PRACTICAL 1

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Q1. Graph each of the following functions.

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

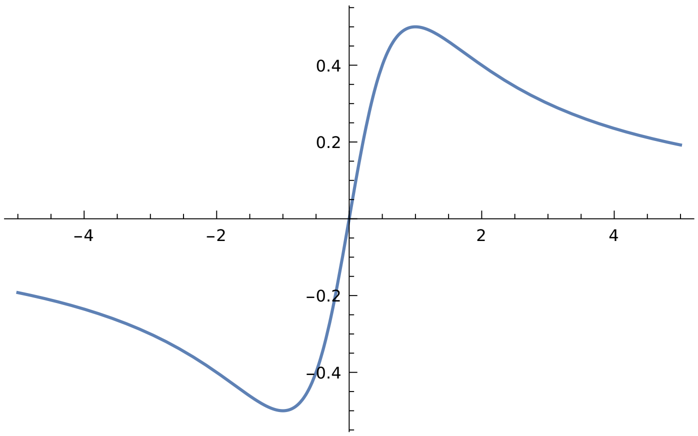
In[15]:=

$$f[x\_] := \frac{x}{1+x^2};$$

In[16]:=

```
Plot[f[x], {x, 5, -5}]
```

Out[16]=

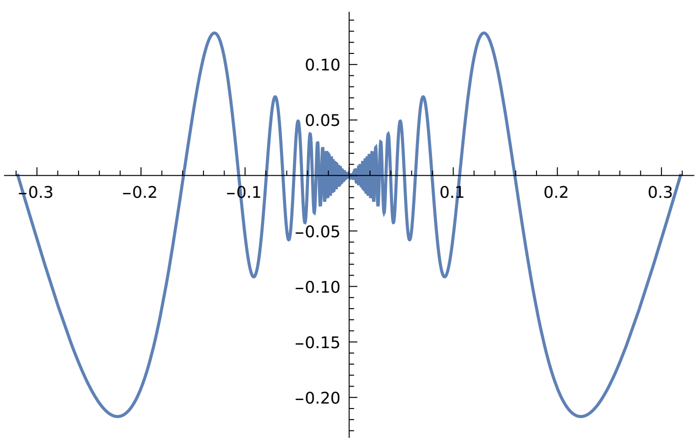


b) y=x Sin(1/x)

In[17]:=

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

Out[18]=

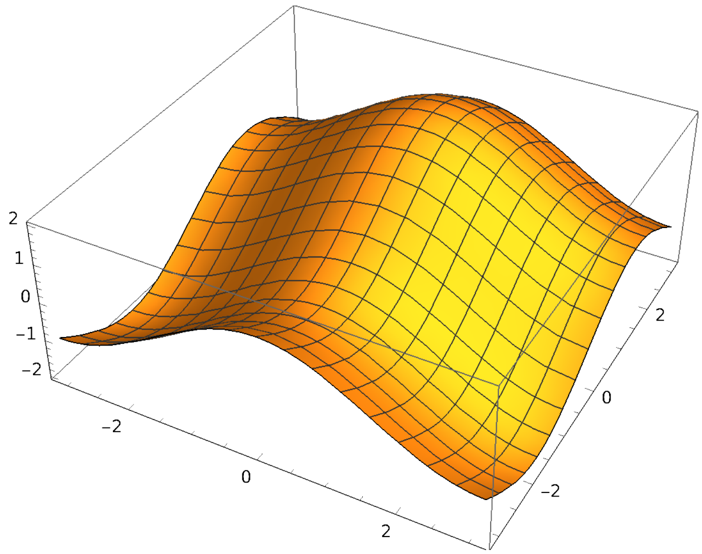


In[19]:=

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

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

Out[20]=

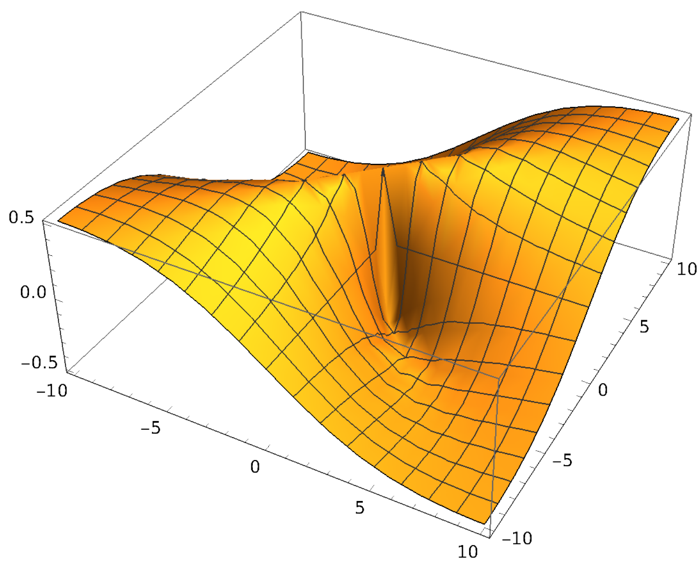


In[21]:= **(d) z =** $\frac{xy}{x^2 + y^2}$

Out[21]= $\frac{xy}{x^2 + y^2}$

In[22]:= `Plot3D[`$\frac{x\,y}{x^2 + y^2}$`, {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]=

$$\frac{8\,x^3}{\left(1+x^2\right)^3}-\frac{6\,x}{\left(1+x^2\right)^2}$$

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) **3527218133309949276293**

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
```