

The background is a gradient from dark purple on the left to dark blue on the right, overlaid with a field of small white stars. On the left side, there are several overlapping circular diagrams. One large diagram features a scale from 140 to 260 in increments of 10, with tick marks and arrows pointing inward. Other diagrams consist of concentric circles, some with dashed lines and arrows indicating a clockwise or counter-clockwise direction.

ALPHA WISKUNDE

The background is a dark blue gradient with a subtle pattern of small white dots. Overlaid on this are several faint, light-colored circular elements. On the left side, there is a large circular scale with tick marks and numbers ranging from 140 to 260. Other circular elements include dashed lines, solid lines, and arrows, some pointing inwards and some outwards, creating a sense of motion or rotation.

WAT VERANDER IN 2023?

GRAAD 12, 2023

- 15 Multikeuse vrae
- Formuleblad

VEKTORE

$$|\mathbf{AB}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

$$\mathbf{u} \times \mathbf{v} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix}$$

$$|\mathbf{OP}| = \sqrt{a^2 + b^2 + c^2}$$

$$\mathbf{u} \cdot \mathbf{v} = |\mathbf{u}| |\mathbf{v}| \cos \theta$$

$$\mathbf{u} \cdot \mathbf{v} = x_1 \cdot x_2 + y_1 \cdot y_2 + z_1 \cdot z_2$$

$$\alpha = \arccos \left(\frac{u_n}{|\mathbf{u}|} \right)$$

$\arctan x$	$x^{-1} + 1$
a^x	$a^x \cdot \ln a$
$\log_a x$	$\frac{1}{x \cdot \ln a}$
e^x	e^x
$\ln x $	$\frac{1}{x}$

The background features a dark blue gradient with a subtle pattern of white stars. Overlaid on this are several faint, light-colored mathematical diagrams. These include circular arcs, dashed lines, and arrows, some of which are arranged in a way that suggests a coordinate system or a complex plane. A prominent feature is a large circular scale on the left side, with numerical markings ranging from 40 to 260 in increments of 10. Other smaller circular diagrams with arrows are scattered throughout the scene, creating a technical and scientific atmosphere.

WORTELS VAN KOMPLEKSE GETALLE

GAUSS

Het bewys dat

$$x^n + \dots = 0$$

n antwoorde het.

$$x^3 = 1$$

Moet 3 antwoorde hê

OF

$\sqrt[3]{1}$ is drie getalle

GEWONE ALGEBRA

$$x^3 - 1 = 0$$

$$(x - 1)(x^2 + x + 1) = 0$$

$$x = 1 \text{ of } x = \frac{-1 \pm \sqrt{1^2 - 4(1)(1)}}{2(1)}$$

$$x = 1 \text{ of } x = -\frac{1}{2} \pm \frac{\sqrt{3}i}{2}$$

KOMPLEKSE GETALLE EN DE MOIVRE

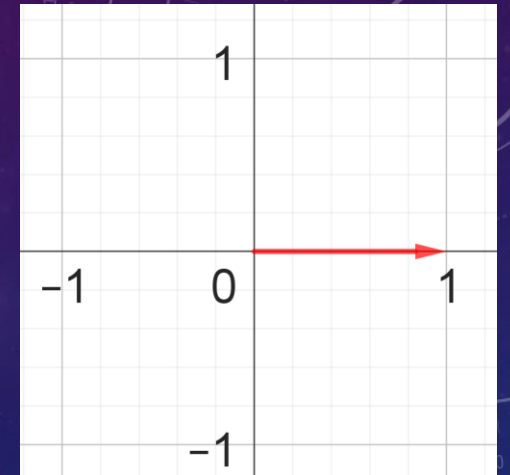
$$z^3 = 1 + 0i$$

Skryf 1 in poolvorm: $1cis(0)$

Tel by hoek 2π by, dit bly dieselfde antwoord

Gaan dit 2 keer doen

Dan is $z = 1cis(0) = 1cis(2\pi) = 1cis(4\pi)$



KRY NOU DERDE MAGS WORTEL

$$z = 1cis(0) = 1cis(2\pi) = 1cis(4\pi)$$

Kry derdemagswortel van r en deel die hoek met 3.

Die derdemagswortel van 1 is gelyk aan 1.

$$\sqrt[3]{z} = \sqrt[3]{1} = 1cis\left(\frac{0}{3}\right) = 1cis\left(\frac{2\pi}{3}\right) = 1cis\left(\frac{4\pi}{3}\right)$$

SKAKEL TERUG NA REGHOEKVORM

$$\sqrt[3]{1} = z^{\frac{1}{3}} = 1cis\left(\frac{0}{3}\right) = 1cis\left(\frac{2\pi}{3}\right) = 1cis\left(\frac{4\pi}{3}\right)$$

$$\sqrt[3]{1} = 1$$

$$\text{of } \sqrt[3]{1} = -\frac{1}{2} + \frac{\sqrt{3}i}{2}$$

$$\text{of } \sqrt[3]{1} = -\frac{1}{2} - \frac{\sqrt{3}i}{2}$$

“RESEP”

- Skryf die getal in poolvorm indien dit nie is nie.
- Tel $2\pi n - 1$ keer by die hoek by, skryf die getalle neer.
- Kry die n 'de mags wortel van r en deel al die hoeke net n .
- Dit is die n antwoorde. Indien gevra, skakel om na reghoelvorm.

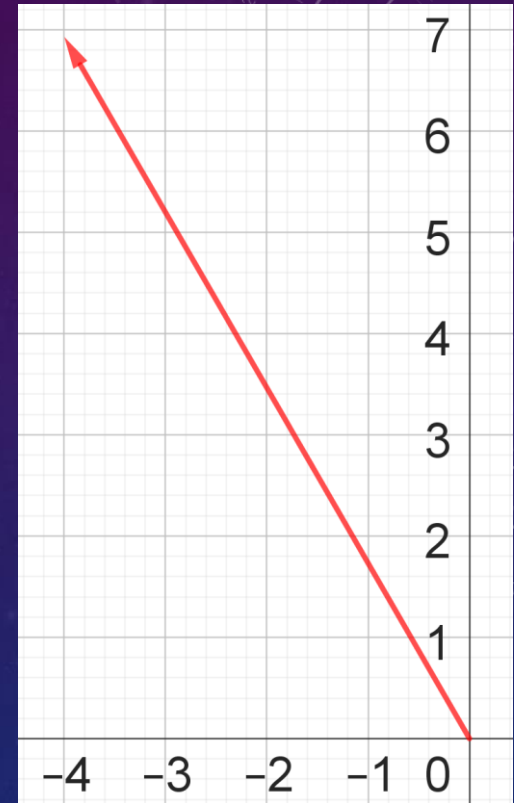
AS $z^3 = -4 + 4\sqrt{3}i$, BEPAAAL z .

$$z^3 = 8\text{cis}\left(\frac{2\pi}{3}\right)$$

$$\text{Dus } z^3 = 8\text{cis}\left(\frac{2\pi}{3}\right) = 8\text{cis}\left(\frac{8\pi}{3}\right) = 8\text{cis}\left(\frac{14\pi}{3}\right)$$

Kry $\sqrt[3]{8}$ en deel die hoek met 3:

$$\text{Dan is } z = 2\text{cis}\left(\frac{2\pi}{9}\right) = 2\text{cis}\left(\frac{8\pi}{9}\right) = 2\text{cis}\left(\frac{14\pi}{9}\right)$$



$$2\text{cis}\left(\frac{2\pi}{9}\right) = 2\text{cis}\left(\frac{8\pi}{9}\right) = 2\text{cis}\left(\frac{14\pi}{9}\right)$$

