



SNS College of Technology(Autonomous)  
Coimbatore-35  
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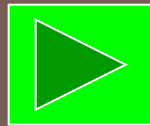
## **UNIT 1 QUANTITATIVE ABILITY III**

**T2: Algebra, Indices and Surds**

# ALGEBRAIC OPERATIONS



Adding / Sub Indices



Negative Indices



Fraction Indices



Harder Indices

# STARTER QUESTIONS

1. Simplify the following fractions :

(a)  $\frac{7}{b} \times \frac{7}{b}$

(b)  $\frac{a}{2a} - \frac{a}{2d}$

2. Simplify  $2c(4 - c) - 5(4 + c)$

3. Multiply out  $(x + 1)(x - 5)$

4. Simplify  $2\sqrt{27} - 5\sqrt{3}$

# Algebraic Operations

## Learning Intention

1. To explain how to multiply and divide indices by adding / subtracting powers.

## Success Criteria

1. Understand basic rules for indices.
2. Simplify indices.

# INDICES

$a^n$  is a short hand way of writing

$a \times a \times a \dots\dots$  (n factors)

a is called the base number

and n is called the index number

Calculate :  $2^3 \times 2^2$       $2 \times 2 \times 2 \times 2 \times 2 = 32$

Calculate :  $2^5 = 32$

Can you spot the connection !

# INDICES

Calculate :  $4^3 \div 4^2$        $4 \times 4 \times 4 \div 4 \times 4 = 4$

Calculate :  $4^1 = 4$

Can you spot the connection !

$a^m \times a^n = a^{(m+n)}$       simply add powers

$a^m \div a^n = a^{(m-n)}$       simply subtract powers

# What Goes In The Box ?

$$b^3 \times b^5 =$$

$$b^8$$

$$y^9 \div y^5 =$$

$$y^4$$

$$f^4 \times g^5 =$$

$$a^3 \times a^0 =$$

1. Simplify the following fractions :

(a)  $\frac{u}{10} \times \frac{5}{u^3}$

(b)  $\frac{a}{2a} \div \frac{a}{2d}$

2. Factorise  $3x^2 + 9x$

3. Factorise  $x^2 + 3x + 2$

4. Simplify  $10\sqrt{27} \div 5\sqrt{3}$



# Algebraic Operations

## Learning Intention

1. To explain how to handle fractional indices of powers.

## Success Criteria

1. Understand basic rules for fractional indices.
2. Simplify fractional indices.

# FRACTIONS AS INDICES

## More Rules

$$\frac{a^3}{a^5} = \frac{a \times a \times a}{a \times a \times a \times a} = \frac{1}{a^2}$$

By the division rule

$$\frac{a^3}{a^5} = a^{3-5} = a^{-2}$$

$$\frac{1}{a^n} = a^{-n}$$

# FRACTIONS AS INDICES

## More Rules

$$\frac{a^5}{a^5} = \frac{a \times a \times a \times a \times a}{a \times a \times a \times a \times a} = 1$$

$$\frac{a^5}{a^5} = a^{5-5} = a^0$$

$$a^0 = 1$$

# FRACTIONS AS INDICES

## More Rules

$$(a^5)^3 = a^5 \times a^5 \times a^5 = a^{5+5+5} = a^{15}$$

$$(a^3)^5 = a^3 \times a^3 \times a^3 \times a^3 \times a^3 \\ = a^{3+3+3+3+3} = a^{15}$$

$$(a^m)^n = a^{mn}$$

# STARTER QUESTIONS

1. Rationalise the denominator :

$$\frac{5}{(1 - \sqrt{2})}$$

2. Find the volume of sphere with diameter 50cm.
3. Factorise  $y^2 + 5y + 6$

# Algebraic Operations

## Learning Intention

1. To explain how to handle fractional indices of powers.

## Success Criteria

1. Understand basic rules for fractional indices.
2. Simplify fractional indices.

# FRACTIONS AS INDICES

$$= a^{\frac{1}{2}} \times a^{\frac{1}{2}} = a^{\frac{1}{2} + \frac{1}{2}} = a$$

$$\sqrt{a} \times \sqrt{a} = a$$

$$\sqrt{a} = a^{\frac{1}{2}}$$

# FRACTIONS AS INDICES

$$a^{\frac{1}{3}} \times a^{\frac{1}{3}} \times a^{\frac{1}{3}} = a^{\frac{1}{3} + \frac{1}{3} + \frac{1}{3}} = a^1 = a$$

$$\sqrt[3]{a} \times \sqrt[3]{a} \times \sqrt[3]{a} = a^1 = a$$

$$\sqrt[3]{a} = a^{\frac{1}{3}}$$



# FRACTIONS AS INDICES

In general we have

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

# FRACTIONS AS INDICES

Examples : Simplify the following

$$8^{\frac{2}{3}}$$
$$= \left( \sqrt[3]{8} \right)^2$$

$$= (2)^2 = 4$$

$$\frac{a}{\sqrt[3]{a}}$$

$$= a^1 \div a^{\frac{1}{3}}$$

$$= a^{1 - \frac{1}{3}} = a^{\frac{2}{3}}$$

$$\frac{a^{\frac{3}{4}}}{2a^{\frac{1}{4}}}$$

$$= \frac{a^{\frac{3}{4} - \frac{1}{4}}}{2}$$

$$= \frac{2}{2}$$

$$= \frac{1}{2}$$

# STARTER QUESTIONS

1. Rationalise the denominator :

$$\frac{6}{(4 - \sqrt{7})}$$

2. Find the volume of cone with diameter 20cm and height 10.
3. Factorise  $m^2 - 7m + 10$



# Algebraic Operations

## Learning Intention

1. To show how to simplify harder fractional indices.

## Success Criteria

1. Simplify harder fractional indices.

# FRACTIONS AS INDICES

Final Rule

$$\left(\sqrt[m]{a}\right)^n = a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

# FRACTIONS AS INDICES

$$\left(\sqrt[m]{a}\right)^n = a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

Examples

$$\left(y^{\frac{3}{4}}\right)^8 = y^{\frac{24}{4}} = y^6$$

$$16^{\frac{3}{4}} = \left(\sqrt[4]{16}\right)^3 = (2)^3 = 8$$

# FRACTIONS AS INDICES

$$\left(\sqrt[m]{a}\right)^n = a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

Examples

$$27^{-\frac{5}{3}} = \frac{1}{27^{\frac{5}{3}}} = \frac{1}{\left(\sqrt[3]{27}\right)^5} = \frac{1}{3^5} = \frac{1}{243}$$

$$\left(2a^2b^3\right)^4 = 2^4 a^8 b^{12} = 16a^8 b^{12}$$

# FRACTIONS AS INDICES

Example : Change to index form

$$\frac{2}{\sqrt{5a^{-3}}} = \frac{2}{(5a^{-3})^{\frac{1}{2}}} = \frac{2}{5^{\frac{1}{2}}a^{-\frac{3}{2}}} = \frac{2a^{\frac{3}{2}}}{5^{\frac{1}{2}}}$$

Example : Change to surd form

$$(3m^{-4})^{\frac{1}{3}} = 3^{\frac{1}{3}}m^{-\frac{4}{3}} = \frac{\sqrt[3]{3}}{\sqrt[3]{m^4}} = \sqrt[3]{\frac{3}{m^4}}$$