# Indicial Equations

This is an equation that has a variable in the equation being power of indices.

Solve the following equations

(i) $2^x = 16$

(ii) $3^x = 27$

(iii) $4^x = 32$

(iv) $9^{x-2} = 243$

(v) $4^{x+1} = 1/32$

(vi) $2.5^{x-2} = \sqrt{50/8}$

(vii) $100^{x-2} = 0.00001$

(viii) $1.2^{x-2} = 1.728$

(ix) $0.2^{x+1} = 625$

(x) $81^{x-1} = 1/729$

Solution

(1)

$2^x = 16$

$2^x = 2^4$

Equating powers

$x = 4$

(2)

$3^x = 27$

$3^x = 3^3$

Equating powers

$x = 3$ //

(3)

$4^x = 32$

$(2^2)^x = 2^5$

$2^{2x} = 2^5$

$2x = 5$

$x = 5/2$

(4)

$9^{x-2} = 243$

$3^{2(x-2)} = 3^5$

$2x - 4 = 5$

$2x = 5 + 4$

$2x = 9$

$x = 9/2$

(5)

$4^{x+1} = 1/32$

$2^{2(x+1)} = 1/2^5$

$2^{2x+2} = 2^{-5}$

$2x + 2 = -5$

$2x = -5 - 2$

$2x = -7$

$x = -7/2$ //

(6)

$2.5^{x-2} = \sqrt{50/8}$

$2.5^{x-2} = \sqrt{25/4}$

$\left(\frac{5}{2}\right)^{x-2} = \left(\frac{5}{2}\right)$

Equating powers

$x - 2 = 1$

$x = 1 + 2$

$x = 3$ //

⑦

$100^{x-2} = 0.00001$

$100^{x-2} = 10^{-5}$

$10^{2(x-2)} = 10^{-5}$

$2x - 4 = -5$

$2x = -5 + 4$

$2x = -1$

$x = -1/2$ //

⑧

$1.2^{x-2} = 1.728$

$1.2^{x-2} = 1.2^3$

Equating powers

$x - 2 = 3$

$x = 3 + 2$

$x = 5$ //

⑨

$0.2^{x+1} = 625$

$\left(\frac{1}{5}\right)^{x+1} = 5^4$

$\left(5^{-1}\right)^{x+1} = 5^4$

Equating powers

$-1(x+1) = 4$

$-x - 1 = 4$

$-x = 4 + 1$

$-x = 5$

$x = -5$ //

⑩

$81^{x-1} = 1/729$

$3^{4(x-1)} = 1/3^6$

$3^{4x-4} = 3^{-6}$

$4x - 4 = -6$

$4x = -6 + 4$

$4x = -2$

$x = -2/4$

$x = -1/2$

INDICIAL EQUATION LEADING TO SIMULTANEOUS EQUATION

① $2^x \times 4^y = 32$

$3^x \times 3^y = 27$

② $\frac{4^{2x}}{8^y} = 2$

$5^{3x} \times 5^y = 625$

③ $\frac{2^{2x+1}}{4^y} = 1/32$

$3^{x+1} \times 3^y = 1$

①

$2^x \times 4^y = 32$

$2^x \times 2^{2y} = 2^5$

$2^{x+2y} = 2^5$

$x + 2y = 5$ —— (i)

$3^x \times 3^y = 27$

$3^{x+y} = 3^3$

$x + y = 3$ —— (ii)

$x + 2y = 5$

$x + y = 3$

$y = 2$

Substitute $y = 2$ in eqn (i)

$x + 2(2) = 5$

$x = 5 - 4$

$x = 1$ //

②

$$\frac{4^{2x}}{8^{y}} = 2$$

$$5^{3x} \times 5^{y} = 625$$

$$\frac{2^{2(2x)}}{2^{3(y)}} = 2$$

$$\frac{2^{4x}}{2^{3y}} = 2^{1}$$

$$2^{4x-3y} = 2^{1}$$

$4x - 3y = 1$ —— (i) × 1

$$5^{3x} \times 5^{y} = 625$$

$$5^{3x+y} = 5^{4}$$

$3x + y = 4$ —— (ii) × 3

$$4x - 3y = 1$$
$$9x + 3y = 12$$

Adding, $13x = 13$

$x = 1$

Substitute $x = 1$ in equation (ii)

$3(1) + y = 4$

$3 + y = 4$

$y = 4 - 3$

$y = 1$

$x = 1, y = 1$

③

$$\frac{2^{2x+1}}{4^{y}} = 1/32$$

$$3^{x+1} \times 3^{y} = 1$$

$$2^{2x+1-2y} = 1/2^{5}$$

$$2^{2x+1-2y} = 2^{-5}$$

$2x - 2y = -5 - 1$

$2x - 2y = -6$

$x - y = -3$ —— (i)

$$3^{x+1} \times 3^{y} = 1$$

$$3^{x+1+y} = 3^{0}$$

$x + 1 + y = 0$

$x + y = -1$ —— (ii)

$$x - y = -3$$
$$x + y = -1$$

$2x = -4$

$x = -2$

Substitute $x = -2$ in equation (ii)

$x + y = -1$

$-2 + y = -1$

$y = -1 + 2$

$y = 1$

$x = -2, y = 1$

Solve $3^{2x} - 3^{x+1} + 2 = 0$
Correct to two significant figures

solution

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

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

let $p = 3^x$

$p^2 - p \times 3 + 2 = 0$

$p^2 - 3p + 2 = 0$

$2p^2$

$-p \quad -2p$

$p^2 - p - 2p + 2 = 0$

$p(p-1) - 2(p-1) = 0$

$p - 2 = 0$ or $p - 1 = 0$

$p = 2$ or $p = 1$

recall, $3^x = p$

$3^x = 2$ or $3^x = 1$

$\log 3^x = \log 2$ or $3^x = 3^0$

$x \log 3 = \log 2$ or $3^x = 3^0$

$x = \frac{\log 2}{\log 3}$ or $x = 0$

$x = \frac{0.3010}{0.4771}$

$x = 0.6309$ or $x = 0$

$x \approx 0.63$ or $x = 0$

Find, Correct to one decimal place the values of $x$ for which

$3^{2x} - 3^{(x+2)} + 8 = 0$

solution

$3^{2x} - 3^{x+2} + 8 = 0$

$(3^x)^2 - 3^x \times 3^2 + 8 = 0$

let $p = 3^x$

$p^2 - 9p + 8 = 0$

$8p^2$

$-8p \quad -p$

$p^2 - 8p - p + 8 = 0$

$p(p-8) - 1(p-8) = 0$

$(p-1)(p-8) = 0$

$p = 1$ or $p = 8$

recall, $3^x = p$

$3^x = 1$ or $3^x = 8$

$3^x = 3^0$ $\quad 3^x = 8$

$x = 0$ $\quad \log 3^x = \log 8$

$x \log 3 = \log 8$

$x = \frac{\log 8}{\log 3}$

$= \frac{0.9031}{0.4771}$

$= 1.893$

$x = 0, x = 1.893$

$x = 0, x = 1.9$