JaQuoya Bracy

Calculus I

September 28,2020

Homework 4

Page 1 Section 2-6: Infinite Limits

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1 For $f(x) = \dfrac{9}{(x-3)^5}$ evaluate,

(a) $\lim\limits_{x \to 3^-} f(x)$

$x-3 \to 0$

$x-3 < 0$

$x-3 \to 0^-$

$(x-3)^5 \to 0^-$ Raising to fith power will not change behavior

$\lim\limits_{x \to 3^-} \dfrac{9}{(x-3)^5} = -\infty$

(b) $\lim\limits_{x \to 3^+} f(x)$

$x-3 \to 0$

$x-3 > 0$

$x-3 \to 0^+$

$(x-3)^5 \to 0^+$

$\lim\limits_{x \to 3^+} \dfrac{9}{(x-3)^5} = \infty$

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1 For $f(x)=\frac{9}{(x-3)^5}$ evaluate,

(c) $\lim_{x\to 3} f(x)$

$\lim_{x\to 3^-} f(x) \neq \lim_{x\to 3^+} f(x)$

The one sided limits are NOT equal, therefore according to the four rules the $\lim_{x\to 3} f(x)$ DOES NOT EXIST.

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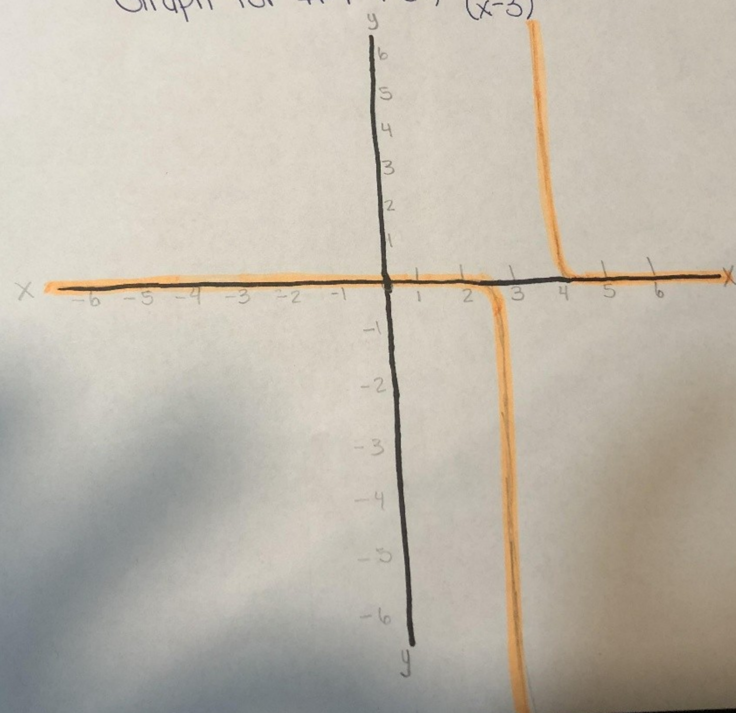
Graph for #1 $f(x) = \frac{9}{(x-3)^5}$



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2 For $h(t) = \frac{2t}{6+t}$ evaluate,

(a) $\lim\limits_{t \to -6^-} h(t)$

$6+t \to 0$

$6+t < 0$

$6+t \to 0^-$

$\lim\limits_{t \to -6^-} \frac{2t}{6+t} = \infty$

(b) $\lim\limits_{t \to -6^+} h(t)$

$6+t \to 0$

$6+t > 0$

$6+t \to 0^+$

$\lim\limits_{t \to -6^+} \frac{2t}{6+t} = -\infty$

2 For $h(t) = \dfrac{2t}{6+t}$ evaluate,

(c) $\lim\limits_{t \to -6} h(t)$

$\lim\limits_{t \to -6^-} h(t) \neq \lim\limits_{t \to -6^+} h(t)$

The one sided limits are Not equal, therefore according to the four rules the $\lim\limits_{t \to -6} h(t)$ Does NOT EXIST

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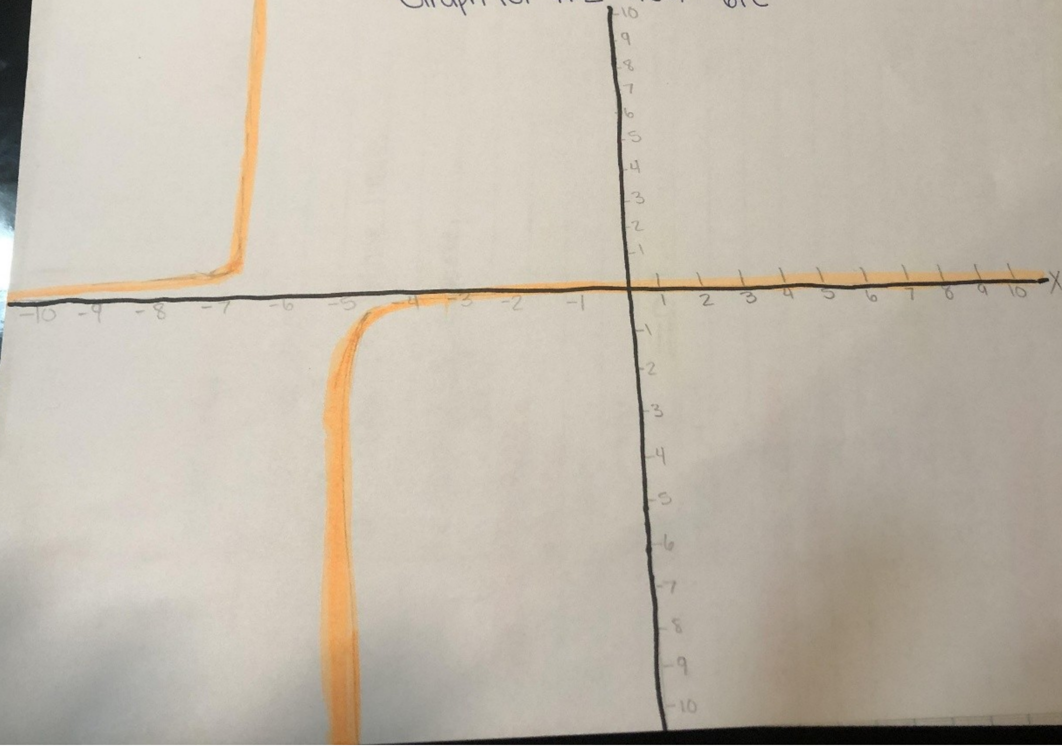
Graph for #2 $h(t) = \frac{2t}{6+t}$



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3 For $g(z) = \dfrac{z+3}{(z+1)^2}$ evaluate,

(a) $\lim\limits_{z \to -1^-} g(z)$

$z+1 \to 0^-$

$(z+1)^2 \to 0^+$

$\lim\limits_{z \to -1^-} \dfrac{z+3}{(z+1)^2} = \infty$

(b) $\lim\limits_{z \to -1^+} g(z)$

$z+1 \to 0^+$

$(z+1)^2 \to 0^+$

$\lim\limits_{z \to -1^+} \dfrac{z+3}{(z+1)^2} = \infty$

(c) $\lim\limits_{z \to -1} g(z)$

$\lim\limits_{z \to -1^-} g(z) = \lim\limits_{z - 1^+} g(z) = \infty$ $\lim\limits_{z \to -1} g(z) = \infty$

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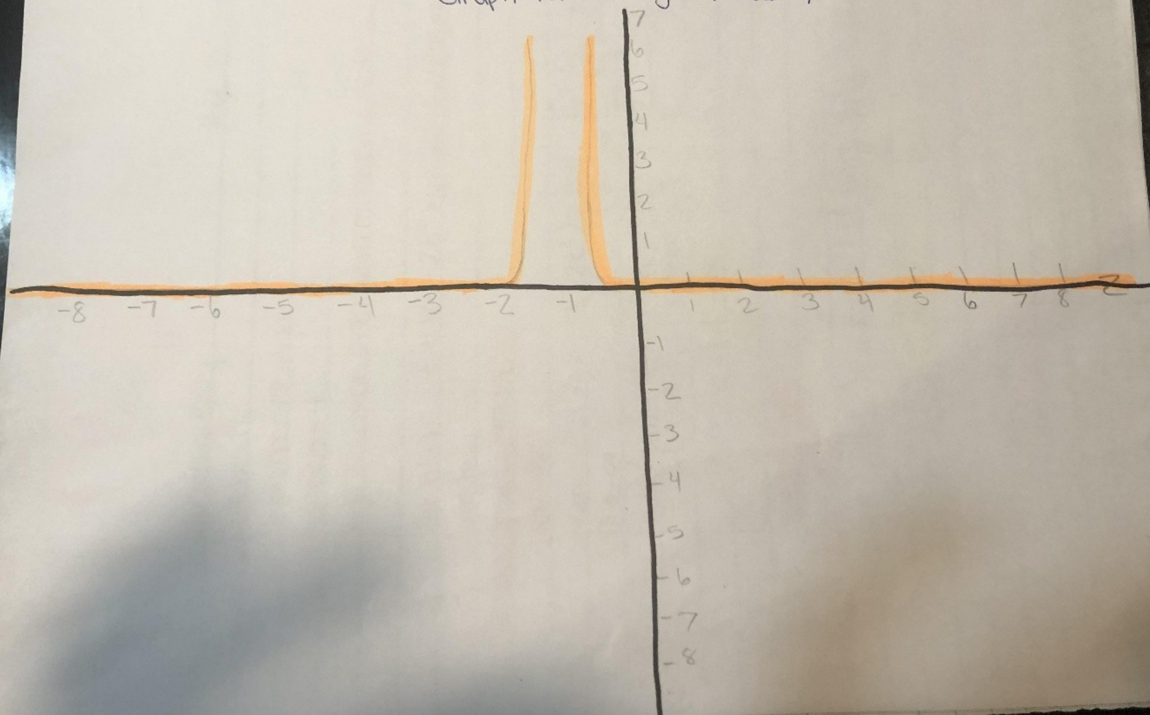
Graph for #3 $g(z) = \frac{z+3}{(z+1)^2}$



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4 for $g(x) = \frac{x+7}{x^2-4}$ evaluate,

(a) $\lim_{x \to 2^-} g(x)$

$x^2-4 \to 0^-$

$\lim_{x \to 2^-} \frac{x+7}{x^2-4} = -\infty$

(b) $\lim_{x \to 2^+} g(x)$

$x^2-4 \to 0^+$

$\lim_{x \to 2^+} \frac{x+7}{x^2-4} = \infty$

(c) $\lim_{x \to 2} g(x)$

$\lim_{x \to 2^-} g(x) \neq \lim_{x \to 2^+} g(x)$

$\lim_{x \to 2} g(x)$ DOES NOT EXIST, the one sided limits are not equal.

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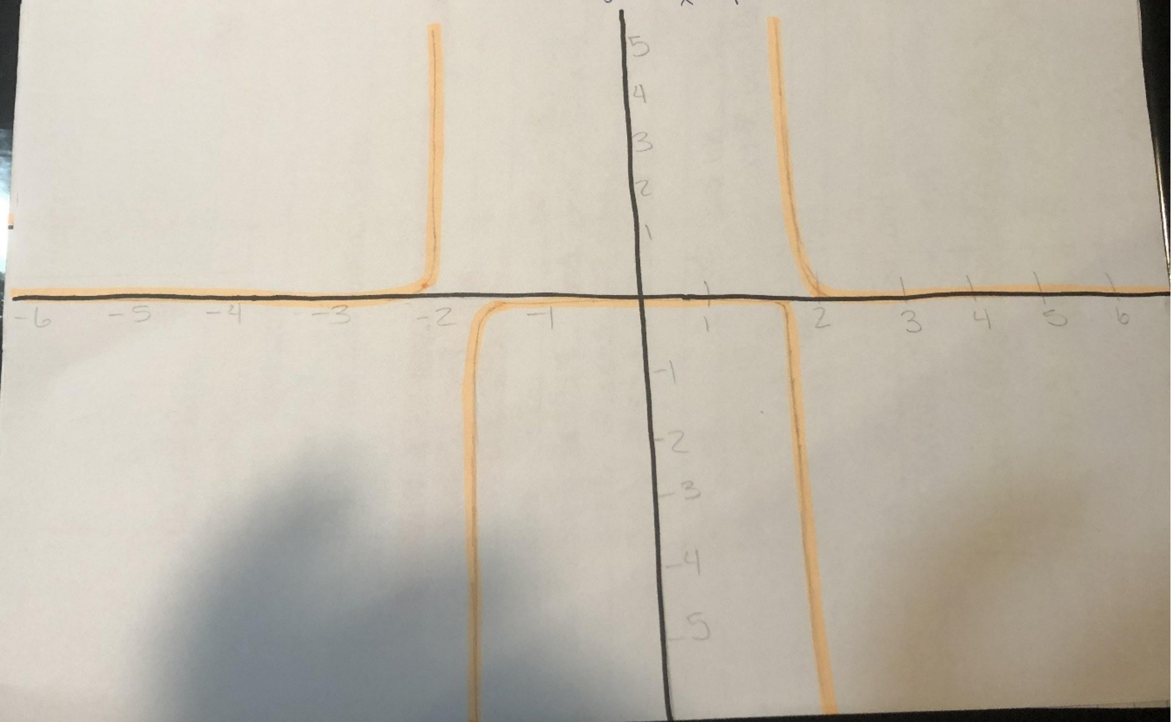
Graph for #4 $g(x)=\frac{x+7}{x^2-4}$



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8 Find all the vertical asymptotes for the given function

$g(x) = \frac{-8}{(x+5)(x-9)}$

$\lim_{x \to -5^-} \frac{-8}{(x+5)(x-9}$ and $\lim_{x \to -5^+} \frac{-8}{(x+5)(x-9)}$

$x \to -5^- \Rightarrow x < -5 \Rightarrow x+5 < 0$

$x \to -5^+ \Rightarrow x > -5 \Rightarrow x+5 > 0$

$\lim_{x \to -5} \frac{-8}{(x+5)(x-9)} = -\infty$ and $\lim_{x \to -5^+} \frac{-8}{(x+5)(x-9)} = \infty$

$x \to 9 \Rightarrow x < 9 \Rightarrow x-9 < 0$

$x \to 9^+ \Rightarrow x > 9 \Rightarrow x-9 > 0$

$\lim_{x \to 9^-} \frac{-8}{(x+5)(x-9)} = \infty$ and $\lim_{x \to 9^+} \frac{-8}{(x+5)(x-9)} = -\infty$

The vertical asymptompes for $g(x) = \frac{-8}{(x+5)(x-9)}$ are $x = -5$ and $x = 9$

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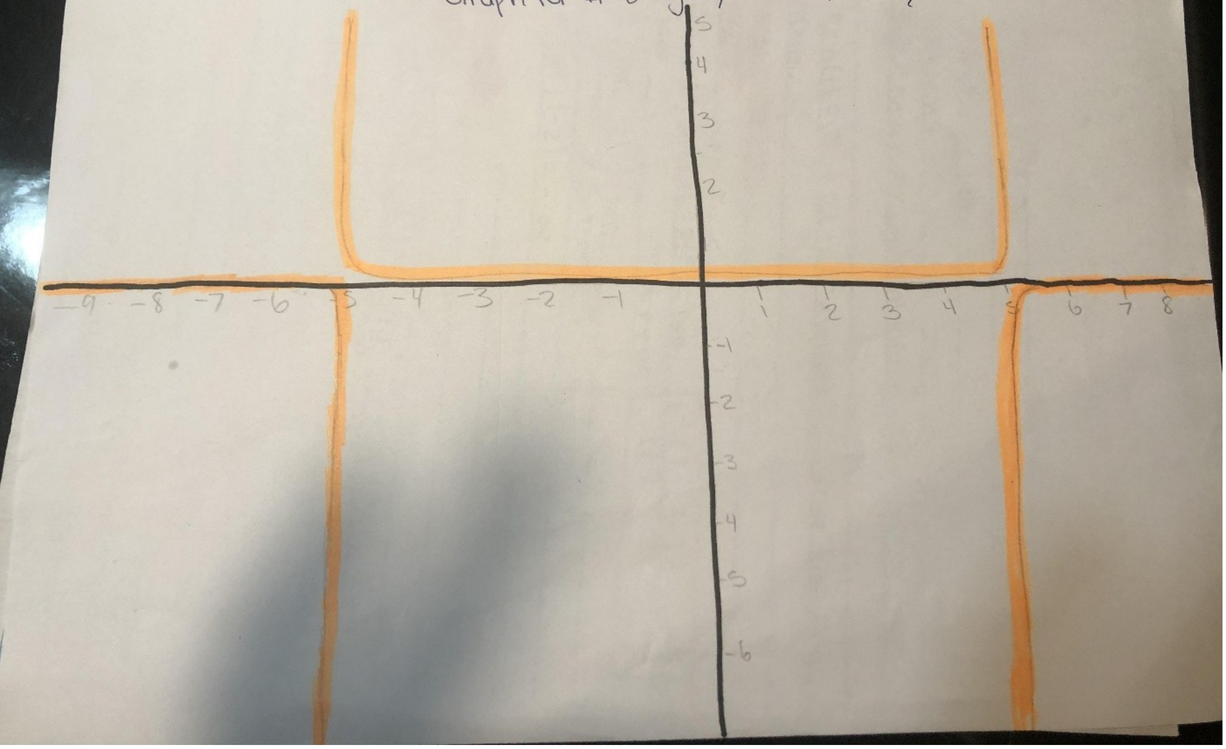
Graph for # 8 $g(x) = \frac{-8}{(x+5)(x-9)}$



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2 For $h(t) = \sqrt[3]{t} + 12t - 2t^2$ evaluate each of the following limits.

(a) $\lim\limits_{x\to-\infty} f(x)$

$$\lim_{t\to-\infty}\left(t^{1/3}+12t-2t^2\right) = \lim_{t\to-\infty}\left[t^2\left(\frac{1}{t^{5/3}}+\frac{12}{t}-2\right)\right]$$

$$= \left(\lim_{t\to-\infty} t^2\right)\left[\lim_{t\to-\infty}\left(\frac{1}{t^{5/3}}+\frac{12}{t}-2\right)\right.$$

$$= (\infty)(-2) = -\infty$$

(b) $\lim\limits_{x\to\infty} f(x)$

$$\lim_{t\to\infty}\left(t^{1/3}+12t-2t^2\right) = \left[\lim_{t\to\infty} t^2\left(\frac{1}{t^{5/3}}+\frac{12}{t}-2\right)\right]$$

$$= (\infty)(-2) = -\infty$$

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Page 2 Section 2-7 Limits at Infinity Part I

4 $f(x)=\frac{3x^7-4x^2+1}{5-10x^2}$

(a) Evaluate $\lim_{x\to-\infty} f(x)$

$$\lim_{x\to-\infty}\frac{3x^7-4x^2+1}{5-10x^2}=\lim_{x\to-\infty}\frac{x^2(3x^5-4+\frac{1}{x^2})}{x^2(\frac{5}{x^2}-10)}$$

$$=\lim_{x\to-\infty}\frac{3x^5-4+\frac{1}{x^2}}{\frac{5}{x^2}-10}=\frac{-\infty}{-10}=\infty$$

(b) Evaluate $\lim_{x\to\infty} f(x)$

$$\lim_{x\to\infty}\frac{3x^7-4x^2+1}{5-10x^2}=\lim_{x\to\infty}\frac{x^2(3x^5-4+\frac{1}{x^2})}{x^2(\frac{5}{x^2}-10)}$$

$$=\lim_{x\to\infty}\frac{3x^5-4+\frac{1}{x^2}}{\frac{5}{x^2}-10}=\frac{\infty}{-10}=-\infty$$

(c) Write down the equation(s) of any horizontal asymptotes for the function.

There are NO HORIZONTAL ASYMPTOTES because neither one of the two limits are infinite.

6 $f(x)=\dfrac{x^3-2x+11}{3-6x^5}$

(a) Evaluate $\lim\limits_{x\to-\infty} f(x)$

$$\lim_{x\to-\infty}\frac{x^3-2x+11}{3-6x^5}=\lim_{x\to-\infty}\frac{x^5\left(\frac{1}{x^2}-\frac{2}{x^4}+\frac{11}{x^5}\right)}{x^5\left(\frac{3}{x^5}-6\right)}$$

$$=\lim_{x\to-\infty}\frac{\frac{1}{x^2}-\frac{2}{x^4}+\frac{11}{x^5}}{\frac{3}{x^5}-6}=\frac{0}{-6}=0$$

(b) Evaluate $\lim\limits_{x\to\infty} f(x)$

$$\lim_{x\to\infty}\frac{x^3-2x+11}{3-6x^5}=\lim_{x\to\infty}\frac{x^5\left(\frac{1}{x^2}-\frac{2}{x^4}+\frac{11}{x^5}\right)}{x^5\left(\frac{3}{x^5}-6\right)}$$

$$=\frac{0}{-6}=0$$

(c) Write down the equation(s) of any horizontal asymptotes for the function.

From the first two parts, the horizontal asymptote is $y=0$ for both $x\to-\infty$ and $x\to\infty$.

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8 $f(x) = \dfrac{\sqrt{7+9x^2}}{1-2x}$

(a) Evaluate $\lim\limits_{x \to -\infty} f(x)$

$$\lim_{x\to-\infty} \frac{\sqrt{7+9x^2}}{1-2x} = \lim_{x\to-\infty} \frac{-x\sqrt{\frac{7}{x^2}+9}}{x(\frac{1}{x}-2)} =$$

$$= \lim_{x\to-\infty} \frac{-\sqrt{\frac{7}{x^2}+9}}{\frac{1}{x}-2} = \frac{-\sqrt{9}}{-2} = \frac{3}{2}$$

(b) Evaluate $\lim\limits_{x \to \infty} f(x)$

$$\lim_{x\to\infty} \frac{\sqrt{7+9x^2}}{1-2x} = \lim_{x\to\infty} \frac{x\sqrt{\frac{7}{x^2}+9}}{x(\frac{1}{x}-2)}$$

$$= \lim_{x\to\infty} \frac{\sqrt{\frac{7}{x^2}+9}}{\frac{1}{x}-2} = \frac{\sqrt{9}}{-2} = -\frac{3}{2}$$

(c) Write down the equation(s) of any horizontal asymptotes for the function.

For $x \to -\infty$ the horizontal asymptote is $y = \frac{3}{2}$

For $x \to \infty$ the horizontal asymptote is $y = -3/2$

10 $f(x) = \dfrac{8+x-4x^2}{\sqrt{6+x^2+7x^4}}$

(a) Evaluate $\lim_{x \to -\infty} f(x)$

$$\lim_{x\to-\infty} \frac{8+x-4x^2}{\sqrt{6+x^2+7x^4}} = \lim_{x\to-\infty} \frac{x^2\left(\frac{8}{x^2}+\frac{1}{x}-4\right)}{x^2\sqrt{\frac{6}{x^4}+\frac{1}{x^2}+7}}$$

$$\lim_{x\to-\infty} \frac{\frac{8}{x^2}+\frac{1}{x}-4}{\sqrt{\frac{6}{x^4}+\frac{1}{x^2}+7}} = \frac{-4}{\sqrt{7}}$$

(b) Evaluate $\lim_{x \to \infty} f(x)$

$$\lim_{x\to\infty} \frac{8+x-4x^2}{\sqrt{6+x^2+7x^4}} = \lim_{x\to\infty} \frac{x^2\left(\frac{8}{x^2}+\frac{1}{x}-4\right)}{x^2\sqrt{\frac{6}{x^4}+\frac{1}{x^2}+7}}$$

$$= \lim_{x\to\infty} \frac{\frac{8}{x^2}+\frac{1}{x}-4}{\sqrt{\frac{6}{x^4}+\frac{1}{x^2}+7}} = \frac{-4}{\sqrt{7}}$$

(c) Write down the equation(s) of any horizontal asymptote.

The Horizontal Asymptote for both $x \to -\infty$ and $x \to \infty$. is $y = -\frac{4}{\sqrt{7}}$