3.1 Power Rule

NOTES

CALCULUS

Write your questions here!

Notation

f' $\quad$ $f'(x)$ $\quad$ y' $\quad$ $\frac{dy}{dx}$

POWER RULE

$$x^n =$$

Find the derivative of the following.

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

$y = 2x^{-3} + 4x + \pi$

Rewrite and then take the derivative.

$y = \sqrt[3]{x^7} - \sqrt{x} + 2\sqrt[5]{x^2}$

$g(x) = \frac{1}{x} + \frac{4}{x^2} - \frac{1}{(3x)^2}$

$f(x) = \frac{-16x^2+5x-1}{2x}$

Evaluate

$f(x) = \frac{1}{2}x^4 - 4x^{-2} + e$

Find $f'(3)$

$y = \frac{1}{\sqrt{x}} + 4x$

Find $\left.\frac{dy}{dx}\right|_{x=4}$

Higher Order Derivatives

$f(x) = x^7 - 2x^4 + 5x^2 - 3x + 9$

$f'(x) =$

$f''(x) =$

$f'''(x) =$

$f^{(4)}(x) =$

$y = \sqrt{x} + x^{-2}$

$\frac{dy}{dx} =$

$\frac{d^2y}{dx^2} =$

Find Derivative on the Calculator

$f(x) = \frac{1}{2}x\sqrt{2x-1}$

$f'(4) =$

$f'(e) =$

$f(\theta) = 1 + \csc\theta$

$f'(\pi) =$

$f'\left(\frac{\pi}{2}\right) =$

Derivative means…

Slope at a point

Given $y = \frac{1}{2}x^4 - x + 2$ find the slope at $x = 2$

Slope of the tangent line

Write the equation of the line tangent to $y = \frac{1}{2}x^4 - x + 2$ at $x = 2$

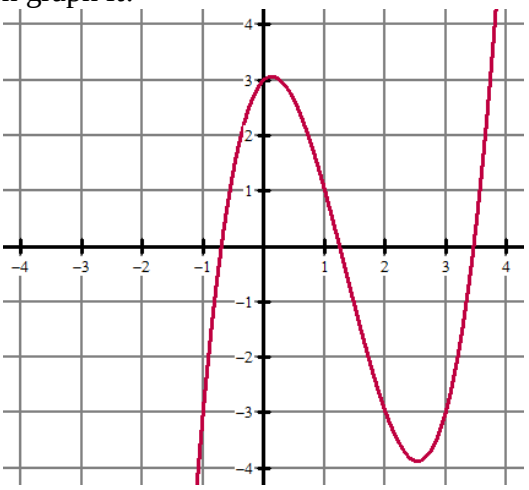
Instantaneous rate of change

What is the instantaneous rate of change at 3 seconds?
$s(t) = -4.9t^2 + 40t + 6$

Normal Line

Write the equation of the normal line at $x = 3$ and then graph it!

$f(x) = x^3 - 4x^2 + x + 3$



Derivative Rules

Constant Rule $\frac{d}{dx}c = 0$

Constant Multiple Rule $\frac{d}{dx}(cu) = c\frac{du}{dx}$

Power Rule $\frac{d}{dx}x^n = nx^{n-1}$

Sum/Difference Rule $\frac{d}{dx}(u \pm v) = \left(\frac{du}{dx} \pm \frac{dv}{dx}\right)$

SUMMARY:

Now, summarize your notes here!

3.1 Power Rule

PRACTICE

Find the derivative of the following.

1. $f(x) = 2x^3 - 4x + 5$

2. $y = 3x^{100} - 2x^8 - 7x$

3. $g(x) = 5x^{-2} - \frac{1}{2}x^4$

4. $h(x) = \frac{x^6}{3} + 6x^{2/3} - 4x^{1/2} + 2$

5. $f(x) = \frac{1}{x^3} + \frac{12}{x}$

6. $y = \frac{3}{x^{-2}} - \frac{1}{(6x)^2}$

7. $f(x) = \sqrt{x} + 3\sqrt[3]{x} + 2$

8. $y = \sqrt[3]{x^2} + 8\sqrt[4]{x^7}$

9. $f(x) = \frac{1}{\sqrt{x}} + \frac{3}{6x}$

10. $f(x) = \frac{1}{\sqrt{x}} + \frac{3}{\sqrt[5]{x^2}}$

11. $s(t) = -16t^2 + 40t + 5$

12. $y = \pi x^2 - \pi$

13. $V(r) = \frac{4}{3}\pi r^3$

14. $f(x) = \frac{2x^3+4x-5}{x}$

15. $g(x) = \frac{6x^3+4x^2-9x}{3}$

Find the derivatives of the following.

16. $f(x) = 3x^7 - 4x^3 + 5x + 7$

$f'(x) =$

$f''(x) =$

$f'''(x) =$

$f^{(4)}(x) =$

17. $y = 4\sqrt{x} + e$

$\frac{dy}{dx} =$

$\frac{d^2y}{dx^2} =$

18. $y = \frac{1}{x^3} - \frac{1}{2}x^4 + ex^2$

$y' =$

$y'' =$

$y''' =$

Given $f(x) = 3x^2 - x + 2$, $g(x) = \frac{1}{x^3} + e^2$, and $h(x) = \sqrt{x}$, find the following.

19. $f'(2) =$

20. $g'''(-3) =$

21. $2h''(4) =$

22. Find the slope of $f(x)$ at $x = 3$.

23. At what value of x is $f'(x) = 0$?

24. What is the slope of the tangent line of $h(x)$ at the point (16, 4) ?

Find the equation for the slope of the line tangent to the given function.

25. $f(x) = 2\sqrt{x} - \pi^2$

26. $y = -2x^3 + \frac{1}{2}x^2 - 7x + 5$

27. $g(x) = \frac{1}{x^2} \quad - \frac{1}{2x}$

Is the slope of the tangent line positive, negative, or zero at the given point?

28. $f(x) = \frac{4x^3 - 16x^2}{2x}$ at $x = 2$

29. $y = 2x^4 + 5x^3$ at $x = -2$

30. $g(x) = 3\sqrt[3]{x^5} - 4x^{-1}$ at $x = 8$

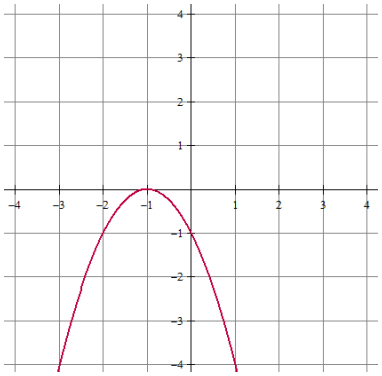
Write the equation of the tangent line and the normal line at the point given.

31. $f(x) = 3\sqrt{x} + 4$ at $x = 4$

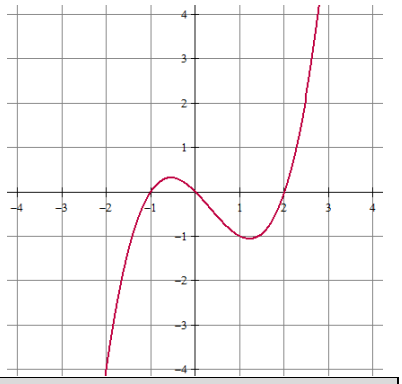
32. $y = \frac{x^2 + 3x - 4}{2}$ at $x = 8$

The function is graphed below. Write the equation of the tangent line at the given point and graph it.

33. $f(x) = -x^2 - 2x - 1$ at $x = -2$

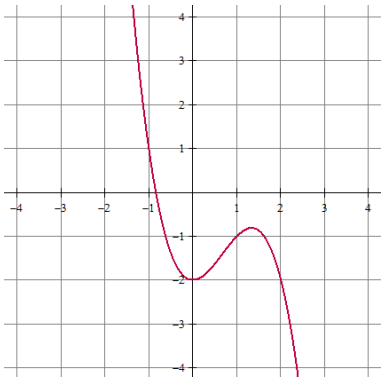


34. $y = \frac{x^3}{2} - \frac{x^2}{2} - x$ at $x = 1$

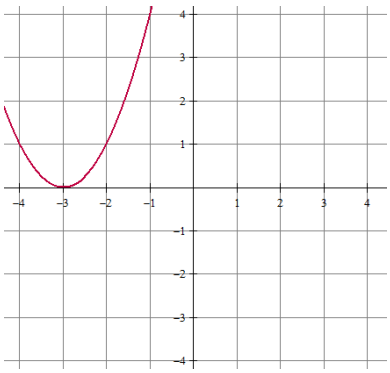


The function is graphed below. Write the equation of the normal line at the given point and graph it.

35. $f(x) = -x^3 + 2x^2 - 2$ at $x = 2$



36. $y = x^2 + 6x + 9$ at $x = -2$



You will need to use a graphing calculator for 37-42

Use the graph to find the derivative of the function at the given value. Round to nearest thousandth.

37. $f(x) = \frac{x^2+1}{x-2}$ at $x = 6$

38. $y = e^x$ at $x = -1$

39. $f(\theta) = 2\sin\theta$ at $\theta = \frac{\pi}{2}$

Write the equation of the tangent line at the point given and sketch the graph. Round to nearest thousandth.

40. $f(x) = -\sqrt{3x+4}$ at $x = 5$

41. $y = \ln(x) + 4$ at $x = e$

42. $f(\theta) = \csc\theta + 1$ at $\theta = \frac{\pi}{4}$

MULTIPLE CHOICE

1. Let $f(x) = x^3 + 2x - 5$. What is the *x*-coordinate of a point where the instantaneous rate of change of *f* is the same as the average rate of change of *f* on the interval $-1 < x < 1$?

   (A) $\frac{\sqrt{3}}{3}$
   (B) $\frac{1}{2}$
   (C) 0
   (D) $\frac{1}{3}$
   (E) $\sqrt{3}$

2. Given $g(x) = 2x^5 + \frac{b}{x^2}$ where *b* is a constant, find the value of *b* if $g'(2) = 180$.

   (A) 10
   (B) 20
   (C) -40
   (D) -80
   (E) none of the above

3. Given $f'(x) = \frac{1}{x}$ and $f(2) = 5$, write an equation for the line which is tangent to the graph of $f(x)$ at the point where $x = 2$.

   (A) $y = \frac{1}{2}x - \frac{1}{2}$
   (B) $y = \frac{1}{5}x + 5$
   (C) $y = \frac{1}{2}x + 4$
   (D) $y = \frac{1}{5}x - \frac{23}{5}$
   (E) $y = \frac{1}{2}x + 5$

4. If the line normal to the graph of f at the point $(1,2)$ passes through the point $(-1,1)$, then which of the following gives the value of $f'(1) = ?$

   (A) -2
   (B) 2
   (C) $-\frac{1}{2}$
   (D) $\frac{1}{2}$
   (E) 3

You are allowed to use a graphing calculator for #5

5. Which of the following is an equation of the line tangent to the graph of $f(x) = x^6 - x^4$ at the point where $f'(x) = -1$?
   (A) $y = -x - 1.031$
   (B) $y = -x - 0.836$
   (C) $y = -x + 0.836$
   (D) $y = -x + 0.934$
   (E) $y = -x + 1.031$

FREE RESPONSE

Your score: ____ out of 5

Use the table to answer the questions below.

x	$f(x)$	$f'(x)$	$f''(x)$	$g(x)$	$g'(x)$	$g''(x)$
0	-10	1	2	-7	3	-4
2	-4	5	2	-1	7	8
5	20	11	2	83	58	26

1. Find the average rate of change of *f* over the interval $0 \le x \le 2$. Find the value of *x* at which the instantaneous velocity of *g* is equal to the average rate of change of *f* over the interval $0 \le x \le 2$.

2. Write the equation of the line normal to $g(x)$ at the point where $x = 2$.

3. $(f + g)''(5) =$

4. If $B = f(x) - 2g(x)$, then $B'(0) =$