Math 30 ***Quiz 1*** ***January 24, 2018***

Provide a clear and organized presentation. Show all of your work, give exact values only, and completely simplify your answers.

1. If $f(x)=\dfrac{\sqrt{18x^3+3x^2-4x-1}}{x-e}$, determine the domain of f in interval notation.

$$\begin{array}{c|cccc} \frac{1}{2} & 18 & 3 & -4 & -1 \\ & & 9 & 6 & 1 \\ \hline & 18 & 12 & 2 & 0 \end{array}$$

So, we now have that:

$$\begin{aligned} f(x) &= \frac{\sqrt{18x^3+3x^2-4x-1}}{x-e} \\ &= \frac{\sqrt{\left(x-\frac{1}{2}\right)\left(18x^2+12x+2\right)}}{x-e} \\ &= \frac{\sqrt{(2x-1)\left(9x^2+6x+1\right)}}{x-e} \\ &= \frac{\sqrt{(2x-1)(3x+1)^2}}{x-e} \end{aligned}$$

Now, we have that $(2x-1)(3x+1)^2 \geq 0$ and $x \neq e$

On a number line, this gives us:

In interval notation, this gives us:

$$\text{dom} f = \left\{-\frac{1}{3}\right\} \cup \left[\frac{1}{2}, e\right) \cup (e, \infty)$$

2. If $f(x) = \frac{x}{x^2 - 2}$, determine $\frac{f(x+h) - f(x)}{h}$

$$\frac{f(x+h)-f(x)}{h} = \frac{\frac{x+h}{(x+h)^2 - 2} - \frac{x}{x^2-2}}{h}$$

$$= \frac{(x+h)(x^2-2) - x(x^2 + 2hx + h^2 - 2)}{h(x^2-2)\left((x+h)^2 - 2\right)}$$

$$= \frac{x^3 - 2x + hx^2 - 2h - x^3 - 2hx^2 - h^2x + 2x}{h(x^2-2)\left((x+h)^2 - 2\right)}$$

$$= \frac{-hx^2 - 2h - h^2x}{h(x^2-2)\left((x+h)^2 - 2\right)}$$

$$= \frac{-x^2 - 2 - hx}{(x^2-2)\left((x+h)^2 - 2\right)}$$