1. Evaluate the following limits.

(a) (3 points)

$$\lim_{x \to 2} \frac{x^2 - x - 2}{x^2 - 4} = \lim_{x \to 2} \frac{(x-2)(x+1)}{(x-2)(x+2)} = \lim_{x \to 2} \frac{x+1}{x+2} = \frac{3}{4}$$

(b) (3 points)

$$\lim_{h \to 1} \frac{\sqrt{8+h} - 3}{h-1}$$

$$= \lim_{h \to 1} \frac{(\sqrt{8+h} - 3)(\sqrt{8+h} +3)}{(h-1)(\sqrt{8+h} +3)}$$

$$= \lim_{h \to 1} \frac{8+h - 9}{(h-1)(\sqrt{8+h} +3)} = \lim_{h \to 1} \frac{h-1}{(h-1)(\sqrt{8+h} +3)}$$

$$= \lim_{h \to 1} \frac{1}{(\sqrt{8+h} +3)} = \frac{1}{\sqrt{11}+3} = \frac{1}{6}$$
2. Let \( f(x) = x^2 - 4 \).

(a) (1 point) Find the slope of the secant line joining the points \( P(1, f(1)) \) and \( Q(2, f(2)) \).

\[
\frac{f(2) - f(1)}{2 - 1} = \frac{(2^2 - 4) - (1^2 - 4)}{1} = 0 - (-3) = 3
\]

(b) (1 point) Find the slope of the secant line joining the points \( P(1, f(1)) \) and \( Q(1 + h, f(1 + h)) \).

\[
\frac{f(1 + h) - f(1)}{1 + h - 1} = \frac{(1 + h)^2 - 4) - (1^2 - 4)}{h} = \frac{1 + 2h + h^2 - 4 + 3}{h} = \frac{2h + h^2}{h} = \frac{h(2 + h)}{h} = 2 + h
\]
as \( h \neq 0 \)

(c) (2 points) Take a limit of the above slope as \( h \to 0 \) in order to find the slope of the tangent line at \( P(1, f(1)) \).

\[
\lim_{h \to 0} \frac{f(1+h) - f(1)}{1+h-1} = \lim_{h \to 0} \frac{2 + h}{h} = 2
\]