7. a) $f(x) = \dfrac{x^2+x}{|x|(x-1)}$

$$\lim_{x\to 0+} \frac{x^2+x}{|x|(x-1)} = \lim_{x\to 0+} \frac{\cancel{x}(x+1)}{\cancel{x}(x-1)} = \frac{0+1}{0-1} = -1$$

$$\lim_{x\to 0-} \frac{x(x+1)}{-x(x-1)} = 1$$

$-1 \neq 1 \Rightarrow$ jump disc.

$$\lim_{x\to 1+} \frac{x^2+x}{|x|(x-1)} = \lim_{x\to 1+} \frac{\cancel{x^2}(1+\frac{1}{x})}{\cancel{x^2}(1-\frac{1}{x})} = \frac{2}{0} = +\infty \Rightarrow$$ a point of essential disc.

b) $$F(x) = \begin{cases} -\dfrac{4}{x-5}, & x \le 1 \\ 3x^2+5x-7, & 1 < x \le 9 \\ \dfrac{9}{x-9}, & x > 9 \end{cases}$$

$$\lim_{x\to 9+} \frac{9}{x-9} = \frac{9}{+0} = +\infty \Rightarrow \text{essential disc.}$$

$$\lim_{x\to 9-} 3x^2+5x-7 = 3\cdot 81+5\cdot 9-7 = 281$$

8) a) $\dfrac{1}{\sin x - \cos x}$

$$\lim_{x\to \frac{\pi}{4}} \frac{1}{\sin x - \cos x} = \frac{1}{\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}} = \frac{1}{0} = \infty \Rightarrow \text{essential disc.}$$

b) $\cos \frac{1}{x}$

$\lim\limits_{x\to 0} \cos \frac{1}{x}$ is not defined $\Rightarrow$ essential disc.

c) $x \sin \frac{1}{x^2}$

$-1 \le \sin \frac{1}{x^2} \le 1$

$-x \le x \sin \frac{1}{x^2} \le x$

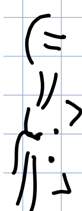
$\lim\limits_{x \to 0^\pm} x = 0 \Rightarrow \lim\limits_{x \to 0^\pm} x \sin \frac{1}{x^2} = 0 \Rightarrow x = 0$ is a point of removable disc.

g) $f(x) = \dfrac{x^2 - (k-2)x + 8}{x - k}$

$$
\begin{array}{l|l}
x^2 - (k-2)x + 8 & x - k \\
\underline{x^2 - kx} & x + 2 \\
0 + 2x + 8 & \\
\quad \underline{2x - 8} & \\
\quad\quad 8 + 2k &
\end{array}
$$

$\Rightarrow 2k + 8 = 0 \Rightarrow 2k = -8 \Rightarrow k = -4$

$\lim\limits_{x \to -4} \dfrac{x^2 + 6x + 8}{x + 4} = \lim\limits_{x \to -4} \dfrac{(x+2)\cancel{(x+4)}}{\cancel{(x+4)}} = \lim\limits_{x \to -4} (x+2) =$



$= -2$ for $x \to -4^\pm \Rightarrow$ removable disc.

This homework was pretty short, so I decided to start a little challenge!
π, but digits double each week.
$\pi = 3.141$