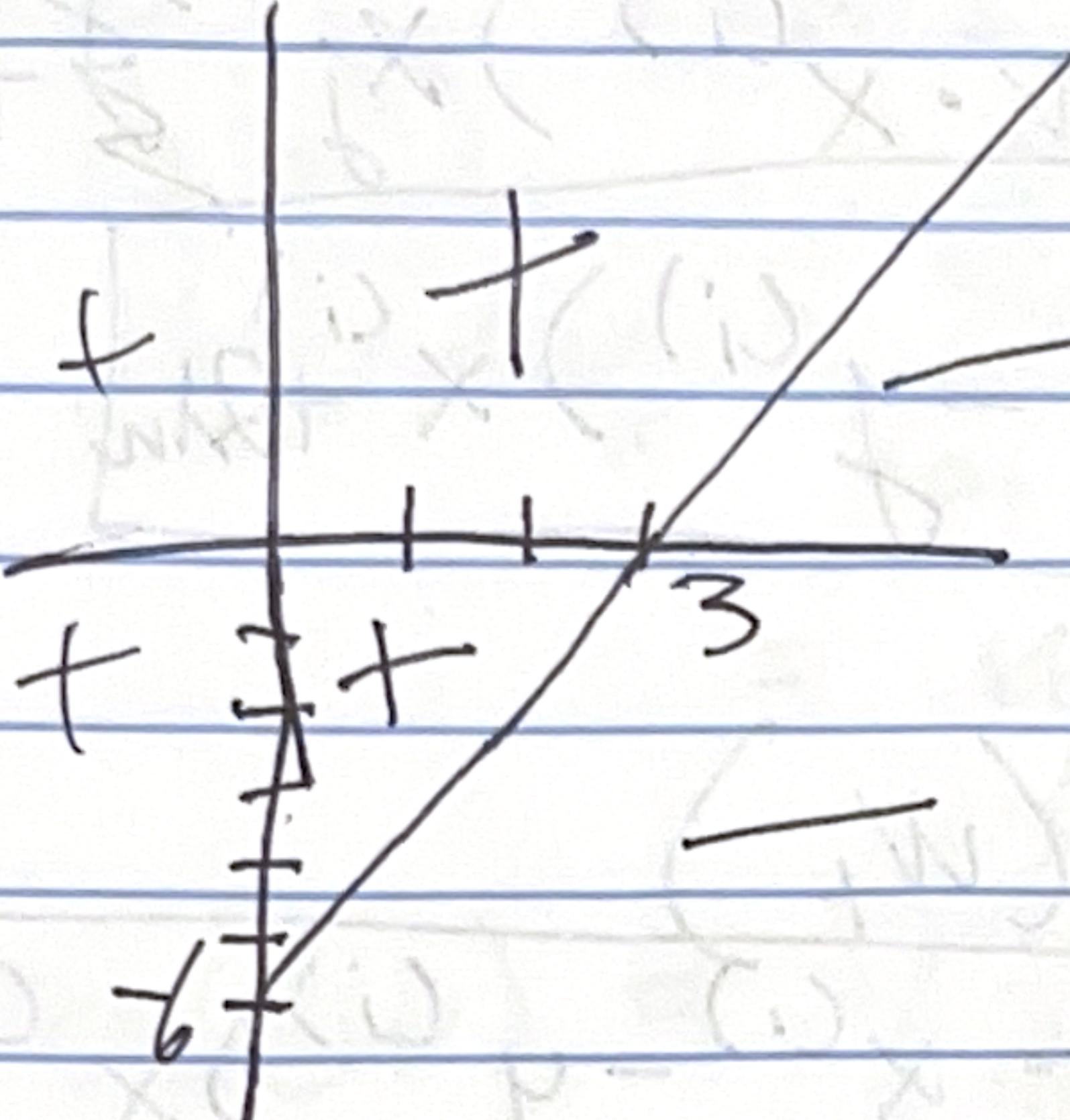


# HW #6

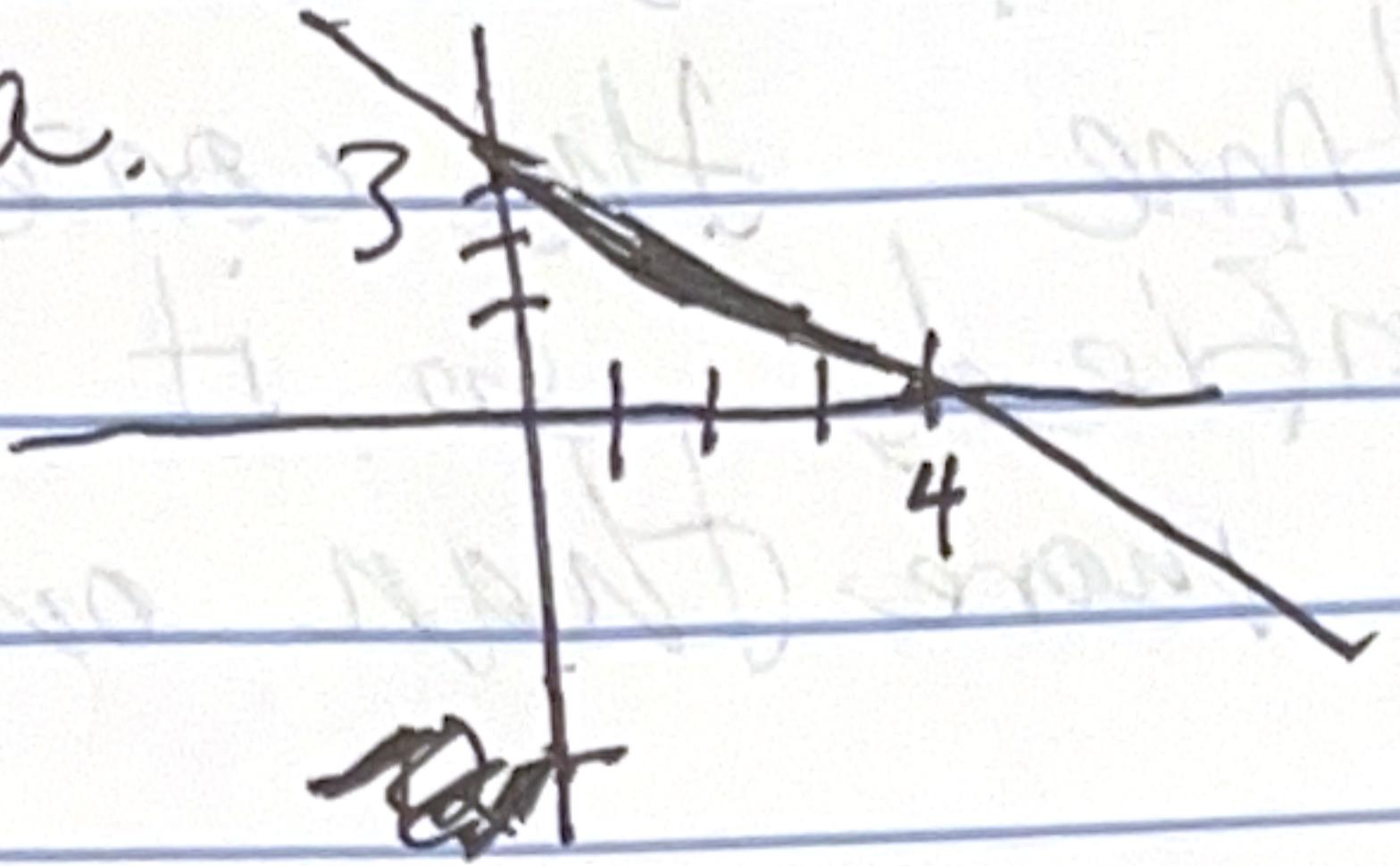
1.  $(2x_1 - x_2 - 6) = 0$      $x_2 = 2x_1 - 6$      $x_1 = 3$   
 $x_2 = -6$



2. a. Definitely true, because the Perceptron algorithm converged.
- b. Definitely true, because the data is linearly separable, the algorithm will always converge regardless of the permutation of the data.
- c. Possibly false, depending on which the order of the points, it could take more or less updates before convergence.
- d. Possibly false, because the algorithm is not bounded by n, and could pass through the dataset many times before it misclassifies a point and updates the weights.

3.  $b = b_0 + \sum y_i$ , p+q updates  
 $b = b_0 + q - p$

4.  $w = (3, 4)$   $b = -12$   $3x_1 + 4x_2 - 12 = 0$

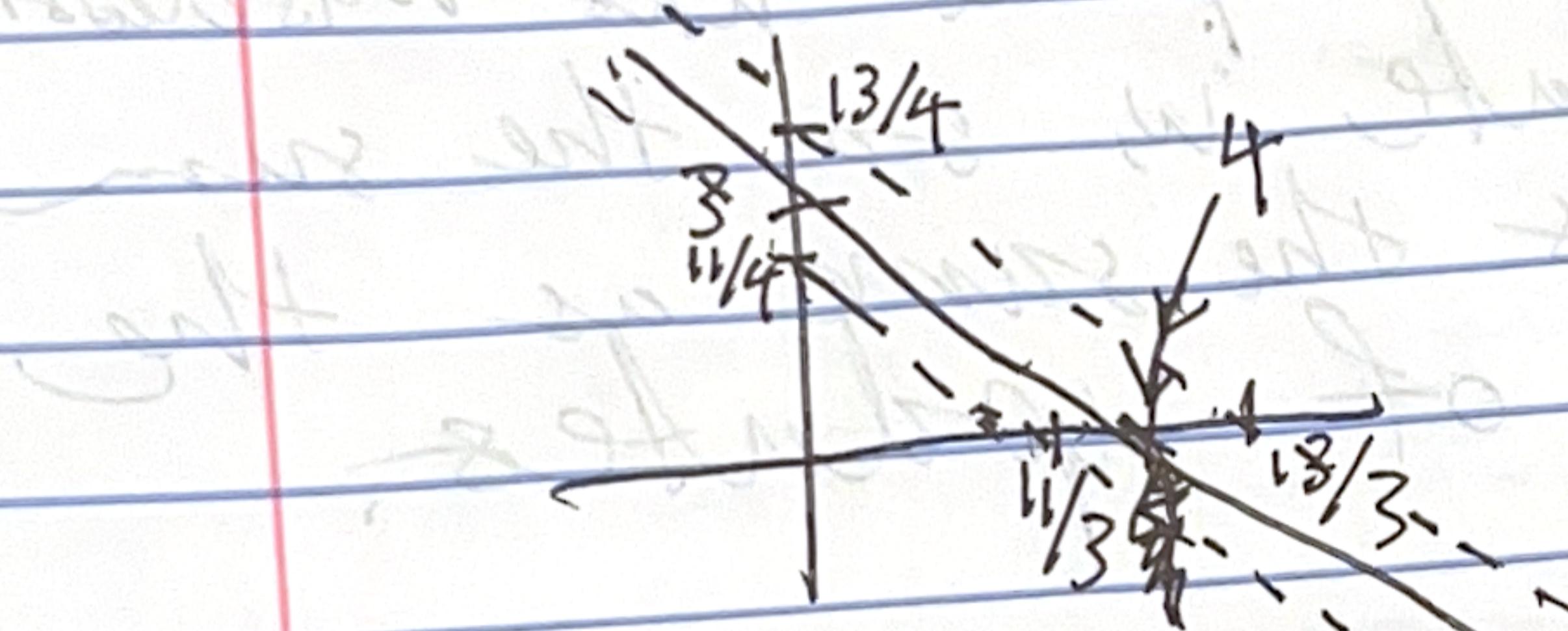
a.   $x_1 = 4$   $x_2 = 3$

b.  $3x_1 + 4x_2 - 12 = 1$   $3x_1 + 4x_2 - 13 = 0$

$$x_2 = -\frac{3}{4}x_1 + \frac{13}{4}$$

$$3x_1 + 4x_2 - 13 = 0$$

$$x_2 = -\frac{3}{4}x_1 + \frac{11}{4}$$



c.  $\gamma = 2/\|w\|$   $w = (3, 4)$

$$\|w\| = \sqrt{3^2 + 4^2} = 5$$

$$\gamma = 2/5$$

d.  $(2, 2)$   $3(2) + 4(2) - 12 = 2 > 0$

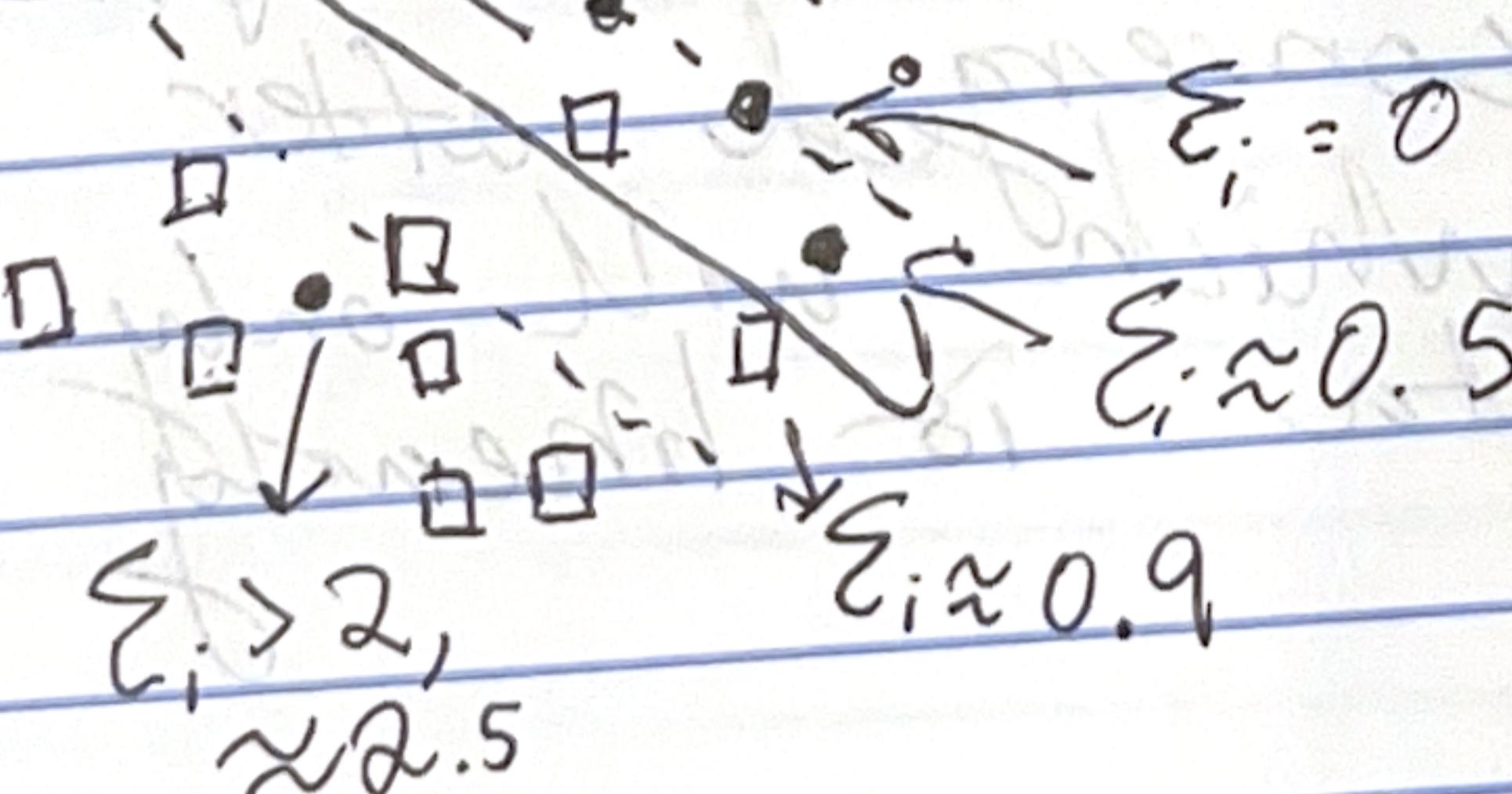
[Positive, +]

$$\varepsilon_i \approx 1.5$$

$$\varepsilon_i = 0$$

5. a.

rest slack is zero



b. Increasing  $C$  will cause the margin to decrease, because we are increasing the penalty on points within the margins.

6. a. Possibly false,  $\alpha_i$  is a counter for each time the corresponding point is misclassified, so it can be misclassified more than once.

b.  $\sum_i \alpha_i = k$

Necessarily true, because  $\alpha_i$  is the # of times the given point was misclassified and used to update  $w$ , so the sum of all of them is the same as the total number of updates.

c. Necessarily true, the most ~~far but~~ since there are  $k$  updates, and  $\alpha_i$  is the # of updates for the  $i$ th point, the max number of nonzero  $\alpha_i$  values would be  $k$ , when there is one per update.

d. Necessary

Necessarily true, because the Perceptron algorithm converged after  $k$  updates, which will only occur iff the data is linearly separable.