

## Simplifying + Solving Using Laws of Exponents

$$\begin{aligned} \text{(1) A)} \quad 4^{-2} &= \frac{1}{4^2} \\ &= \frac{1}{16} \end{aligned}$$

$$\begin{aligned} \text{B)} \quad \left(\frac{2}{5}\right)^{-3} &= \left(\frac{5}{2}\right)^3 \\ &= \frac{125}{8} \end{aligned}$$

$$\begin{aligned} \text{C)} \quad 32^{-2} &= \frac{1}{32^2} \\ &= \frac{1}{1024} \end{aligned}$$

$$\begin{aligned} \text{D)} \quad \left(\frac{1}{8}\right)^{-3} &= 8^3 \\ &= 512 \end{aligned}$$

$$\begin{aligned} \text{(3) A)} \quad 3^{-2} &= \frac{1}{9} \\ \text{B)} \quad (-2)^2 + \left(\frac{1}{7}\right)^{-2} \end{aligned}$$

$$\text{B)} \quad 5^0 = 1$$

$$\text{(c)} \quad (-2)^0 = 1$$

$$\begin{aligned} &= 1 + 7^2 \\ &= 1 + 49 \\ &= 50 \end{aligned}$$

$$\text{D)} \quad \left(\frac{1}{4}\right)^{-1} = 4$$

$$\text{E)} \quad \left(\frac{2}{5}\right)^{-2} = \left(\frac{5}{2}\right)^2 = \frac{25}{4}$$

$$\text{F)} \quad -3^0 = -1$$

$$\text{G)} \quad \left(\frac{-5}{7}\right)^0 = 1$$

$$\text{H)} \quad \frac{1}{4^{-2}} = 4^2 = 16$$

$$\text{I)} \quad (-6)^{-2} = \frac{1}{(-6)^2} = \frac{1}{36}$$

$$\text{J)} \quad -6^{-2} = \frac{1}{-6^2} = -\frac{1}{36}$$

$$\textcircled{2} \text{ A) } (-2)^0 + \left(\frac{1}{7}\right)^{-2}$$

$$= 1 + 7^2$$

$$= 1 + 49$$

$$= 50$$

$$\text{B) } 4^{-2} - 8^0 + 4^{-1}$$

$$= \frac{1}{16} - 1 + \frac{1}{4}$$

$$= \frac{1}{16} - \frac{16}{16} + \frac{4}{16} = \frac{-11}{16}$$

$$\text{C) } \left(\frac{4}{5}\right)^{-1} - 2^{-2}$$

$$= \frac{5}{4} - \frac{1}{2} = \frac{5}{4} - \frac{2}{4}$$

$$= \frac{3}{4}$$

$$\textcircled{4} \text{ A) } (y^{-2} + x^{-1})^{-2}$$

$$= \left(\frac{1}{y^2} + \frac{1}{x}\right)^{-2}$$

$$= \left(\frac{x + y^2}{xy^2}\right)^{-2}$$

$$= \left(\frac{xy^2}{x + y^2}\right)^2$$

$$= \frac{x^2 y^4}{x^2 + 2xy^2 + y^4}$$

$$\text{B) } (2y^2 + 3x^{-1})^{-1}$$

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

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

$$= \frac{x}{2xy^2 + 3}$$

$$\textcircled{4} \text{C) } ((3^{-1}y^{-2} + 4x^{-2})^{-3})^0 \\ = 1$$

$$\text{D) } (3^{-2} + 2^{-2}) \div (3^{-1} - 2^{-1})$$

$$= \left(\frac{1}{9} + \frac{1}{4}\right) \div \left(\frac{1}{3} - \frac{1}{2}\right)$$

$$= \left(\frac{13}{36}\right) \div \left(-\frac{1}{6}\right) = \frac{13}{36} \times \frac{6}{-1}$$

$$= -\frac{13}{6}$$

$$\textcircled{5} \text{A) } (2x^{\frac{1}{2}})(2x^{-\frac{1}{2}})$$

$$= 4x^0$$

$$= 4$$

$$\text{B) } (4x^{\frac{3}{2}}) \div (2x^{\frac{1}{2}})$$

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

$$= 2x$$

$$\text{C) } (a^0)^{10}$$

$$= a^0$$

$$= 1$$

$$\text{D) } (a^{\frac{2}{3}})^{-\frac{3}{2}}$$

$$= a^{-1}$$

$$= \frac{1}{a}$$

$$\text{E) } [(3^n)(3^{n+2})][(3^{2-n})(2^{n-4})]$$

$$= (3^{n+4})(2^{n-4})$$

$$(6) A) 4^{5x+1} = 4^{11}$$

$$5x+1 = 11$$

$$5x = 10$$

$$\boxed{x = 2}$$

$$B) 9^x = 3$$

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

$$2x = 1$$

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

$$C) 4^{9x-2} = 256$$

$$(2^2)^{9x-2} = 2^8$$

$$18x-4 = 8$$

$$18x = 12$$

$$x = \frac{12}{18}$$

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

$$D) 23^{4x-2} = \frac{1}{23^{2x}}$$

$$23^{4x-2} = 23^{-2x}$$

$$4x-2 = -2x$$

$$6x = 12$$

$$\boxed{x = 2}$$

$$E) 25^{3x-1} = 5^{4-7x}$$

$$(5^2)^{3x-1} = 5^{4-7x}$$

$$6x-2 = 4-7x$$

$$13x = 6$$

$$\boxed{x = \frac{6}{13}}$$

$$F) 5^{8x+17} = \frac{1}{125}$$

$$5^{8x+17} = 5^{-3}$$

$$8x+17 = -3$$

$$8x = -20$$

$$x = \frac{-20}{8}$$

$$\boxed{x = \frac{-5}{2}}$$

$$\textcircled{G} \quad \frac{1}{81^{2x}} = 9^{12-5x}$$

$$(3^{-4})^{2x} = (3^2)^{12-5x}$$

$$-8x = 26 - 10x$$

$$2x = 26$$

$$\boxed{x = 13}$$

$$\text{H) } 4^{5-9x} = \frac{1}{8^{x-2}}$$

$$(2^2)^{5-9x} = (2 \cdot 3)^{x-2}$$

$$10 - 18x = -3x + 6$$

$$4 = 15x$$

$$\boxed{\frac{4}{15} = x}$$

$$\text{I) } 8(2^x) = 128$$

$$2^x = 16$$

$$2^x = 2^4$$

$$\boxed{x = 4}$$

$$\text{J) } 4^{2x-3} - 9 = 55$$

$$4^{2x-3} = 64$$

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

$$2x - 3 = 3$$

$$\boxed{x = 3}$$

$$\text{K) } 9^{2x+1} = 81(27^x)$$

$$(3^2)^{2x+1} = (3^4)(3^{3x})$$

$$4(x+1) = 4 + 3x$$

$$\boxed{x = 2}$$

$$\text{L) } \left(\frac{4}{9}\right)^{x+1} = \left(\frac{27}{8}\right)^{x+6}$$

$$\left(\frac{3^{-2}}{2^{-2}}\right)^{x+1} = \left(\frac{3^3}{2^3}\right)^{x+6}$$

$$\left(\frac{3}{2}\right)^{-2x-2} = \left(\frac{3}{2}\right)^{3x+18}$$

$$-2x - 2 = 3x + 18$$

b16

$$-5x = 20$$

$$\boxed{x = -4}$$

$$7) A) 4^x - 6(2^x) + 8 = 0$$

$$2^{2x} - 6(2^x) + 8 = 0$$

$$\text{Let } a = 2^x$$

$$a^2 - 6a + 8 = 0$$

$$(a-2)(a-4) = 0$$

$$a = 2 \quad a = 4$$

$$2^x = 2 \quad 2^x = 4$$

$$\boxed{x=1}$$

$$\boxed{x=2}$$

$$B) 4^y - (2^y) - 2 = 0$$

$$2^{2x} - 2^x - 2 = 0$$

$$\text{Let } a = 2^x$$

$$a^2 - a - 2 = 0$$

$$(a-2)(a+1) = 0$$

$$2^x = 2 \quad 2^x = -1$$

no solution

$$\boxed{x=1}$$

$$C) 9^y - 12(3^y) + 27 = 0$$

$$3^{2x} - 12(3^x) + 27 = 0$$

$$\text{Let } a = 3^x$$

$$a^2 - 12a + 27 = 0$$

$$(a-9)(a-3) = 0$$

$$a = 9 \quad a = 3$$

$$3^x = 9 \quad 3^x = 3$$

$$\boxed{x=2}$$

$$\boxed{x=1}$$

$$D) 25^x - 23(5^x) - 50 = 0$$

$$5^{2x} - 23(5^x) - 50 = 0$$

$$\text{Let } a = 5^x$$

$$a^2 - 23a - 50 = 0$$

$$(a-25)(a+2) = 0$$

$$a = 25 \quad a = -2$$

$$5^x = 25$$

$$5^x = -2$$

no solution

$$\boxed{x=2}$$

$$E) 49^x + 1 = 2(7^x)$$

$$7^{2x} - 2(7^x) + 1 = 0$$

$$\text{Let } a = 7^x$$

$$a^2 - 2a + 1 = 0$$

$$(a-1)(a-1) = 0$$

$$a = 1$$

$$7^x = 1$$

$$\boxed{x=0}$$

