# Definition of the Derivative Practice

**Interpret each of the following as a derivative. Evaluate if possible.**

1. $\lim_{x \to \frac{\pi}{3}} \frac{\sin x - \frac{\sqrt{3}}{2}}{x - \frac{\pi}{3}}$

2. $\lim_{h \to 0} \frac{e^{3(x+h)} - e^{3x}}{h}$

3. $\lim_{h \to 0} \frac{\tan\left(\frac{\pi}{4} + h\right) - 1}{h}$

4. $\lim_{h \to 0} \frac{\cos(x+h) - \cos x}{h}$

5. $\lim_{x \to 1} \frac{3x^2 + 4x - 7}{x - 1}$

6. $\lim_{x \to \frac{3\pi}{4}} \frac{\cos x - \cos\left(\frac{3\pi}{4}\right)}{x - \frac{3\pi}{4}}$

7. $\lim_{x \to 0} \frac{e^{x^2} - 1}{x}$

8. $\lim_{x \to 1} \frac{\arctan x - \frac{\pi}{4}}{x - 1}$

9. $\lim_{h \to 0} \frac{\sec(x+h) - \sec x}{h}$

10. $\lim_{h \to 0} \frac{\arcsin\left(\frac{1}{2} + h\right) - \frac{\pi}{6}}{h}$

11. Given $\lim_{h \to 0} \frac{f(2+h) - f(2)}{h} = 5$, which of the following must be true? (not multiple choice)

    A) $f(x)$ is continuous at $x = 2$

    B) $f'(2)$ exists

    C) $f(x)$ is differentiable at $x = 2$

    D) $f(2)$ exists

    E) $f''(2)$ exists

**Using the given *u*-substitution, determine a definite integral that would have the same value.**

1. $u = \sqrt{x}$, $\int_4^9 \frac{\sin\sqrt{x}}{\sqrt{x}}\,dx$

2. $u = 2x+3$, $\int_1^3 \sqrt[3]{2x+3}\,dx$

3. $u = \ln x$, $\int_1^e \frac{(\ln x)^5}{x}\,dx$

4. $u = 3x-1$, $\int_0^2 e^{3x-1}\,dx$

5. $u = \sqrt[3]{x}$, $\int_0^8 \frac{e^{\sqrt[3]{x}}}{\sqrt[3]{x^2}}\,dx$

6. $u = 3x-2$, $\int_2^4 \cos(3x-2)\,dx$

**Use the given information to determine an equivalent equation involving a definite integral.**

7. $\int_2^4 f(2x)\,dx = 12$

8. $\int_1^3 f(2x-3)\,dx = 5$

9. $\int_3^6 f\left(\frac{x}{3}\right)dx = 6$

10. $\int_2^5 f(2-x)\,dx = 4$

11. $\int_4^6 f\left(\frac{x}{2}+1\right)dx = 3$

12. $\int_0^4 f\left(e^{3x}\right)\cdot e^{3x}\,dx = -3$