MATH 152 Lab 7

Put team members' names and section number here.

In [9]:
```
import sympy as sp
from sympy.plotting import (plot,plot_parametric)
import matplotlib.pyplot as plt
import numpy as np
```

Question 1

1a

In [10]:
```
n = sp.symbols('n', real = True, positive = True)
an = sp.Rational(7/8)**n
display(an)
limit_an = sp.limit(an,n,sp.oo)
print(f"As n ----> oo, the limit of {an} is : {limit_an}")
```

$\displaystyle \left(\frac{7}{8}\right)^{n}$

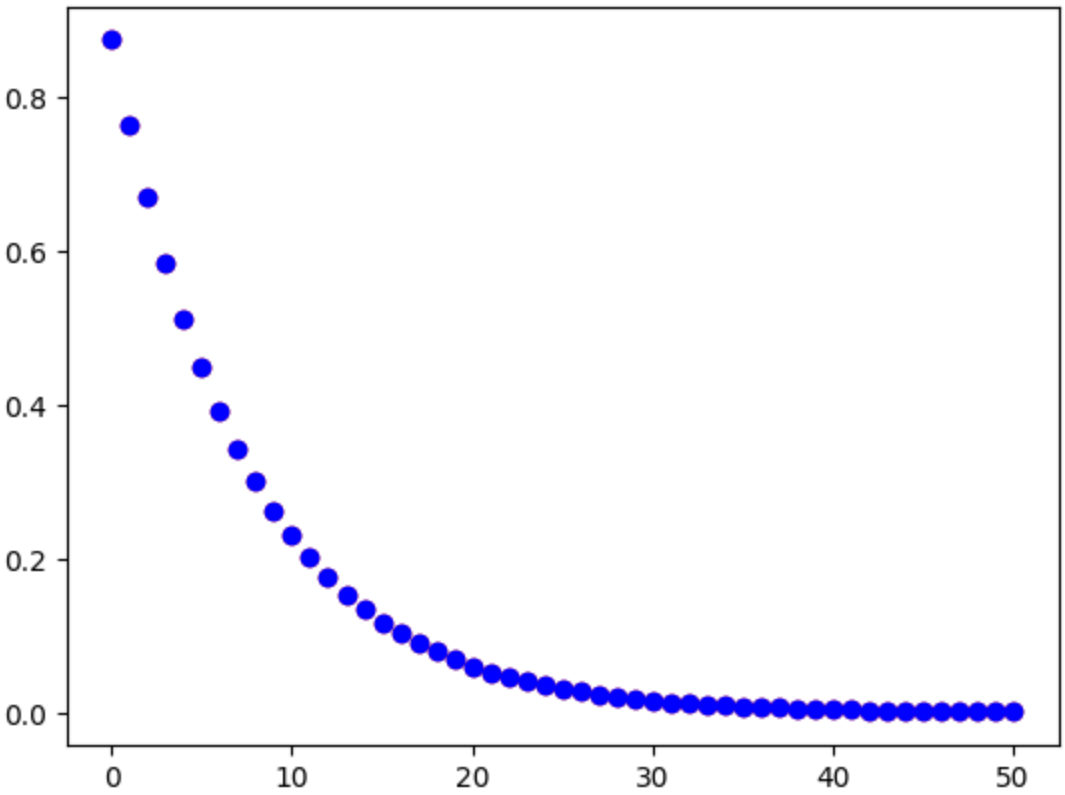
```
As n ----> oo, the limit of (7/8)**n is : 0
```

1b

In [33]:
```
matplotlib inline
```

In [50]:
```
nvals = range(0,51)
an_50 = [sp.Abs(an.subs(n,i)) for i in nvals]
an = sp.Rational(7/8)**(n+1)
an_partial = [np.cumsum(an.subs(n,i)) for i in nvals]
plt.plot(nvals, an_50,'ro', nvals, an_partial,'bo')
```

Out[50]:
```
[<matplotlib.lines.Line2D at 0x7fde34cc4bb0>,
 <matplotlib.lines.Line2D at 0x7fde34cc4ac0>]
```



1c

In [59]:
```
S_exact = ((7/8)**51) / (1 - 7/8)
print("Exact sum:", S_exact)

n = 1
S_approx = (7/8)**n + 1
while n < 50:
    n += 1
    S_approx += (7/8)**n + 1
print("Approximate sum:", S_approx)
```

```
Exact sum: 0.008820652058412898
Approximate sum: 56.99117934794159
```

Question 2

2a

In [13]:
```
x = sp.symbols('x', real = True, positive = True)
f_x = (x**2)*(sp.E**-x)
f_integral = sp.integrate(f_x,(x,1,sp.oo))
display(f_integral)
```

$\displaystyle \frac{5}{e}$

2b

In [14]:
```
print('Based om the result the function is convergence')
```

```
Based om the result the function is convergence
```

2c

In [15]:
```
from mpmath import nsum, inf
s10 =[f_x.subs({x:i}) for i in range(2,10)]
print(f'S(10) = {sum(s10).evalf()}')
S50 = [f_x.subs({x:i}) for i in range(2,50)]
print(f'S(50) = {sum(S50).evalf()}')
S100 = [f_x.subs({x:i}) for i in range(2,100)]
Sum_100 = sum(S100).evalf()
print(f'S(100) = {Sum_100}')

S = nsum(lambda x: (x**2)*(sp.E**-x),[2,inf])
print(f'S = {S}')
```

```
S(10) = 1.61630674244305
S(50) = 1.62441532595354
S(100) = 1.62441532595354
S = 1.62441532595354
```

2d

In [16]:
```
print('The difference between S ad S(100) is ', abs(S-Sum_100))
```

```
The difference between S ad S(100) is  0.0
```

2e

In [23]:
```
x, n, N = sp.symbols('x n N', real = True , positive=True)
f_x = (x**2)*(sp.E**-x)
an = (n**2)*(sp.E**-n)

Interror = sp.Abs(an).subs(n,N+1)
#display(Interror)
# Interror = sp.integrate(f_x,(x,N,inf))
error = Interror - 10**-10
Nmin = sp.solve(error,N)
print('The minimum numbers of N is', Nmin[0], 'so 29 terms are needed')
```

$\displaystyle \left(N + 1\right)^{2} e^{- N - 1}$

```
The minimum numbers of N is 28.8159370304108 so 29 terms are needed
```

Question 3

3a

In [24]:
```
an = ((5*n**2) - 1) / (3*n**4 + 5*n + 1)
bn = 5 / (3*n**2)
display(bn)
```

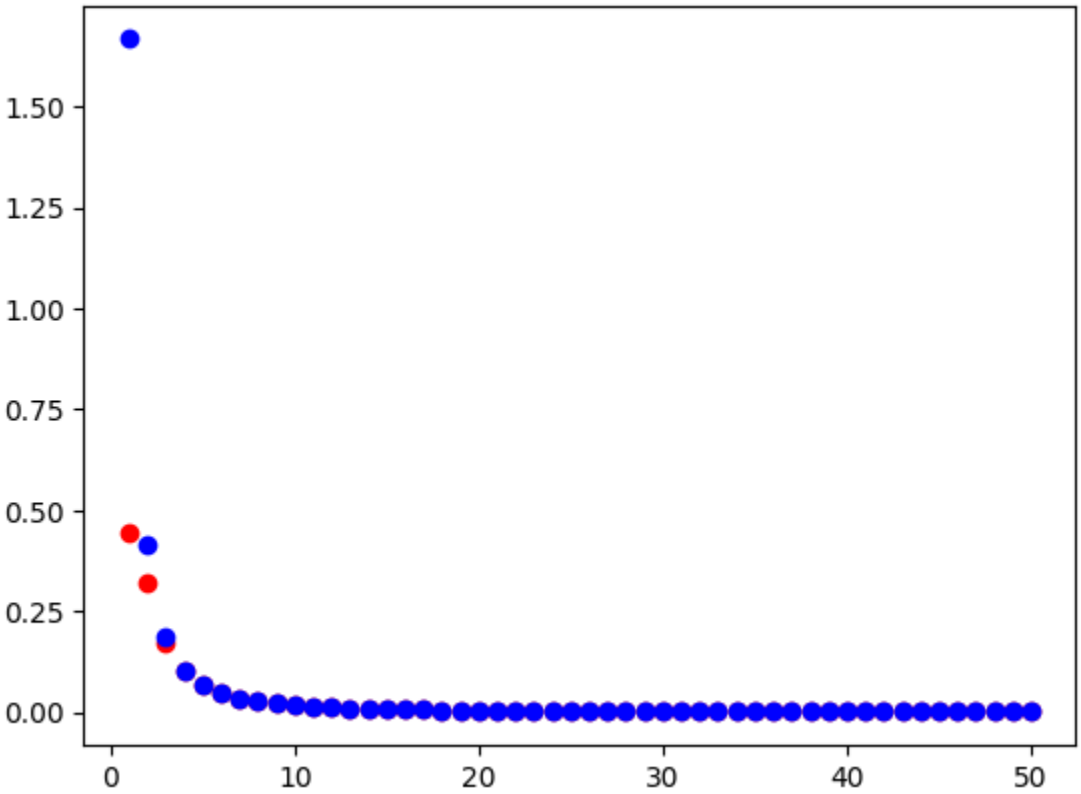
$\displaystyle \frac{5}{3 n^{2}}$

3b

In [27]:
```
matplotlib inline
```

In [28]:
```
an_50 = [sp.Abs(an.subs({n:i})) for i in range(1,51)]
bn_50 = [sp.Abs(bn.subs({n:i})) for i in range(1,51)]
plt.plot(range(1,51), an_50,'ro',range(1,51), bn_50,'bo')
```

Out[28]:
```
[<matplotlib.lines.Line2D at 0x7fde37a9b760>,
 <matplotlib.lines.Line2D at 0x7fde37a9b790>]
```



3c

In [ ]:
```
bn_lim = sp.limit(bn,n,sp.oo)
print('Since the limit of bn is {bn_lim} the series converges and \n thus an
```

```
Since the limit of bn is {bn_lim} the series converges and
 thus an will also converge, since bn is greater than an as per the comparis
on test
```

3d

In [60]:
```
# Leave this blank if you already drew a conclusion in Part C.
```

In [ ]:
```

```