



## Indices SOLUTIONS



1. (a)  $n = 7$   
(b)  $n = 2$   
(c)  $n = 18$   
(d)  $n = -12$   
(e)  $n = -5$   
(f)  $n = \frac{1}{2}$   
(g)  $n = \frac{3}{2}$   
(h)  $n = \frac{5}{2}$   
(i)  $n = -\frac{1}{2}$   
(j)  $n = \frac{13}{2}$
2.  $x = 3$
3.  $x = 3$
4.  $x = \frac{5}{2}$
5.  $x = \frac{5}{2}$
6.  $x = \frac{13}{6}$
7.  $x = -3$
8.  $x = -5$
9.  $x = \frac{1}{2}$  (S\*)
10.  $x = \frac{1}{2}$
11.  $x = -\frac{1}{2}$  (S\*)
12.  $x = \frac{1}{4}$
13.  $x = -\frac{1}{2}$
14.  $x = -\frac{3}{2}$
15.  $x = -\frac{3}{4}$  (S\*)





16.  $x = \frac{1}{2}$  (S\*)
17.  $x = \frac{13}{4}$  (S\*)
18.  $x = 4$   $x = 1$
19.  $x = -\frac{1}{4}$   $x = 1$  (S\*)
20.  $x = 1$   $y = 2$  (S\*)
21.  $x = 2$   $y = 3$
22.  $x = -2$   $y = 1$  (S\*)
23.  $x = 3$   $y = -1$  (S\*)
24. (a)  $x = 2$   $x = 0$   
(b)  $x = 3$   $x = 0$   
(c)  $x = 4$   $x = 0$   
(d)  $x = -1$   $x = 3$   
(e)  $x = 1$   $x = -2$  (S\*)  
(f)  $x = 1$   $x = -1$  (S\*)  
(g)  $x = 2$   $x = -3$
25. (a)  $x = 2$   $x = 0$   
(b)  $x = -1$   $x = 2$  (S\*)  
(c)  $x = 2$   $x = 0$   
(d)  $x = 1$   $x = -1$  (S\*)  
(e)  $x = -2$   $x = 0$   
(f)  $x = 2$   $x = -1$  (S\*)

**Question 9**

$$\begin{aligned}9^{x-2} &= \frac{1}{27} \\(3^2)^{x-2} &= \frac{1}{3^3} \\3^{2x-4} &= 3^{-3} \\2x - 4 &= -3 \\2x &= 1 \\x &= \frac{1}{2}\end{aligned}$$



**Question 11**

$$\begin{aligned}5^{x+1} &= \sqrt{5} \\5^{x+1} &= 5^{\frac{1}{2}} \\x + 1 &= \frac{1}{2} \\x &= -\frac{1}{2}\end{aligned}$$

**Question 15**

$$\begin{aligned}9^x &= \frac{1}{\sqrt{27}} \\(3^2)^x &= \frac{1}{(3^3)^{\frac{1}{2}}} \\3^{2x} &= \frac{1}{3^{\frac{3}{2}}} \\3^{2x} &= 3^{-\frac{3}{2}} \\2x &= -\frac{3}{2} \\x &= -\frac{3}{4}\end{aligned}$$

**Question 16**

$$\begin{aligned}8^{x-1} &= \frac{\sqrt{32}}{16} \\(2^3)^{x-1} &= \frac{(2^5)^{\frac{1}{2}}}{2^4} \\2^{3x-3} &= \frac{2^{\frac{5}{2}}}{2^4} \\2^{3x-3} &= 2^{\frac{5}{2}-4} \\2^{3x-3} &= 2^{-\frac{3}{2}} \\3x - 3 &= -\frac{3}{2} \\3x &= -\frac{3}{2} + 3 \\3x &= \frac{3}{2} \\x &= \frac{1}{2}\end{aligned}$$



**Question 17**

$$\sqrt{2}(2^{2x}) = \left(\frac{32}{\sqrt{8}}\right)^2$$

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

$$2^{\frac{1}{2}+2x} = \left(\frac{2^5}{2^{\frac{3}{2}}}\right)^2$$

$$2^{\frac{1}{2}+2x} = (2^{5-\frac{3}{2}})^2$$

$$2^{\frac{1}{2}+2x} = (2^{\frac{7}{2}})^2$$

$$2^{\frac{1}{2}+2x} = 2^7$$

$$\frac{1}{2} + 2x = 7$$

$$2x = 7 - \frac{1}{2}$$

$$2x = \frac{13}{2}$$

$$x = \frac{13}{4}$$

**Question 19**

$$\frac{(81^x)^x}{27^x} = 3$$

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

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

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

$$4x^2 - 3x = 1$$

$$4x^2 - 3x - 1 = 0$$

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

$$x = -\frac{1}{4} \quad x = 1$$





**Question 20**

$$2^{x+y} = 8$$

$$3^{4x-y} = 9$$

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

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

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$$x + y = 3$$

$$4x - y = 2$$

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$$5x = 5$$

$$x = 1$$

$$y = 2$$

**Question 22**

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

$$2^x \times 4^y = 1$$

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

$$2^x \times 2^{2y} = 2^0$$

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

$$2^{x+2y} = 2^0$$

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$$x + y = -1$$

$$x + 2y = 0$$

Solve simultaneous equations:

$$x = -2$$

$$y = 1$$

**Question 23**

$$\frac{3^x}{9^y} = 243$$

$$3^x \times 27^y = 1$$

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$$\frac{3^x}{3^{2y}} = 3^5$$

$$3^x \times 3^{3y} = 3^0$$

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$$3^{x-2y} = 3^5$$

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

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$$x - 2y = 5$$

$$x + 3y = 0$$

Solve simultaneous equations:

$$x = 3$$

$$y = -1$$



**Question 24(e)**

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

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

$$(3^x)^2(9) - 28(3^x) + 3 = 0$$

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

$$9y^2 - 28y + 3 = 0$$

$$(9y - 1)(y - 3) = 0$$

$$y = \frac{1}{9} \quad y = 3$$

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

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

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

**Question 24(f)**

$$5^{2x+1} - 26(5^x) + 5 = 0$$

$$(5^{2x})(5^1) - 26(5^x) + 5 = 0$$

$$(5^x)^2(5) - 26(5^x) + 5 = 0$$

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

$$5y^2 - 26y + 5 = 0$$

$$(5y - 1)(y - 5) = 0$$

$$y = \frac{1}{5} \quad y = 5$$

$$5^x = \frac{1}{5} \quad 5^x = 5$$

$$5^x = 5^{-1} \quad 5^x = 5^1$$

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



**Question 25(b)**

$$3^{x+1} + 3^{2-x} = 28$$

$$(3^x)(3^1) + \frac{3^2}{3^x} = 28$$

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

$$3y + \frac{9}{y} = 28 \quad (\times y)$$

$$3y^2 + 9 = 28y$$

$$3y^2 - 28y + 9 = 0$$

$$(3y - 1)(y - 9) = 0$$

$$y = \frac{1}{3} \quad y = 9$$

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

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

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

**Question 25(d)**

$$2^{x+1} + 2^{1-x} - 5 = 0$$

$$(2^x)(2^1) + \frac{2^1}{2^x} - 5 = 0$$

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

$$2y + \frac{2}{y} - 5 = 0 \quad (\times y)$$

$$2y^2 + 2 - 5y = 0$$

$$2y^2 - 5y + 2 = 0$$

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

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

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

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

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





## Question 25(f)

$$2^{x-1} + 2^{-x} = \frac{9}{4}$$

$$\frac{2^x}{2^1} + \frac{1}{2^x} = \frac{9}{4}$$

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

$$\frac{y}{2} + \frac{1}{y} = \frac{9}{4} \quad (\times 4y)$$

$$2y^2 + 4 = 9y$$

$$2y^2 - 9y + 4 = 0$$

$$(2y - 1)(y - 4) = 0$$

$$y = \frac{1}{2} \quad y = 4$$

$$2^x = \frac{1}{2} \quad 2^x = 4$$

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

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

