

## Laws of Indices and Surds (Higher)

**Indices and products**

Simplify fully:

a)  $a^3 \times a^2 = a^5$

b)  $t^5 \times t \times t^3 = t^9$

c)  $h \times h^{-4} \times h^3 = 1$

**Indices and algebraic fractions**

Simplify fully:

a)  $\frac{r^9}{r^2} = r^7$

b)  $\frac{e^3 \times e^7}{e^6} = e^4$

c)  $\frac{c^4 \times g^2 \times g^5 \times c^3}{c^2 \times g^8} = c^5 g^{-1}$

**Arithmetic with surds**

Write in simplest form:

a)  $\sqrt{3} + 4\sqrt{3} = 5\sqrt{3}$

b)  $3\sqrt{2} - 2\sqrt{2} = \sqrt{2}$

c)  $\sqrt{16} - \sqrt{9} = 1$

**Indices and surds**Write in the form  $x^n$  where  $n$  is a fraction in its simplest form:

a)  $\sqrt[4]{h^3} = h^{\frac{3}{4}}$

b)  $\sqrt[3]{d^{-5}} = d^{-\frac{5}{3}}$

Write in the form  $\sqrt[n]{x^b}$ :

c)  $w^{\frac{2}{3}} = \sqrt[3]{w^2}$

**Reducing surds**

Simplify fully:

a)  $\sqrt{98} = 7\sqrt{2}$

c)  $\sqrt{108} = 6\sqrt{3}$

b)  $\sqrt{28} = 2\sqrt{7}$

d)  $\sqrt{116} = 2\sqrt{29}$

**Surds and brackets**

Expand and fully simplify:

a)  $\sqrt{5}(3 + \sqrt{5}) = 3\sqrt{5} + 5$

c)  $\sqrt{2}(\sqrt{14} - \sqrt{3}) = 2\sqrt{7} - \sqrt{6}$

b)  $\sqrt{10}(\sqrt{20} - \sqrt{5}) = 5\sqrt{2}$

d)  $\sqrt{3}(\sqrt{27} + \sqrt{3}) = 12$

**Indices and division**

Simplify fully:

a)  $p^9 \div p^4 = p^5$

c)  $u^2 \div u^3 = u^{-1}$

b)  $w^{-3} \div w^{-5} = w^2$

d)  $d \div d^{-4} = d^5$

**Further simplification**

Simplify:

a)  $3a^2b^5 \times 4a^3b^6 = 12a^5b^{11}$

c)  $\frac{9w^8}{15w} = \frac{3w^7}{5}$

b)  $7d^{-3}e \times 2d^4e^{-3} = 14de^{-2}$

d)  $\frac{2g^3h \times 9g^2h^5}{6g^5h^4} = 3h^2$

**Indices and brackets**

Simplify:

a)  $(r^3)^2 = r^6$

b)  $(x^4)^{-3} = x^{-12}$

Write in the form  $kx^n$  where  $k$  and  $n$  are integers:

c)  $(2j^5)^3 = 8j^{15}$

d)  $3(h^{-2})^{-3} = 3h^6$

**Rationalising denominators**

Rationalise the denominator and simplify fully:

a)  $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

c)  $\frac{1}{1 + \sqrt{7}} = \frac{-1 + \sqrt{7}}{6}$

b)  $\frac{2}{\sqrt{10}} = \frac{\sqrt{10}}{5}$

d)  $\frac{13 + 5\sqrt{7}}{\sqrt{7}} = \frac{13\sqrt{7} + 35}{7}$

**Calculations with brackets**

Evaluate, leaving your answer as a fraction when necessary:

a)  $(-2)^3 = -8$

c)  $(\frac{2}{3})^{-4} = \frac{81}{16}$

b)  $(\frac{3}{4})^3 = \frac{27}{64}$

d)  $(\frac{16}{25})^{-\frac{3}{2}} = \frac{125}{64}$

**Products of binomials involving surds**

Expand and fully simplify:

a)  $(3 + \sqrt{5})(3 + \sqrt{5}) = 6\sqrt{5} + 14$

b)  $(2 + \sqrt{3})(4 - \sqrt{3}) = 5 + 2\sqrt{3}$

c)  $(5 + \sqrt{3})(5 - \sqrt{3}) = 22$

d)  $(\sqrt{3} + \sqrt{6})(3 + \sqrt{2}) = 5\sqrt{3} + 4\sqrt{6}$