3) $g(x)$ has the following negative and positive intervals:

$x = -2$, $x = 4$

$- \quad | \quad - \quad | \quad +$

- within $h(x)$ this means that if:

$g(x) \geq 4$

$g(x) \geq 0$, so:

$$f(g(x)) = e^{-g(x)}$$

$g(x) < 4$

$g(x) < 0$, so:

$$f(g(x)) = \sqrt{|g(x)|}$$

$\therefore$ the only possibility for a discontinuity is at 4. Consider the following sequences:

$$x_n = \frac{4n^2 + n}{n^2}, \quad \lim_{n \to \infty} = 4$$

$$y_n = \frac{4n^2 - n}{n^2}, \quad \lim_{n \to \infty} = 4$$

NTP: $\lim_{x \to \infty} h(x_n) \neq \lim_{x \to \infty} h(y_n)$

LHS: ($x_n > 4$, for any x_n)

$$\Rightarrow \lim_{n \to \infty} h(x_n)$$

$$\Rightarrow \lim_{n \to \infty} f(g(x_n))$$

$$\Rightarrow \lim_{n \to \infty} f((x_n - 4)(x_n + 1)^2)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\left(\frac{4n^2 + n}{n^2} - 4\right)\left(\frac{4n^2 + n}{n^2} + 1\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\left(4 + \frac{1}{n} - 4\right)\left(4 + \frac{1}{n} + 1\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\frac{1}{n}\left(5 + \frac{1}{n}\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\frac{1}{n}\left(25 + \frac{10}{n} + \frac{1}{n^2}\right)\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(25 \cdot \frac{1}{n} + 10 \cdot \frac{1}{n} \cdot \frac{1}{n} + \frac{1}{n} \cdot \frac{1}{n} \cdot \frac{1}{n}\right)$$

RHS: ($y_n < 4$, for any y_n)

$$\Rightarrow \lim_{n \to \infty} h(y_n)$$

$$\Rightarrow \lim_{n \to \infty} f(g(y_n))$$

$$\Rightarrow \lim_{n \to \infty} f((y_n - 4)(y_n + 1)^2)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\left(\frac{4n^2 - n}{n^2} - 4\right)\left(\frac{4n^2 - n}{n^2} + 1\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(\left(4 - \frac{1}{n} - 4\right)\left(4 - \frac{1}{n} + 1\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(-\frac{1}{n}\left(5 - \frac{1}{n}\right)^2\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(-\frac{1}{n}\left(25 - \frac{10}{n} + \frac{1}{n^2}\right)\right)$$

$$\Rightarrow \lim_{n \to \infty} f\left(-25 \cdot \frac{1}{n} + 10 \cdot \frac{1}{n} \cdot \frac{1}{n} - \frac{1}{n} \cdot \frac{1}{n} \cdot \frac{1}{n}\right)$$

/ Note from Q1, $\lim_{n \to \infty} \frac{1}{n} = 0$ /