

1

```
> restart;
diff(log(1+x), x);
```

$$\frac{1}{1+x}$$

(1.1)

```
> restart;
eq1:=log((1+x)/(1-x));
eq2:=series(eq1, x);
```

$$eq1 := \ln\left(\frac{1+x}{1-x}\right)$$

$$eq2 := 2x + \frac{2}{3}x^3 + \frac{2}{5}x^5 + O(x^7)$$

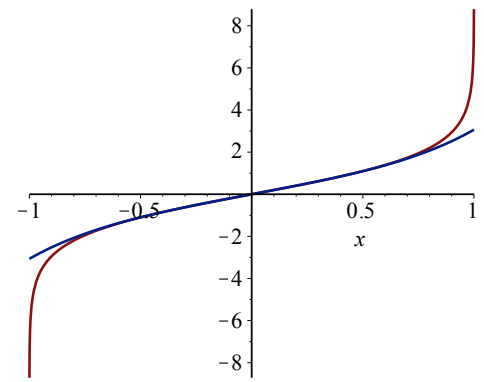
(1.2)

```
> eq3:=convert(eq2, polynom);
```

$$eq3 := 2x + \frac{2}{3}x^3 + \frac{2}{5}x^5$$

(1.3)

```
> plot([eq1, eq3], x=-1..1);
```



2

(a)

```
> restart;
eq1:=sin(x)^2/(a^2*sin(x)^2+b^2*cos(x)^2);
```

$$eq1 := \frac{\sin(x)^2}{a^2 \sin(x)^2 + b^2 \cos(x)^2}$$

(2.1.1)

```
> int(eq1, x=0..Pi/2);
```

$$-\frac{1}{2} \frac{\pi \left(b \operatorname{csgn}\left(\frac{a}{b}\right) - a \right)}{(a^2 - b^2) a}$$

(2.1.2)

```
> assume(b>0);
```

```
assume(a>0);
```

```
> int(eq1, x=0..Pi/2);
```

$$\frac{1}{2} \frac{\pi}{a - (a - b)}$$

(2.1.3)

(b)

```
> int(int(1/sqrt(y^3+1), y=sqrt(x)..2), x=0..4);
```

$$\int_0^4 \left(-\frac{1}{3} \frac{1}{\sqrt{x^{3/2}+1}} \left((I\sqrt{3}-3) \left(\operatorname{EllipticF}\left(\sqrt{3} \sqrt{-\frac{2}{I\sqrt{3}-3}}, \sqrt{-\frac{I\sqrt{3}-3}{I\sqrt{3}+3}} \right) \right. \right. \right.$$

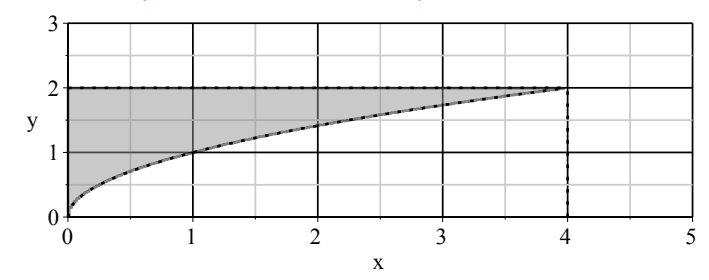
$$\left. \left. \sqrt{\frac{I\sqrt{3}+3}{I\sqrt{3}-3}} \sqrt{\frac{I\sqrt{3}-3}{I\sqrt{3}+3}} \sqrt{3} \sqrt{-\frac{2}{I\sqrt{3}-3}} \sqrt{x^{3/2}+1} \right. \right.$$

$$\left. \left. - 3 \operatorname{EllipticF}\left(\sqrt{-\frac{2\sqrt{x}+2}{I\sqrt{3}-3}}, \sqrt{-\frac{I\sqrt{3}-3}{I\sqrt{3}+3}} \right) \right. \right.$$

$$\left. \left. \sqrt{\frac{I\sqrt{3}+2\sqrt{x}-1}{I\sqrt{3}-3}} \sqrt{\frac{I\sqrt{3}-2\sqrt{x}+1}{I\sqrt{3}+3}} \sqrt{-\frac{2\sqrt{x}+2}{I\sqrt{3}-3}} \right) \right) dx$$

(2.2.1)

```
> with(plots):
inequal({y-sqrt(x)>0, y<2, x<4}, x=0..5, y=0..3);
```



```
> ?inequal;
```

```
> int(int(1/sqrt(y^3+1), x=0..y^2), y=0..2);
```

$$\frac{4}{3}$$

(2.2.2)

3

(a)

```
> A:=Matrix([[1,-2,-2],[2,-3,-2],[-2,2,1]]);
```

$$A := \begin{bmatrix} 1 & -2 & -2 \\ 2 & -3 & -2 \\ -2 & 2 & 1 \end{bmatrix}$$

(3.1.1)

```
> with(LinearAlgebra):
> l,P:=Eigenvectors(A);
```

$$l, P := \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 & 1 & 1 \\ -1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

(3.1.2)

```
> MatrixInverse(P).A.P;
```

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

(3.1.3)

(b)

```
> A:=Matrix([[0,-1],[1,1]]);
```

$$A := \begin{bmatrix} 0 & -1 \\ 1 & 1 \end{bmatrix}$$

(3.2.1)

```
> E:=IdentityMatrix(2);
```

$$E := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(3.2.2)

```
> f:=unapply(Determinant(A-t*E),t);
```

$$f := t \rightarrow t^2 - t + 1$$

(3.2.3)

```
> f(A);
```

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

(3.2.4)

4

original

```
> restart;
```

```
> eq1:=2*x^2-4*(a+1)*x+10*a+1;
```

$$eq1 := 2x^2 - 4(a+1)x + 10a + 1$$

(4.1.1)

```
> sol1:=solve(diff(eq1,x),x);
```

$$sol1 := a + 1$$

(4.1.2)

```
> eq2:=expand(subs(x=sol1,eq1));
```

$$eq2 := -2a^2 + 6a - 1$$

(4.1.3)

```
> solve(eq2,a);
```

(4.1.4)

$$\frac{3}{2} - \frac{1}{2}\sqrt{7}, \frac{3}{2} + \frac{1}{2}\sqrt{7}$$

(4.1.4)

```
> a1:=solve(sol1=-1,a);
```

$$a1 := -2$$

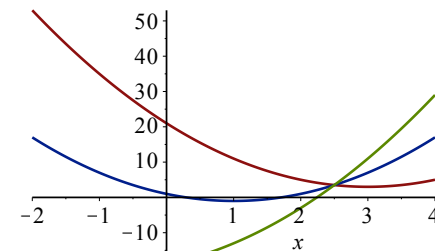
(4.1.5)

```
> a2:=solve(sol1=3,a);
```

$$a2 := 2$$

(4.1.6)

```
> plot([subs(a=a2,eq1),subs(a=0,eq1),subs(a=a1,eq1)],
x=-2..4);
```



```
> eq3:=subs(x=-1,eq1);
```

$$eq3 := 7 + 14a$$

(4.1.7)

```
> eq4:=subs(x=3,eq1);
```

$$eq4 := 7 - 2a$$

(4.1.8)

```
> solve(eq2=7/9,a);
```

$$\frac{1}{3}, \frac{8}{3}$$

(4.1.9)

```
> solve(eq4=7/9,a);
```

$$\frac{28}{9}$$

(4.1.10)

modified

```
> restart;
```

```
> eq1:=2*x^2-3.5*(a+1)*x+10*a+1;
```

$$eq1 := 2x^2 - 3.5(a+1)x + 10a + 1$$

(4.2.1)

```
> sol1:=solve(diff(eq1,x),x);
```

$$sol1 := 0.8750000000a + 0.8750000000$$

(4.2.2)

```
> eq2:=expand(subs(x=sol1,eq1));
```

$$eq2 := -1.531250000a^2 + 6.937500000a - 0.531250000$$

(4.2.3)

```
> solve(eq2,a);
```

$$0.07791657029, 4.452695675$$

(4.2.4)

```
> a1:=solve(sol1=-1,a);
```

$$a1 := -2.142857143$$

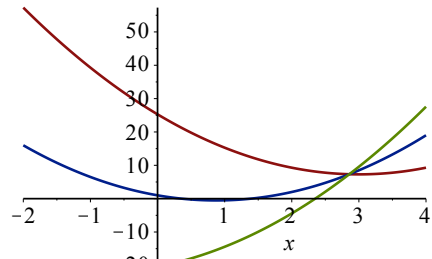
(4.2.5)

```
> a2:=solve(sol1=3,a);
```

$$a2 := 2.428571429$$

(4.2.6)

```
> plot([subs(a=a2,eq1),subs(a=0,eq1),subs(a=a1,eq1)],
x=-2..4);
```



```
> eq3:=subs(x=-1,eq1);
eq3 := 6.5 + 13.5 a (4.2.7)
```

```
> eq4:=subs(x=3,eq1);
eq4 := 8.5 - 0.5 a (4.2.8)
```

```
> sol2:=solve(eq2=7/9,a);
sol2 := 0.1972789116, 4.333333333 (4.2.9)
```

```
> evalf(sol2);
0.1972789116, 4.333333333 (4.2.10)
```

```
> sol3:=solve(eq4=7/9,a);
sol3 := 15.44444444 (4.2.11)
```

```
> plot([subs(a=sol2[1],eq1),subs(a=sol2[2],eq1),subs
(a=sol3,eq1)],x=-2..4);
```

