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Quadratic Functions

Question 1 a)

As a varies, the graph stretches when $a > 1$ and compresses when $0 < a < 1$

As p varies, the graph moves to either the right (when p is negative) or left (when p is positive).

As q varies, the graph moves either up (when q is positive) or down (when q is negative).

Question 1 b)

I would first find the vertex which is equal to is at (AOS, optimal value), or $(\frac{-b}{2a}, \frac{-b^2}{4a} + c)$.

In this case it would be at $(\frac{-13}{6}, \frac{-169}{12} + 4)$

Then by using the step property, which is $1a, 3a, 5a \cdots \implies 3, 9, 15 \cdots$, I can plot the points on the graph. In addition, since a is positive, the graph will be opening upward.

Question 2 a)

By plugging 3 as the time into the relation $h = -5t^2 + 100t$, we get:

$h = -5(3)^2 + 100(3) \implies h = -5(9) + 300 \implies h = 255$

The flare will be $255m$ tall.

Question 2 b)

The maximum height reached by the flare is when $t = \frac{-b}{2a}$ (optimal value).

So, $\frac{-b}{2a} = \frac{-100}{-10} = 10$

$\therefore h = -5(10)^2 + 100(10) \implies h = 500$

The maximum height reached by the flare is $500m$.

Question 2 c)

By setting $h = 80$, we can get the 2 times where the flare reaches $80m$, and by taking the difference in x values, we get the time the flare stayed above $80m$.

$80 = -5t^2 + 100t$

$5t^2 - 100t + 80 = 0$

$t^2 - 20t + 16 = 0$

$t = \frac{20 \pm \sqrt{366}}{2}$

$\therefore$ The duration is $2(\frac{\sqrt{336}}{2}) = \sqrt{336}$

Question 3 a)

We can represent the area as hw, where $h + w = 20$, so we can model a quadratic equation as such: $w(20 - w)$. Therefore the AOS is when $w = 10$

Question 3 b)

Since the maximum area is when $w = 10$, and $h = 20 - w \implies h = 10$. So the dimension is a pen $10m$ by $10m$.

Question 4

The cross-sectional area can be modeled by the equation $(50-2x)x$.

Therefore the AOS is when $\frac{25}{2}$ since $x=0,25$ are the solutions to this quadratic equation when it equals 0, and the AOS is the average of them both.

Therefore the value of $x=12.5cm$ gives the maximum area for the sectional area.