AB Calculus Name________________________________

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Derivatives Practice

Date________________ Period____

Use the function $g(x) = 2x^3 - 3x + 5$ to answer questions 1 – 3

$g(x+h) = 2(x+h)^3 - 3(x+h) + 5$

1) Use the original limit definition of the derivative to find $g'(x)$

$2(x^3 + 3x^2h + 3xh^2 + h^3) - 3x - 3h + 5$

$$g'(x) = \lim_{h\to 0} \frac{g(x+h) - g(x)}{h}$$

$$\frac{\cancel{2x^3} + 6x^2\cancel{h} + 6xh^{\cancel{2}} + 2h^{\cancel{3}\,2} - \cancel{3x} - 3\cancel{h} + \cancel{5} - \cancel{2x^3} + \cancel{3x} - \cancel{5}}{\cancel{h}}$$

$$\lim_{h\to 0} 6x^2 + 6xh + 2h^2 - 3 = 6x^2 - 3$$

$$\boxed{g'(x) = 6x^2 - 3}$$

2) Find the equation of a tangent line at $x = 3$

3) Find the equation of a normal line at $x = 3$

$g'(3) = 6(3)^2 - 3 = 54 - 3 = 51$

$g(3) = 2(3)^3 - 3(3) + 5 = 54 - 9 + 5 = 50$

$$\boxed{y - 50 = 51(x - 3)}$$

$$\boxed{y - 50 = \frac{-1}{51}(x - 3)}$$

4) If $y = \dfrac{4}{3x^2}$ use the limit definition of the derivative to find $\dfrac{dy}{dx}$

$$\frac{dy}{dx} = \lim_{h\to 0} \frac{\frac{x^2}{x^2}\cdot\frac{4}{3(x+h)^2} - \frac{4}{3x^2}\cdot\frac{(x+h)^2}{(x+h)^2}}{h}$$

$$\frac{-8x\cancel{h} - 4h^{\cancel{2}}}{3\cancel{h}\cdot x^2(x+h)^2}$$

$4x^2 - 4(x+h)^2$

$4x^2 - 4(x^2 + 2xh + h^2)$

$4x^2 - 4x^2 - 8xh - 4h^2$

$-8xh - 4h^2$

$$\lim_{h\to 0} \frac{-8x - 4h}{3x^2(x+h)^2} = \frac{-8x}{3x^2\ x^2} = \frac{-8x}{3x^4} = \boxed{\frac{-8}{3x^3}}$$

$\frac{2\sqrt{5}}{8} = \frac{\sqrt{5}}{4}$

5) If $f(x) = \sqrt{5x}$ use the alternative definition of the derivative to find $f'(4)$ $\frac{5}{2\sqrt{20}}\cdot\frac{\sqrt{20}}{\sqrt{20}} \to \frac{5\sqrt{20}}{2\cdot 20} = \frac{\sqrt{20}}{8}$ =

A) $\dfrac{5\sqrt{20}}{20}$ B) $\dfrac{\sqrt{2}}{5}$ C) $\dfrac{\sqrt{5}}{4}$ D) $\dfrac{\sqrt{5}}{20}$ E) $\dfrac{1}{2\sqrt{2}}$

$$\lim_{x\to 4} \frac{\sqrt{5x} - \sqrt{20}}{x - 4}\cdot\frac{\sqrt{5x} + \sqrt{20}}{\sqrt{5x} + \sqrt{20}} \to \lim_{x\to 4} \frac{5x - 20 \to 5\cancel{(x-4)}}{\cancel{(x-4)}(\sqrt{5x} + \sqrt{20})} = \frac{5}{2\sqrt{20}}$$

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