Completing the Square with Exact Values

Why fractions? Some quadratic functions have fractional vertex coordinates. The method has not changed: keep values exact rather than changing them to decimals.

Reminder:

Factor a from the quadratic.
Halve the coefficient of x.
Account for the coefficient outside.

Example: $y = 6x^2 - 8x + 1$.
Example: $y = 16x^2 - 30x + 11$.

For **every** quadratic function, complete the square, write the function in **exact vertex form**, and state its **exact vertex**. Show your algebraic steps. Simplify fractions when necessary. **No decimals.**

Mild

1. $y = 2x^2 + 2x + 3$

2. $y = 2x^2 + 6x + 1$

Medium

3. $y = 3x^2 + 9x + 5$

4. $y = 2x^2 + 3x + 2$

5. $y = 4x^2 - 6x + 1$

6. $y = 8x^2 - 10x - 3$

7. $y = 5x^2 - 7x - 1$

Spicy

8. $y = 6x^2 - 7x + 1$

9. $y = -9x^2 + 13x - 4$

10. $y = 12x^2 - 17x + 4$

11. $y = 16x^2 - 23x + 3$

Extra Spicy

12. $y = 20x^2 - 27x + 7$

13. $y = -18x^2 + 29x - 7$

14. $y = 32x^2 - 59x + 17$

15. $y = 142x^2 - 375x + 147$

16. **Error Analysis:** For Question 7, a learner halves -10. Explain the error.

17. **Understanding the Outside Coefficient:** For Question 10, explain how the negative leading coefficient affects the constant correction.

18. **Verification:** Expand your vertex form for Question 8 to confirm that it reproduces the original quadratic function.