5. (a) (4 points) Let the function f be defined as follows:

$$f(x) = \begin{cases} 2^p\ (x-1) & \text{for} \quad x > 2 \\ x^2 & \text{for } 0 \le x \le 2 \\ \cos(x^2) + k & \text{for} \quad x < 0 \end{cases}$$

Find the values of p and k so that f is a continuous function.

For p we need to make $2^p\ (x-1) = x^2$ at $x = 2$, *i.e.*,

$$2^p = 4, \quad \text{and thus} \quad p = 2.$$

$p =$ 2______________

For k we need to make $\cos(x^2) + k = x^2$ at $x = 0$, *i.e.*,

$$1 + k = 0, \quad \text{and thus} \quad k = -1.$$

$k =$ -1______________

(b) (4 points) Using $f(x)$ as determined in part (a) and $g(x)$ given by:

$$g(x) = \begin{cases} \dfrac{x^3}{3} & \text{for } x \ge 3 \\ |x| & \text{for } x < 3 \end{cases}$$

find

(i) $\lim_{x \to 3^+} f(x)g(x)$

This is the limit from the RIGHT. Therefore

$$\lim_{x \to 3^+} f(x)g(x) = \lim_{x \to 3^+} \frac{x^3}{3}\ 4\ (x-1) = 72$$

(ii) $\lim_{x \to 3^-} f(x)g(x)$

This is the limit from the LEFT. Therefore

$$\lim_{x \to 3^-} f(x)g(x) = \lim_{x \to 3^+} |x|\ 4\ (x-1) = 24$$