Week 9 Activities: Newton's Method

Required Materials

- 3 physical copies each of Image A and Image B at the end of the document.
- Straight edge or ruler.
- Pen or pencil.

1. On your first copy, carefully draw the tangent line of f(x) at $x = a_0$.
    - Label the place where this tangent line crosses the x axis as a1.
    - Find and label the point, (a1, f(a1)).
    - Repeat #1-3 until you have found a2, a3, and a4.
    - What value are the a's approaching?

the values of a approach r

You have just used Newton's Method for finding the root of an equation.

2. On a second copy of the image, repeat and illustrate this method with a different starting point between 0 and r. Did you get the same result?

approximately yes!

3. On a third copy of the image, try this method at a starting point where the derivative of f(x) appears to be 0.

- What happens? The tangent line does not cross the x-axis, can't find a_1.
- If we were coding this method with a user chosen starting point, what error message should be returned?
- What is a simple next step if the user gets this error?

Invalid starting point- slope =0 choose a different start point

Choose the next point along f(x) that does not have slope of 0, ideally a much larger slope

4. Make 3 physical copies of Image B at the end of the document. On each copy, pick a starting point and illustrate finding a root using Newton's Method.

5. Now let's code Newton's method to take a user start value and return a root of the f(x) - no graphs.

Hard code in the function f(x) = x^2 / 4 + x/4 - 5.

Include a method for calculating the derivative at a point. You may hard code in the derivative function of f(x) or use a numerical derivative-at-a-point solver (from a previous Activity).

Let the user input a starting point.

6. Test your code with various inputs. f(x) has roots at 4 and –5.

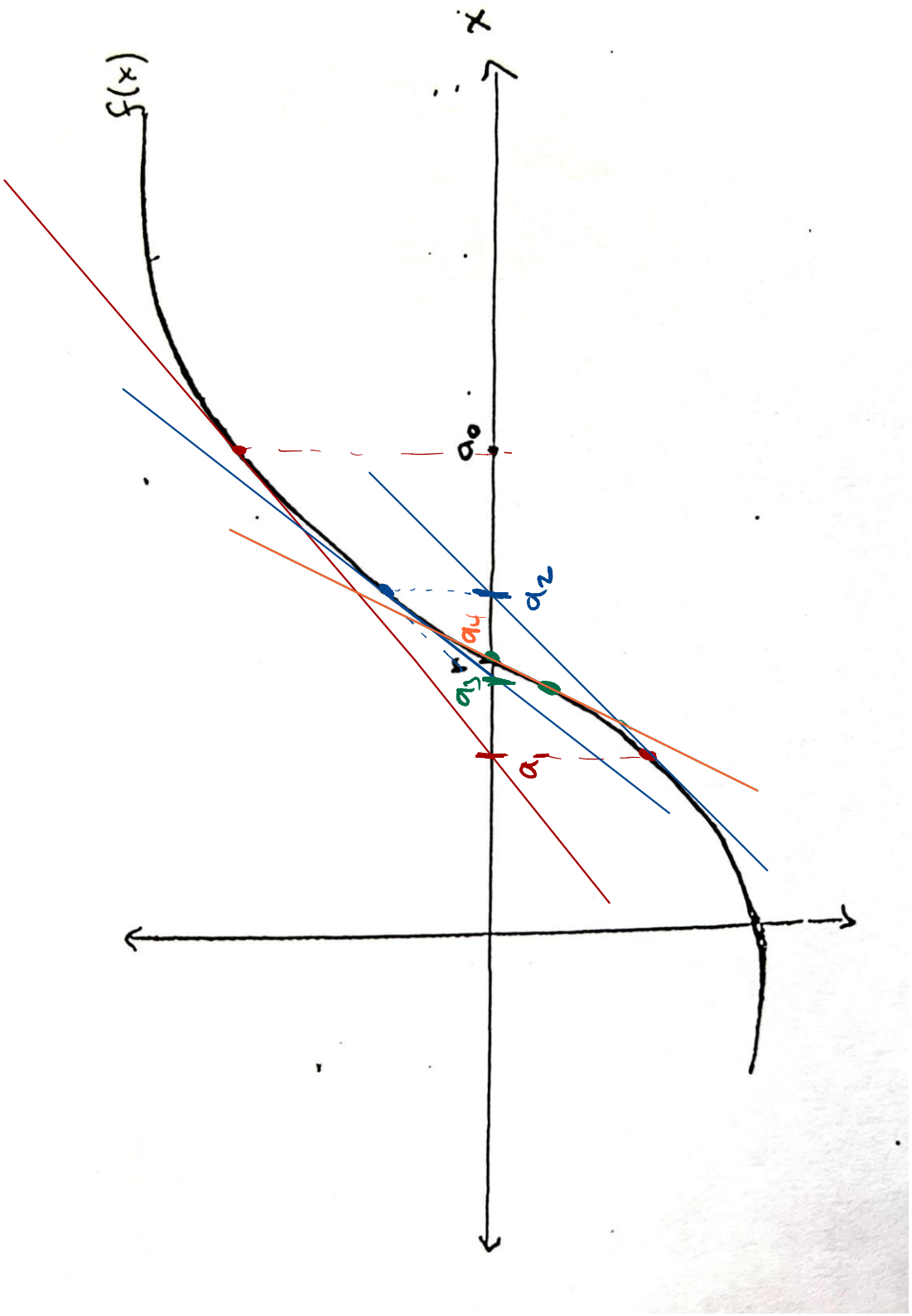
- Can your code find both?
- How many random inputs does it take for you to find both roots?

7. What starting value for this f(x) will result in an error (do you have an error message?). Illustrate what happens when you input this failed start value.

8. Now add graphs and demo the graphs to illustrate Newton's Method with a series of images or an animation of Newton's method.

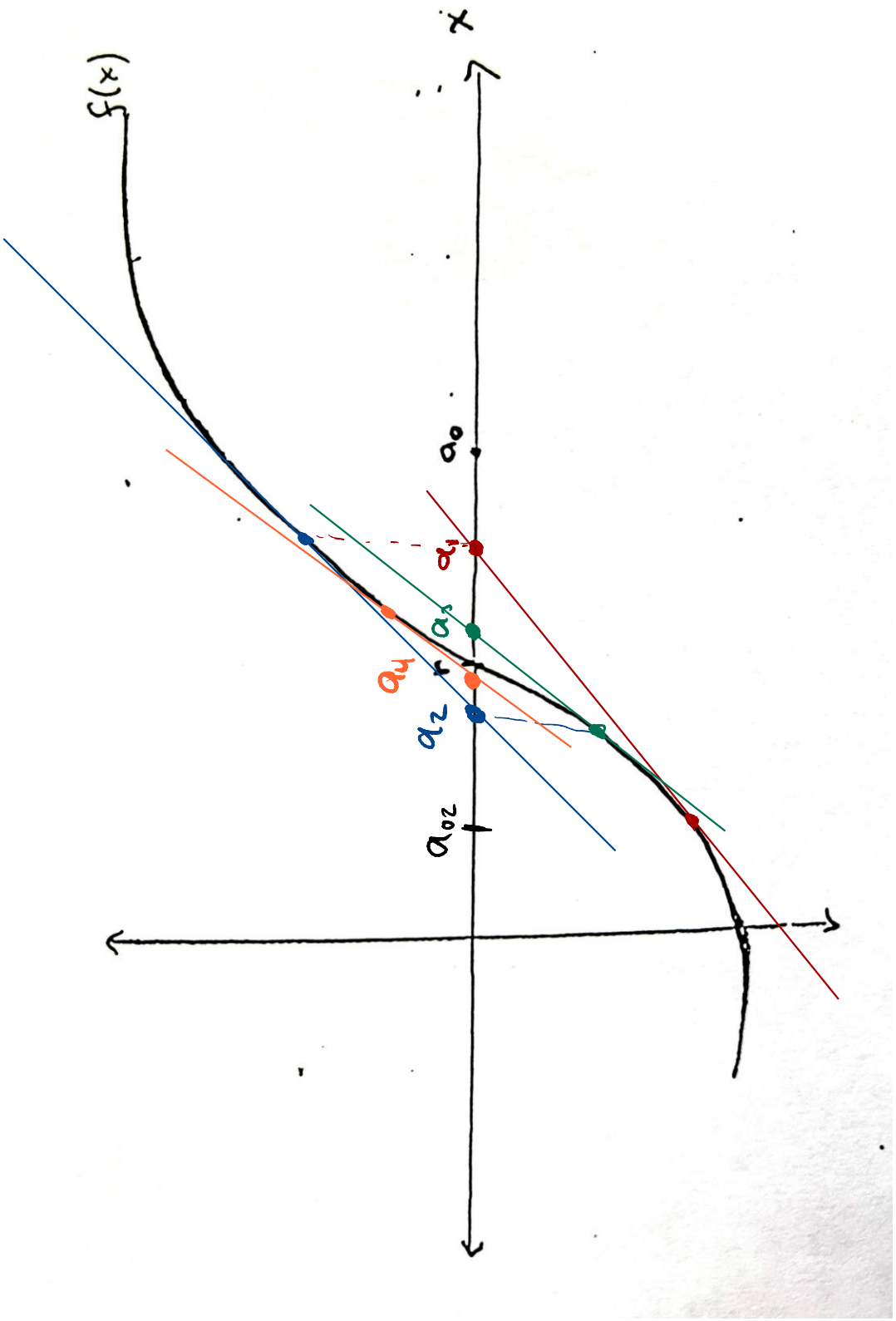
Q1

Image A:



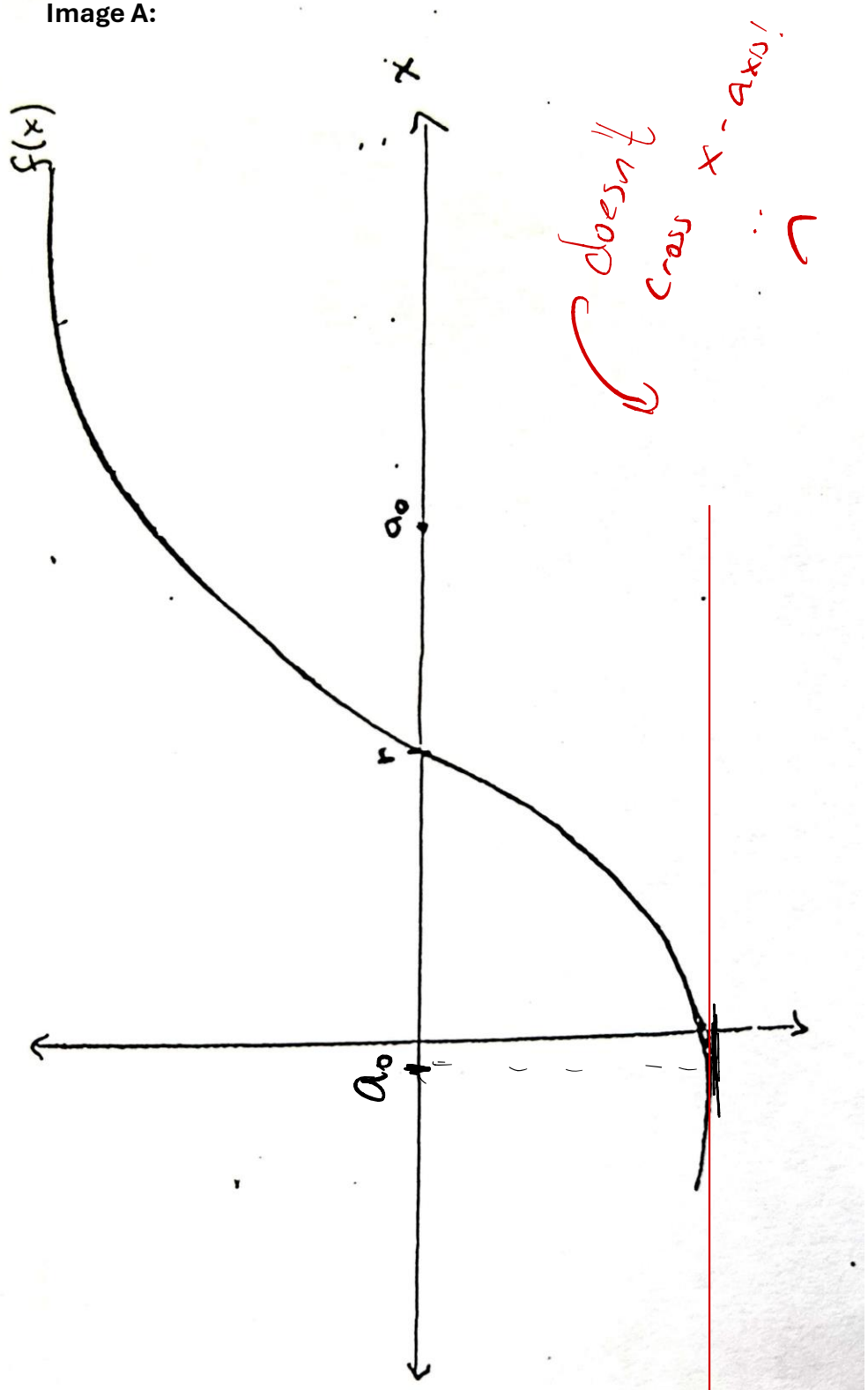
Q2

Image A:



Q3

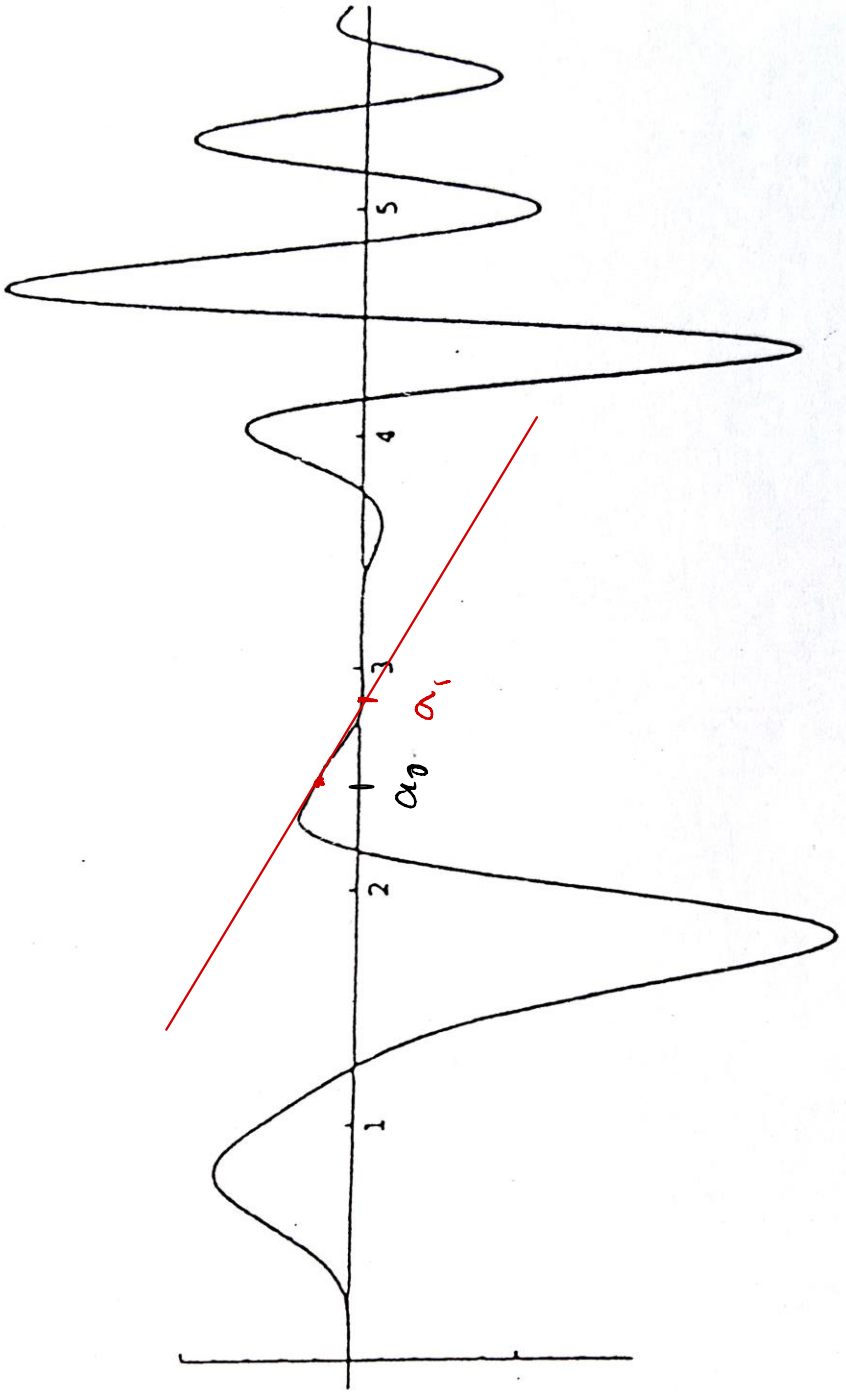
Image A:



doesn't cross x-axis!
∴ ∩

Q4

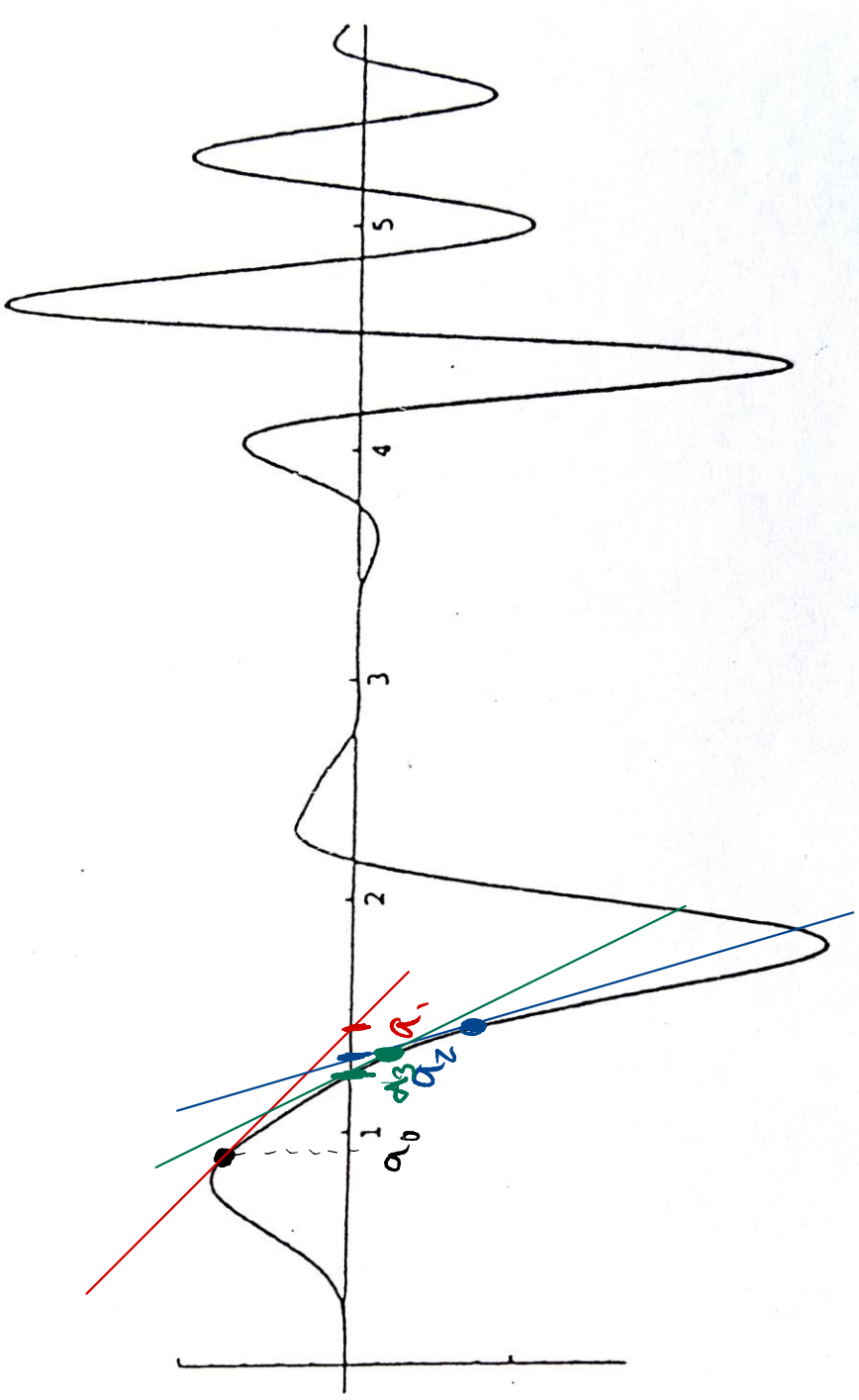
Image B



a_1 already at a root of $f(x)$

Q4

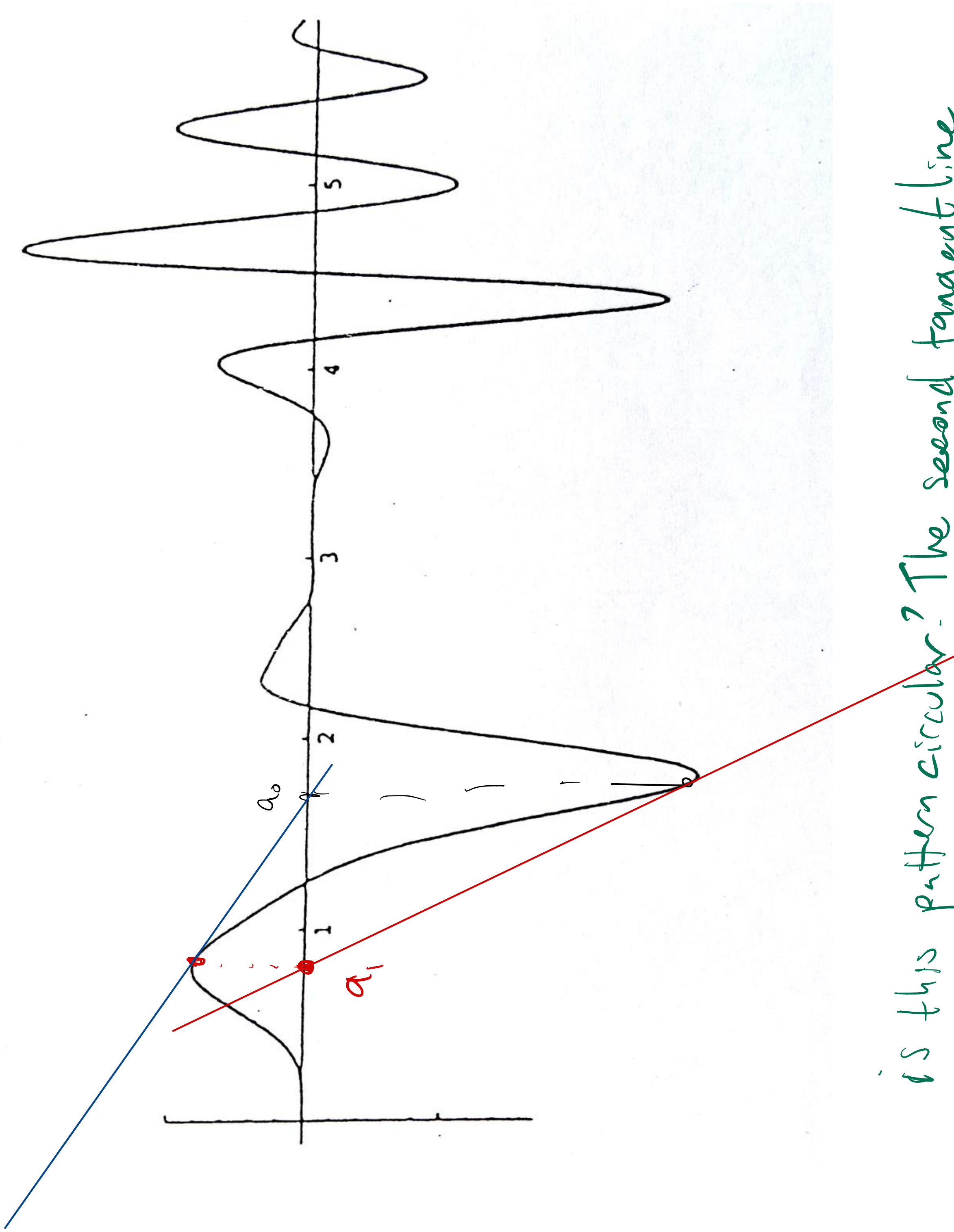
Image B



Root found at a_3

Q4

Image B



is this pattern circular? The second tangent line
Passes through the x-axis at a0 again