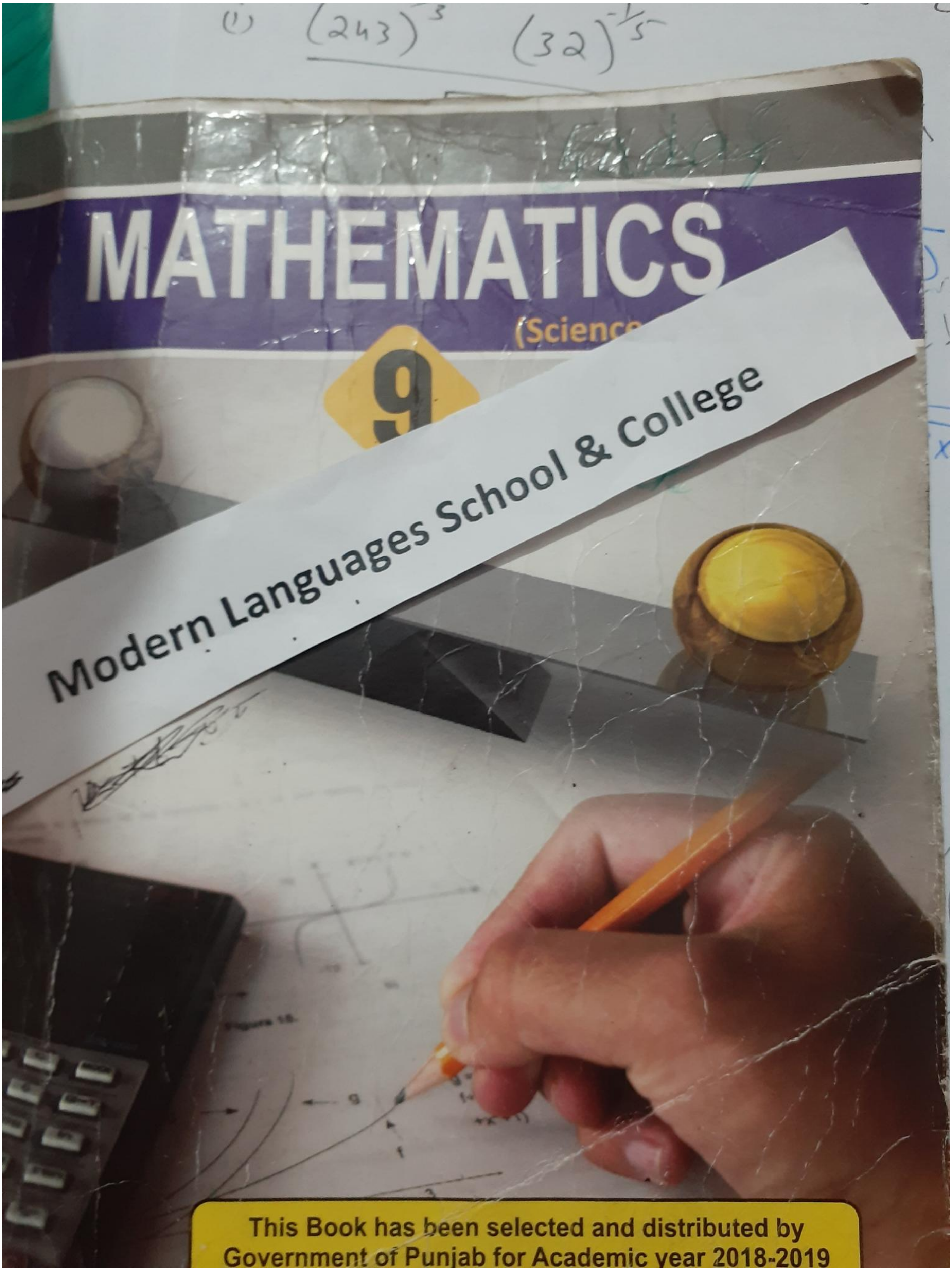
MATHEMATICS
(Science
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Modern Languages School & College
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(i) $\sqrt[3]{-64}$ (ii) 2 (iii) −7 (iv) $y^{-2/3}$

2. Tell whether the following statements are true or false?

(i) $5^{1/5} = \sqrt{5}$ F (ii) $2^{2/3} = \sqrt[3]{4}$ T (iii) $\sqrt{49} = \sqrt{7}$ F (iv) $\sqrt[3]{x^{27}} = x^3$ F

3. Simplify the following radical expressions.

(i) $\sqrt[3]{-125}$ (ii) $\sqrt[4]{32}$ (iii) $\sqrt[5]{\frac{3}{32}}$ (iv) $\sqrt[3]{-\frac{8}{27}}$

2.4 Laws of Exponents / Indices

2.4.1 Base and Exponent

In the exponential notation a^n (read as a to the nth power) we call 'a' as the base and 'n' as the *exponent* or the power to which the base is raised.

From this definition, recall that, we have the following *laws of exponents.*

If $a, b \in$ R and m, n are positive integers, then

I. $a^m \cdot a^n = a^{m+n}$

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

III $(ab)^n = a^n b^n$

IV $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$

V $\frac{a^m}{a^n} = a^{m-n}, \quad a \neq 0$

VI $a^0 = 1$, where $a \neq 0$

VII $a^{-n} = \frac{1}{a^n}$, where $a \neq 0$

2.4.2 Applications of Laws of Exponents

The method of applying the laws of indices to simplify algebraic expressions is explained in the following examples.

Example 1

Use rules of exponents to simplify each expression and write the answer in terms of positive exponents.

(i) $\dfrac{x^{-2}x^{-3}y^7}{x^{-3}y^4}$ (ii) $\left(\dfrac{4a^3b^0}{9a^{-5}}\right)^{-2}$

Solution

(i) $\dfrac{x^{-2}x^{-3}y^{7}}{x^{-3}y^{4}} = \dfrac{x^{-5}y^{7}}{x^{-3}y^{4}}$ $\quad (a^m a^n = a^{m+n})$

$= \dfrac{y^{7-4}}{x^{-3+5}} = \dfrac{y^3}{x^2}$ $\quad \left(\dfrac{a^m}{a^n} = a^{m-n}\right)$

(ii) $\left(\dfrac{4a^3 b^0}{9a^{-5}}\right)^{-2} = \left(\dfrac{4a^{3+5} \times 1}{9}\right)^{-2}$ $\quad \left(\dfrac{a^m}{a^n} = a^{m-n}, b^0 = 1\right)$

$= \left(\dfrac{4a^8}{9}\right)^{-2} = \left(\dfrac{9}{4a^8}\right)^{+2}$ $\quad \left(\dfrac{a}{b}\right)^{-n} = \left(\dfrac{b}{a}\right)^{n}$

$= \dfrac{81}{16a^{16}}$ $\quad \left(\dfrac{a}{b}\right)^{n} = \dfrac{a^n}{b^n}$

Example 2

Simplify the following by using laws of indices:

(i) $\left(\dfrac{8}{125}\right)^{-4/3}$ (ii) $\dfrac{4(3)^n}{3^{n+1} - 3^n}$

Solution Using Laws of Indices,

(i) $\left(\dfrac{8}{125}\right)^{-4/3} = \left(\dfrac{125}{8}\right)^{4/3} = \dfrac{(125)^{4/3}}{(8)^{4/3}} = \dfrac{(5^3)^{4/3}}{(2^3)^{4/3}} = \dfrac{5^4}{2^4} = \dfrac{625}{16}$

(ii) $\dfrac{4(3)^n}{3^{n+1} - 3^n} = \dfrac{4(3)^n}{3^n[3-1]} = \dfrac{4(3)^n}{2(3^n)} = \dfrac{4}{2} = 2$

EXERCISE 2.4

1. Use laws of exponents to simplify:

(i) $\dfrac{(243)^{-2/3}(32)^{-1/5}}{\sqrt{(196)^{-1}}}$ (ii) $(2x^5 y^{-4})(-8x^{-3} y^2)$

(iii) $\left(\dfrac{x^{-2} y^{-1} z^{-4}}{x^4 y^{-3} z^0}\right)^{-3}$ (iv) $\dfrac{(81)^n \cdot 3^5 - (3)^{4n-1}(243)}{(9^{2n})(3^3)}$

2. Show that

$$\left(\frac{x^a}{x^b}\right)^{a+b} \times \left(\frac{x^b}{x^c}\right)^{b+c} \times \left(\frac{x^c}{x^a}\right)^{c+a} = 1$$

1. (i) $(-64)^{1/3}$ (ii) $\sqrt[3]{2^3}$ (iii) $-\sqrt[3]{7}$ (iv) $\sqrt[3]{y^{-2}}$
2. (i) F (ii) T (iii) F (iv) F
3. (i) -5 (ii) $2\sqrt[4]{2}$ (iii) $\frac{\sqrt[5]{3}}{2}$ (iv) $-\frac{2}{3}$

EXERCISE 2.4

1. (i) $\frac{7}{27(\sqrt[3]{3})}$ (ii) $-\frac{16x^2}{y^2}$ (iii) $\frac{x^{18}z^{12}}{y^6}$ (iv) 6
3. (i) 2 (ii) 6 (iii) 25 (iv) $\frac{1}{x^3}$

EXERCISE 2.5

1. (i) $-i$ (ii) -1 (iii) 1 (iv) 1 (v) $-i$
2. (i) $2-3i$ (ii) $3+5i$ (iii) i (iv) $-3-4i$ (v) -4
3. (i) Re(Z) = 1 I