C3 Modulus Function

Solve the following equations.

1. $|2x| = 7$. $\boxed{x = \pm\frac{7}{2}}$
2. $|x| + 10 = 0$. $\boxed{\text{No solutions}}$
3. $|x + 6| = 7$. $\boxed{x = 1 \text{ or } x = -13}$
4. $2|x - 5| + 1 = 3$. $\boxed{x = 4 \text{ or } x = 6}$
5. $|x - a| = 1$. $\boxed{x = a - 1 \text{ or } x = a + 1}$
6. $|x + 2| = |x + 3|$. $\boxed{x = -\frac{5}{2}}$
7. $|3x - 2| = |7x - 1|$. $\boxed{x = -\frac{1}{4} \text{ or } x = \frac{3}{10}}$
8. $|3x - 2| = |7x - 1| + 1$.
9. $x + 2 = |x| + |2x - 1|$. $\boxed{x = -\frac{1}{4} \text{ or } x = \frac{3}{2}}$
10. $-\frac{1}{2}x = |x| - |x + 1|$. $\boxed{x = -2 \text{ or } x = -\frac{2}{3} \text{ or } x = 2}$
11. $|x| + 2 = 2 - |2x - 1|$. $\boxed{\text{No solutions}}$
12. $|x - 2| + |x + 2| = |\frac{x}{2}| + \frac{7}{2}$. $\boxed{x = -\frac{7}{3} \text{ or } x = -1 \text{ or } x = 1 \text{ or } x = \frac{7}{3}}$
13. $x = |-x| + |x| - |2x - 3|$. $\boxed{x = -3 \text{ or } x = 1 \text{ or } x = 3}$
14. $7 - |x + 3| = 2|x - 2| + |x - 1|$. $\boxed{x = \frac{1}{2} \text{ or } x = \frac{9}{4}}$
15. $|x + 1| - |x| + 3|x - 1| - 2|x - 2| = x + 2$ [USSR Olympiad]. $\boxed{x = -2 \text{ or } x \geqslant 2}$

Sketch the following graphs.

1. $y = |x - 3|$.
2. $y = |2x + 1|$.
3. $y = |x - 4| - 4$.
4. $y = |x| - |x - 2|$.
5. $y = |x| + |x - 2|$.
6. $y = |x| - |x + 3| + |3x - 1|$.
7. $y = |x^2 - 4|$.
8. $y = |x^2 - 4| - |x^2 - 1|$.
9. $y = |x^2 - 4| + |x^2 - 1|$.
10. $y = |x^3 - x| - |x^3|$.

Solve the following inequalities.

1. $2 - |x| < |x - 2| + |2x| - |x + 4|$. $\boxed{x < \frac{4}{5} \text{ or } x > \frac{8}{3}}$
2. $|x| - |2x + 3| - |x - 5| \leqslant -\frac{x}{2} - 7$. $\boxed{x \leqslant -2 \text{ or } -\frac{2}{3} \leqslant x \leqslant 2 \text{ or } x \geqslant 6}$
3. $|3x| - |x - 3| - |x + 4| > 2x - 6$. $\boxed{x < -\frac{1}{5} \text{ or } 1 < x < 5}$
4. $|x^2 + x| - |x^2 - x - 2| > x$. $\boxed{-2 < x < -\frac{2}{3} \text{ or } x > \frac{1+\sqrt{17}}{4}}$