

Chapter 10 / **Example 19****Finding roots of a complex number**

Use your calculator to find all the solutions of the equation  $z^5 = 2 + 5i$  in Cartesian form.

Press **MENU** 1 **Run-Matrix** to display the Run-Matrix screen for arithmetical calculations.

Find the fifth root of  $2 + 5i$  and store it as Z.

Type  $\sqrt[5]{2+5i}$  **→** **ALPHA** Z and press **EXE** **□**

The calculator gives just one solution of the multiple valued root.

Calculator screen showing the fifth root of  $2 + 5i$  stored in Z. The result is  $1.360867038 + 0.3302271356i$ . The screen also shows the menu bar with options: JUMP, DELETE, MAT/VCT, MATH.

Where  $z = r \operatorname{cis} \theta$ ,  $\sqrt[n]{z} = \sqrt[n]{r} \operatorname{cis} \frac{\theta + 2k\pi}{n}$ ,  $k = 0, 1, 2, \dots, n-1$ .

Find  $r$  and store it by typing  $|Z|$  **→** **ALPHA** r and press **EXE** **□**

To enter the modulus function press **F4** MATH **F3** Abs.

Calculator screen showing the modulus of Z stored in r. The result is 1.400360331. The screen also shows the menu bar with options: MAT/VCT, Logab, Abs, d/dx, d2/dx2, and a right arrow.

Find  $\theta$  and store it by typing **Arg** Z **→** **ALPHA**  $\theta$  and press **EXE** **□**

To enter the argument press **OPTN** **F3** COMPLEX **F3** Arg.

Calculator screen showing the argument of Z stored in  $\theta$ . The result is 0.2380579899. The screen also shows the menu bar with options: i, Abs, Arg, Conj, and a right arrow.

Now use the formula for arguments to find all the solutions and convert these to Cartesian form.

Type  $\left( r \times e^{i\left(\frac{\theta + 2\pi}{5}\right)} \right)$ .

press **OPTN** **F3** COMPLEX **F6** **▷** **F4** a+bi and press **EXE** **□**

Calculator screen showing the conversion of the polar form to Cartesian form. The result is  $0.1064663728 + 1.396307262i$ . The screen also shows the menu bar with options: ReP, ImP,  $r/\theta$ , a+bi, and a right arrow.

To repeat this calculation, select it and press **SHIFT** **8** CLIP **F1** CPY-LINE.

Press **◀** to return to the entry line and press **SHIFT** **9** PASTE.

Edit the expression, changing 2 to 4 and press **EXE**.

Calculator screen showing the conversion of the polar form to Cartesian form with the angle changed to  $4\pi/5$ . The result is  $-1.295067201 + 0.5327382109i$ . The screen also shows the menu bar with options: JUMP, DELETE, MAT/VCT, MATH.

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Repeat changing 4 to 6 and press **EXE**.

$$\left( r \times e^{\left( \theta + \frac{6\pi}{5} \right) i} \right)^{\frac{1}{a}} \triangleright a+bi$$

$$-0.906861921 - 1.06705694i$$

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Repeat changing 6 to 8 and press **EXE**.

$z_1 = 1.36 + 0.330i$ ,  $z_2 = 0.106 + 1.40i$ ,  $z_3 = -1.30 + 0.533i$ ,  
 $z_4 = -0.907 - 1.07i$ ,  $z_5 = 0.735 - 1.19i$ .

$$\left( r \times e^{\left( \theta + \frac{8\pi}{5} \right) i} \right)^{\frac{1}{a}} \triangleright a+bi$$

$$0.7345957111 - 1.192215668i$$

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