Complete the square. Fill in the number that makes the polynomial a perfect-square quadratic.

a. $x^2 + 8x +$ ☐

b. $m^2 - 8m +$ ☐

c. $w^2 + 6w +$ ☐

d. $h^2 + 10h +$ ☐

e. $f^2 - 2f +$ ☐

f. $p^2 - 4p +$ ☐

g. $d^2 + 12d +$ ☐

h. $z^2 - 14z +$ ☐

i. $q^2 - 16q +$ ☐

j. $r^2 + 4r +$ ☐

KEYS

a. $x^2 + 8x +$ ☐

With quadratic expression like $x^2 + bx$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$x^2 + 8x + \left(\frac{b}{2}\right)^2$$

$= \quad x^2 + 8x + \left(\frac{b}{2}\right)^2$ Plug in b=8

$= \quad x^2 + 8x + \left(\frac{8}{2}\right)^2$ Divide

$= \quad x^2 + 8x + 4^2$ Square

$= \quad x^2 + 8x + 16$

This quadratic can be written as a square, $(x + 4)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 16.

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b. $m^2 - 8m +$ ☐

With quadratic expression like $m^2 - bm$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$m^2 - 8m + \left(\frac{b}{2}\right)^2$$

$= \quad m^2 - 8m + \left(\frac{b}{2}\right)^2$ Plug in b= - 8

= $m^2 - 8m + \left(\frac{-8}{2}\right)^2$ Divide

= $m^2 + 8m + (-4)^2$ Square

= $m^2 + 8m + 16$

This quadratic can be written as a square, $(m - 4)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 16.

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c. $w^2 + 6w +$ ☐

With quadratic expression like $w^2 + wx$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$w^2 + 6w + \left(\frac{b}{2}\right)^2$$

= $w^2 + 6w + \left(\frac{b}{2}\right)^2$ Plug in b=6

= $w^2 + 6w + \left(\frac{6}{2}\right)^2$ Divide

= $w^2 + 6w + 3^2$ Square

= $w^2 + 6w + 9$

This quadratic can be written as a square, $(w + 3)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 9.

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d. $h^2 + 10h +$ ☐

With quadratic expression like $h^2 + bh$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$h^2 + 10h + \left(\frac{b}{2}\right)^2$$

= $h^2 + 10h + \left(\frac{b}{2}\right)^2$ Plug in b=10

= $h^2 + 10h + \left(\frac{10}{2}\right)^2$ Divide

= $h^2 + 10h + 5^2$ Square

= $h^2 + 10h + 25$

This quadratic can be written as a square, $(h+5)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 25.

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e. $f^2 - 2f +$ ☐

With quadratic expression like $f^2 - bf$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$f^2 - 2f + \left(\frac{b}{2}\right)^2$$

= $f^2 - 2f + \left(\frac{b}{2}\right)^2$ Plug in b=-2

= $f^2 - 2f + \left(\frac{-2}{2}\right)^2$ Divide

= $f^2 - 2f + (-1)^2$ Square

= $f^2 - 2f + 1$

This quadratic can be written as a square, $(f - 1)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 1.

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f. $p^2 - 4p +$ ☐

With quadratic expression like $p^2 - bp$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$p^2 - 4p + \left(\frac{b}{2}\right)^2$$

= $p^2 - 4p + \left(\frac{b}{2}\right)^2$ Plug in b=-4

= $p^2 - 4p + \left(\frac{-4}{2}\right)^2$ Divide

= $p^2 - 4p + (-2)^2$ Square

= $p^2 - 4p + 4$

This quadratic can be written as a square, $(p - 2)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 4.

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g. $d^2 + 12d +$ ☐

With quadratic expression like $d^2 + bd$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$d^2 + 12d + \left(\frac{b}{2}\right)^2$$

= $d^2 + 12d + \left(\frac{b}{2}\right)^2$ Plug in b=12

= $d^2 + 12d + \left(\frac{12}{2}\right)^2$ Divide

= $d^2 + 12d + 6^2$ Square

= $d^2 + 12d + 36$

This quadratic can be written as a square, $(d + 6)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 36.

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h. $z^2 – 14z +$ ☐

With quadratic expression like $d^2 - bd$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$z^2 - 14z + \left(\frac{b}{2}\right)^2$$

= $z^2 - 14z + \left(\frac{b}{2}\right)^2$ Plug in b=-14

= $z^2 - 14z + \left(\frac{-14}{2}\right)^2$ Divide

= $z^2 – 14z + (-7)^2$ Square

= $z^2 – 14z + 49$

This quadratic can be written as a square, $(z - 7)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 49.

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i. $q^2 - 16q + \square$

With quadratic expression like $d^2 - bd$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$q^2 - 16q + \left(\frac{b}{2}\right)^2$$

$= q^2 - 16q + \left(\frac{b}{2}\right)^2$ Plug in b=-16

$= q^2 - 16q + \left(\frac{-16}{2}\right)^2$ Divide

$= q^2 - 16q + (-8)^2$ Square

$= q^2 - 16q + 64$

This quadratic can be written as a square, $(q - 8)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 64.

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j. $r^2 + 4r + \square$

With quadratic expression like $d^2 + bd$, you can complete the square by adding $\left(\frac{b}{2}\right)^2$.

Add $\left(\frac{b}{2}\right)^2$ to complete the square.

$$r^2 + 4r + \left(\frac{b}{2}\right)^2$$

= $r^2 + 4r + \left(\frac{b}{2}\right)^2$ Plug in b=4

= $r^2 + 4r + \left(\frac{4}{2}\right)^2$ Divide

= $r^2 + 4r + 2^2$ Square

= $r^2 + 4r + 4$

This quadratic can be written as a square, $(r + 2)^2$, so it is a perfect-square quadratic. The number needed to complete the square was 4.
