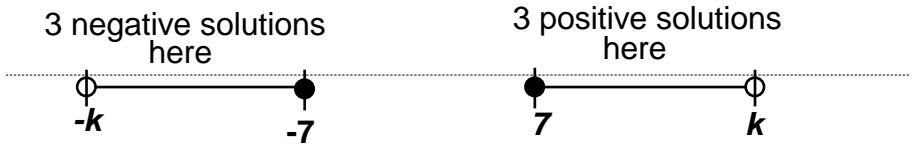


**MASSACHUSETTS MATHEMATICS LEAGUE
CONTEST 1 - OCTOBER 2016 SOLUTION KEY**

Round 5

A) Graphically, the solution set is



$$k = \underline{10} \Rightarrow -7, -8, -9, 7, 8, 9$$

B) Clearly, $x \leq 7$, otherwise the right side of the equation is negative and the result would be extraneous.

$$|3x+1| = \begin{cases} 3x+1 \\ -(3x+1) \end{cases} \text{ depending on whether } x \geq -\frac{1}{3} \text{ or } x < -\frac{1}{3}.$$

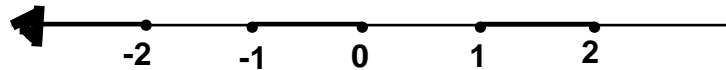
$$\text{For } x \geq -\frac{1}{3}, 3x+1 \leq 7-x \Rightarrow x \leq \frac{3}{2} \Rightarrow -\frac{1}{3} \leq x \leq \frac{3}{2}$$

$$\text{For } x < -\frac{1}{3}, -3x-1 \leq 7-x \Rightarrow x \geq -4 \Rightarrow -4 \leq x < -\frac{1}{3}$$

$$\Rightarrow \underline{-4 \leq x \leq \frac{3}{2}}.$$

$$\text{C) } -x^5 + 5x^3 - 4x = -x(x^4 - 5x^2 + 4) = -x(x^2 - 1)(x^2 - 4) > 0$$

Multiplying by -1 and factoring, $x(x+1)(x-1)(x+2)(x-2) < 0$, we have critical points at $x = -2, -1, 0, 1$ and 2 . At the extreme left, all 5 factors are negative. As we move from left to right, every time a critical point is passed one more factor becomes positive.



So the sign of the product alternates negative and positive. In the highlighted regions, the product is negative, i.e. $x < -2$ or $-1 < x < 0$ or $1 < x < 2$.