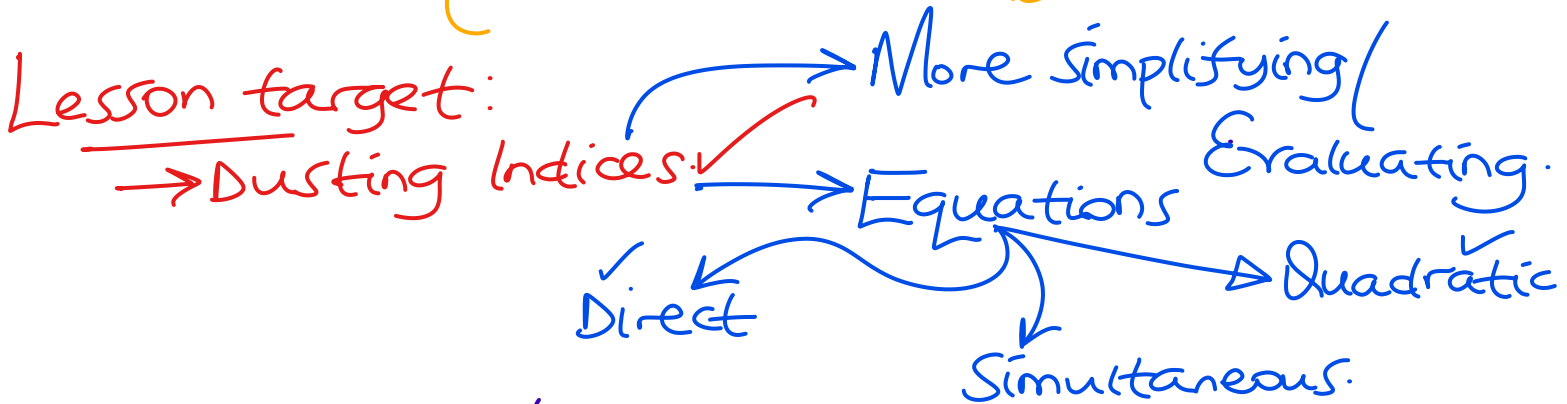


SCIENCE SCHOLARS ACADEMY

INDICES

{ Part 2 - Last part }

Lesson target:



→ Research / Assignment ✓

→ Next stop ✓ { Logarithms } → ✓

HANDS-ON: Evaluate

$$\begin{aligned} (1). & (0.125)^{\frac{1}{3}} \times (2.5)^{-2} \div (0.4)^3 \\ &= \left(\frac{125}{1000}\right)^{\frac{1}{3}} \times \left(\frac{25}{10}\right)^{-2} \div \left(\frac{4}{10}\right)^3 \\ &= \left(\frac{5}{10}\right)^{\frac{1}{3}} \times \left(\frac{5}{2}\right)^{-2} \times \left(\frac{5}{2}\right)^3 \\ &= \frac{5}{10} \times \left(\frac{5}{2}\right)^{-2+3} \end{aligned}$$

$$\frac{1}{2} \times \frac{5}{2} \rightarrow \left(\frac{5}{4}\right) \checkmark$$

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Qn 2: Evaluate;

$$\begin{aligned}
 & 2^4 \left(16 \right)^{\frac{1}{2}} + 64^{\frac{1}{3}} + \left(\frac{8}{125} \right)^{\frac{2}{3}} \\
 & \rightarrow 2^2 + 2^{-2} + \frac{2^2}{5^2} \\
 & \rightarrow 2^2 + \frac{1}{2^2} + \frac{2^2}{5^2} \rightarrow \frac{4}{1} + \frac{1}{4} + \frac{4}{25} \\
 & \rightarrow \frac{400 + 25 + 16}{100} \\
 & \rightarrow \frac{441}{100}
 \end{aligned}$$

Qn 3:

Simplify;

$$\frac{(12)^{\frac{3}{2}} \times (27)^{\frac{1}{6}}}{(18)^{\frac{1}{2}} \times (16)^{\frac{1}{8}}}$$

Note:

$$(a \times b)^n = a^n \times b^n$$

$$\begin{aligned}
 & = \frac{(2^2 \times 3)^{\frac{3}{2}} \times (3^3)^{\frac{1}{6}}}{(2 \times 3^2)^{\frac{1}{2}} \times (2^4)^{\frac{1}{8}}} \\
 & \rightarrow \frac{2^3 \times 3^{\frac{3}{2}} \times 3^{\frac{1}{2}}}{2^2 \times 3^1 \times 2^{\frac{1}{2}}} \rightarrow \frac{2^3 \times 3^2}{2^1 \times 3^1} \rightarrow \left(\frac{2^3}{2^1} \right) \times \left(\frac{3^2}{3^1} \right)
 \end{aligned}$$

$$\rightarrow \frac{2^3 \times 3^2}{2^1 \times 3^1} \rightarrow \left(\frac{2^3}{2^1} \right) \times \left(\frac{3^2}{3^1} \right)$$

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$$\rightarrow 2^2 \times 3^1 \rightarrow \frac{12}{\underline{\underline{12}}}$$

(4). Simplify
$$\frac{(x^{1/2} - x^{-1/2})(x^{3/2} + x^{1/2})}{(x^{3/2} - x^{1/2})^2}$$

Note: $(a+b)(x+y) = ax + ay + bx + by$ ✓

$$(a+b)^2 = (a+b)(a+b) \rightarrow a^2 + b^2 + 2ab \quad \checkmark$$

$$(x+y)^2 = x^2 + y^2 + 2xy \quad \checkmark$$

$$(p^2 + 2q)^2 = p^4 + 4q^2 + 4qp^2 \quad \checkmark$$

$$(x^4 + y^{-2})^2 = x^8 + y^{-4} + 2x^4y^{-2} \quad \checkmark$$

$$(x-y)^2 = x^2 + y^2 - 2xy \quad \checkmark$$

$$(a^3 - 3b)^2 = a^6 + 9b^2 - 6a^3b \quad \checkmark$$

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$$\frac{(x^{\frac{1}{2}} - x^{-\frac{1}{2}})(x^{\frac{3}{2}} + x^{\frac{1}{2}})}{(x^{\frac{3}{2}} - x^{\frac{1}{2}})^2} = \frac{x^2 + x^1 - x^1 - x^0}{x^3 + x^1 - 2x^2} \checkmark$$

$$\frac{x^2 - 1}{x(x^2 - 2x + 1)} = \frac{x^2 - 1}{x^3 - 2x^2 + x} \checkmark$$

$x(x^2 - 2x + 1)$
 ↑ pdt → 1
 ↓ sum → -2
 factors → $\{-1, -1\}$ ✓ replace the sum.

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

$$a^2 - b^2 = (a+b)(a-b) \checkmark$$

$$x^2 - y^2 = (x+y)(x-y)$$

$$x^4 - y^4 = (x^2)^2 - (y^2)^2 = (x^2 + y^2)(x^2 - y^2)$$

$$a^6 - b^6 = (a^3)^2 - (b^3)^2 = (a^3 + b^3)(a^3 - b^3)$$

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

$$\frac{x^2 - 1}{x(x^2 - 2x + 1)} = \frac{(x+1)(x-1)}{x(x-1)(x-1)} = \frac{x+1}{x(x-1)} \checkmark$$

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EQUATIONS: ✓

→ Rule of equality!

(1). If $a^b = a^c$, then $b = c$ ✓

(2). If $a^x = b^x$, then $a = b$ ✓

EXAMPLES:

(a). $2^{4x} = 128$ →

$2^{4x} = 2^7 \rightarrow 4x = 7 \rightarrow x = 7/4$ ✓

(b). $(0.2)^{3/4} = \left(\frac{1}{25}\right)^{-x}$

$\left(\frac{1}{5}\right)^{3/4} = \left(\frac{1}{5^2}\right)^{-x}$ →

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$$\rightarrow 4^{2x} - 4^{x+1} + 4 = 0$$

$$\rightarrow (4^x)^2 - (4^x)(4^1) + 4 = 0$$

Let; $4^x = y$

$$\rightarrow y^2 - 4y + 4 = 0$$

$$\rightarrow y^2 - 2y - 2y + 4 = 0$$

$$\rightarrow y(y-2) - 2(y-2) = 0 \quad \checkmark$$

$$(y-2)(y-2) = 0 \quad \checkmark$$

$$(y-2)^2 = 0$$

$$y-2 = 0$$

$$\underline{y = 2} \quad \checkmark$$

But $4^x = y$

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for $y = 2$, $4^x = 2 \rightarrow \checkmark$

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$$4^x = 2$$

$$2^{2x} = 2^1$$

$$2x = 1$$

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

Assignment: Solve for x.

$$(1). 9^x - 3^{(x+1)} = 10$$

$$\begin{cases} x = 1.465 \\ x = \text{undefined} \end{cases}$$

$$(2). 2(9^x) - 5(3^x) + 2 = 0$$

$$\begin{cases} x = 0.631 \\ x = -0.631 \end{cases}$$

$$(3). 4^x - 2^{x+1} - 15 = 0$$

$$\begin{cases} x = 2.322 \\ x \text{ is undefined} \end{cases}$$

$$(4). 2^{2x-1} + \frac{3}{2} = 2^{x+1}$$

$$\begin{cases} x = 0 \\ x = 1.585 \end{cases}$$

$$(5). 3(3^{2x}) + 2(3^x) - 1 = 0$$

→ DONE below.

END

Hint: $\rightarrow 9^x = 3^{2x} = (3^x)^2$

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TASK: Attempt the first 4 Equations ✓

TOGETHER → No. 5

$$3(3^{2x}) + 2(3^x) - 1 = 0$$

$$3(3^x)^2 + 2(3^x) - 1 = 0$$

Let $3^x = y$

$$\boxed{3y^2} + 2y - \boxed{1} = 0$$

sum = 2

$$\{-1, 3\}$$

$$pdt = -3$$

$$-1 \times 3 = -3$$

$$1 \times -3 = -3$$

$$3y^2 + 3y - y - 1 = 0$$

$$3y(y+1) - 1(y+1) = 0$$

$$(3y-1)(y+1) = 0$$

Either; $3y-1=0$.

OR

$$y+1=0$$

$$y = -1 \checkmark$$

for $y = \frac{1}{3}$

$$y = \frac{1}{3} \checkmark$$

But $3^x = y$

for $y = -1$

$$3^x = -1 \checkmark$$

→ x is undefined

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

$$\log 3^x = \log\left(\frac{1}{3}\right)$$

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$$x \log 3 = \log\left(\frac{1}{3}\right)$$

$$x = \frac{\log\left(\frac{1}{3}\right)}{\log 3}$$

$$x = -1 \checkmark$$

$$x = \frac{\log\left(\frac{1}{3}\right)}{\log 3} = -1 \checkmark$$

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$$\rightarrow (x^{\frac{1}{5}})^5 = 3^5 \rightarrow x = 243 \checkmark$$

$$\rightarrow (x^{\frac{4}{3}})^{\frac{3}{4}} = 81^{\frac{3}{4}} \rightarrow x = 3^{4 \times \frac{3}{4}} = 3^3 = \underline{27} \checkmark$$

$$\rightarrow (2x^{\frac{3}{4}})^4 = (x^{\frac{1}{2}})^4 \rightarrow 16x^3 = x^2$$

$$16x^3 - x^2 = 0$$

$$x^2(16x - 1) = 0$$

$$x^2 = 0$$

$$\underline{x = 0} \checkmark$$

$$16x - 1 = 0$$

$$x = \frac{1}{16} \checkmark$$

$$\rightarrow \underline{x^{\frac{1}{3}} - 3 = 28x^{-\frac{1}{3}}}$$

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

$$x^{\frac{1}{3}} - 3 = \frac{28}{x^{\frac{1}{3}}} \rightarrow y$$

$$yxy - 3xy = \frac{28xy}{y} \rightarrow y^2 - 3y = 28$$

$$\rightarrow y^2 - 3y - 28 = 0$$

$$\text{Sum} = -3, \text{Pdt} = -28 \quad \{4, -7\}$$

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$$y^2 + 4y - 7y - 28 = 0$$

$$y(y+4) - 7(y+4) = 0$$

$$(y-7)(y+4) = 0$$

$$y = 7 \quad \text{or} \quad y = -4$$

$$y = 7$$

$$\text{But } x^{\frac{1}{3}} = y$$

$$\text{for } y = 7 \\ (x^{\frac{1}{3}})^3 = 7^3$$

$$x = 343 \checkmark$$

$$\text{for } y = -4 \\ (x^{\frac{1}{3}})^3 = (-4)^3$$

$$x = -64 \checkmark$$

Research: (Simultaneous)

$$(1). \quad 2^x + 4^y = 12, \quad 3(2^x) - 2(2^{2y}) = 16$$

$$(2). \quad (27)^{x+y} = 9^{x-y}, \quad 2^{x^2-y^2} = 64$$

Qn: find x & y .

END

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