

SIMPLIFICATION (SURDS & INDICES)

SURDS & LAW OF SURDS

WHAT IS SURDS?

- A **surd** is an expression that involves a root ($\sqrt{\quad}$) and cannot be simplified to a rational number.
- In other words, a surd is a number that is **irrational** and is expressed in radical form.

EXAMPLES OF SURDS

$\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, $\sqrt{7}$, $\sqrt{10}$...

$\sqrt{4} = 2$ is **NOT** a surd, because it simplifies to a rational number.

LAWS OF SURDS

1 Product Law

$$\sqrt[p]{a} \times \sqrt[p]{b} = \sqrt[p]{ab}$$

Example:

$$\sqrt{3} \times \sqrt{5} = \sqrt{15}$$

2 Quotient Law

$$\frac{\sqrt{a}}{\sqrt{b}} = \frac{\sqrt{a}}{\sqrt{b}} \quad (b > 0)$$

Example:

$$\frac{\sqrt{18}}{\sqrt{2}} = \frac{\sqrt{18}}{\sqrt{2}} = \sqrt{9} = 3$$

3 Power Law

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

(n is any integer)

Example:

$$(\sqrt{5})^2 = \sqrt{5^2} = 5$$

4 Addition Law

$$c\sqrt{a} + d\sqrt{a} = (c+d)\sqrt{a}$$

Example:

$$2\sqrt{3} + 5\sqrt{3} = (2+5)\sqrt{3} = 7\sqrt{3}$$

★ **Note:** Surds can be added or subtracted only if they are like surds (same surd part).

5 Subtraction Law

$$c\sqrt{a} - d\sqrt{a} = (c-d)\sqrt{a}$$

Example:

$$6\sqrt{2} - 3\sqrt{2} = (6-3)\sqrt{2} = 3\sqrt{2}$$

IMPORTANT NOTES

✓ $\sqrt[n]{a \times b} = \sqrt[n]{a} \times \sqrt[n]{b}$

✓ $\sqrt[n]{a \div b} = \sqrt[n]{a} \div \sqrt[n]{b}$

BUT!!

✗ $\sqrt[n]{a+b} \neq \sqrt[n]{a} + \sqrt[n]{b}$

✗ $\sqrt[n]{a-b} \neq \sqrt[n]{a} - \sqrt[n]{b}$

! Surds cannot be added or subtracted unless they are like surds.

INDICES AND LAW OF INDICES



WHAT IS INDICES?

Indices (or ^{Power} exponents) show how many times a number (the base) is multiplied by itself.

$$a^n$$

← Index/Exponent/Power
↑ Base

Example:

$$2^3 = 2 \times 2 \times 2 = 8$$

(2 is the base, 3 is the index)

LAW OF INDICES

Let a and b be non-zero real numbers and m, n be integers.

- | | | | |
|----------|---------------------------------------|--|--|
| 1 | Product of Powers (Same Base) | $a^m \times a^n = a^{m+n}$ | Example:
$2^3 \times 2^4 = 2^{3+4} = 2^7$ |
| 2 | Quotient of Powers (Same Base) | $\frac{a^m}{a^n} = a^{m-n}$
<small>($a \neq 0$)</small> | Example:
$2^5 \div 2^2 = 2^{5-2} = 2^3$ |
| 3 | Power of a Power | $(a^m)^n = a^{mn}$ | Example:
$(3^2)^4 = 3^{2 \times 4} = 3^8$ |
| 4 | Power of a Product | $(ab)^n = a^n b^n$ | Example:
$(2 \times 3)^4 = 2^4 \times 3^4$ |
| 5 | Power of a Quotient | $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
<small>($b \neq 0$)</small> | Example:
$\left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3}$ |
| 6 | Zero Index | $a^0 = 1$
<small>($a \neq 0$)</small> | Example:
$5^0 = 1$ $5^1 = 5$ |
| 7 | Negative Index | $a^{-n} = \frac{1}{a^n}$
<small>($a \neq 0$)</small> | Example:
$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$ ✓ |

Q 1. If $5^7 + 5^7 + 5^7 + 5^7 + 5^7 = 5^y$ then find the value of y .

$5^7 + 5^7 + 5^7 + 5^7 + 5^7 = 5^y$ எனில் y ன் மதிப்பு

(A) 5

(B) 7

(C) 8

(D) 9

(E) Answer not known / விடை தெரியவில்லை

$$5(5^7) = 5^y$$

$$5^8 = 5^y$$

$$8 = y$$



Q 2. $2^{40} + 2^{40}$ is equal to _____

$2^{40} + 2^{40}$ - ன் மதிப்பு

(A) 4^{40}

(B) 2^{80}

(C) 2^{41}

(D) 4^{80}

(E) Answer not known / விடை தெரியவில்லை

$$2(2^{40}) = 2^{41}$$

We Shine Academy™

Guiding you to get through

Q 3. Simplify: (சுருக்குக.)

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

(A) 1/m

(B) m

(C) 1

(D) $m^{(a+b+c)}$

(E) Answer not known / விடை தெரியவில்லை

$$\left(\frac{m^a}{m^b}\right)^{(a+b)} = \left(m^{(a-b)}\right)^{(a+b)} = m^{(a-b)(a+b)} = m^{(a^2-b^2)}$$

$$\left(\frac{m^b}{m^c}\right)^{b+c} = m^{b^2-c^2}$$

$$\left(\frac{m^c}{m^a}\right)^{c+a} = m^{c^2-a^2}$$

$$= m^{a^2-b^2} \times m^{b^2-c^2} \times m^{c^2-a^2} \times \frac{1}{m}$$

$$= m^{[a^2-b^2+b^2-c^2+c^2-a^2]} \times \frac{1}{m}$$

$$= m^0 \times \frac{1}{m}$$

$$\therefore 1 \times \frac{1}{m} = \frac{1}{m}$$

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

11/2

Q 4. If $A = 2^{65}$ and $B = 2^{64} + 2^{63} + 2^{62} + \dots + 2^0$, which of the following is true?

$A = 2^{65}$ மற்றும் $B = 2^{64} + 2^{63} + 2^{62} + \dots + 2^0$ எனக்

கொடுக்கப்பட்டுள்ளது. பின்வருவனவற்றில் எது உண்மை?

- (A) B is larger than A by 1 / B ஆனது A-ஐ விட 1 அதிகம்
 (B) B is 2^{64} more than A / B ஆனது A-ஐ விட 2^{64} அதிகம்
 (C) A and B are equal / A மற்றும் B சமம்
 (D) A is larger than B by 1 / A ஆனது B-ஐ விட 1 அதிகம்
 (E) Answer not known / விடை தெரியவில்லை

$$B = 2^{64} + 2^{63} + \dots + 2^0$$

$$= 1 + 2 + 4 + \dots + 2^{64}$$

$$r = \frac{2}{1} = 2, \quad a = 1, \quad n = 65$$

$$S_n = \frac{a(r^n - 1)}{r - 1} = \frac{1(2^{65} - 1)}{2 - 1}$$

$$B = 2^{65} - 1$$

$$B = A - 1$$

$$\boxed{B + 1 = A}$$

Q 5. Simplify: சுருக்குக.

$$\frac{(14p^3q^3)}{(2p^2q)} - \frac{(12p^3q^4)}{(3q^2)}$$

(A) $11p^3q^2$

(B) $3p^6q^4$

(C) $3p^3q^2$

(D) $11p^6q^4$

(E) Answer not known / விடை தெரியவில்லை

$$= 7p^3q^2 - 4p^3q^2$$

$$= p^3q^2(7-4)$$

$$= 3p^3q^2$$



Q 6. If $\left(\frac{p}{q}\right)^{(1-3x)} = \left(\frac{q}{p}\right)^{\left(\frac{1}{2}\right)}$ then find the value of x.

$\left(\frac{p}{q}\right)^{(1-3x)} = \left(\frac{q}{p}\right)^{\left(\frac{1}{2}\right)}$ எனில் X-ன் மதிப்பு காண்க.

- (A) 4^{-1}
- (B) 3^{-1}
- ✓ (C) 2^{-1}
- (D) 1^{-1}
- (E) Answer not known / விடை தெரியவில்லை

$$\left(\frac{p}{q}\right)^{(1-3x)} = \frac{1}{\left(\frac{q}{p}\right)^{\frac{1}{2}}}$$

$$\left(\frac{p}{q}\right)^{(1-3x)} = \left(\frac{p}{q}\right)^{-\frac{1}{2}}$$

$$1-3x = -\frac{1}{2}$$

$$1 + \frac{1}{2} = 3x$$

$$\frac{3}{2} = 3x$$

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

$$\boxed{2^{-1} = x}$$

Guiding you to get through



Q 7. What is half of 2^{10} ?

2^{10} இல் பாதி எவ்வளவு?

$$= \frac{2^{10}}{2} = 2^{10-1} = 2^9$$

(A) 2^5

(B) 2^6

(C) 2^9

(D) 2^8

(E) Answer not known / விடை தெரியவில்லை

We Shine AcademyTM

Guiding you to get through



Q 8. The solution of $(2x - 1)^2 = 9$ is equal to

$(2x - 1)^2 = 9$ என்ற சமன்பாட்டின் தீர்வு

(A) -1

(B) 2

(C) -1, 2

(D) 1, 2

(E) Answer not known / விடை தெரியவில்லை

$$\sqrt{a} = \pm$$
$$\sqrt{4} = \pm 2$$

$$(2x-1)^2 = 9$$

$$2x-1 = \sqrt{9}$$

$$2x-1 = \pm 3$$

$$2x-1 = 3$$

$$2x = 4$$

$$x = 2$$

$$2x-1 = -3$$

$$2x = -3+1$$

$$2x = -2$$

$$x = -1$$

Q 9. P^0 is equal to

P^0 க்கு சமமானது

(A) 0

(B) 1

(C) -1

(D) P





1

Q 10. Simplify: $(4^{-1} + 4^{-2} + 4^{-3})^0 \times (4^{-1} + 4^{-2} + 4^{-3})^1$

சுருக்குக: $(4^{-1} + 4^{-2} + 4^{-3})^0 \times (4^{-1} + 4^{-2} + 4^{-3})^1$

(A) 63/19

(B) 19/63

(C) 21/64

(D) 64/21

(E) Answer not known / விடை தெரியவில்லை

$$1 \times \left[\frac{1}{4} + \frac{1}{4^2} + \frac{1}{4^3} \right]^1$$

$$\frac{1}{4} + \frac{1}{16} + \frac{1}{64}$$

$$\frac{16 + 4 + 1}{64} = \frac{21}{64}$$

Q 11. The algebraic statement for '5 less than 2 times p'

'p' ன் 2 மடங்கில் 5 குறைவு என்பதற்கான இயற்கணித கூற்று.

→ $2p - 5$ ✓

(A) $5p - 2$

✓ (B) $2p - 5$

(C) $2 - 5p$

(D) $5 - 2p$

(E) Answer not known / விடை தெரியவில்லை

$5 - 2p$ X

We Shine Academy™

Guiding you to get through



Q 12. Find x such that $3^{(x+2)} = 3^x + 216$

216

X-ன் மதிப்பு காண்க: $3^{(x+2)} = 3^x + 216$

(A) 3

$$3^{(x+2)} = 3^x + 216$$

(B) 4

$$3^x \cdot 3^2 = 3^x + 216$$

(C) 5

$$9(3^x) - 3^x = 216$$

(D) 6

$$8(3^x) = 216$$

(E) Answer not known / விடை தெரியவில்லை

$$(3^x) = \frac{216}{8}$$

$$\begin{array}{r} 3 \overline{)216} \\ \underline{9} \\ 3 \\ \underline{3} \\ 0 \end{array}$$

$$3^x = 27$$

$$3^x = 3^3$$

$$\boxed{x=3}$$

Guiding you to get through



Q 13. Simplify $(72)^5 \div (12)^5 \times (3)^5$

சுருக்குக: $(72)^5 \div (12)^5 \times (3)^5$

(A) 18^5

(B) 5^{18}

(C) 6^5

(D) 3^5

(E) Answer not known / விடை தெரியவில்லை

$$= \frac{(72)^5}{(12)^5} \times (3)^5$$

$$= \left(\frac{72}{12}\right)^5 \times (3)^5$$

$$= 6^5 \times 3^5$$

$$= (6 \times 3)^5$$

$$= 18^5$$

