

Cubic function

1. Przykładowe wyniki: (Poprawność kodu sprawdzana w serwisie WolframAlpha)

a.

The image shows a Visual Studio console window and a web interface for solving a cubic equation. The console window displays the following text:

```
Konsola debugowania programu Microsoft Visual Studio
Podaj a: 2
Podaj b: 6
Podaj c: 9
Podaj d: 4

Wynik to:
x1: -0,68709
x2: -1,15645 + 1,25437i
x3: -1,15645 - 1,25437i

D:\Users\Mateusz.Twardowski\Desktop\git\Algorytmy-i-struktury-danych\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\bin\Debug\net5.0\Lab_2 (3.0) poprawne.exe (proces 11748) zakończono z kodem 0.
Naciśnij dowolny klawisz, aby zamknąć to okno...
```

The web interface shows a form with four input fields for coefficients a, b, c, and d. The values entered are a=2, b=6, c=9, and d=4. A blue 'Submit' button is located below the fields.

Real solution:

[More digits](#) | [Exact form](#)

$x \approx -0.68709$

[Need a step by step solution for this problem? >>](#)

Complex solutions:

[Cartesian form](#) ▼ | [More digits](#) | [Exact forms](#) | [Step-by-step solution](#)

$x \approx -1.1565 - 1.2544 i$

$x \approx -1.1565 + 1.2544 i$

b.

```
Konsola debugowania programu Microsoft Visual Studio

Podaj a: -4
Podaj b: -7
Podaj c: 8
Podaj d: -2

Wynik to:
x1: -2,59497
x2: 0,42249 + 0,1191i
x3: 0,42249 - 0,1191i

D:\Users\Mateusz.Twardowski\Desktop\git\Algorytmy-i-struktury-danych\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\bin\Debug\net5.0\Lab_2 (3.0) poprawne.exe (proces 13316) zakończono z kodem 0.
Naciśnij dowolny klawisz, aby zamknąć to okno...
```

a	<input type="text" value="-4"/>
b	<input type="text" value="-7"/>
d	<input type="text" value="8"/>
c	<input type="text" value="-2"/>
<input type="button" value="Submit"/>	

Real solution:

[More digits](#) | [Exact form](#)

$$x \approx -2.5950$$

[Need a step by step solution for this problem? >>](#)

Complex solutions:

[More digits](#) | [Exact forms](#) | [Step-by-step solution](#)

$$x \approx 0.42249 - 0.11910 i$$

$$x \approx 0.42249 + 0.11910 i$$

C.

```
WybierzKonsola debugowania programu Microsoft Visual Studio

Podaj a: 5
Podaj b: -2
Podaj c: 6
Podaj d: 12

Wynik to:
x1: -0,95886
x2: 0,67943 + 1,42875i
x3: 0,67943 - 1,42875i

D:\Users\Mateusz.Twardowski\Desktop\git\Algorytmy-i-struktury-danych\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\Lab_2 (3.0) poprawne\bin\Debug\net5.0\Lab_2 (3.0) poprawne.exe (proces 12140) zakończono z kodem 0.
Naciśnij dowolny klawisz, aby zamknąć to okno...
```

a	<input type="text" value="5"/>
b	<input type="text" value="-2"/>
d	<input type="text" value="6"/>
c	<input type="text" value="12"/>
<input type="button" value="Submit"/>	

Real solution:

[More digits](#) | [Exact form](#)

$$x \approx -0.95886$$

[Need a step by step solution for this problem? >>](#)

Complex solutions:

▼

[More digits](#) | [Exact forms](#) | [Step-by-step solution](#)

$$x \approx 0.6794 - 1.4288 i$$

$$x \approx 0.6794 + 1.4288 i$$

2. Kod źródłowy:

```
using System;

namespace Lab_2 //Qubic Function
{
    class Program
    {
        static void Main(string[] args)
        {
            double a, b, c, d;
            double w, p, q, delta;
            double u, v, phi;
            string x1, x2, x3;

            Console.Write("Podaj a: ");
            a = Int32.Parse(Console.ReadLine());
            Console.Write("Podaj b: ");
            b = Int32.Parse(Console.ReadLine());
            Console.Write("Podaj c: ");
            c = Int32.Parse(Console.ReadLine());
            Console.Write("Podaj d: ");
            d = Int32.Parse(Console.ReadLine());
            Console.WriteLine(); Console.WriteLine();
            Console.WriteLine("Wynik to: ");

            if (a == 0)
            {
                Console.WriteLine("Błąd danych - wprowadzono a=0");
                return;
            }

            w = -b / (3 * a);
            p = ((3 * a * Math.Pow(w, 2)) + (2 * b * w) + c) / a;
            q = ((a * Math.Pow(w, 3)) + (b * Math.Pow(w, 2)) + (c * w) + d) / a;
            delta = (Math.Pow(q, 2) / 4) + (Math.Pow(p, 3) / 27);

            if (delta > 0)
            {
                u = Math.Cbrt(-(q / 2) + Math.Sqrt(delta));
                v = Math.Cbrt(-(q / 2) - Math.Sqrt(delta));

                x1 = "" + Math.Round(u + v + w, 5);

                x2 = "" + Math.Round(-(u + v) / 2 + w, 5);
                x2 += " + " + Math.Round((Math.Sqrt(3) / 2) * (u - v), 5);

                x3 = "" + Math.Round(-(u + v) / 2 + w, 5);
                x3 += " - " + Math.Round((Math.Sqrt(3) / 2) * (u - v), 5);

                Console.WriteLine($"x1: {x1}");
                Console.WriteLine($"x2: {x2}i");
                Console.WriteLine($"x3: {x3}i");
            }

            if (delta < 0)
            {
                phi = Math.Acos(3 * q / (2 * p * Math.Sqrt(-p / 3.0)));
                x1 = "" + Math.Round(w + (2 * Math.Sqrt(p / 3.0) * Math.Cos(phi / 3)),
5);
                x2 = "" + Math.Round(w + (2 * Math.Sqrt(p / 3.0) * Math.Cos(phi / 3 *
(2 / 3 * Math.PI))), 5);
```

```

        x3 = "" + Math.Round(w + (2 * Math.Sqrt(p / 3.0) * Math.Cos(phi / 3 *
(4 / 3 * Math.PI))), 5);

        Console.WriteLine($"x1: {x1}");
        Console.WriteLine($"x2: {x2}");
        Console.WriteLine($"x3: {x3}");
    }

    if (delta == 0)
    {
        x1 = "" + (w - 2 * Math.Cbrt(q / 2.0));
        x2 = "" + (w + Math.Cbrt(q / 2.0));

        Console.WriteLine($"x1: {x1}");
        Console.WriteLine($"x2,x3: {x2}");
    }
}
}
}

```