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

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

**Answer:**

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

**Answer:**

3. 2 marks Let $f(x) = \frac{x}{x+2}$. Use the limit definition of the derivative to find $f'(1)$. 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 \( \ln(x) = x^4 - 2 \) has a solution. Justify your answer.