```
In [4]:  import sympy as sp
         from sympy.solvers import solve
```

```
In [ ]:  #15
```

```
In [5]:  #oppgave 1a
         x, y = sp.symbols("x y")
         unknown = [x, y]
         eq_a = [
             sp.Eq(2*x+4*y, 6),
             sp.Eq(-2*x+y, 4)
         ]
```

```
In [41]:  sp.solve(eq_a, unknown)
```

Out[41]: {x: -1, y: 2}

```
In [ ]:  Oppgave 1 b
```

```
In [16]:  eq_b = [
             sp.Eq(2*x-y, -1),
             sp.Eq(x**2+x-y, 1)
         ]
```

Out[16]: $x^2 + x - y = 1$

```
In [39]:  sp.solve(eq_b, unknown)
```

Out[39]: [(-1, -1), (2, 5)]

```
In [ ]:  Oppgave 2 a
```

```
In [37]:  #0ppgave 2a
         eq_c = [
             sp.Eq(3*x - 12, -6*y),
             sp.Eq(4*x - 8*y, 16)
         ]
```

```
In [38]:  sp.solve(eq_c, unknown)
```

Out[38]: {x: 4, y: 0}

```
In [ ]:  2 b
```

```
In [35]:  #oppgave 2b
         eq_d = [
             sp.Eq(x**2 + 4*x - 3, 3*y),
             sp.Eq(2*y, 8 - x)
         ]
```

```
In [36]:  sp.solve(eq_d, unknown)
```

Out[36]: [(-15/2, 31/4), (2, 3)]

```
In [ ]:  #16
```

```
In [33]:  #0ppgave 1a
         eq_e = [
             sp.Eq(4*x - 4*y, 8),
             sp.Eq(6*x - 2*y, 26)
         ]
```

```
In [34]:  sp.solve(eq_e, unknown)
```

Out[34]: {x: 11/2, y: 7/2}

```
In [31]:  #oppgave 1b
         eq_f = [
             sp.Eq(2*x + y**2, 25),
             sp.Eq(x - 2*y, 10)
         ]
         eq_f[1]
```

Out[31]: $x - 2y = 10$

```
In [32]:  sp.solve(eq_f, unknown)
```

Out[32]: [(0, -5), (12, 1)]

```
In [43]:   #Oppgave 2a
           eq_g = [
               sp.Eq(4*x - 4*y, 8),
               sp.Eq(9*x - 5*y, 26)
           ]
           sp.solve(eq_g, unknown)

Out[43]:   {x: 4, y: 2}
```

```
In [44]:   #oppgave 2b
           eq_h = [
               sp.Eq(x + 2*y**2, 15),
               sp.Eq(x**2- 4*y**2, 33)
           ]
           sp.solve(eq_h, unknown)

Out[44]:   [(-9, -2*sqrt(3)), (-9, 2*sqrt(3)), (7, -2), (7, 2)]
```

```
In [ ]:    #17
```

```
In [46]:   #oppgave 1a
           eq_i = [
               sp.Eq(x*y**2 - x, 0),
               sp.Eq(x + y**2, 16)
           ]
           sp.solve(eq_i, unknown)

Out[46]:   [(0, -4), (0, 4), (15, -1), (15, 1)]
```

```
In [49]:   #oppgave 1b
           eq_j = [
               sp.Eq(x**2 + y**2, 100),
               sp.Eq(x**2*y - 36*y, 0)
           ]
           sp.solve(eq_j, unknown)

Out[49]:   [(-10, 0), (-6, -8), (-6, 8), (6, -8), (6, 8), (10, 0)]
```

```
In [50]:   #oppgave 2a
           eq_k = [
               sp.Eq(x*y**2 - 49*x, 0),
               sp.Eq(x**2 + y**2, 58)
           ]
           sp.solve(eq_k, unknown)

Out[50]:   [(-3, -7), (-3, 7), (0, -sqrt(58)), (0, sqrt(58)), (3, -7), (3, 7)]
```

```
In [51]:   #oppgave 2b
           eq_l = [
               sp.Eq(x**2 + y**2, 5/4),
               sp.Eq(2*x*y + y, 0)
           ]
           sp.solve(eq_l, unknown)

Out[51]:   [(-1.11803398874989, 0.0),
            (-0.500000000000000, -1.00000000000000),
            (-0.500000000000000, 1.00000000000000),
            (1.11803398874989, 0.0)]
```

```
In [ ]:    #19
```

```
In [61]:   def a19(x):
               return x**5
           sp.diff(a19(x), x)
```

Out[61]: $5x^4$

```
In [62]:   def b19(x):
               return x+12
           sp.diff(b19(x), x)
```

Out[62]: 1

```
In [63]:   def c19(x):
               return x**3 + 4*x**2
           sp.diff(c19(x), x)
```

Out[63]: $3x^2 + 8x$

```
In [65]:   def d19(x):
               return 2*x**3 + sp.sqrt(36)
           sp.diff(d19(x), x)
```

```
Out[65]: 6x²
```

```
In [67]: def e19(x):
             return sp.sqrt(x) + 5**2
         sp.diff(e19(x), x)
```

$$Out[67]: \frac{1}{2\sqrt{x}}$$

```
In [69]: def f19(x):
             return x**3 + 1/x
         sp.diff(f19(x), x)
```

$$Out[69]: 3x^2 - \frac{1}{x^2}$$

```
In [72]: def g19(x):
             return x**3 - x**2 + (1/4)*x
         sp.diff(g19(x), x)
```

$$Out[72]: 3x^2 - 2x + 0.25$$

```
In [76]: #oppgave 2
         def h19(x):
             return 1/x + 6*x**6
         sp.diff(h19(x), x)
```

$$Out[76]: 36x^5 - \frac{1}{x^2}$$

```
In [77]: def i19(x):
             return -x + 1/2 * x**3
         sp.diff(i19(x), x)
```

$$Out[77]: 1.5x^2 - 1$$

```
In [78]: def j19(x):
             return x * (x**2 + 2*x -3)
         sp.diff(j19(x), x)
```

$$Out[78]: x^2 + x\left(2x + 2\right) + 2x - 3$$

```
In [ ]: #20
```

```
In [82]: def e20(x):
             return x**4 * x**5
         sp.diff(e20(x))
```

$$Out[82]: 9x^8$$

```
In [85]: def f20(x):
             return x * sp.sqrt(x)
         sp.diff(f20( x))
```

$$Out[85]: \frac{3\sqrt{x}}{2}$$

```
In [86]: def g20(x):
             return 2 / x**3
         sp.diff(g20(x))
```

$$Out[86]: -\frac{6}{x^4}$$

```
In [88]: def h20(x):
             return (x**2 -2) / x**3
         sp.diff(h20(x))
```

$$Out[88]: \frac{2}{x^2} - \frac{3\left(x^2 - 2\right)}{x^4}$$

```
In [89]: def i20(x):
             return sp.sqrt(x) * x**6
         sp.diff(i20(x))
```

$$Out[89]: \frac{13x^{\frac{11}{2}}}{2}$$

```
In [90]: def j20(x):
```

```
        return x * (x**2 + 1)
sp.diff(j20(x))
```

Out[90]: $3x^2 + 1$

In [92]:
```
def k20(x):
    return (x**2 + 4) / (x**3 - 1)
sp.diff(k20(x))
```

Out[92]: $-\dfrac{3x^2\left(x^2+4\right)}{\left(x^3-1\right)^2} + \dfrac{2x}{x^3-1}$

In [93]:
```
def l20(x):
    return (x**2) / (x**2 + 2*x)
sp.diff(l20(x))
```

Out[93]: $\dfrac{x^2\left(-2x-2\right)}{\left(x^2+2x\right)^2} + \dfrac{2x}{x^2+2x}$

In [95]:
```
def m20(x):
    return (x**2 + 4*x + 2) / (x - 2)
sp.diff(m20(x))
```

Out[95]: $\dfrac{2x+4}{x-2} - \dfrac{x^2+4x+2}{\left(x-2\right)^2}$

In [96]:
```
def n20(x):
    return (x**3 - 2*x) / (x**2 - 1)
sp.diff(n20(x))
```

Out[96]: $-\dfrac{2x\left(x^3-2x\right)}{\left(x^2-1\right)^2} + \dfrac{3x^2-2}{x^2-1}$

In [98]:
```
def o20(x):
    return (x**2 + 1) * (x**2 - 1)
sp.diff(o20(x))
```

Out[98]: $2x\left(x^2-1\right) + 2x\left(x^2+1\right)$

In [99]:
```
def p20(x):
    return (3*x - 4) / (x**3 + 7)
sp.diff(p20(x))
```

Out[99]: $-\dfrac{3x^2\cdot\left(3x-4\right)}{\left(x^3+7\right)^2} + \dfrac{3}{x^3+7}$

In [4]:
```
#21
```

In [6]:
```
def a21(x):
    return (x**3 + 6*x)**5

sp.diff(a21(x))
```

Out[6]: $\left(15x^2 + 30\right)\left(x^3 + 6x\right)^4$

In [7]:
```
def b21(x):
    return sp.sqrt(2*x**2 + 5)
sp.diff(b21(x))
```

Out[7]: $\dfrac{2x}{\sqrt{2x^2+5}}$

In [8]:
```
def c21(x):
    return (2*x / x**2 + x)**4
sp.diff(c21(x))
```

Out[8]: $\left(4 - \dfrac{8}{x^2}\right)\left(x + \dfrac{2}{x}\right)^3$

In [9]:
```
def d21(x):
    return (2*x**4 + 9)**3/2
sp.diff(d21(x))
```

Out[9]: $12x^3\left(2x^4 + 9\right)^2$

In [10]:
```
def e21(x):
    return 1 / sp.sqrt(1 + x**2)
```

```
sp.diff(d21(x))
```

Out[10]: $12x^3 \left(2x^4 + 9\right)^2$

In [19]:
```
def f21(x):
    return x**2 * (x** + 2*x)**3
sp.diff(f21(x))
```

Out[19]: $11x^{10}$

In [20]:
```
def g21(x):
    return x**2 * sp.sqrt(x**2 - 2*x)
sp.diff(g21(x))
```

Out[20]: $\dfrac{x^2 \left(x - 1\right)}{\sqrt{x^2 - 2x}} + 2x\sqrt{x^2 - 2x}$

In [21]:
```
def h21(x):
    return x**2 / (x**2 + x)**3
sp.diff(h21(x))
```

Out[21]: $\dfrac{x^2 \left(-6x - 3\right)}{\left(x^2 + x\right)^4} + \dfrac{2x}{\left(x^2 + x\right)^3}$

In [22]:
```
def i21(x):
    return (x**2 + 1) * ( x**3 + 1)**3
sp.diff(i21(x))
```

Out[22]: $9x^2 \left(x^2 + 1\right) \left(x^3 + 1\right)^2 + 2x\left(x^3 + 1\right)^3$

In [23]:
```
def j21(x):
    return sp.sqrt(3*x**2 + 2*x)**4
sp.diff(j21(x))
```

Out[23]: $\left(12x + 4\right) \left(3x^2 + 2x\right)$

In [24]:
```
def k21(x):
    return (x**3 + 3) * (x**2 + 3)**4
sp.diff(k21(x))
```

Out[24]: $3x^2 \left(x^2 + 3\right)^4 + 8x\left(x^2 + 3\right)^3 \left(x^3 + 3\right)$

In [26]:
```
def l21(x):
    return sp.sqrt(x**2 + 1 * x**2)
sp.diff(l21(x))
```

Out[26]: $\dfrac{\sqrt{2}\sqrt{x^2}}{x}$

In [27]:
```
def m21(x):
    return (2**x + 3*x**2)**3 / x**2
sp.diff(m21(x))
```

Out[27]: $\dfrac{\left(2^x + 3x^2\right)^2 \cdot \left(3 \cdot 2^x \log\left(2\right) + 18x\right)}{x^2} - \dfrac{2\left(2^x + 3x^2\right)^3}{x^3}$

In [33]:
```
def n21(x):
    return sp.root(x**4-5, 3)
sp.diff(n21(x))
```

Out[33]: $\dfrac{4x^3}{3\left(x^4 - 5\right)^{\frac{2}{3}}}$

In [36]:
```
def o21(x):
    return x**3 / sp.sqrt(x**4 - 1)
sp.diff(o21(x))
```

Out[36]: $-\dfrac{2x^6}{\left(x^4 - 1\right)^{\frac{3}{2}}} + \dfrac{3x^2}{\sqrt{x^4 - 1}}$

In [ ]:
```
#22
```

In [58]:
```
sp.diff(sp.log(5*x))
```

Out[58]: $\dfrac{1}{x}$
```
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```
In [57]: sp.diff(sp.exp(-2*x), x)
```

Out[57]: $-2e^{-2x}$

```
In [59]: sp.diff(sp.log(12*x)-3, x)
```

Out[59]: $\dfrac{1}{x}$

```
In [63]: def d22(x):
             return 2**x
         sp.diff(d22(x))
```

Out[63]: $2^x \log{(2)}$

```
In [53]: sp.diff(
```

Out[53]: $3e^{3x+5}$

```
In [64]: sp.diff(sp.exp(3*x**5*1))
```

Out[64]: $15x^4 e^{3x^5}$

```
In [65]: sp.diff(sp.exp(4*x**2+8*x))
```

Out[65]: $(8x + 8)\, e^{4x^2+8x}$

```
In [67]: sp.diff(sp.log(1/x))
```

Out[67]: $-\dfrac{1}{x}$

```
In [68]: sp.diff(6*sp.log(x)+3*sp.exp(4*x))
```

Out[68]: $12e^{4x} + \dfrac{6}{x}$

```
In [70]: sp.diff(x*sp.exp(-x))
```

Out[70]: $-xe^{-x} + e^{-x}$

```
In [71]: sp.diff(x**2*sp.log(x**2*2))
```

Out[71]: $2x \log{(2x^2)} + 2x$

```
In [72]: sp.diff(x**3*sp.exp(2*x))
```

Out[72]: $2x^3 e^{2x} + 3x^2 e^{2x}$

```
In [76]: sp.diff(sp.log(x**2-1 / x**2+ 1))
```

Out[76]: $\dfrac{2x + \frac{2}{x^3}}{x^2 + 1 - \frac{1}{x^2}}$

```
In [75]: sp.diff(x**2*sp.log(x**2+2))
```

Out[75]: $\dfrac{2x^3}{x^2 + 2} + 2x \log{(x^2 + 2)}$

```
In [77]: sp.diff(sp.exp(-x)/(x**2+1))
```

Out[77]: $-\dfrac{2xe^{-x}}{(x^2 + 1)^2} - \dfrac{e^{-x}}{x^2 + 1}$