Rules of indices Pg 21 log tables.

① $a^p a^q = a^{p+q}$

Multiplication
- add the powers

When we multiply different powers with the same base value we add the powers

Eg 1) $2^3 \times 2^2 = 2^{3+2} = 2^5$

Base value = 2

Eg 2) $7^4 \cdot 7^4 = 7^{4+4} = 7^8$

$\cdot$ ↓ means multiply

Notes: a is the base value.
p and q are the powers or the indices and can be any numbers or letters.

Eg 3) $(5^5)(5^3)$

Brackets mean multiply

$5^{5+3} = 5^8$

Pg 289 Q2 (i) → (vii)

Q2)

$2^{1} \times 2^{1} \times 2^{1} = 2^{1+1+1} = 2^{3}$

$2^{1} \times 2^{3} = 2^{1+3} = 2^{4}$

$4^{2} \times 4^{3} = 4^{2+3} = 4^{5}$

$5^{1} \times 5^{2} \times 5^{3} = 5^{1+2+3} = 5^{6}$

$a^{1} \times a^{5} = a^{1+5} = a^{6}$

$\underline{2}x^{2} \times \underline{4}x^{3} = 8x^{2+3} = 8x^{5}$

$\underline{2}x^{2} \times \underline{3}x^{1} = 6x^{2+1} = 6x^{3}$

② Rule – Division Log table

$$\frac{a^{p}}{a^{q}} = a^{p-q}$$

Top power = p

bottom power = q

When we divide different powers of the same base value, we subtract the bottom power from the top power.

Eg1) $\frac{7^{7}}{7^{3}}$ ↷ subtract $= 7^{7-3} = 7^{4}$

HW
Pg 289
Q 4

Eg2) $2^{3} \div 2^{2} = 2^{3-2} = 2$ or 2^{1}

③ Brackets to a power pg 21 log tables

$(a^p)^q$

a = base value
q and p are powers

Rule : Multiply the powers.

$a^{p \times q}$

Eg 1) $(4^2)^3 = 4^{2\times3} = 4^6$

Eg 2) $(2^4)^6 = 2^{4\times6} = 2^{24}$

(4) The power of zero.

$a^0 = 1$

Any number or letter to the power of 0 is 1

calculater

[Number] [x ▪] [0] = 1

$20^{\boxed{0}} = 1$

(5) Negative powers

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

Method: To make a power positive put 1 over the power (reciprocal) and make the power positive

Eg 1) $4^{-5} = \frac{1}{4^5}$

Eg 2) $\frac{1}{3^{-2}} = 3^2$

C/W page 289 Q6, 7, 8

NOTE: 1/number is a reciprocal

20 as a reciprocal

$$= \frac{1}{20}$$

$$20 = \frac{20}{1} = \frac{1}{20}$$

Q8 $\frac{q^7}{q^{\square}} = q^3$

$q^{7-\square} = q^3$

$7 - 4 = 3$

$\frac{3^9}{3^{\square}} = 3^1$

$9 - 8 = 1$

⑥ Fractional Indices pg 21 log tables.

$a^{1/q} = \sqrt[q]{\ }$ The power is a fraction

Eg 1 $2^{1/2} = \sqrt{2}$ The power of $1/2$ is equal to the $\sqrt{\ }$ (square root)

Eg 2) $2^{1/3} = \sqrt[3]{2}$ The power of $1/3$ is equal to the cubed root $3\sqrt{\ }$

Eg 3) $a^{1/4} = \sqrt[4]{a}$ 4th root

Q1) Rewrite using $\sqrt{\ }$ sign

Rule (7)

$a^{p/q} = \left(\sqrt[q]{a}\right)^{p}$

(1) $a^{2/3} = \left(\sqrt[3]{a}\right)^{2}$

(2) $a^{5/2}$ $\left(\sqrt{a}\right)^{5}$

(3) $a^{3/4} = \left(\sqrt[4]{a}\right)^{3}$

(4) $25^{3/2}$ $\left(\sqrt{25}\right)^{3} = (5)^{3} = 5 \times 5 \times 5 = 125.$

write as a whole number

Index form

⑧ Rule $(ab)^p = a^p b^p$

A product to a power.

Eg 1) $(3 \times 4)^2$

$3^2 \times 4^2$

$9 \times 16 = 144$

Eg 2) $(2 \times 3)^2$

$2^2 \times 3^2$

$4 \times 9 = 36$

(9) Rule $\left(\frac{a}{b}\right)^P = \frac{a^P}{b^P}$ → A quotient to a power

- put the numerator and denominator to the power.

Eg 1) Simplify

$$\left(\frac{1}{2}\right)^3 \Rightarrow \frac{1^3}{2^3} = \frac{1}{8}$$

Eg 2) $\left(\frac{2}{3}\right)^2 \Rightarrow \frac{2^2}{3^2} = \frac{4}{9}$

H W

$(ab)^p = a^p b^p$

Q1 Simplify $(abc)^3 = a^3 b^3 c^3$

Q2 Simplify $\left(\frac{4a}{5b}\right)^2 = \frac{16a^2}{25b^2}$

$a^{p/q} = (\sqrt[q]{a})^p$

Q3) Write as a whole number $27^{\frac{2}{3}}$

$(\sqrt[3]{27})^2$

$(3)^2 = 9$

Writing a number as a power/index form.

Main BASE values - prime number

① - Even numbers will be written as 2^n, $n \in \mathbb{Z}$

Eg 1) Write the following in the form 2^n, $n \in \mathbb{Z}$

① 1

$2^0 = 1$

② 8

2^3

$2 \times 2 \times 2 = 8$

③ 16

2^4

$2 \times 2 \times 2 \times 2$

④ 32

2^5

$2 \times 2 \times 2 \times 2 \times 2$

$= 32.$

(2) Powers of 3.

Write the following in the form 3^k, $k \in Z$

(1) $\frac{1}{27}$

1

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

$= 3^{-3}$

(2) 9

3^2

(3) 81

3^4

(4) $\frac{1}{3}$

$\frac{1}{3^1}$

3^{-1}

Powers of 5.

Write the following in the form 5^n, $n \in \mathbb{R}$

① $\sqrt{25}$

$(5^2)^{1/2}$

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

5^1

② $125^{\frac{2}{3}}$

$(\sqrt[3]{125})^2$

$(5)^2$

③ $\frac{5^7}{5^5}$

5^{7-5}

5^2

④ 5×5^4

5^5