## Laws of Exponents

Laws of exponents are rules that help simplify expressions involving powers. These laws are useful when the base is the same and make calculations easier. There are several important laws used in exponents.

## **Important Laws of Exponents**

- Product Law:  $a^m \times a^n = a^{(m+n)}$
- Quotient Law:  $a^m \div a^n = a^{(m-n)}$
- Power of a Power:  $(a^m)^n = a^{(m \times n)}$
- Power of a Product:  $(a \times b)^m = a^m \times b^m$
- Power of a Quotient:  $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$
- Zero Exponent Law:  $a^{o} = 1$  (where  $a \neq 0$ )

## **Examples with Solutions**

Example – Product Law

Simplify  $5^3 \times 5^2$ 

 $= 5^{(3+2)} = 5^5 = 3125$ 

Example – Quotient Law

Simplify 7<sup>6</sup> ÷ 7<sup>2</sup>

 $= 7^{(6-2)} = 7^4 = 2401$ 

Example – Power of a Power

Simplify (2<sup>2</sup>)<sup>3</sup>

 $= 2^{(2\times3)} = 2^6 = 64$ 

Example – Power of a Product

Simplify  $(3 \times 4)^2$ 

 $= 3^2 \times 4^2 = 9 \times 16 = 144$ 

Example – Power of a Quotient

Simplify 
$$(\frac{6}{2})^3$$
  
=  $\frac{6^3}{2^3} = \frac{216}{8} = 27$ 

## **Summary Points**

- Laws of exponents are used to simplify expressions with powers.
- They work only when the base is the same (except in product or quotient laws of different bases).
- a<sup>o</sup> = 1 for any non-zero number.
- Always add exponents when multiplying, subtract when dividing, and multiply exponents when raising to a power.
- Exponents are helpful in algebra and higher-level mathematics.