**Completing the square**

 **A LEVEL LINKS**

 **Scheme of work:** 1b. Quadratic functions – factorising, solving, graphs and the discriminants

Key points

* Completing the square for a quadratic rearranges *ax*2 + *bx* + *c* into the form *p*(*x* + *q*)2 + *r*
* If *a* ≠ 1, then factorise using *a* as a common factor.

Examples

**Example 1** Complete the square for the quadratic expression *x*2 + 6*x* − 2

|  |  |
| --- | --- |
| *x*2 + 6*x* − 2= (*x* + 3)2 − 9 − 2= (*x* + 3)2 − 11 | **1** Write *x*2 + *bx* + *c* in the form **2** Simplify |

**Example 2** Write 2*x*2 − 5*x* + 1 in the form *p*(*x* + *q*)2 + *r*

|  |  |
| --- | --- |
| 2*x*2 − 5*x* + 1= = = =  | **1** Before completing the square write *ax*2 + *bx* + *c* in the form **2** Now complete the square by writing  in the form **3** Expand the square brackets – don’t forget to multiply by the factor of 2**4** Simplify |

Practice

**1** Write the following quadratic expressions in the form (*x* + *p*)2 + *q*

 **a** *x*2 + 4*x* + 3 **b** *x*2 – 10*x* – 3

 **c** *x*2 – 8*x* **d** *x*2 + 6*x*

 **e** *x*2 – 2*x* + 7 **f** *x*2 + 3*x* – 2

**2** Write the following quadratic expressions in the form *p*(*x* + *q*)2 + *r*

 **a** 2*x*2 – 8*x* – 16 **b** 4*x*2 – 8*x* – 16

 **c** 3*x*2 + 12*x* – 9 **d** 2*x*2 + 6*x* – 8

**3** Complete the square.

 **a** 2*x*2 + 3*x* + 6 **b** 3*x*2 – 2*x*

 **c** 5*x*2 + 3*x* **d** 3*x*2 + 5*x* + 3

Extend

**4** Write (25*x*2 + 30*x* + 12) in the form (*ax* + *b*)2 + *c*.

Answers

**1 a** (*x* + 2)2 – 1 **b** (*x* – 5)2 – 28

 **c** (*x* – 4)2 – 16 **d** (*x* + 3)2 – 9

 **e** (*x* – 1)2 + 6 **f** 

**2 a** 2(*x* – 2)2 – 24 **b** 4(*x* – 1)2 – 20

 **c** 3(*x* + 2)2 – 21 **d** 

**3 a**  **b** 

 **c**  **d** 

**4** (5*x* + 3)2 + 3