Name: _____

Clear your desk of everything excepts pens, pencils and erasers. If you have a question raise your hand and I will come to you.

1. (2 points) **Multiple Choice. No work needed. No partial credit available.** Compute the following limit.

$$\lim_{x\to\infty} \sqrt{9x^2+x} - 3x$$

A. ∞

B. $\frac{1}{12}$

C. $\frac{1}{6}$

D. $-\infty$

E. 1

Extra Work Space.

(1) $\lim_{x\to\infty} \sqrt{9x^2+x} - 3x \left(\frac{\sqrt{9x^2+x}+3x}{\sqrt{9x^2+x}+3x}\right) = \lim_{x\to\infty} \frac{9x^2+x-9x^2}{\sqrt{9x^2+x}+3x} = \lim_{x\to\infty} \frac{x}{\sqrt{9x^2+x}+3x}$

$= \lim_{x\to\infty} \frac{1}{\sqrt{9+\frac{1}{x}}+3} = \frac{1}{\sqrt{9}+3} = \frac{1}{6}$

Continue on to back side

3. (3 points) Draw a graph of the curve $y = (x-3)\sqrt{x}$. Make sure to clearly identify any intercepts, asymptotes, intervals of increase and decrease, local extrema, and the concavity of the curve.

Domain $x \geq 0$

Intercepts y-intercept $y=0$

x-intercepts $x=3,0$

Symmetry None

Asymptotes None

Increasing/Decreasing

$f'(x) = \sqrt{x} + (x-3)\frac{1}{2\sqrt{x}}$ } DNE at $x=0$

$0 = \sqrt{x} + (x-3)\frac{1}{2\sqrt{x}}$

$0 = 2x + x - 3$

$3 = 3x$

$1 = x$

$x=0,1$ are critical numbers

Interval	Sign of $f'(x)$	
$(0,1)$	$-$	Decreasing
$(1,\infty)$	$+$	Increasing

Local Maxima/Minima

$(0,0)$ is a local max

$(1,-2)$ is a local min

Concavity

$f''(x) = \frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{x}} + (x-3)\left(\frac{-1}{4x^{3/2}}\right)$

$= \frac{1}{\sqrt{x}} + (x-3)\left(\frac{-1}{4x^{3/2}}\right)$

$0 = \frac{1}{\sqrt{x}} + (x-3)\left(\frac{-1}{4x^{3/2}}\right)$

$0 = 4x + (x-3)(-1)$

$0 = 4x - x + 3$

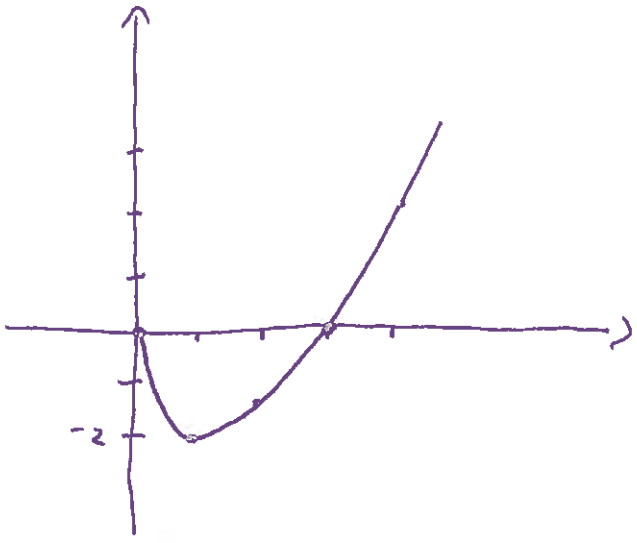
$0 = 3x + 3$

$x = -1$

Not in domain

Positive everywhere

⇒ Concave up everywhere



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