Show all work and circle/box your final answer. All answers must be simplified unless stated otherwise.

1. For what value of a is

$$f(x) = \begin{cases} x^2 - 1, & x < 3 \\ 2ax, & x \geq 3 \end{cases}$$

   continuous at every x?

2. Using the limit definition of the derivative, find the equation of the line tangent to the curve $f(x) = x^2 + x + 5$ at $x = 2$

3. Using the limit definition of the derivative, find $f'(x)$ for $f(x) = \dfrac{1}{x+1}$

4. Show that there are at least two real zeroes of the function $f(x) = x^3 - 5x^2 + 3x + 6$

5. Find the first and second derivative of the following functions:

   (a) $f(x) = -x^2 + 3$

   (b) $f(x) = \dfrac{x^3}{3} + \dfrac{x^2}{2} + \dfrac{x}{4}$

   (c) $r(\theta) = \dfrac{2}{\theta} - \dfrac{3}{\theta^3} + \dfrac{1}{\theta^4}$