

Absolute Value Equations and Inequalities

Name: _____ Date: _____ Score: _____ / 24

Quick Review

The **absolute value** $|x|$ measures how far x sits from 0 on the number line, so it is never negative. To solve $|x| = c$ when $c \geq 0$, split it into **two cases**: $x = c$ or $x = -c$. For $|x| < c$, the answer is the band *between* the boundaries, $-c < x < c$ (an “and” statement). For $|x| > c$, the answer is everything *outside* the boundaries, $x < -c$ or $x > c$. And if c is negative, $|x| = c$ has **no solution** — a distance can never be negative.

◊ **Example:** Solve $|2x - 1| = 9$.

⇒ Here is the key idea: the expression $2x - 1$ sits 9 units from zero, and that can happen in *two* ways — it could be 9 or it could be -9 . So we make two little equations and solve each one. **First way:** $2x - 1 = 9$, so $2x = 10$ and $x = 5$. **Second way:** $2x - 1 = -9$, so $2x = -8$ and $x = -4$. Both answers check out — with absolute value, always keep both!

Answer: $x = 5$ or $x = -4$

PRACTICE

Solve each equation or inequality. Write the complete solution set.

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|--------------------|-------|-----------------------|-------|
| 1. $ x = 8$ | _____ | 11. $ 5x - 10 = 25$ | _____ |
| 2. $ x = 15$ | _____ | 12. $ 4x + 4 = 12$ | _____ |
| 3. $ x - 6 = 10$ | _____ | 13. $ x < 6$ | _____ |
| 4. $ x + 3 = 7$ | _____ | 14. $ x \leq 9$ | _____ |
| 5. $ 2x = 14$ | _____ | 15. $ x - 2 < 5$ | _____ |
| 6. $ 3x = 21$ | _____ | 16. $ x + 4 \leq 10$ | _____ |
| 7. $ x + 9 = 0$ | _____ | 17. $ x > 3$ | _____ |
| 8. $ 2x - 5 = 11$ | _____ | 18. $ x \geq 8$ | _____ |
| 9. $ 3x + 6 = 18$ | _____ | 19. $ x - 5 > 2$ | _____ |
| 10. $ x - 7 = -2$ | _____ | 20. $ 2x + 2 \leq 8$ | _____ |

Word Problems

21. A thermostat keeps a greenhouse within 3°F of 68°F . Write and solve an absolute value inequality for the acceptable temperature T . _____
22. A snack bag should weigh 9 oz, with an allowed error of 0.4 oz. Write and solve an absolute value inequality for the acceptable weight w . _____
23. A machine cuts bolts to a diameter of 12 mm and must stay within 0.05 mm of that target. Write and solve an absolute value inequality for the acceptable diameter d . _____
24. A delivery drone is told to stay within 50 ft of its planned altitude of 400 ft. Write and solve an absolute value inequality for the acceptable altitude a . _____



Answer Keys

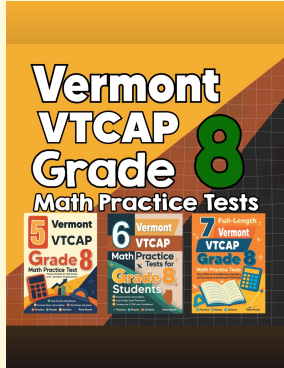
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| <p>1. $x = \pm 8$</p> <p>2. $x = \pm 15$</p> <p>3. $x = 16$ or $x = -4$</p> <p>4. $x = 4$ or $x = -10$</p> <p>5. $x = \pm 7$</p> <p>6. $x = \pm 7$</p> <p>7. $x = -9$</p> <p>8. $x = 8$ or $x = -3$</p> <p>9. $x = 4$ or $x = -8$</p> <p>10. no solution</p> <p>11. $x = 7$ or $x = -3$</p> <p>12. $x = 2$ or $x = -4$</p> | <p>13. $-6 < x < 6$</p> <p>14. $-9 \leq x \leq 9$</p> <p>15. $-3 < x < 7$</p> <p>16. $-14 \leq x \leq 6$</p> <p>17. $x < -3$ or $x > 3$</p> <p>18. $x \leq -8$ or $x \geq 8$</p> <p>19. $x < 3$ or $x > 7$</p> <p>20. $-5 \leq x \leq 3$</p> <p>21. $T - 68 \leq 3$; $65 \leq T \leq 71$</p> <p>22. $w - 9 \leq 0.4$; $8.6 \leq w \leq 9.4$</p> <p>23. $d - 12 \leq 0.05$; $11.95 \leq d \leq 12.05$</p> <p>24. $a - 400 \leq 50$; $350 \leq a \leq 450$</p> |
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Step-by-Step Explanations

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| <p>1. Absolute value asks "how far from zero?" Two numbers sit 8 units away — 8 and -8 — so $x = \pm 8$.</p> <p>2. Same idea: the numbers exactly 15 units from 0 are 15 and -15, giving $x = \pm 15$.</p> <p>3. Set the inside equal to 10 and to -10: $x - 6 = 10$ gives $x = 16$, and $x - 6 = -10$ gives $x = -4$.</p> <p>4. Two cases again: $x + 3 = 7 \Rightarrow x = 4$, and $x + 3 = -7 \Rightarrow x = -10$. Always check both!</p> <p>5. If $2x = 14$, then $2x = \pm 14$. Divide by 2 to get $x = \pm 7$.</p> <p>6. From $3x = 21$ we get $3x = \pm 21$. Dividing by 3 gives $x = \pm 7$.</p> <p>7. Zero is special — an absolute value equals 0 only when the inside is 0. So $x + 9 = 0$ and $x = -9$ (just one answer).</p> <p>8. $2x - 5 = 11 \Rightarrow 2x = 16 \Rightarrow x = 8$. $2x - 5 = -11 \Rightarrow 2x = -6 \Rightarrow x = -3$.</p> <p>9. $3x + 6 = 18 \Rightarrow x = 4$. $3x + 6 = -18 \Rightarrow 3x = -24 \Rightarrow x = -8$.</p> <p>10. Pause before solving — the right side is negative. A distance can never be -2, so there is no solution.</p> <p>11. $5x - 10 = 25 \Rightarrow 5x = 35 \Rightarrow x = 7$. $5x - 10 = -25 \Rightarrow 5x = -15 \Rightarrow x = -3$.</p> <p>12. $4x + 4 = 12 \Rightarrow 4x = 8 \Rightarrow x = 2$. $4x + 4 = -12 \Rightarrow 4x = -16 \Rightarrow x = -4$.</p> | <p>13. "Less than" makes a band. Everything closer than 6 units to zero works: $-6 < x < 6$.</p> <p>14. Same band idea, but \leq includes the endpoints: $-9 \leq x \leq 9$.</p> <p>15. Unpack to $-5 < x - 2 < 5$, then add 2 to every part: $-3 < x < 7$.</p> <p>16. Unpack to $-10 \leq x + 4 \leq 10$, then subtract 4 everywhere: $-14 \leq x \leq 6$.</p> <p>17. "Greater than" splits into two pieces — the values <i>outside</i> the band: $x < -3$ or $x > 3$.</p> <p>18. Outside the band again, and \geq keeps the endpoints: $x \leq -8$ or $x \geq 8$.</p> <p>19. Split it: $x - 5 > 2 \Rightarrow x > 7$, and $x - 5 < -2 \Rightarrow x < 3$.</p> <p>20. Unpack to $-8 \leq 2x + 2 \leq 8$, subtract 2 to get $-10 \leq 2x \leq 6$, then divide by 2: $-5 \leq x \leq 3$.</p> <p>21. "Within 3° of 68°" is exactly what absolute value describes, so write $T - 68 \leq 3$. Unpacking gives $-3 \leq T - 68 \leq 3$, so $65 \leq T \leq 71$ (degrees F).</p> <p>22. The weight may differ from 9 oz by at most 0.4 oz: $w - 9 \leq 0.4$. That unpacks to $-0.4 \leq w - 9 \leq 0.4$, so $8.6 \leq w \leq 9.4$ oz.</p> <p>23. The diameter is within 0.05 mm of 12 mm, so $d - 12 \leq 0.05$. Unpack: $-0.05 \leq d - 12 \leq 0.05$, which gives $11.95 \leq d \leq 12.05$ mm.</p> <p>24. "Within 50 ft of 400 ft" becomes $a - 400 \leq 50$. Unpacking gives $-50 \leq a - 400 \leq 50$, so the drone may fly between 350 ft and 450 ft.</p> |
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