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Evaluate each of the following :

1.(a) 3^4

Ans. 81

(b) $(-2x)^3$

Ans. $-8x^3$

Sol. $= (-2)^3(x)^3$
 $= -8x^3$

(c) $\left(\frac{3y}{4}\right)^3$

Ans. $\frac{27y^3}{64}$

Sol. $= \frac{3^3 y^3}{4^3}$

$= \frac{27y^3}{64}$

(d) 4^{-3}

Ans. $\frac{1}{64}$

Sol. $= \frac{1}{4^3} = \frac{1}{64}$

(e) $(-4x)^{-2}$

Ans. $\frac{1}{16x^2}$

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

$= \frac{1}{16x^2}$

(f) $(2y^{-1})^{-1}$

Ans. $\frac{y}{2}$

Sol. $= 2^{-1}(y^{-1})^{-1}$

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

(g) $\frac{3^{-1}x^2y^{-4}}{2^{-2}x^{-3}y^3}$

Ans. $\frac{4x^5}{3y^7}$

Sol. $\frac{2^2}{3^1} \cdot x^2 \cdot x^3 \cdot \frac{1}{y^3 y^4}$

$= \frac{4}{3} \cdot \frac{x^5}{y^7}$

(h) $(16)^{1/4}$

Ans. 2

Sol. $= (2^4)^{1/4}$

$= 2^1$

(i) $\frac{8^{-2/3}(-8)^{2/3}}{8^{1/3}}$

Ans. $\frac{1}{2}$

Sol. $\frac{(-8)^{2/3}}{(8)^{2/3}} \cdot \frac{1}{8^{1/3}} = \left(\frac{-8}{8}\right)^{2/3} \cdot \frac{1}{(2^3)^{1/3}}$


$= (-1)^{2/3} \frac{1}{2} = \frac{1}{2}$

(j) $(-a^3b^3)^{-2/3}$

Ans. $\frac{1}{a^2b^2}$

Sol. $= \frac{1}{(-a^3b^3)^{2/3}} = \frac{1}{(-1)^{2/3}(a^3)^{2/3} \cdot (b^3)^{2/3}}$

$= \frac{1}{1 \cdot a^2 \cdot b^2} = \frac{1}{a^2b^2} = 1$

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(k) $-3(-1)^{-\frac{1}{5}}(4)^{-\frac{1}{2}}$

Ans. $\frac{3}{2}$

Sol. $\frac{(-3)}{(-1)^{1/5}} \cdot \frac{1}{4^{1/2}}$

$$\frac{-3}{-1} \cdot \frac{1}{(2^2)^{1/2}} = \frac{3}{2}$$

(l) $(10^3)^0$

Ans. 1

Sol. =1

(m) $(x-y)^0[(x-y)^4]^{-1/2}, x \neq y$

Ans. $\frac{1}{(x-y)^2}$

Sol. $\frac{1}{[(x-y)^4]^{1/2}} = \frac{1}{[(x-y)^2]^{1/2}}$

$$= \frac{1}{(x-y)}$$

(n) $x^y x^{4y}$

Ans. x^{5y}

Sol. $= x^{y+4y} = x^{5y}$

(o) $3y^{2/3}y^{4/3}$

Ans. $3y^2$

Sol. $3 \cdot y^{\frac{2}{3}+\frac{4}{3}}$
 $3y^2$

(p) $(4 \cdot 10^3)(3 \cdot 10^{-5})(6 \cdot 10^4)$

Ans. 7200

Sol. $72 \cdot 10^{3-5+4}$
 $72 \cdot 10^2 = 7200$

2. (a) $\frac{2^3 \cdot 2^{-2} \cdot 2^4}{2^{-1} \cdot 2^0 \cdot 2^{-3}}$

Ans. 2^9

Sol. $\frac{2^3 \cdot 2^1 \cdot 2^4 \cdot 2^3}{2^2 2^0} = \frac{2^{11}}{2^2} = 2^9$

(b) $\frac{10^{x+y} \cdot 10^{y-x} \cdot 10^{y+1}}{10^{y+1} \cdot 10^{2y+1}}$

Ans. $\frac{1}{10}$

Sol. $10^{x+y+y-x-2y-1} = 10^{-1} = \frac{1}{10}$

(c) $\frac{3^{1/2} \cdot 3^{-2/3}}{3^{-1/2} \cdot 3^{1/3}}$

Ans. 1


Sol. $\frac{3^{1/2} \cdot 3^{1/2}}{3^{2/3} 3^{1/3}} = \frac{3^1}{3^1} = 1$

(d) $\frac{(x+y)^{2/3}(x+y)^{-1/6}}{[(x+y)^2]^{1/4}}$

Ans. 1

Sol. $= \frac{(x+y)^{2/3} \cdot (x+y)^{-1/6}}{(x+y)^{1/2}}$

$$(x+y)^{\frac{2}{3}-\frac{1}{6}-\frac{1}{2}} = (x+y)^0 = 1$$

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(e) $\frac{(10^2)^{-3}(10^3)^{1/6}}{\sqrt{10} \cdot (10^4)^{-1/2}}$

Ans. 10^{-4}

Sol. $\frac{10^{-6} \cdot 10^{1/2}}{10^{1/2} \cdot 10^{-2}} = 10^{-4}$

(g) $\frac{4^{-1/2} a^{2/3} b^{-1/6} c^{-3/2}}{8^{2/3} a^{-1/3} b^{-2/3} c^{5/2}}$

Ans. $\frac{a\sqrt{b}}{8c^4}$

Sol. $\frac{a^{2/3} a^{1/3} b^{2/3} b^{-1/6}}{4^{1/2} \cdot 8^{2/3} c^{5/2} c^{3/2}}$

$\frac{ab^{1/2}}{8c^4} = \frac{a\sqrt{b}}{8c^4}$

(i) $\sqrt{\frac{4\sqrt{a^2} \sqrt[3]{b^5}}{c^{-2}d^2}}$

Ans. $\frac{a^{1/4} b^{5/6} c}{d}$

Sol. $= \sqrt{\frac{(a^2)^{1/4} (b^5)^{1/3}}{c^{-2}d^2}} = \frac{(a^{1/2})^{1/2} (b^{5/3})^{1/2}}{(c^{-2})^{1/2} (d^2)^{1/2}} = \frac{a^{1/4} b^{5/6}}{c^{-1}d} = \frac{a^{1/4} b^{5/6} c}{d}$

3. (a) $\sqrt{27^{-2/3}} + 5^{2/3} \cdot 5^{1/3}$

Ans. $\frac{16}{3}$

Sol. $[(3^3)^{-2/3}]^{1/2} + 5^{2/3} + \frac{1}{3}$

$3^{-1} + 5^1 = \frac{1}{3} + 5 = \frac{16}{3}$

(c) $8^{2/3} + 3^{-2} - \frac{1}{9}(10)^0$

Ans. 4

Sol. $(2^3)^{2/3} + \frac{1}{3^2} - \frac{1}{9}(1)$

(f) $[(x^{-1})^{-2}]^{-3}$

Ans. x^{-6}

Sol. $= x^{(-1) \cdot (-2) \cdot (-3)} = x^{-6}$

(h) $\left(\frac{2^{-8} \cdot 3^4}{5^{-4}}\right)^{-1/4}$

Ans. $\frac{4}{15}$

Sol. $= \frac{(2^{-8})^{-1/4} (3^4)^{-1/4}}{(5^{-4})^{-1/4}}$

$= \frac{2^2 3^{-1}}{5} = \frac{4}{15}$

(b) $4\left(\frac{1}{2}\right)^0 + 2^{-1} - (16)^{-1/2} \cdot 4 \cdot 3^0$

Ans. $\frac{7}{2}$

Sol. $4 + \frac{1}{2} - (4^2)^{-1/2} \cdot 4$

$4 + \frac{1}{2} - \frac{1}{4} \cdot 4$

$4 + \frac{1}{2} - 1 = 4 - \frac{1}{2} = \frac{7}{2}$

(d) $(27)^{2/3} - 3(3x)^0 + (25)^{1/2}$


Ans. 11

Sol. $(3^3)^{2/3} - 3(1) + (5^2)^{1/2}$

$3^2 - 3 + 5$

$4 + \frac{1}{9} - \frac{1}{9} = 4$

$9 - 3 + 5 = 11$

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(e) $(8)^{2/3} \cdot (16)^{-3/4} \cdot 2^0 - 8^{-2/3}$

Ans. $\frac{1}{4}$

Sol. $(2^3)^{2/3} \cdot (2^4)^{-3/4} \cdot (1) - (2^3)^{-2/3}$

$$\frac{2^2 \cdot 2^{-3} - 2^{-2}}{(-2)^2} = \frac{1}{4}$$

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

(g) $x^{3/2} + 4x^{-1} - 5x^0$ when $x = 4$

Ans. 4

Sol. $4^{3/2} + 4 \cdot 4^{-1} - 5 \cdot 4^0$

$$(2^2)^{3/2} + 4 \cdot \frac{1}{4} - 5(1)$$

$$2^3 + 1 - 5$$

$$9 - 5 = 4$$

(i) $64^{-2/3} \cdot 16^{5/4} \cdot 2^0 \cdot (\sqrt{3})^4$

Ans. 18

Sol. $(4^3)^{-2/3} \cdot (2^4)^{5/4} \cdot (1) \cdot (3^{\frac{1}{2}})^4$

$$4^{-2} \cdot 2^5 \cdot 3^2 = \frac{1}{16} \cdot 3^2 \cdot 9$$

$$= 18$$

(f) $\sqrt[3]{(x-2)^{-2}}$ when $x = -6$

Ans. $\frac{1}{4}$

Sol. $[(-6-2)^{-2}]^{1/3} = (-8)^{-2/3}$

$$= [(-2)^{35}]^{-2/3} = (-2)^{-2} =$$

(h) $y^{2/3} + 3y^{-1} - 2y^0$ when $y = 1/8$

Ans. $\frac{89}{4}$

Sol. $\left(\frac{1}{8}\right)^{2/3} + 3\left(\frac{1}{8}\right)^{-1} - 2\left(\frac{1}{8}\right)^0$

$$\left[\left(\frac{1}{2}\right)^3\right]^{2/3} + 3 \cdot (8) - 2$$

$$\frac{1}{4} + 24 - 2 = \frac{89}{4}$$


(j) $\frac{\sqrt{a} \cdot a^{-2/3}}{\sqrt[6]{a^5}} + \frac{a^{-5/6}}{\sqrt[3]{a^2} \cdot a^{-1/2}}$

Ans. $\frac{2}{a}$

Sol. $\frac{a^{1/2} a^{-2/3}}{a^{5/6}} + \frac{a^{-5/6}}{(a^2)^{1/3} a^{-1/2}}$

$$= a^{1/2 - \frac{2}{3} - \frac{5}{6}} + a^{1/2 - 2/3 - 5/6}$$

$$= 2 \left(a^{1/2 - 2/3 - 5/6} \right) = 2(a^{-1}) = \frac{2}{a}$$

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(k) $\left(\frac{\sqrt{72y^{2n}}}{3} \cdot 9^0\right)(2y^{n+2})^{-1}$

Ans. $\frac{\sqrt{2}}{y^2}$

Sol. $\frac{\sqrt{72}\sqrt{y^{2n}}}{3}(1) \cdot \frac{1}{2y^{n+2}}$
 $\frac{6\sqrt{2}y^n}{3} \cdot \frac{1}{2y^{n+2}} = \frac{\sqrt{2}}{y^2}$

4. (a) $(25)^0 + (0.25)^{1/2} - 8^{1/3} \times 4^{-1/2} + (0.027)^{1/3}$

Ans. 0.8

Sol. $1 + \left(\frac{1}{4}\right)^{1/2} - (2^3)^{1/3} \cdot (2^2)^{-1/2} + \left(\frac{27}{1000}\right)^{1/3}$

$$1 + \left[\left(\frac{1}{2}\right)^2\right]^{1/2} - 2 \cdot 2^{-1} + \left[\left(\frac{3}{10}\right)^3\right]^{1/3} = 1 + \frac{1}{2} - 1 + \frac{3}{10}$$

$$= 0.5 + 0.3 = 0.8$$

(b) $\frac{1}{8^{-2/3}} - 3(a)^0 + (3a)^0 + (27)^{-1/3} - 1^{3/2}, a \neq 0$

Ans. $\frac{4}{3}$

Sol. $8^{2/3} - 3(1) + (1) + (3^3)^{\frac{1}{3}} - 1$

$$(2^3)^{2/3} - 3 + 3^{-1}$$

$$4 - 3 + \frac{1}{3} = \frac{4}{3}$$

(c) $\frac{3^{-2}+5(2)^0}{3-4(3)^{-1}}$

Ans. $\frac{46}{15}$

Sol. $= \frac{\frac{1}{9}+5(1)}{3-4/3} = \frac{46/9}{5/3}$
 $= \frac{46}{15}$


(d) $\frac{3^0x+4x^{-1}}{x^{-2/3}}$ if $x = 8$

Ans. 34

Sol. $\left(x + \frac{4}{x}\right)x^{2/3} = \left(8 + \frac{4}{8}\right)8^{2/3}$
 $\left(8 + \frac{1}{2}\right) \cdot 4 = \frac{17}{2} \cdot 4 = 34$

(e) $\frac{2+2^{-1}}{5} + (-8) - 4^{3/2}$

(f) $(64)^{-2/3} - 3(150)^0 + 12(2)^{-2}$

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Ans. $\frac{-31}{2}$

Sol. $\frac{2+\frac{1}{2}}{5} - 8 - (2^2)^{3/2}$

$$\frac{5/2}{5} - 8 - 8 = \frac{1}{2} - 16 = -\frac{31}{2}$$

Ans. $\frac{1}{16}$

Sol. $(4^3)^{-2/3} - 3(1) + 12\left(\frac{1}{2^2}\right)$

$$\frac{1}{4^2} - 3 + \frac{12}{4}$$

$$\frac{1}{16} - 3 + 3 = \frac{1}{16}$$

(g) $(0.125)^{-2/3} + \frac{3}{2+2-1}$

Ans. $\frac{26}{5}$

Sol. $\left(\frac{1}{8}\right)^{-2/3} + \frac{3}{2+\frac{1}{2}}$

$$\left[\left(\frac{1}{2}\right)^3\right]^{-2/3} + \frac{3}{5/2} = 4 + \frac{6}{5}$$

$$= \frac{26}{5}$$

(h) $\sqrt[n]{\frac{32}{2^{5+n}}}$

Ans. $\frac{1}{2}$

Sol. $= \left(\frac{2^5}{2^5 \cdot 2^n}\right)^{1/n}$

$$= \left(\frac{1}{2^n}\right)^{1/n} = \frac{1}{2}$$

(i) $\frac{(60000)^3(0.00002)^4}{(100)^2(72000000)(0.0002)^5}$

Ans. 150


Sol. $\frac{(6 \times 10^4)^3 \cdot \left(\frac{2}{10^5}\right)^4}{(10^2)^2 \cdot (72 \times 10^6) \cdot \left(\frac{2}{10^4}\right)^5} = \frac{6^3 \cdot 10^{12} \cdot 2^4 / 10^{20}}{10^4 \cdot 72 \cdot 10^6 \cdot 2^5 / 10^{20}} = \frac{6^3 \cdot 100}{72 \cdot 2}$
 $= 25 \cdot 6 = 150$

5. (a) $\frac{(x^2+3x+4)^{1/3} \left[\frac{-1}{2}(5-x)^{-1/2} \right] - (5-x)^{1/2} \left[\frac{1}{3}(x^2+3x+4)^{-2/3} (2x+3) \right]}{(x^2+3x+4)^{2/3}}$ if $x = 1$

Ans. $\frac{-1}{3}$

Sol. Putting $x = 1$ in $x^2 + 3x + 4 = 8$ $5 - x = 4$

$$\frac{\left[(8^{1/3}) \left(\frac{-1}{2} \right) (4^{-1/2}) \right] - (4^{1/2}) \cdot \frac{1}{3} (8)^{-2/3} \cdot 5}{8^{2/3}} = \frac{\left[2 \cdot \left(\frac{-1}{2} \right) \cdot \left(\frac{1}{2} \right) \right] - \left(2 \cdot \frac{1}{3} \cdot \frac{1}{4} \cdot 5 \right)}{\frac{1}{4} \left(\frac{-1}{2} \cdot \frac{5}{6} \right) = \frac{-1}{8} \cdot \frac{5}{24}} = \frac{-3-5}{24} = \frac{-8}{24} = -\frac{1}{3}$$

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(b) $\frac{(9x^2-5y)^{1/4}(2x)-x^2\left[\frac{1}{4}(9x^2-5y)^{-3/4}(18x)\right]}{(9x^2-5y)^{1/2}}$ if $x = 2, y = 4$

Ans. $\frac{7}{8}$

Sol. putting $x = 2, y = 4$

$$9x^2 - 5y = 36 - 20 = 16$$

$$2x = 4$$

$$x^2 = 4$$

$$18x = 36$$

$$\frac{(16)^{1/4} \cdot (4) - (4) \cdot \frac{1}{4} (16)^{-3/4} (36)}{(16)^{1/2}}$$

$$\frac{(2 \cdot 4) - \frac{1}{8} (36)}{4}$$

$$2 - \frac{9}{8} = \frac{7}{8}$$


(c) $\frac{(x+1)^{2/3} \left[\frac{1}{2}(x-1)^{-1/2} \right] - (x-1)^{1/2} \left[\frac{2}{3}(x+1)^{-1/3} \right]}{(x+1)^{4/3}}$

Ans. $\frac{7-x}{6(x-1)^{1/2}(x+1)^{5/3}}$

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

$$= \frac{\frac{3(x+1)^{2/3}(x+1)^{1/3} - 4(x-1)^{1/2}(x-1)^{1/2}}{6(x-1)^{1/2}(x+1)^{1/3}}}{(x+1)^{4/3}}$$

$$= \frac{\frac{3(x+1) - 4(x-1)}{6(x-1)^{1/2}(x+1)^{1/3}(x+1)^{4/3}}}{(7-x)}$$

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(d) $x - 1 + \sqrt{x^2 + 2x + 1}$

Ans. $2x$ if $x \geq -1$, -2 if $x \leq -1$

Sol. $(x - 1) + \sqrt{(x + 1)^2}$
 $(x - 1) + |x + 1|$

case(i) $x + 1 \geq 0$ case (ii) $x + 1 < 0$

$$\begin{array}{ll} (x - 1) + (x + 1) & (x - 1) - (x + 1) \\ = 2x & = -2 \end{array}$$

(e) $3x - 2y - \sqrt{4x^2 - 4xy + y^2}$

Ans. $x - y$ if $2x \geq y$, $5x - 3y$ if $2x < y$

Sol. $(3x - 2y) - \sqrt{(2x - y)^2}$
 $(3x - 2y) - |2x - y|$

case (i) $2x - y \geq 0$ case (ii) $2x - y < 0$

$$\begin{array}{ll} (3x - 2y) - (2x - y) & (3x - 2y) + (2x - y) \\ = x - y & = 5x - 3y \end{array}$$