Short answer questions — you must show your work

1. **2 marks** Find the value of $a$ for which $f(x)$ is continuous at $x = -1$, where

$$f(x) = \begin{cases} \frac{x^2 + (a+1)x + a}{x+1}, & x \neq -1 \\ -1, & x = -1 \end{cases}.$$ 

Answer:

2. **2 marks** Evaluate $\lim_{x \to 1^-} f(f(x))$ where $f(x) = \begin{cases} \frac{1}{x+1}, & x < 0 \\ \ln(x), & 0 < x < 1 \\ e^x, & x > 1 \end{cases}$

Answer:

3. **2 marks** Let $f(x) = \frac{x}{x+1}$. Use the limit definition of the derivative to find $f'(2)$. No marks will be given for the use of any differentiation rules.

Answer:
Long answer question — you must show your work

4. 4 marks Show that the equation \( \ln(x) = x^3 - 2 \) has a solution. Justify your answer.