

Nat 5 Revision: Rules of Indices

1. Write each of the following in its simplest index form.

(a) $a^2 \times a^{12}$ (b) $y^5 \times y^5$ (c) $b^{10} \times b^{30}$ (d) $p \times p^9$ (e) $x^{30} \times x^{50}$
 (f) $q^{11} \times q^9$ (g) $t^3 \times t^7$ (h) $f^4 \times f^3$ (i) $k \times k^{12}$ (j) $c^2 \times c^9$

2. Write each of the following in its simplest index form.

(a) $y^{20} \div y^{10}$ (b) $b^4 \div b^1$ (c) $p^{12} \div p^{11}$ (d) $c^7 \div c^7$ (e) $q^8 \div q^2$
 (f) $d^4 \div d$ (g) $\frac{x^9}{x^3}$ (h) $\frac{a^8}{a^2}$ (i) $\frac{m^{14}}{m}$ (j) $\frac{d^{20}}{d^{12}}$

3. Write each of the following in its simplest index form.

(a) $(x^4)^2$ (b) $(y^8)^5$ (c) $(a^3)^7$ (d) $(m^4)^4$ (e) $(b^3)^6$ (f) $(p^5)^3$

4. Write the following without brackets.

(a) $(2b)^2$ (b) $(7a)^3$ (c) $(3x)^4$ (d) $(2y)^5$ (e) $(ab)^4$ (f) $(xy)^7$
 (g) $(wz)^5$ (h) $(st)^3$ (i) $(pq^2)^3$ (j) $(x^4y)^2$ (k) $(a^2b^3)^5$ (l) $(6a^5)^2$

5. Simplify these expressions.

(a) $2a^3 \times 5a^5$ (b) $7x \times 9x^8$ (c) $3y \times (2y^2)^3$ (d) $(4c^3)^3 \div 8c^2$
 (e) $k^2(k^3 + k^5)$ (f) $m^5(m^2 - m^3)$ (g) $2x^4(x^3 + 3x^2)$ (h) $5a^5(2a^2 - 3a^3)$
 (i) $\frac{x^5 \times x^4}{x^6}$ (j) $\frac{(m^5)^4}{m^6}$ (k) $\frac{5c^3 \times 4c^7}{2c^6}$ (l) $\frac{(3q^3)^2 \times 4q^4}{6q^7}$

6. Rewrite the following with positive indices.

(a) a^{-5} (b) x^{-2} (c) p^{-7} (d) y^{-10} (e) $2b^{-3}$ (f) $10q^{-x}$

7. Simplify the following expressions.

(a) $m^3 \times m^{-5}$ (b) $x^7 \times x^{-2}$ (c) $p^{-8} \times p^5$ (d) $a^{-3} \times a^{-5}$
 (e) $(y^3)^{-4}$ (f) $(c^{-5})^3$ (g) $(q^3)^{-5}$ (h) $(w^{-2})^{-4}$
 (i) $4b^{-4} \times 5b^5$ (j) $3x^6 \times 9x^{-6}$ (k) $4k^3 \div 2k^{-2}$ (l) $18d \div 12d^4$
 (m) $x^2(x^3 + x^{-1})$ (n) $p^{-3}(p^4 - p^{-8})$ (o) $3a^5(2a + 3a^{-2})$ (p) $\frac{v^3 \times v^5}{v^{-2}}$
 (q) $\frac{4h^7 \times 3h^{-4}}{2h^4}$ (r) $\frac{4c^{-5} \times 9c^6}{6c^{-4}}$ (s) $\frac{5x^4 \times 6x^{-8}}{3x^{-4}}$ (t) $\frac{1}{2} m^{-2}(4m^{-3} - 10m^6)$

8. Simplify the following expressions, giving your answers with positive indices.

(a)	$(x^{\frac{1}{2}})^6$	(b)	$(p^{\frac{1}{3}})^6$	(c)	$(a^{\frac{3}{4}})^8$	(d)	$(y^{-\frac{2}{3}})^9$
(e)	$(q^{\frac{1}{5}})^{10}$	(f)	$(k^{\frac{2}{5}})^1$	(g)	$(g^4)^{\frac{1}{2}}$	(h)	$(m^{12})^{-\frac{2}{3}}$
(i)	$(c^9)^{\frac{2}{3}}$	(j)	$(h^5)^{\frac{1}{2}}$	(k)	$(z^4)^{\frac{3}{4}}$	(l)	$(b^{16})^{-\frac{3}{4}}$
(m)	$x^{\frac{1}{2}} \times x^{\frac{1}{2}}$	(n)	$y^{\frac{1}{3}} \times y^{\frac{2}{3}}$	(o)	$d^{-\frac{1}{4}} \times d^{\frac{9}{4}}$	(p)	$s^{\frac{7}{2}} \times s^{\frac{1}{2}}$
(q)	$3x^{\frac{1}{2}} \times 4x^{\frac{1}{2}}$	(r)	$6x^{\frac{1}{2}} \times 2x^{\frac{1}{2}}$	(s)	$2x^{\frac{1}{2}} \times 5x^{\frac{1}{2}}$	(t)	$3x^{\frac{2}{3}} \times 2x^{\frac{1}{3}}$
(u)	$x^{\frac{1}{2}} \div x^{\frac{1}{2}}$	(v)	$2x^{\frac{1}{2}} \div x^{\frac{1}{2}}$	(w)	$8x^{\frac{2}{3}} \div 2x^{\frac{1}{3}}$	(x)	$6x^{\frac{1}{3}} \div 4x^{\frac{2}{3}}$

9. Simplify each of the following by (i) changing root signs to fractional powers;
(ii) moving x's onto the numerators;
(iii) expanding brackets where necessary.

(a)	$x^{\frac{1}{2}}(x^4 + 1)$	(b)	$x^{-\frac{1}{2}}(x^{\frac{3}{2}} - x^2)$	(c)	$\frac{1}{x^2}(x^{\frac{1}{2}} + x)$	(d)	$\frac{2}{x^{-3}}(x^2 + \frac{1}{x})$
(e)	$\frac{1}{\sqrt{x}}(x^2 - \sqrt{x})$	(f)	$(x^2 + \frac{1}{x})^2$	(g)	$\frac{1}{x}(\sqrt{x} + x)$	(h)	$(x + \frac{1}{\sqrt{x}})^2$
(i)	$x^{-2}(\frac{1}{x} - \sqrt[3]{x})$	(j)	$\frac{x^2 + 3}{x}$	(k)	$\frac{\sqrt{x} - x}{x^2}$	(l)	$\frac{(2x+1)^2}{x^{\frac{3}{2}}}$

10. Find the value of

(a)	$25^{\frac{1}{2}}$	(b)	$81^{\frac{3}{4}}$	(c)	$125^{\frac{2}{3}}$	(d)	$64^{\frac{1}{2}}$	(e)	$216^{\frac{1}{3}}$	(f)	$16^{\frac{1}{4}}$
(g)	$4^{\frac{3}{2}}$	(h)	$16^{\frac{5}{4}}$	(i)	$9^{-\frac{1}{2}}$	(j)	$27^{-\frac{2}{3}}$	(k)	$256^{-\frac{3}{4}}$	(l)	$1000^{-\frac{2}{3}}$

Answers

1.	(a) a^{14}	(b) y^{10}	(c) b^{40}	(d) p^{10}	(e) x^{80}	(f) q^{20}	(g) t^{10}	(h) f^7
	(i) k^{13}	(j) c^{11}						
2.	(a) y^{10}	(b) b^3	(c) p	(d) 1	(e) q^6	(f) d^3	(g) x^6	(h) a^6
	(i) m^{13}	(j) d^8						

3. (a) x^8 (b) y^{40} (c) a^{21} (d) m^{16} (e) b^{18} (f) p^{15}
4. (a) $4b^2$ (b) $343a^3$ (c) $81x^4$ (d) $32y^5$ (e) a^4b^4 (f) x^7y^7
 (g) w^5z^5 (h) s^3t^3 (i) p^3q^6 (j) x^8y^2 (k) $a^{10}b^{15}$ (l) $36a^{10}$
5. (a) $10a^8$ (b) $63x^9$ (e) $24y^7$ (g) $8c^7$
 (i) $k^5 + k^7$ (j) $m^7 - m^8$ (k) $2x^7 + 6x^6$ (l) $10a^7 - 15a^8$
 (m) x^3 (n) m^{14} (o) $10c^4$ (p) $6q^3$
6. (a) $\frac{1}{a^5}$ (b) $\frac{1}{x^2}$ (c) $\frac{1}{p^7}$ (d) $\frac{1}{y^{10}}$ (e) $\frac{2}{b^3}$ (f) $\frac{10}{q^x}$
7. (a) m^{-2} (b) x^5 (c) p^{-3} (d) a^{-8} (e) y^{-12} (f) c^{-15}
 (g) q^{-15} (h) w^8 (i) $20b$ (j) 27 (k) $2k^5$ (l) $1.5d^{-3}$
 (m) $x^5 + x$ (n) $p - p^{-11}$ (o) $6a^6 + 9a^3$ (p) $2m^{-5} - 5m^4$
 (q) v^{10} (r) $6h^{-1}$ (s) $6c^5$ (t) 10
8. (a) x^3 (b) p^2 (c) a^6 (d) $\frac{1}{y^6}$ (e) $\frac{1}{q^2}$ (f) $\frac{1}{k^{\frac{2}{5}}}$
 (g) g^2 (h) $\frac{1}{m^8}$ (i) c^6 (j) $\frac{1}{h^{\frac{5}{2}}}$ (k) $\frac{1}{z^3}$ (l) $\frac{1}{b^{12}}$
 (m) 1 (n) y (o) d^2 (p) s^3 (q) $12x$ (r) 12
 (s) $10x$ (t) $6x^{\frac{1}{3}}$ (u) 1 (v) $2x$ (w) $4x^{\frac{1}{3}}$ (x) $\frac{3}{2x^{\frac{1}{3}}}$
9. (a) $x^{\frac{9}{2}} + x^{\frac{1}{2}}$ (b) $x - x^{\frac{3}{2}}$ (c) $x^{-\frac{3}{2}} + x^{-1}$ (d) $2x^5 + 2x^2$
 (e) $x^{\frac{3}{2}} - 1$ (f) $x^4 + 2x + \frac{1}{x^2}$ (g) $x^{-\frac{1}{2}} + 1$ (h) $x^2 + 2x^{\frac{1}{2}} + x^{-1}$
 (i) $x^{-3} - x^{-\frac{5}{3}}$ (j) $x + 3x^{-1}$ (k) $x^{-\frac{3}{2}} - x^{-1}$ (l) $4x^{\frac{1}{2}} + 4x^{-\frac{1}{2}} + x^{-\frac{3}{2}}$
10. (g) 5 (h) 27 (i) 25 (j) 8 (k) 6 (l) 2
 (m) 8 (n) 32 (o) $\frac{1}{3}$ (p) $\frac{1}{9}$ (q) $\frac{1}{64}$ (r) $\frac{1}{100}$