

**Calculus 1      Worksheet #11**  
**Equations of Tangent and Normal Lines**

**Learn: Tangent and Normal Curves**

**Remember: A derivative = slope of the Tangent line at that points x-coordinate**

**Example:**

$$f(x) = x^2 + 3 \quad \text{pt}(1,4), \quad f'(x) = 2x \Rightarrow f'(1) = 2$$

$$\text{Tangent line: } y - 4 = 2(x - 1) \Rightarrow y - 4 = 2x - 2 \Rightarrow y = 2x + 2$$

$$\text{Normal line: } y - 4 = -\frac{1}{2}(x - 1) \Rightarrow y - 4 = -\frac{1}{2}x + \frac{1}{2} \Rightarrow y = -\frac{1}{2}x + \frac{9}{2}$$

For the following:

- 1) Sketch a graph of  $f(x)$ .      Use Graph Paper !!!!!
- 2) Find slope at point p.
- 3) Find equation of tangent at point p. Sketch line.
- 4) Find equation of normal at point p. Sketch line.

1. $y = x^2 - 3$	p(2,1)	2. $y = 6 - x^2$	p(2,2)
3. $y = 4x - x^2$	p(2,4)	4. $y = x^2 - x - 6$	p(3,0)
5. $y = x^3 - x$	p(1,0)	6. $y = x^{1/2}$	p(4,2)
7. $y = 6x^{-1}$	p(3,2)	8. $y = x^3 - x$	p(-1,0)
9. $y = 2 - \sqrt{x}$	p(4,0)	10. $y = 4x^2 - x^4$	p( $\sqrt{2}$ , 4)
11. $y = 2 - 4x^{-2}$	p(2,1)	12. $y = 1 + x^{2/3}$	p(0,1)

13 – 17, at the specified point, find the equation of the normal to the curve  $f(x)$ .

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| 13. $f(x) = x^2$ ; (-3, _)                 | 14. $f(x) = x^2 - x$ ; (1, _)              |
| 15. $f(x) = x^3$ ; (1, _)                  | 16. $f(x) = x^{1/2}$ , $x \geq 0$ ; (1, _) |
| 17. $f(x) = 9x^{-1}$ , $x \neq 0$ ; (3, _) |  |

18. Use the **DEFINITION OF THE DERIVATIVE** to find  $f'(x)$  if  $f(x) = x^3 + 2x$

**Answers:**

1. 4, $y = 4x - 7$ , $y = -\frac{1}{4}x + \frac{3}{2}$	2. -4, $y = -4x + 10$ , $y = \frac{1}{4}x + \frac{3}{2}$
3. 0, $y = 4$ , $x = 2$	4. 5, $y = 5x - 15$ , $y = -\frac{1}{5}x + \frac{3}{5}$
5. 2, $y = 2x - 2$ , $y = -\frac{1}{2}x + \frac{1}{2}$	6. $\frac{1}{4}$ , $y = \frac{1}{4}x + 1$ , $y = -4x + 18$
7. $-\frac{2}{3}$ , $y = -\frac{2}{3}x + 4$ , $y = \frac{3}{2}x - \frac{5}{2}$	8. 2, $y = 2x + 2$ , $y = -\frac{1}{2}x - \frac{1}{2}$
9. $-\frac{1}{4}$ , $y = -\frac{1}{4}x + 1$ , $y = 4x - 16$	10. 0, $y = 4$ , $x = \sqrt{2}$
11. 1, $y = x - 1$ , $y = -x + 3$	12. { }, none, none
13. $y = \frac{1}{6}x + \frac{19}{2}$	14. $y = -x + 1$
15. $y = \frac{-1}{3}x + \frac{4}{3}$	16. $y = -2x + 3$

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17. $y = x$	18. $3x^2 + 2$
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