

1. Calculate $\sqrt{2}$ with 100 decimal places.

```
import sympy
import mpmath
mpmath.mp.dps = 100
sqrt_two = mpmath.sqrt(2)
print(sqrt_two)
```

1.4142135623730950488016887242096980785696718753769480731766797379907324784

2. Calculate $1/2 + 1/3$ in rational arithmetic.

```
import sympy
num1 = sympy.Rational(1, 2)
num2 = sympy.Rational(1, 3)
result = num1 + num2
print(result)
```

5/6

3. Calculate the expanded form of $(x+y)^6$.

```
import sympy
x, y = sympy.symbols('x y')
expanded_form = sympy.expand((x+y)**6)
print(expanded_form)
```

$x^6 + 6x^5y + 15x^4y^2 + 20x^3y^3 + 15x^2y^4 + 6xy^5 + y^6$

4. Simplify the trigonometric expression $\sin(x)/\cos(x)$.

```
import sympy
x = sympy.symbols('x')
expr = sympy.sin(x) / sympy.cos(x)
simplified_expr = sympy.simplify(expr)
print(simplified_expr)
```

$\tan(x)$

5.

```
import sympy as sp
x = sp.Symbol('x')
f = (sp.sin(x) - x) / x**3
limit = sp.limit(f, x, 0)
print(limit)
```

$-1/6$

6. Calculate the derivative of $\log(x)$, $1/x$, $\sin(x)$, $\cos(x)$ for x .

```
import sympy
x = sympy.symbols('x')
x1= sympy.log(x)
d1 = x1.diff(x)
print('Derivative of log(x):', d1)
x2 = 1/x
d2 = x2.diff(x)
print('Derivative of 1/x:', d2)
x3 = sympy.sin(x)
d3 = x3.diff(x)
print('Derivative of sin(x):', d3)
x4 = sympy.cos(x)
d4 = x4.diff(x)
print('Derivative of cos(x):', d4)
```

Derivative of $\log(x)$: $1/x$
 Derivative of $1/x$: $-1/x**2$
 Derivative of $\sin(x)$: $\cos(x)$
 Derivative of $\cos(x)$: $-\sin(x)$

7. Solve the system of equations $x+y=2$, $2x+y=0$.

```
import sympy
x, y = sympy.symbols('x y')
eq1 = sympy.Eq(x + y, 2)
eq2 = sympy.Eq(2*x + y, 0)
solution = sympy.solve((eq1, eq2), (x, y))
print(solution)
```

$\{x: -2, y: 4\}$

8. Integrate $x^2, \sin(x), \cos(x)$ in terms of x and y .

```
import sympy as sp
x, y = sp.symbols('x y')
x1 = sp.integrate(x**2, x)
print(f"The integral of x^2 in terms of x is: {x1}")
x2 = sp.integrate(sp.sin(x), x)
print(f"The integral of sin(x) in terms of x is: {x2}")
x3 = sp.integrate(sp.cos(x), x)
print(f"The integral of cos(x) in terms of x is: {x3}")
```

The integral of x^2 in terms of x is: $x**3/3$
 The integral of $\sin(x)$ in terms of x is: $-\cos(x)$
 The integral of $\cos(x)$ in terms of x is: $\sin(x)$

9. Solve $f''(x) + 9f(x) = 1$.

```
import sympy
x = sympy.symbols('x')
f = sympy.Function('f')(x)
de = sympy.Eq(f.diff(x, 2) + 9*f, 1)
solution = sympy.dsolve(de)
print(solution)
```

$\text{Eq}(f(x), C1*\sin(3*x) + C2*\cos(3*x) + 1/9)$

10. Using matrices solve the linear equations: $3x+7y=12z$ $4x-2y=5z$

```
import sympy
x, y, z = sympy.symbols('x y z')
A = sympy.Matrix([[3, 7], [4, -2]])
X = sympy.Matrix([x, y])
B = sympy.Matrix([12*z, 5*z])
solution = sympy.linsolve((A, B))
print(solution)
```

$\{(59*z/34, 33*z/34)\}$

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