3.4 Chain Rule

NOTES

CALCULUS

Write your questions here!

Find the derivative.

$$f(x) = (3x+1)^2$$

CHAIN RULE

$$\frac{d}{dx} f\big(g(x)\big) =$$

Find the derivative of the following.

$$f(x) = (x^2-5)^4$$

$$f(x) = \sqrt{4x-3}$$

$$y = 2(4x-7)^3$$

$$f(x) = \frac{1}{\sqrt[3]{5x-3}}$$

Evaluate

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

Find $f'(-3)$

Find the derivative.

$$f(x) = \left(\frac{t^2+1}{2t-5}\right)^3$$

Find $f'(4)$ given the following:

$$g(4) = 4 \text{ and } g'(4) = -2$$
$$h(4) = 9 \text{ and } h'(4) = 5$$

$f(x) = \left(g(x)\right)^2$	$f(x) = \sqrt{h(x)}$	$f(x) = h\left(g(x)\right)$

SUMMARY:

Now, summarize your notes here!

3.4 Chain Rule

PRACTICE

Find the derivative of the following.	
1. $f(x) = (3x^2 - 1)^5$	2. $f(r) = \sqrt[3]{5r^2 - 2r + 1}$
3. $y = \frac{1}{(7x^2-1)^2}$	4. $h(x) = 2\sqrt{3x^2 - 5}$
5. $f(x) = (\pi x - 1)^2 + 7$	6. $g(x) = 4x - \frac{3}{\sqrt{2x+1}}$

Find the derivatives of the following.

7. $y = x\sqrt{2x-1}$

8. $y = (x^3 + e)^{-2}$

9. $g(x) = 2x(x^3 - 1)^2$

10. $h(x) = \frac{6x^2-5}{\sqrt{2-5x}}$

Evaluate the derivative at a point.

11. $f(x) = \sqrt{1 + (x^2-1)^3}$

$f'(2) =$

12. $y = \frac{x+1}{\sqrt{2x-1}}$

$\left.\frac{dy}{dx}\right|_{x=1}$

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

13. $f(x) = \sqrt{x^2 - 9}$ at $x = 5$

14. $f(x) = \frac{1}{(3-2x)^2}$ at $x = 1$

Particle Motion

15. The position of a particle moving along a coordinate line is $s = \sqrt{1 + 4t}$, with s in meters and t in seconds. Find the particle's velocity at $t = 6$.

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16. If $s = \frac{t}{t^2+5}$ is the position function of a moving particle for $t \geq 0$, then at what instant of time will the particle start to reverse its direction of motion and where is it at the instant?

Find $f'(5)$ given the following.

	17. $f(x) = g(x) + h(x)$	18. $f(x) = \left(h(x)\right)^2$
$\boldsymbol{g(5) = 9}$ **and** $\boldsymbol{g'(5) = 6}$ $\boldsymbol{h(5) = 5}$ **and** $\boldsymbol{h'(5) = -4}$	19. $f(x) = \sqrt{g(x)}$	20. $f(x) = 2g(x)h(x)$
	21. $f(x) = \frac{1}{h(x)}$	22. $f(x) = g\left(h(x)\right)$

MULTIPLE CHOICE

1. Let $f(x) = x \cdot g(h(x))$ where $g(4) = 2, g'(4) = 3, h(3) = 4,$ and $h'(3) = -2$. Find $f'(3)$.

   (A) -18
   (B) -16
   (C) -7
   (D) 7
   (E) 11

2. Let *m* and *b* be real numbers and let the function *f* be defined by

$$f(x) = \begin{cases} 1 + 3bx + 2x^2 & \text{for } x \leq 1 \\ mx + b & \text{for } x > 1 \end{cases}$$

   If *f* is both continuous and differentiable at *x* = 1, then

   (A) $m = 1, b = 1$
   (B) $m = 1, b = -1$
   (C) $m = -1, b = 1$
   (D) $m = -1, b = -1$
   (E) none of the above

3. A particle moves on the *x*-axis with position defined by: $x(t) = t^3 - 6t^2 + 2t + 1$ where $t \geq 0$. What is the velocity of the particle when its acceleration is zero?

   (A) -11
   (B) -10
   (C) -1
   (D) 2
   (E) 50

4. If $f(x) = \sqrt{1 + \sqrt{x}}$, find $f'(x)$.

   (A) $\frac{-1}{4\sqrt{x}\sqrt{1+\sqrt{x}}}$
   (B) $\frac{1}{2\sqrt{x}\sqrt{1+\sqrt{x}}}$
   (C) $\frac{1}{4\sqrt{1+\sqrt{x}}}$
   (D) $\frac{1}{4\sqrt{x}\sqrt{1+\sqrt{x}}}$
   (E) $\frac{-1}{2\sqrt{x}\sqrt{1+\sqrt{x}}}$

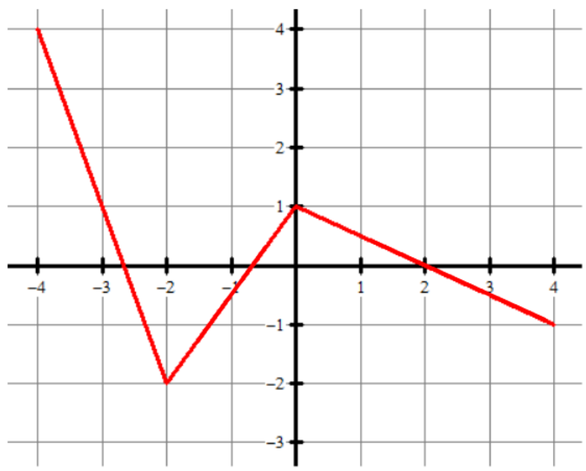
 **You are allowed to use a graphing calculator for #5** 

5. If $f(x) = \left(1 + \frac{x}{20}\right)^5$, find $f''(40)$.

   (A) 0.068
   (B) 1.350
   (C) 5.400
   (D) 6.750
   (E) 540.000

<u>FREE RESPONSE</u> **Your score: ____ out of 4**

1. The graph of the function *f*, shown below, consists of three line segments. Suppose $g(x)$ is a function whose derivative is *f*.



Graph of *f*

(a) Suppose $y = x + 7$ is the equation for the line tangent to the graph of $g(x)$ at $x = -3$. Let h be the function defined by $h(x) = (g(x))^2$. Find $h'(-3)$.

(b) Describe the shape of the graph of $g(x)$ near $x = 2$.

(c) Give a piecewise defined equation for $g''(x)$.