

Student Name

Mathematics Stage 5 Paths

EQUATIONS B

Book 2 Solve cubic equations

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Simple Cubic Equations2

OVERVIEW

SYLLABUS CONTENT

MA5-EQU-P-01 solves monic quadratic equations, linear inequalities and cubic equations of the form $ax^3 = k$

Solve cubic equations

- Determine that for any value of k there is a unique value of x that solves a cubic equation of the form $ax^3 = k$ where $a \neq 0$
- Solve cubic equations of the form $ax^3 = k$, leaving answers in exact form and as decimal approximations

REVIEW OF PRIOR KNOWLEDGE

1 Cube root these numbers.

a $\sqrt[3]{8}$

b $\sqrt[3]{27}$

c $\sqrt[3]{125}$

d $\sqrt[3]{-8}$

e $\sqrt[3]{-64}$

f $\sqrt[3]{-0.125}$

2 Solve these equations.

a $x^2 = 16$

b $x^2 + 4 = 13$

c $3x^2 = 75$

d $2x^2 + 11 = 15.5$

e $-\frac{x^2}{10} = -3.6$

f $3x^2 - 15 = 177$

SIMPLE CUBIC EQUATIONS

- **Cubic equations** have unknowns to the power of 3: x^3 “x cubed”
 - **Cube rooting** $\sqrt[3]{}$ is the inverse operation of cubing
 - A cubic equation in the form $ax^3 = k$ always has **one** real solution.
 - Both positive and negative numbers can be cube rooted.
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- To solve cubic equations:
 1. Isolate x^3
 2. Cube root both sides.

Example Solve cubic equations in the form $ax^3 = k$.

$x^3 = 27$ 2. Cube root $\sqrt[3]{} = \sqrt[3]{}$ $x = \sqrt[3]{27}$ $x = 3$	$-2x^3 = 16$ 1. Isolate x^3 $\div -2 \quad \div -2$ $x^3 = -8$ 2. Cube root $\sqrt[3]{} = \sqrt[3]{}$ $x = \sqrt[3]{-8}$ $x = -2$
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Solve these equations.

a $x^3 = 64$

b $x^3 = 125$

c $x^3 = -27$

d $x^3 + 2 = -6$ $x = 4$

e $2x^3 = 2000$ $x = 5$

f $\frac{x^3}{2} = 108$ $x = -3$

$x = -2$

$x = 10$

$x = 6$

Key ideas

1. The inverse operation of cubing is

1 Solve the following. Round your answer to 2 d.p, if appropriate.

a $x^3 = 8$ $x = 2$	b $x^3 = -64$ $x = -4$	c $x^3 = 216$ $x = 6$
d $x^3 = 27$ $x = 3$	e $x^3 = -1000$ $x = -10$	f $x^3 = -125$ $x = -5$
g $27x^3 = 8$ $x = \frac{2}{3}$	h $125x^3 = -27$ $x = -\frac{3}{5}$	i $27x^3 = 125$ $x = \frac{5}{3}$
j $8x^3 = 8$ $x = 1$	k $7x^3 = 8$ $x = \sqrt[3]{\frac{8}{7}} \approx 1.05$	l $-8x^3 = 11$ $x = \sqrt[3]{-\frac{11}{8}} \approx -1.11$
m $n^3 = -184.7$ $x = \sqrt[3]{-184.7} \approx -5.69$	n $b^3 = \frac{125}{8}$ $b = \frac{5}{2}$	o $r^3 = -0.343$ $r = -0.7$
p $5x^3 = 135\,000$ $x = 30$	q $-8n^3 = 569$ $n = \sqrt[3]{-\frac{569}{8}} \approx -4.14$	r $\frac{k^3}{4} = 65$ $k = \sqrt[3]{260} \approx 6.38$
s $\frac{2t^3}{5} = -3200$ $t = -20$	t $3r^3 - 41\,472 = 0$ $r = 24$	u $32 - \frac{x^3}{9} = -48$ $x = \sqrt[3]{720} \approx 8.96$
v $7(y^3 - 2) = 2183$ $y = \sqrt[3]{\frac{2197}{7}} \approx 6.80$	w $6y^3 = 4y^3 + 45$ $y = \sqrt[3]{\frac{45}{2}} \approx 2.82$	

2

a Write the volume of a cube with side x cm:

$$V = x^3$$

b The volume of three cube shaped containers is 18 m^3 .
Calculate the side length of one of the cubes in exact form.

$$18 = 3x^3$$

$$x = \sqrt[3]{6}\text{ cm}$$

3 A rectangular prism has dimensions in ratio 1:2:3.
Calculate the side lengths if the volume is 4374 cm^3 .

$$x \times 2x \times 3x = 4374$$

$$x = 9$$

$$\therefore 9:18:27\text{ cm}$$