**Rules of indices**

 **A LEVEL LINKS**

 **Scheme of work:** 1a. Algebraic expressions – basic algebraic manipulation, indices and surds

Key points

* *am* × *an* = *am* + *n*
* 
* (*am*)*n* = *amn*
* *a*0 = 1
*  i.e. the *n*th root of *a*
* 
* 
* The square root of a number produces two solutions, e.g. .

Examples

**Example 1** Evaluate 100

|  |  |
| --- | --- |
| 100 = 1 | Any value raised to the power of zero is equal to 1 |

**Example 2** Evaluate 

|  |  |
| --- | --- |
|  = 3 | Use the rule  |

**Example 3** Evaluate 

|  |  |
| --- | --- |
|  =  = 9 | **1** Use the rule **2** Use  |

**Example 4** Evaluate 

|  |  |
| --- | --- |
|   | **1** Use the rule **2** Use  |

**Example 5** Simplify 

|  |  |
| --- | --- |
|  = 3*x*3 | 6 ÷ 2 = 3 and use the rule  to give  |

**Example 6** Simplify 

|  |  |
| --- | --- |
|  = *x*8 − 4 = *x*4 | **1** Use the rule **2** Use the rule  |

**Example 7** Write  as a single power of *x*

|  |  |
| --- | --- |
|  | Use the rule , note that the fraction  remains unchanged |

**Example 8** Write  as a single power of *x*

|  |  |
| --- | --- |
|  | **1** Use the rule **2** Use the rule  |

Practice

**1** Evaluate.

 **a** 140 **b** 30 **c** 50 **d** *x*0

**2** Evaluate.

 **a**  **b**  **c**  **d** 

**3** Evaluate.

 **a**  **b**  **c**  **d** 

**4** Evaluate.

 **a** 5–2 **b** 4–3 **c** 2–5 **d** 6–2

**5** Simplify.

 **a**  **b** 

 **c**  **d** 

**Watch out!**

Remember that any value raised to the power of zero is 1. This is the rule *a*0 = 1.

 **e**  **f** 

 **g**  **h** 

**6** Evaluate.

 **a**  **b**  **c** 

 **d**  **e**  **f** 

**7** Write the following as a single power of *x*.

 **a**  **b**  **c** 

 **d**  **e**  **f** 

**8** Write the following without negative or fractional powers.

 **a**  **b** *x*0 **c** 

 **d**  **e**  **f** 

**9** Write the following in the form *axn*.

 **a**  **b**  **c** 

 **d**  **e**  **f** 3

# **Extend**

**10** Write as sums of powers of *x*.

 **a**  **b**  **c** 

Answers

**1 a** 1 **b** 1 **c** 1 **d** 1

**2 a** 7 **b** 4 **c** 5 **d** 2

**3 a** 125 **b** 32 **c** 343 **d** 8

**4 a**  **b**  **c**  **d** 

**5 a**  **b** 5*x*2

 **c** 3*x* **d** 

 **e**  **f** *c*–3

**g** 2*x*6 **h** *x*

**6 a**  **b**  **c** 

 **d**  **e**  **f** 

**7 a** *x*–1 **b** *x*–7 **c** 

 **d**  **e**  **f** 

**8 a**  **b** 1 **c** 

 **d**  **e**  **f** 

**9 a**  **b** 2*x*–3 **c** 

 **d**  **e**  **f** 3*x*0

**10 a**  **b**  **c** 