**2**. [12 points] Consider the function $y = p(x) = 2x^2 - \sqrt{33}x - 6$.

**a**. [4 points] Find the zeros of $p(x)$ in exact form, if there are any, or explain why there aren't any. Show your work. Answers obtained using a calculator with no work shown will receive no credit.

The zeros of $p(x)$ are $\frac{\sqrt{33}\pm 9}{4}$

*Solution:* Using the quadratic formula, we have

$$x = \frac{\sqrt{33} \pm \sqrt{33 - 4(-6)(2)}}{4} = \frac{\sqrt{33} \pm 9}{4}$$

**b**. [5 points] Find the $x-$ and $y-$coordinates of the vertex of $p(x)$ by completing the square. You must show all your steps and write $p(x)$ in vertex form to receive credit.

The vertex of $p(x)$ is $(\frac{\sqrt{33}}{4}, -\frac{81}{8})$

*Solution:* $p(x) = 2x^2 - \sqrt{33}x - 6$.
$p(x) = 2(x^2 - \frac{\sqrt{33}}{2}x) - 6$.
$p(x) = 2(x^2 - \frac{\sqrt{33}}{2}x + \frac{33}{16}) - 6 - 2(\frac{33}{16})$.
$p(x) = 2(x^2 - \frac{\sqrt{33}}{4})^2 - \frac{81}{8}$.

**c**. [3 points] Suppose $p(x + h) = 2x^2 + \sqrt{33}x - 6$ for some number $h$. Find $h$. Support your answer with graphical or algebraic evidence.

$h =$ $\frac{\sqrt{33}}{2}$

*Solution:* Completing the square for $p(x + h)$ is identical to the calculation for $p(x)$ except you have $(x + \frac{\sqrt{33}}{4})^2$ instead of $(x - \frac{\sqrt{33}}{4})^2$. This means

$$p(x + h) = 2(x^2 + \frac{\sqrt{33}}{4})^2 - \frac{81}{8}.$$

This means the vertex of this new function is $(-\frac{\sqrt{33}}{4}, -\frac{81}{8})$, so the shift must have been $\frac{\sqrt{33}}{2}$ to the left.