Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_ Block:\_\_\_\_\_

**Completing the square worksheet**

**PRACTICE**

**Complete the square to form a perfect square trinomial. Then factor the trinomial.**

|  |  |  |  |
| --- | --- | --- | --- |
| **1.** | m2 + 10m +        | **2.** | g2 − 20g +        |
|  |                                                  |  |                                                |
| **3.** | y2 + 2y +        | **4.** | w2 − 11w +        |
|  |                                                  |  |                                                |

**Solve the equation by completing the square.**

|  |  |  |  |
| --- | --- | --- | --- |
| **5.** | s2 + 4s = −4 | **6.** | r2 − 10r = 0 |
|  |                                                |  |                                                |
| **7.** | y2 + 4y - 6 = 0 | **8.** | x2 + 6x + 9 = 1 |
|  |                                                |  |                                                |
| **9.** | 3t2 - 12t + 6 = 0 | **10.** | x2 - 3x = *x* - 1 |
|  |                                                |  |                                                |
| **11.** | g2 + 8g = 11 | **12.** | 4p2 +4p + 1 = 49 |
|  |                                                |  |                                                |

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## Writing Quadratic Functions in Different Forms

* **A**  Write the function f(x) = 2(x − 4)2 + 3 in the form f(x) = ax2 + bx + c.

|  |
| --- |
| f(x) = 2(x − 4)2 + 3 |
| f(x) = 2(x2 −  + ) + 3 |   | Multiply to expand (x − 4)2. |
| f(x) = 2(x2) − (8x) + (16) + 3 |   | Distribute 2. |
| f(x) = 2x2 −  +  +3 |   | Multiply. |
| f(x) = 2x2 − 16x +  |   | Combine like terms. |

So, f(x) = 2(x − 4)2 + 3 is equivalent to .

* **B**  Write the function f(x) = x2 + 6x + 4 in vertex form.
Recall that the vertex form of a quadratic function is f(x) = a(x − h)2 + k. Write the given function in vertex form by completing the square.

|  |
| --- |
| f(x) = x2 + 6x + 4 |
|  |   | Set up for completing the square. |
| f(x) = (x2 + 6x +9) + 4 − 9 |   | Add a constant so the expression inside the parentheses is a perfect square trinomial. Subtract the constant to keep the equation balanced. |
| f(x) = (x + )2 + 4 − 9 |   | Write (x2 + 6x + 9) as a binomial squared. |
| f(x) = (x + 3)2 −  |   | Combine like terms. |

So, f(x) = x2 + 6x + 4 is equivalent to .

**Graph the function by first writing it in vertex form. Then give the maximum or minimum of the function and identify its zeros.**

 **A**  f(x) = x2 − 8x + 12

|  |  |  |  |
| --- | --- | --- | --- |
|  | **•** | Write the function in vertex form. |  |
|  |  |  | Set up for completing the square. |
|  |  | f(x) = (x2 − 8x + ) + 12 −  | Add a constant to complete the square. Subtract the constant to keep the equation balanced. |
|  |  | f(x) = (x − )2 + 12 − 16 | Write the expression in parentheses as a binomial squared. |
|  |  | f(x) = (x − 4)2 −  | Combine like terms. |
|  |  |  |  |
|  | **•** | The vertex is .Two points to the left of the vertex are(2, ) and (3, ) .Two points to the right of the vertex are(5, ) and (6, ).Describe the function’s properties. The minimum is. The zeros are and . |  |

 **B**  f(x) = −2x2 − 12x − 16

|  |  |  |  |
| --- | --- | --- | --- |
|  | **•** | Write the function in vertex form. |  |
|  |  | f(x) = (x2 + 6x) − 16 | Factor the variable terms so that the coefficient of x2 is 1. |
|  |  |  | Set up for completing the square. |
|  |  | f(x) = −2 (x2 + 6x + ) − 16 − (−2) | Complete the square. Since the constant is multiplied by −2, subtract the product of −2 and the constant to keep the equation balanced. |
|  |  | f(x) = −2 (x + )2 − 16 − (−2)9 | Write the expression in parentheses as a binomial squared. |
|  |  | f(x) = −2(x + 3)2 − 16 − () | Simplify (−2)9. |
|  |  | f(x) = −2(x + 3)2 +  | Combine like terms. |
|  |  |  |  |
|  | **•** | Sketch a graph of the function.The vertex is .Two points to the left of the vertex are ( −5, ) and (−4,).Two points to the right of the vertex are(−2, ) and (− 1, ).Describe the function’s properties.The maximum is .The zeros are and  . |  |

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## Writing Quadratic Functions in Vertex Form

**Write the function in vertex form. Then give the maximum or minimum of the function and identify its zeros.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1.** | f(x) = x2 − 6x + 9 |        | **2.** | f(x) = x2 − 2x − 3 |
|  |  |  |  |  |
|    |  |      |    |  |
|  |  |  |  |  |
|  | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |    | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
|  |  |  |  |  |
| **3.** | f(x) = −7 x2 − 14x |        | **4.** | f(x) = 3x2 − 12x - 9 |
|  |  |  |  |  |
|    |  |      |    |  |
|  |  |  |  |  |
|  | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |    | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
|  |  |  |  |  |
| **5.** | f(x) = 2x2 − 6x - 1 |        | **6.** | f(x) = - x2 + 4x - 1 |
|  |  |  |  |  |
|    |  |      |    |  |
|  |  |  |  |  |
|  | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |    | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

* **5.** A company is marketing a new toy. The function s(p) = −50p2 + 3000p models how the total sales s of the toy, in dollars, depend on the price p of the toy, in dollars.
* **a.** Write the function in vertex form.

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* **b.** What is the vertex of the graph of the function? What does the vertex represent in this situation?

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* **6.** A circus performer throws a ball from a height of 32 feet. The model h(t) = −16t2 + 16t + 32 gives the height of the ball in feet t seconds after it is thrown.
* **a.** Write the function in vertex form.

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* **b.** What is the maximum height that the ball reaches?

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* **c.** What is a reasonable domain of the function? Explain.

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* **d.** What is the y-intercept of the function’s graph? What does it represent in this situation? What do you notice about the y-intercept and the value of c when the function is written in standard form?

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