

Indices

Remember:

Anything to the power 0 is 1 i.e.

$$4^0 = 1 \quad 11^0 = 1 \quad x^0 = 1 \quad (ab)^0 = 1 \quad (\frac{1}{3})^0 = 1$$

A negative power indicates a fraction i.e.

$$4^{-1} = 1/4$$

1. Simplify

(1) $a^4 \times a^3$

(2) $c^6 \times c^{-2}$

(3) $3m^4 \times 2m$

(4) $5d^{-3} \times 2d^4$

(5) $e^4 \div e^2$

(6) $g^{-2} \div g^{-6}$

(7) $20h^3 \div 4h^6$

(8) $18p^{-3} \div 3p^{-7}$

(9) $\frac{4m^3 \times 3m^4}{2m^2}$

(10) $\frac{5n^{-2} \times 4n^5}{10n^{-3}}$

(11) $\frac{24n^9}{2n^3 \times 4n^{-1}}$

(12) $\frac{18p^7}{(3p^2)^2}$

(13) $\frac{6p^{-1} \times 3p^5}{9p^{-4}}$

(14) $\frac{4a \times 3a^{-5}}{6a^{-2}}$

(15) $\frac{(4u)^2}{8u^{-3}}$

(16) $\frac{(2p)^3}{8p^2}$

(17) $(y^4)^{-2}$

(18) $(a^{-4})^{-2}$

(19) $\frac{(c^2)^4}{c^3}$

(20) $\frac{(d^{-2})^4}{d^{-5}}$

(21) $(m^4)^{-2} \times m^4$

(22) $e^8 \times (e^4)^{-2}$

(23) $\frac{y^8}{(y^2)^3}$

(24) $\frac{(b^{-4})^2}{b \times b^3}$

(25) $(2v^2)^3$

(26) $(3n^{-3})^2$

(27) $(a^4)^{\frac{1}{2}}$

(28) $(p^{-6})^{\frac{2}{3}}$

(29) $4t^{\frac{1}{2}} \times t^{\frac{3}{2}}$

(30) $6u^{\frac{3}{4}} \times 3u^{\frac{1}{4}}$

(31) $5w^{\frac{1}{2}} \times 2w^{-\frac{1}{2}}$

(32) $10x^{\frac{1}{2}} \div 2x^{-\frac{1}{2}}$

(33) $24y^3 \div 4y^{\frac{1}{2}}$

(34) $16z^{\frac{1}{3}} \div 2z^{-2}$

(35) $\frac{4a^{\frac{1}{2}} \times 5a^{\frac{1}{2}}}{10a}$

(36) $\frac{6c^{\frac{2}{3}} \times 3c^{\frac{4}{3}}}{9c^2}$

(37) $\frac{(4d^{\frac{3}{5}})^2}{8d^{\frac{2}{5}}}$

(38) $\frac{3e^{-3} \times 4e^{\frac{1}{2}}}{2e}$

(39) $\frac{5g^{-\frac{1}{5}} \times g^2}{g^{\frac{1}{5}}}$

(40) $\frac{24h^4}{(2h^{\frac{1}{2}})^2}$

(41) $m^4 \times \sqrt{m}$

(42) $a^{-3} \times \sqrt{a}$

(43) $u^2 \times \sqrt[3]{u^2}$

(44) $\sqrt[4]{c^5} \times c$

(45) $e^3 \div \sqrt{e}$

(46) $m^{-4} \div \sqrt{m}$

(47) $\sqrt[3]{k^2} \div k$

(48) $f^{-2} \div \sqrt[4]{f}$

(49) $6\sqrt{a} \times 3a^2$

(50) $4p^{-2} \div 2\sqrt[3]{p}$

2. Expand the brackets

(1) $x(x^3 - 4)$

(2) $2y^2(3y^4 + 5y^{-2})$

(3) $3a^{-1}(4a^3 + 2a)$

(4) $3c(4c^3 - 6c^{-4})$

(5) $m(2m^{-1} - 4m^{-4})$

(6) $2u^{-5}(u + 3u^5)$

(7) $5n^4(n^2 + \frac{2}{n^3})$

(8) $2w^5\left(\frac{1}{w} + 4w^{-2}\right)$

(9) $p^4\left(3p^{-4} - \frac{2}{p^3}\right)$

(10) $4d^{1/2}(3d^{3/2} - d^{-1/2})$

(11) $e^{2/3}(e^{1/3} - 2e^{2/3})$

(12) $3m^{3/2}(m^{1/2} + \frac{3}{m^{1/2}})$

(13) $n^{1/2}(2n^{-1/3} - \frac{1}{\sqrt[3]{n^2}})$

(14) $x^{1/2}(2x^{3/5} + \frac{3}{\sqrt[5]{x}})$

(15) $2a^{5/3}\left(\frac{1}{\sqrt[3]{a^2}} - 4\sqrt[3]{a^4}\right)$

(16) $x^{1/2}(2x - 3)$

(17) $3a(a^{1/2} + 2a^{-2})$

(18) $u^{1/2}(3u + u^3)$

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

(20) $2p^{3/4}(p^{1/4} - p)$

3. Find the value of

(1) $\sqrt[3]{27^2}$

(2) $\sqrt[4]{16^5}$

(3) $\sqrt[2]{100^3}$

(4) $\sqrt[3]{8^6}$

(5) $\sqrt[3]{64^{-2}}$

(6) $\sqrt[3]{1^5}$

(7) $\sqrt{4^{-5}}$

(8) $\sqrt[3]{1000^{-2}}$

(9) $\sqrt[3]{\frac{1}{8}}$

(10) $\sqrt[4]{\frac{1}{16}}$

(11) 8^{-2}

(12) $25^{3/2}$

(13) $32^{3/5}$

(14) $9^{5/2}$

(15) $16^{3/4}$

(16) $125^{2/5}$

(17) $1^{-7/2}$

(18) $\left(\frac{1}{4}\right)^{3/2}$

(19) $\left(\frac{8}{27}\right)^{2/3}$

(20) $\left(\frac{1}{8}\right)^{3/5}$

4. Find x in each of the following

(1) $4^x = 32$

(2) $9^x = 27$

(3) $16^x = 32$

(4) $4^x = \sqrt{32}$

(5) $25^x = 125$

(6) $4^x = 128$

(7) $3^x = \sqrt{27}$

(8) $9^x = \sqrt{27}$

(9) $100^x = 1000$

(10) $8^x = \sqrt{32}$

(11) $4^x = \sqrt{8}$

(12) $2^{3x} = \sqrt{64}$

(13) $2^{5x} = \sqrt{64}$

(14) $8^x = \sqrt{128}$

(15) $4^x = \sqrt[3]{32}$

(16) $9^x = \sqrt[5]{27}$

(17) $25^x = \sqrt[4]{125}$

(18) $8^x = \sqrt[4]{32}$

(19) $9^x = \sqrt[3]{81}$

(20) $1000^x = \sqrt[5]{100}$

5. A formula is given as $P = \frac{27}{3^x}$

- (a) Calculate P when $x = 2$.
- (b) Calculate x when $P = 9$.
- (c) Calculate the maximum value of P given $x \geq 0$

6. A formula is given as $H = \frac{2^a}{4}$

- (a) Calculate H when $a = 6$.
- (b) Calculate a when $H = 8$.
- (c) Calculate the minimum value of H given $a \geq 0$

7. The intensity of light, I, emerging after passing through a liquid with concentration, c, is given the formula

$$I = \frac{20}{2^c} \quad c \geq 0$$

- (a) Find the intensity of light when the concentration is 3.
- (b) Find the concentration of the liquid when the intensity is 10.
- (c) What is the maximum possible intensity?