PRACTICAL 1

Priyanka Talwar. MAT/19/71

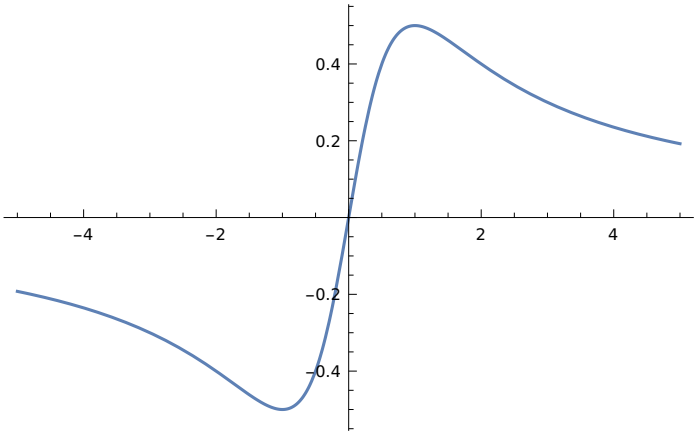
Q1. Graph each of the following functions.

a) f(x)=x/(1+x^2)

In[15]:=
```
f[x_] := x/(1 + x^2);
```

In[16]:=
```
Plot[f[x], {x, 5, -5}]
```

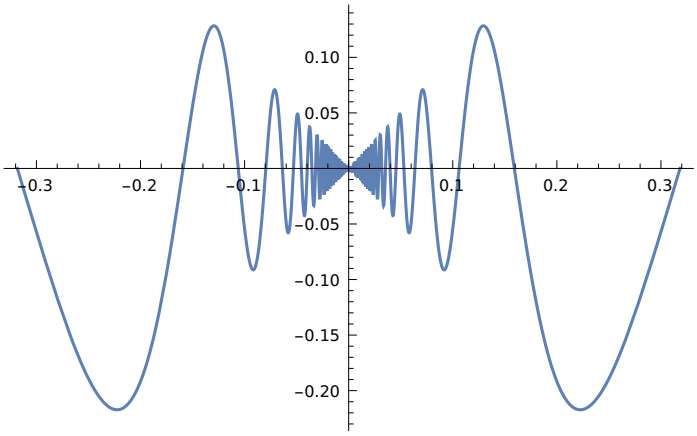
Out[16]=



b) y=x Sin(1/x)

In[17]:=
```
y[x_] := x Sin (1 / x);
Plot[x Sin[1 / x], {x, 1 / π, -1 / π}]
```

Out[18]=

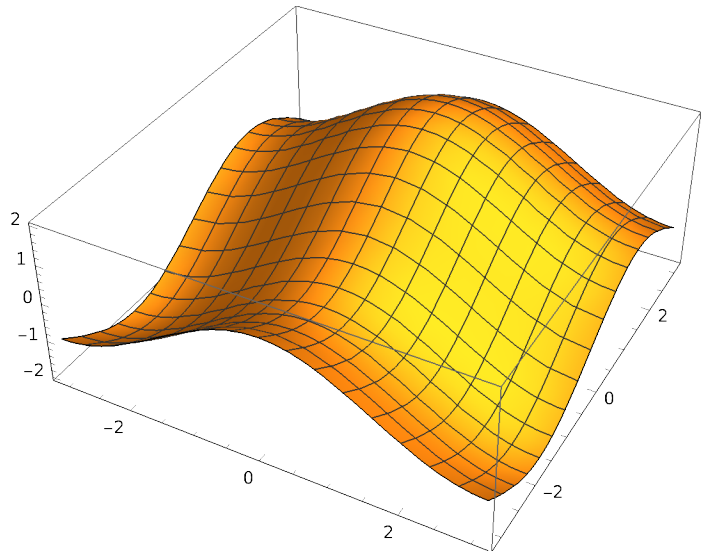


In[19]:=

c) g(x,y)=Cos(x)+Sin(y)

In[20]:=
```
Plot3D[Cos[x] + Sin[y], {x, π, -π}, {y, π, -π}]
```

Out[20]=



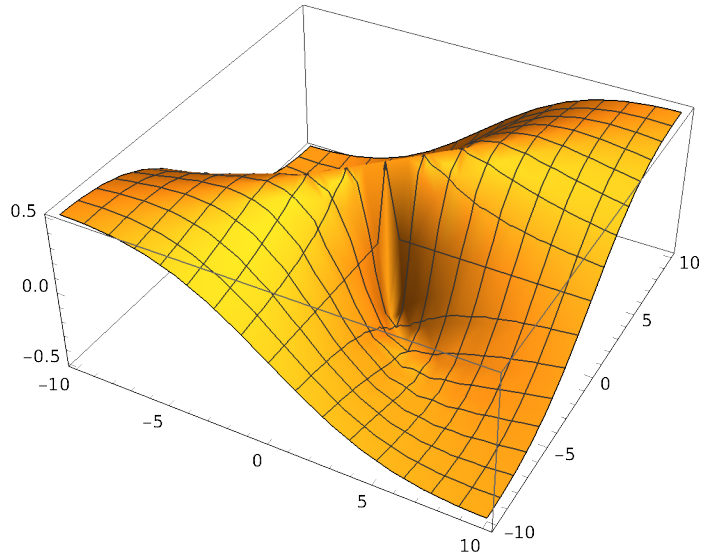
In[21]:=
```
(d) z = xy / (x^2 + y^2)
```

Out[21]=

$$\frac{xy}{x^2 + y^2}$$

In[22]:=
```
Plot3D[x y / (x^2 + y^2), {x, 10, -10}, {y, 10, -10}]
```

Out[22]=



Q2. Let f[x_] := x / (1 + x ^ 2)

(a) f '[x]

Out[24]= $-\frac{2\,x^2}{(1+x^2)^2}+\frac{1}{1+x^2}$

In[25]:= `f ' '[x]`

Out[25]= $\frac{8\,x^3}{(1+x^2)^3}-\frac{6\,x}{(1+x^2)^2}$

b) Find f'(-1) and f'(0)

In[26]:= `f '[-1]`

Out[26]= 0

In[27]:= `f '[0]`

Out[27]= 1

c) Find f''(0) and f''(1)

In[28]:= `f ' '[0]`

Out[28]= 0

In[29]:= `f ' '[1]`

Out[29]= $-\frac{1}{2}$

Q3). Find the prime factorization of each integer.

a) **352721813330994927 6293**

In[30]:= `FactorInteger [ 3 527 218 133 309 949 276 293 ]`

Out[30]= {{15 013 , 2}, {25 013 , 3}}

(b) **471945325930166269**

In[31]:= `FactorInteger [ 471 945 325 930 166 269 ]`

Out[31]= {{4211 , 1}, {34 589 , 1}, {46 747 , 1}, {69 313 , 1}}

(c)**471945325930166281**

In[32]:= `FactorInteger [ 471 945 325 930 166 281 ]`

Out[32]= {{471 945 325 930 166 281 , 1}}

Q4. Compute each expression. Do you notice a pattern?

(a) 3^6 mod 7

In[33]:= `PowerMod[3, 6, 7]`

Out[33]= 1

(b)6^10 mod11

In[34]:=
```
PowerMod[6, 10, 11]
```

Out[34]= 1

(c)7^20 mod21

In[35]:=
```
PowerMod[7, 20, 21]
```

Out[35]= 7

(d)7^22 mod23

In[36]:=
```
PowerMod[7, 22, 23]
```

Out[36]= 1

Q8. Let M={{1,1},{0,1}}

(a) Find M^2,M^3.....M^10.

In[37]:=
```
M = {{1, 1}, {1, 0}}
```

Out[37]= {{1, 1}, {1, 0}}

In[38]:=
```
Table[MatrixPower[M, n], {n, 2, 10}]
```

Out[38]= {{{2, 1}, {1, 1}}, {{3, 2}, {2, 1}}, {{5, 3}, {3, 2}}, {{8, 5}, {5, 3}}, {{13, 8}, {8, 5}},
{{21, 13}, {13, 8}}, {{34, 21}, {21, 13}}, {{55, 34}, {34, 21}}, {{89, 55}, {55, 34}}}

In[39]:=
```
Fibonacci[100, M]
```

Out[39]= {{354 224 848 179 261 915 075 , 354 224 848 179 261 915 075 }, {354 224 848 179 261 915 075 , 0}}

In[40]:=
```
Fibonacci[100]
```

Out[40]= 354 224 848 179 261 915 075

Q9. Find solutions to the following equations or systems of equations.

(a) Find x ,if x^2+x=1.

In[41]:=
```
Solve[x^2 + x == 1, x]
```

Out[41]= $\left\{\left\{x \to \frac{1}{2}\left(-1-\sqrt{5}\right)\right\}, \left\{x \to \frac{1}{2}\left(-1+\sqrt{5}\right)\right\}\right\}$

(b) Find x, if x^2+x=-1

In[42]:=
```
Solve[x^2 + x == -1, x]
```

Out[42]= $\{\{x \to -(-1)^{1/3}\}, \{x \to (-1)^{2/3}\}\}$

(c) Find x and y. 4x-3y=5 and 6x+2y=14

In[43]:=
```
Solve[4 x - 3 y == 5 && 6 x + 2 y == 14, {x, y}]
```

Out[43]= {{x → 2, y → 1}}

(d) Find x,y,z and t.

-2x-2y+3z+t=8 , -3x+0y-6z+t=-19 , 6x-8y+6z+5t=47 , x+3y-3z-t=-9.

In[44]:=
```
Solve[-2 x - 2 y + 3 z + t == 8 &&
  -3 x + 0 y - 6 z + t == -19 && 6 x - 8 y + 6 z + 5 t == 47 && x + 3 y - 3 z - t == -9]
```

Out[44]= {{t → 5, x → 2, y → 1, z → 3}}

Q10. Solve this equation for r.

In[45]:=
```
Solve[{250 e^r + 300 e^0.75 r + 350 e^0.5 r + 400 e^0.25 r == 1365}, r]
```

Out[45]= {{r → 0.541896}}

Q11. Write a function called mysqrt that accepts one argument, begins with an initial guess of 1.0, 0 finds 20 new guesses, and returns the answer.

In[46]:=
```
mysqrt[n_] := Module[{i = 1, g = 1}, While[i ≤ 20, g = 1/2 (g + n/g); i = i + 1]; g]
```

In[47]:=
```
N[mysqrt[2], 6]
```

Out[47]= 1.41421

In[48]:=
```
N[Sqrt[2], 6]
```

Out[48]= 1.41421

In[49]:=
```
N[mysqrt[3]]
```

Out[49]= 1.73205

Q12. (a) Write a function called collatz that accepts a single argument, n, and returns:

- **0 if n=1,**
- **1+collatz(n/2) if n is even.**
- **1+collatz(3*n+1) if n is odd.**

In[50]:=
```
collatz[n_] := Which[n = 1], collatz[n] = 0, EvenQ[n],
  collatz[n] = 1 + collatz[n / 2], OddQ[n], collatz[n] = 1 + collatz[3 * n + 1]];
```

In[50]:=
```
collatz[1]
```

Out[50]= 0

In[51]:=
```
collatz[2]
```

Out[51]= 1

In[52]:=
```
collatz[6]
```

Out[52]= 8

In[53]:=
```
collatz[27]
```

Out[53]= 111