r, 2/3*r0)
one_r0 = v.subs(r, r0)
print(f'{twothirds_r0} is greater than {half_r0} and {one_r0} on [.5r0, r0], so v has
```

```
0.148148148148148*k*r0**3 is greater than 0.125*k*r0**3 and 0 on [.5r0, r0], so v has
an abs max at r = (2/3)*r0 on [.5r0, r0]
```

2b

In [7]:
```
print(f'the abs max value of v on [.5r0, r0] is {twothirds_r0}')
```

```
the abs max value of v on [.5r0, r0] is 0.148148148148148*k*r0**3
```

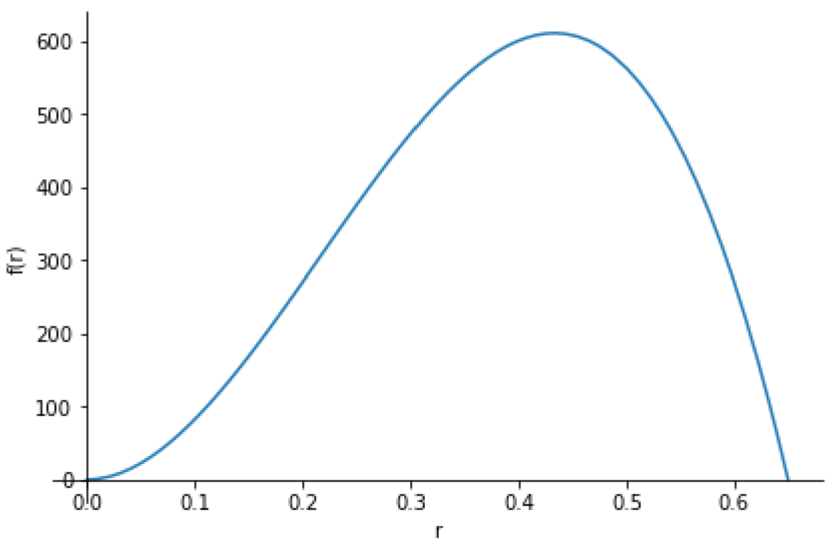
2c

In [8]:
```
vsub = v.subs({k:15000, r0: .65})
print(f'the maximum value of the function is {vsub.subs(r,130/300)} and it occurs at r
```

```
the maximum value of the function is 610.277777777778 and it occurs at r = 130/300 (o
r r = .4333)
```

2d

In [9]:
```
vplot = plot(vsub,(r,0,.65))
```



Question 3

3a

In [10]:
```
x = symbols("x")
fx = atan(x)
gx = acot(x)

dfx = diff(fx, x)
dgx = diff(gx, x)
print(f"The derivative of f(x) + g(x) is {simplify(dfx + dgx)}")
```

```
The derivative of f(x) + g(x) is 0
```

3b

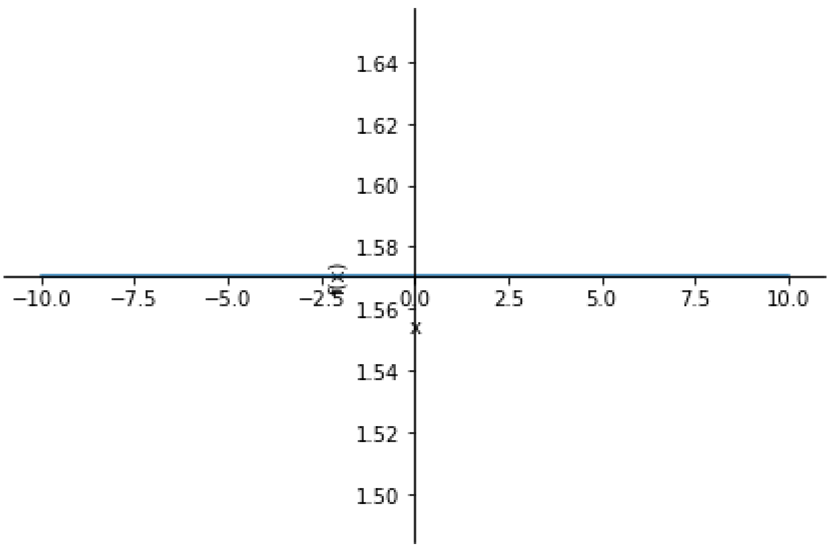
In [11]:
```
print("The derivative of f(x) + g(x) tells you that the graph of f(x) + g(x) is flat f
```

```
The derivative of f(x) + g(x) tells you that the graph of f(x) + g(x) is flat for all
x
```

3c

In [12]:
```
combined = Piecewise((fx + gx + pi, x <= 0), (fx + gx, x > 0))
plot(combined)

print("The function is arctan(x) + arccot(x) + pi when x <= 0, and arctan(x) + arccot(
```




```
The function is arctan(x) + arccot(x) + pi when x <= 0, and arctan(x) + arccot(x) whe
n x is greater than 0
```

3d

In [13]:
```
print("This makes sense for x > 0 because tan x is equal to cot(pi / 2 - x)")
```

```
This makes sense for x > 0 because tan x is equal to cot(pi / 2 - x)
```