4 Indices and surds

1 Simplify the following; give your answers in the form x^n.

a) $3^4 \times 3^8$

b) $4^{-2} \times 4^7$

c) $5^4 \div 5^3$

d) $6^5 \div 6^{-2}$

e) $(2^4)^2$

f) $(7^2)^{-3}$

2 Simplify the following; leave your answers in standard form.

a) $(5 \times 10^4) \times (3 \times 10^3)$

b) $(2 \times 10^6) \times (4 \times 10^{-3})$

c) $(8 \times 10^4) \div (2 \times 10^2)$

d) $(6 \times 10^9) \div (2 \times 10^{-3})$

3 Rewrite each of the following as a number raised to a positive integer power.

a) 2^{-4}

b) 4^{-3}

c) $\left(\frac{1}{2}\right)^{-2}$

d) $\left(\frac{2}{5}\right)^{-3}$

4 Find the value of each of the following. Answer as a whole number or fraction.

a) $5^3 \times 5^{-2}$

b) $7^{-5} \times 7^3$

c) $2^8 \div 2^3$

d) $(3^2)^3$

e) $\left(\frac{2}{3}\right)^{-2}$

f) $\left(\frac{4}{5}\right)^3$

g) $16^{-\frac{1}{2}}$

h) $25^{\frac{3}{2}}$

i) $19^7 \times 19^{-7}$

5 Rank each set of numbers in order of increasing size.

a) $3^3, 4^2, 2^5$

b) $4^{-3}, 7^{-2}, 3^{-4}$

6 Find the value of x.

a) $\frac{2^x \div 2^2}{2^4 \times 2^3} = 2^4$

b) $\frac{(7^5 \times 7)^x}{7^3 \times 7^2} = 7^7$

7 Simplify:

a) $3n^3 \times 2n^2$

b) $5\mathrm{p}^2q^4 \times 3q^{-2}$

c) $(2a^3)^3$

d) $9b^5 \div 3b^2$

e) $6x^2y^{-5} \times 4x^6y^{-4}$

f) $\frac{20a^2b^3}{4a^4b^5}$

8 Find integers a and b such that

a) $5^a \times 2^b = 10^3$

$a =$ $b =$

b) $10^a \div 5^b = 2^6 \times 5^2$.

$a =$ $b =$

9 Write each of the following in its simplest form.

a) $\sqrt{72}$

b) $2\sqrt{2} + 5\sqrt{2}$

c) $\sqrt{32} + \sqrt{128}$

d) $3\sqrt{112} - 2\sqrt{28}$

10 Express each of the following as the square root of a single number:

a) $2\sqrt{5}$

b) $3\sqrt{7}$

c) $9\sqrt{2}$

d) $6\sqrt{3}$

11 Write each of the following in the form $a\sqrt{b}$ where a and b are integers and b is as small as possible.

A rational number is an integer or fraction.

a) $\frac{\sqrt{72}}{64}$

b) $\frac{\sqrt{75}}{16}$

c) $\frac{\sqrt{18}}{8}$

d) $\frac{\sqrt{32}}{144}$

12 Simplify the following by collecting like terms:

a) $(2 + \sqrt{3}) + (6 + 3\sqrt{3})$

b) $5(\sqrt{2} + 1) - 3(1 - \sqrt{2})$

13 Expand and simplify:

a) $(5+\sqrt{5})(5-\sqrt{5})$

b) $\sqrt{2}\,(6+\sqrt{2}\,)$

c) $(6+\sqrt{3}\,)^2$

d) $(5-2\sqrt{2}\,)(5+2\sqrt{2}\,)$

14 Rationalise the denominators. Give each answer in its simplest form.

a) $\dfrac{1}{\sqrt{5}}$

b) $\dfrac{3}{\sqrt{3}}$

c) $\dfrac{1}{\sqrt{6}-2}$

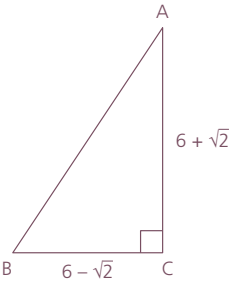
d) $\dfrac{5+\sqrt{2}}{3-\sqrt{2}}$

15 Write the following in the form $a+b\sqrt{c}$ where c is an integer and a and b are rational numbers.

a) $\dfrac{7+\sqrt{3}}{2-\sqrt{3}}$

b) $\dfrac{3\sqrt{3}}{\sqrt{3}-1}$

16 Work out the length of AB. Answer in the simplest surd form.



AB =

17 A rectangle has sides of length x cm and $2x$ cm and a diagonal of length 15 cm.

a) Use Pythagoras' Theorem to find the exact value of x in its simplest surd form.

b) Work out the area of the rectangle.

18 An isosceles triangle has sides of length $\sqrt{5}$ cm, $\sqrt{5}$ cm and $\sqrt{2}$ cm. Work out:

a) the height of the triangle in its simplest surd form

b) the area of the triangle.