

$$\textcircled{1} \begin{aligned} 2^3 &= 2x+1 \\ 2x+1 &= 8 \\ x &= \frac{7}{2} \end{aligned}$$

$$\textcircled{2} \begin{aligned} 3x-2 &= 9 \\ 3x &= 11 \\ x &= \frac{11}{3} \end{aligned}$$

$$\textcircled{3} \begin{aligned} x^2+1 &= 3^2 \\ x^2+1 &= 9 \\ x^2 &= 8 \\ x &= \pm 2\sqrt{2} \end{aligned}$$

$$\textcircled{4} \begin{aligned} 5^2 &= x^2+x+4 \\ x^2+x-21 &= 0 \\ -1 \pm \sqrt{1^2-4(21)} \end{aligned}$$

$$\textcircled{5} \begin{aligned} \log_3 \sqrt{x} &= \log_3 2^2 \\ \sqrt{x} &= 2^2 \\ x &= 2^4 = 16 \end{aligned}$$

$$-1 \pm \sqrt{85} \text{ both work!}$$

$$\textcircled{6} \begin{aligned} \log_4 x^2 &= \log_4 9 \\ \frac{1}{x^2} &= 9 \\ 9x^2 &= \frac{1}{9} \end{aligned}$$

$$\textcircled{7} \begin{aligned} \log_5 x^2 &= \log_5 4^3 \\ \sqrt{x^2} &= \sqrt[3]{4^3} \\ x &= \pm 8 \end{aligned}$$

-8 does not work!

$$x^2 = \frac{1}{9} \quad x = \pm \frac{1}{3}$$

~~$x = -\frac{1}{3}$~~ , $\frac{1}{3}$

$$\textcircled{8} \begin{aligned} \log_2 x^3 &= \log_2 27 \\ \sqrt[3]{x^3} &= \sqrt[3]{27} \\ x &= \frac{1}{3} \end{aligned}$$

$$\textcircled{9} \begin{aligned} \log_2 (x-1)^3 + \log_2 4 &= 5 \\ \log_2 4(x-1)^3 &= 5 \\ 2^5 &= 4(x-1)^3 \\ 32 &= 4(x-1)^3 \end{aligned}$$

$$\textcircled{10} \begin{aligned} \log_3 (x+4)^2 - \log_3 9 &= 2 \\ \log_3 \frac{(x+4)^2}{9} &= 2 \\ (3^2)^2 &= \left(\frac{(x+4)^2}{9}\right) \cdot 9 \\ \sqrt{81} &= \sqrt{(x+4)^2} \\ 9 &= (x+4) \\ -4 & \quad -4 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} \sqrt[3]{8} &= \sqrt[3]{(x-1)^3} \\ 2 &= (x-1) \\ +1 & \quad +1 \\ 3 &= x \end{aligned}$$

$$\textcircled{11} \begin{aligned} \log x(x+15) &= 2 \\ 10^2 &= x^2+15x \\ 0 &= x^2+15x-100=0 \\ (x-5)(x+20) &= 0 \\ x &= 5 \quad x = \cancel{-20} \end{aligned}$$

$$\log(x^2+15x) \neq 2$$

$$\begin{aligned} \textcircled{12} \quad & \log_4 x + \log_4 (x-3) = 1 \\ & \log_4 x^2 = 3x = 1 \\ & x^2 = 3x = 4 \\ & x^2 - 3x - 4 = 0 \\ & (x-4)(x+1) = 0 \\ & x = 4 \quad \cancel{x = -1} \end{aligned}$$

$$\begin{aligned} \textcircled{13} \quad & x^2 = 4 \\ & x = 2 \end{aligned}$$

$$\textcircled{14} \quad x^3 = \frac{1}{8} \quad x = \frac{1}{2}$$

$$\begin{aligned} \textcircled{15} \quad & 3^2 = (x-1)^2 \\ & 3 = x-1 \\ & x = 4 \end{aligned}$$

$$\begin{aligned} \textcircled{16} \quad & 2^6 = (x+4)^3 \\ & 2^2 = x+4 \\ & x = 0 \end{aligned}$$

$$\textcircled{17} \quad \left(\frac{1}{2}\right)^{2^3} = \left((3x+1)^{\frac{1}{3}}\right)^3$$

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

$$\begin{array}{r} 2^6 = 3x+1 \\ -1 \quad \quad -1 \\ \hline 63 = 3x \end{array}$$

$$\begin{array}{r} 63 = 3x \\ \underline{3 \quad 3} \\ 21 = x \end{array}$$

$$\textcircled{18} \quad (3)^2 = (1-2x)^{\frac{1}{2} \cdot 2}$$

$$9 = 1 - 2x$$

$$8 = -2x$$

$$\begin{array}{r} -2 \quad -2 \\ \hline x = -4 \end{array}$$

$$\begin{aligned} \textcircled{19} \quad & 2^{x+1} = 2^2 \\ & x+1 = 2 \\ & \underline{-1 \quad -1} \\ & x = 1 \end{aligned}$$

$$\begin{aligned} \textcircled{20} \quad & 5^{1-2x} = 5^{-1} \\ & 1-2x = -1 \\ & \underline{-1 \quad -1} \end{aligned}$$

$$\begin{array}{r} -2x = -2 \\ \underline{-2 \quad -2} \\ x = 1 \end{array}$$

$$\boxed{x=0}$$

$$x = \frac{1}{2} = 0$$

$$\begin{aligned} \textcircled{21} \quad & 3^{x^3} = 3^{2x} \\ & x^3 = 2x \\ & \sqrt{x^2} = \sqrt{2} \\ & x = \pm 2 \\ & x = 0 \quad x = \pm 2 \\ & x^3 = 2x \\ & x^3 - 2x = 0 \\ & x(x^2 - 2) = 0 \\ & \boxed{x=0 \quad x = \pm 2} \end{aligned}$$

$$\begin{aligned} \textcircled{22} \quad & 4x^2 = 2x \\ & 2x^2 = x \\ & 2(x^2) = x \\ & \cancel{2x^2} = \cancel{x} \\ & \cancel{2x} = 1 \\ & 2x^2 - x = 0 \\ & x(2x-1) = 0 \\ & x=0 \quad x = \frac{1}{2} \end{aligned}$$

$$(23) \quad 2^{3(x^2-2x)} = 2^{-1}$$

$$3x^2 - 6x = -1$$

$$3x^2 - 6x + 1 = 0$$

$$\frac{6 \pm \sqrt{36 - 4(3)}}{6} = \frac{6 \pm \sqrt{24}}{6} = \frac{6 \pm 2\sqrt{6}}{6} \quad \left(1 \pm \frac{\sqrt{6}}{3}\right)$$

$$(24) \quad 3^{-2x} = 3^{-1}$$

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

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

$$(25) \quad 2^x \cdot 8^{-x} = 4^x$$

$$2^x \cdot 2^{-3x} = 2^{2x}$$

$$-2x = 2x \quad 0 = 4x$$

$$+2x - 2x \quad x = 0$$

$$(26) \quad (2)^{x-1} = 2^2$$

$$x-1 = 2$$

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

$$(27) \quad (2^x)^2 + (2^x) - 12 = 0$$

$$x^2 + x - 12 = 0$$

$$(x+4)(x-3) = 0$$

$$x = -4 \quad x = 3$$

$$2^x = -4 \quad 2^x = 3$$

$$2^x = x$$

$$(28) \quad (3)^{x^2} + 3^x - 2 = 0 \quad x = 3^x$$

$$x^2 + x - 2 = 0$$

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

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

$$3^x = -2 \quad 3^x = 1$$

$$x = \log_3 -2 \quad x = 0$$

$$(30) \quad 4^x - 2^x = 0$$

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

$$x = 0$$

$$(29) \quad (3^x)^2 + (3^x) - 4 = 0$$

$$x^2 + 3x - 4 = 0 \quad x = 3^x$$

$$(x+4)(x-1) = 0$$

$$x = -4 \quad x = 1$$

$$3^x = -4 \quad 3^x = 1$$

$$x = \log_3 -4 \quad x = 0$$

$$(31) \quad 4^x = 8$$

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

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

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

$$\textcircled{32} \quad 3^{2 \cdot 2x} = 3^3$$

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

$$\textcircled{34} \quad 3^x = 14$$

$$x = \log_3 14$$

$$= \frac{\log 14}{\log 3}$$

$$\textcircled{33} \quad 2^x = 10$$

$$x = \log_2 10 = \frac{\log 10}{\log 2}$$

$$\textcircled{35} \quad 8^{-x} = 1.2$$

$$x = -\log_8 1.2$$

$$x = -\frac{\log 1.2}{\log 8}$$

$$\textcircled{36} \quad 2^{-x} = 1.5$$

$$x = -\log_2 1.5$$

$$= -\frac{\log 1.5}{\log 2}$$

$$\textcircled{37} \quad 3^{1-2x} = 4^x$$

$$(1-2x) \ln 3 = x \ln 4$$

$$\ln 3 - 2x \ln 3 = x \ln 4$$

$$+ 2x \ln 3 = 2x \ln 3$$

$$\ln 3 = x(\ln 4 + 2 \ln 3)$$

$$\ln 4 + 2 \ln 3 \quad \ln 4 + 2 \ln 3$$

$$x = \frac{\ln 3}{\ln 4 + 2 \ln 3}$$

$$\textcircled{38} \quad 2^{x+1} = 5^{1-2x}$$

$$(x+1) \ln 2 = (1-2x) \ln 5$$

$$x \ln 2 + \ln 2 = \ln 5 - 2x \ln 5$$

$$x \ln 2 + 2x \ln 5 = \ln 5 - \ln 2$$

$$x(\ln 2 + 2 \ln 5) = \ln 5 - \ln 2$$

$$\ln 2 + 2 \ln 5 \quad \ln 2 + 2 \ln 5$$

$$x = \frac{\ln 5 - \ln 2}{\ln 2 + 2 \ln 5}$$

$$\textcircled{39} \quad x \ln \left(\frac{3}{5}\right) = (1-x) \ln 7$$

$$x \ln \left(\frac{3}{5}\right) = \ln 7 - x \ln 7$$

$$x \ln \left(\frac{3}{5}\right) + x \ln 7 = \ln 7$$

$$x \left(\ln \left(\frac{3}{5}\right) + \ln 7 \right) = \ln 7$$

$$\ln \left(\frac{3}{5}\right) + \ln 7 \quad \ln \left(\frac{3}{5}\right) + \ln 7$$

$$\begin{aligned} (40) \quad (1-x) \ln\left(\frac{4}{3}\right) &= x \ln 5 \\ \ln\left(\frac{4}{3}\right) - x \ln\left(\frac{4}{3}\right) &= x \ln 5 \\ \ln\left(\frac{4}{3}\right) &= x \ln 5 + x \ln\left(\frac{4}{3}\right) \\ \ln\left(\frac{4}{3}\right) &= x (\ln 5 + \ln\left(\frac{4}{3}\right)) \\ \frac{\ln\left(\frac{4}{3}\right)}{\ln 5 + \ln\left(\frac{4}{3}\right)} &= \frac{\ln\left(\frac{4}{3}\right)}{\ln 5 + \ln\left(\frac{4}{3}\right)} \end{aligned}$$

$$\begin{aligned} (41) \quad x \ln 1.4 &= -x \ln(5) \\ x \ln 1.4 + \ln(5) &= 0 \quad x=0 \end{aligned}$$

$$\begin{aligned} (42) \quad (1+x) \ln(.3) &= (2x-1) \ln(1.7) \\ \ln .3 + x \ln .3 &= 2x \ln 1.7 - \ln 1.7 \\ \ln .3 + \ln 1.7 &= 2x \ln 1.7 - x \ln .3 \\ \ln .3 + \ln 1.7 &= x (2 \ln 1.7 - \ln .3) \\ \frac{2 \ln 1.7 - \ln 3}{2 \ln 1.7 - \ln 3} &= \frac{2 \ln 1.7 - \ln 3}{2 \ln 1.7 - \ln 3} \\ x &= \frac{\ln 3 + \ln 1.7}{2 \ln 1.7 - \ln 3} \quad x = -.2973 \end{aligned}$$

$$\begin{aligned} (43) \quad (1-x) \ln \pi &= x \\ \ln \pi - x \ln \pi &= x \\ \ln \pi &= x + x \ln \pi \\ \ln \pi &= x (1 + \ln \pi) \\ \frac{\ln \pi}{1 + \ln \pi} &= \frac{\ln \pi}{1 + \ln \pi} \quad x = .5337 \end{aligned}$$

$$\begin{aligned} (44) \quad (x+3) \ln e &= x \ln \pi \\ x+3 &= x \ln \pi \\ 3 &= x \ln \pi - x \\ 3 &= x (\ln \pi - 1) \\ \frac{3}{\ln \pi - 1} &= \frac{3}{\ln \pi - 1} \end{aligned}$$

$$\begin{aligned} (45) \quad 2^{3x} &= \frac{8}{5} \\ 3x \ln 2 &= \ln\left(\frac{8}{5}\right) \\ x &= .226 \end{aligned}$$

$$x = 3.939$$

$$\log_4$$

$$\frac{x+10}{x} = \log_4 \frac{x+10}{x}$$

$$(46) 4^{2x} = \frac{2}{3}$$

$$\frac{2x \ln 4}{\ln 4} = \frac{\ln(\frac{2}{3})}{\ln 4}$$
$$2x = -0.2925$$
$$x = -1.46$$

$$(47) e^{2x} = \frac{6}{4}$$
$$\frac{2x}{2} = \frac{\ln(\frac{6}{4})}{2}$$

$$x = 2.027$$

$$(48) e^{3x} = \frac{6}{5}$$
$$3x \ln e = \ln(\frac{6}{5})$$
$$3x = 0.1823$$
$$x = 0.6077$$

$$(49) \log_a \frac{x-1}{x+6} = \log_a \frac{x-2}{x+3}$$
$$(x-1)(x+3) = (x-2)(x+6)$$
$$x^2 + 2x - 3 = x^2 + 4x - 12$$
$$9 = 2x$$
$$x = \frac{9}{2}$$

$$(50) \log_a (x^2 - 2x) = \log_a (x+4)$$
$$x^2 - 2x = x+4$$
$$x^2 - 3x - 4 = 0$$
$$(x-4)(x+1) = 0$$
$$x = 3$$

$$(52) \log_4 \frac{x^2 - 9}{x+3} = 3$$
$$4^3 = \frac{x^2 - 9}{x+3}$$
$$64 = x-3$$
$$67 = x$$

$$(51) \log_{\frac{1}{3}} \frac{x^2 + x}{x^2 - x} = -1$$

$$\log_{\frac{1}{3}} \frac{x(x+1)}{x(x-1)} = -1$$

$$\log_{\frac{1}{3}} \frac{(x+1)}{(x-1)} = -1$$

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

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

$$3x - 3 = x + 1$$
$$-x \quad -x$$

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

$$(53) \log_2 8^x = -3$$
$$2^{-3} = 8^x$$
$$2^{-3} = 2^{3x}$$
$$\frac{-3}{3} = \frac{3x}{3} \quad x = -1$$

$$(54) x = -1$$

$$3^{16} \quad 7^8$$

$$\sqrt{2 \times 18}$$
$$x^2 = 8$$

$$(x+1)(x-1)$$