

MATH141 - Worksheet INDICES

$$a^m \times a^n = a^{m+n} \quad a^m \div a^n = a^{m-n} \quad (ab)^m = a^m b^m \quad (a^m)^n = a^{mn}$$

$$a^{-m} = \frac{1}{a^m} \quad a^0 = 1 \quad a^{\frac{m}{n}} = (\sqrt[n]{a})^m = (\sqrt[m]{a^n})$$

1. Try the following exercises **without** your calculator first and then check your answers using your calculator.

(a) $4^3 \times 4^4$	(b) $2^4 \times 2^3$	(c) $5^2 \times 5^5$	(d) 3×3^5
(e) $3^6 \div 3^2$	(f) $5^4 \div 5^3$	(g) $10^6 \div 10^4$	(h) $2^8 \div 2$
(i) 4^0	(j) 10^0	(k) 3×5^0	(l) $8 + 3^0$
(m) 4^{-1}	(n) 10^{-3}	(o) 8^{-1}	(p) 3^{-3}
(q) $49^{\frac{1}{2}}$	(r) $8^{\frac{2}{3}}$	(s) $25^{\frac{2}{3}}$	(t) $32^{\frac{2}{3}}$
(u) $(2^3)^2$	(v) $(3^4)^{\frac{1}{4}}$	(w) $(5^{-1})^{-1}$	(x) $\left(\frac{1}{2}\right)^{-3}$

2. Simplify each of the following.

(a) $a^3 \times a^2$	(b) $t^4 \times t^3$	(c) $y^2 \times y$	(d) $m^5 \times m^3$
(e) $x \times x^2$	(f) $x^4 \times x^2$	(g) $y^2 \times y^b$	(h) $a^m \times a^n$
(i) $a^3 \div a^2$	(j) $y^8 \div y^3$	(k) $m^5 \div m$	(l) $x^9 \div x^2$
(m) $t^4 \div t^2$	(n) $x^{-11} \div x^6$	(o) $b^3 \div b^4$	(p) $x^7 \div x^{-2}$
(q) x^0	(r) $(ax)^0$	(s) $a \times b^0$	(t) $x + y^0$
(u) $(x^3)^4$	(v) $(a^2 b^4)^4$	(w) $(p^{-1} q^5)^{-1}$	(x) $\left(a^{\frac{1}{2}}\right)^3$

3. Express each of the following with a positive index.

(a) $(2a)^{-1}$	(b) $12a^{-3}$	(c) $\left(\frac{1}{x}\right)^{-1}$	(d) y^{-3}
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4. Simplify each of the following.

(a) $2^2 \times 2^6 \times 2^{-2}$	(b) $2^3 \times 4^2 \times 8^2$	(c) $9^2 \times 3 \times 27^{\frac{1}{3}}$	(d) $6^a \times 3^b \times 2^2$
(e) $2^n \times 2^{2n} \times 2^{3n}$	(f) $a^3 \times a^5 \times a^{-2}$	(g) $x^2 \times x^4 \times x^3$	(h) $(p^2 q)^4 \times (q^2 p)^5$
(i) $a^3 b^{-2} \times (a^2 b^2)^4$	(j) $(2x^2)^5 \times (4x^3)^2$	(k) $m^2 p^3 \times (m^3 n^2)^3 \times (p^{-1})^2$	

5. Simplify each of the following, expressing with positive indices.

(a) $\frac{(b^2)^3 \times b^{-2}}{b^3}$	(b) $\frac{a^{-2} b \times ab^{-2}}{a^{-4} b^3}$	(c) $(25x^{10}y^4)^{1/2}$	(d) $(a^2)^0 \times (a^{\frac{1}{2}})^4$
(e) $\frac{(2x)^{-3}}{x^3}$	(f) $\frac{2a^2 b^{-2}}{2^{-3} b^{-4}}$	(g) $\frac{x^{-1} + y^{-1}}{x + y}$	(h) $\frac{10^n - 4^n}{5^n - 2^n}$

6. Simplify each of the following.

(a) $\frac{(x^2 y^3)^4 \times (xy)^{-2}}{xy}$	(b) $\frac{(ab^2)^3 \times (a^2 b)^2}{(a^2 b^2)^2}$	(c) $\frac{(2m^2 n)^3}{(mn^3)^2 \times (4m^2)^2}$	(d) $\frac{5x^5 y^2 \times 3(xy^3)^2}{15x^2 y}$
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7. Find the value of x that makes each of the following true.

(a) $3^x = 81$	(b) $2^x = 8$	(c) $x^{-2} = 9$	(d) $2^{x+3} = 16$
(e) $x^3 = -125$	(f) $4^x = 32$	(g) $4^{x+1} = \frac{1}{8}$	(h) $9 \times 3^{x-1} = \frac{1}{27}$