

Honors Precalculus  
Ms Abrao  
Limits and Derivatives Test  
CALCULATOR ALLOWED

Name: KEY  
Date: \_\_\_\_\_  
Period: \_\_\_\_\_

Round to 3 decimal places.  
Show all work.

Multiple Choice (3 pts.)

1.  $\lim_{x \rightarrow 1} \frac{\sqrt{x}-1}{x-1} = \frac{0}{0} = \lim_{x \rightarrow 1} \frac{\sqrt{x}-1}{x-1} \cdot \frac{\sqrt{x}+1}{\sqrt{x}+1} = \lim_{x \rightarrow 1} \frac{x-1}{(x-1)(\sqrt{x}+1)} = \lim_{x \rightarrow 1} \frac{1}{\sqrt{x}+1} = \frac{1}{2}$

(a) 0      (b) 1/2      (c) 1      (d) 3/2      (e) The limit does not exist.

2. Find the slope of the tangent line to the curve  $y = x^2 + 2x$  at the point (1,3).

- (a) 10      (b) 8      (c) 6      (d) 4      (e) 3

$y' = 2x + 2$   
 $y'|_{x=1} = 4$

3. If  $f(x) = -x^3 + x + \frac{1}{x}$ , then  $f'(-1) =$

- (a) 3      (b) 1      (c) -1      (d) -3      (e) -5

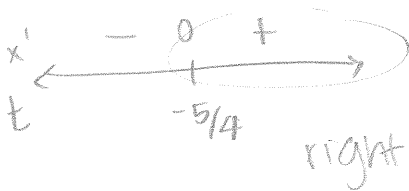
$f(x) = -x^3 + x + x^{-1}$   
 $f'(x) = -3x^2 + 1 - x^{-2}$   
 $f'(-1) = -3 + 1 - 1$

**Free Response (10 pts. each)**

1. A particle's position  $(x(t), y(t))$  at time  $t$  is described by the parametric equations  $x(t) = 2t^2 + 5t - 12$ ,  $y(t) = 2t^3 + t^2 - 13t + 6$ . When is the particle moving right and down?

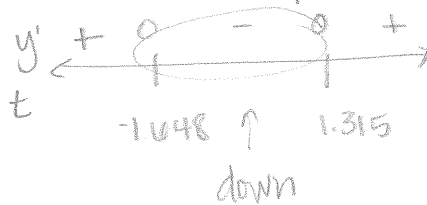
$$x'(t) = 4t + 5$$

$$\text{c.v. } t = -5/4$$



$$y'(t) = 6t^2 + 2t - 13$$

$$\text{c.v. } t = 1.315, -1.048$$



Particle moving right and down when  $t \in (-1.25, 1.315)$

2. The motion of a particle is described by  $x(t) = 4t^3 - 63t^2 + 86t - 14$ .

- When is the particle stopped?
- Which direction is it moving at  $t = 7$ ?
- Where is it at  $t = 7$ ?
- Find  $a(7)$ .

$$\textcircled{a} \quad v(t) = 12t^2 - 126t + 86 = 0$$

$$t = 9.766, .734$$

Particle stopped @  $t = 9.766, .734$

$$\textcircled{b} \quad v(7) = -208 \quad \text{Particle is moving to the left.}$$

$$\textcircled{c} \quad x(7) = -1127$$

$$\textcircled{d} \quad a(t) = 24t - 126$$

$$a(7) = 42$$

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4. At what point on the graph of  $y = \frac{1}{2}x^2$  is the tangent line parallel to the line

$2x - 4y = 3$ ?  $2x - 4y = 3$   $4y = 2x - 3$   $y = \frac{1}{2}x - \frac{3}{4}$   $m = \frac{1}{2}$   $y' = x = \frac{1}{2}$   
 $(\frac{1}{2}, \frac{1}{8})$

(a)  $(\frac{1}{2}, -\frac{1}{2})$  (b)  $(\frac{1}{2}, \frac{1}{8})$  (c)  $(1, -\frac{1}{4})$  (d)  $(1, \frac{1}{2})$  (e) (2,2)

5. If  $f(x) = \sqrt{x^2 - 1}$ , which of the following is equivalent to  $f'(3)$ ?  $f'(3) = \lim_{x \rightarrow 3} \frac{f(x) - f(3)}{x - 3}$

(a)  $\lim_{x \rightarrow 3} \frac{\sqrt{(x+h)^2 - 1} - \sqrt{8}}{x - 3}$  (b)  $\lim_{h \rightarrow 0} \frac{\sqrt{(x+h)^2 - 1} - \sqrt{x^2 - 1}}{h}$   
 (c)  $\lim_{h \rightarrow 0} \frac{\sqrt{(x+h)^2 - 1} - \sqrt{8}}{h}$  (d)  $\lim_{x \rightarrow 3} \frac{\sqrt{x^2 - 1} - \sqrt{8}}{x - 3}$  (e)  $\lim_{h \rightarrow 0} \frac{\sqrt{x^2 - 1} - \sqrt{8}}{x - 3}$

6. A particle moves according to a law of motion  $s = 4t^3 - 9t^2 + 6t + 2$ ,  $t \geq 0$  where  $s$  is measured in feet and  $t$  in seconds. When is the particle at rest?

(a)  $t = \frac{1}{2}$  (b)  $t = 1$  (c)  $t = 0$  (d)  $t = \frac{1}{2}, 1$  (e)  $t = 1, 0$

$S' = 12t^2 - 18t + 6 = 0$   
 $6(2t^2 - 3t + 1) = 0$   
 $6(2t - 1)(t - 1) = 0$

Free Response (10 pts. each)

3. Set up, but do not solve, the LIMIT definition of the derivative for  $f(x) = 13x^3 + 3x + 4021$ .

$f'(x) = \lim_{h \rightarrow 0} \frac{13(x+h)^3 + 3(x+h) + 4021 - 13x^3 - 3x - 4021}{h}$

4. Find the following limits:

$$(a) \lim_{x \rightarrow 2} \frac{\sqrt{x+2} - \sqrt{2x}}{x^2} = \frac{\sqrt{4} - \sqrt{4}}{4} = 0$$

$$(b) \lim_{x \rightarrow 3} \frac{x^2 - 9}{x^2 - 2x - 3} = \lim_{x \rightarrow 3} \frac{(x-3)(x+3)}{(x-3)(x+1)} = \frac{6}{4} = \frac{3}{2}$$

$$5. D_x \left[ 16x^{15} - 18x^2 + 41x - e + 2 + \frac{3}{\sqrt{x^3}} + \frac{1}{x} \right]$$

$$= D_x \left[ 16x^{15} - 18x^2 + 41x - e + 2 + 3x^{-3/2} + x^{-1} \right]$$

$$= 240x^{14} - 36x + 41 - \frac{9}{2}x^{-5/2} - x^{-2}$$

$$\begin{array}{r} 316 \\ \underline{15} \\ 80 \\ \underline{16} \\ 240 \end{array}$$