

$$1) \lim_{x \rightarrow 0} \frac{x+1}{x^2+3} = 0$$

$$12) f(-1) = -1-2 = -1$$

$$f(-2) = -2-2 = 0$$

$$2) \lim_{x \rightarrow 0} \frac{\sin 3x}{5x}$$

$$f(0) = 0^2 - 0 = 0$$

$$\frac{1}{5} \lim_{x \rightarrow 0} \frac{\sin 3x}{x}$$

$$f(1) = 1^2 - 1 = 0$$

$$\frac{1}{5} (3) \lim_{x \rightarrow 0} \frac{\sin 3x}{3}$$

$$f(2) = 2^2 - 2 = 2$$

$$\frac{3}{5} (1) = \frac{3}{5}$$

$$f(3) = 3^2 - 3 = 6$$

$$f(4) = 3(4) - 2 = 10 \quad f(3) = 3(3) - 2 = 4$$

$$3) \lim_{x \rightarrow 0} \frac{x + \sin x}{x}$$

$$f(5) = 3(5) - 2 = 13$$

$$\lim_{x \rightarrow 0} \frac{x}{x} + \lim_{x \rightarrow 0} \frac{\sin x}{x}$$

$$f(6) = 3(6) - 2 = 16$$

$$1 + 1 = 2$$

$$4) \lim_{x \rightarrow \infty} \frac{4x^2 + 3x - 2}{3x^2 - 7} = \frac{4}{3}$$

$$14) f(x) = \begin{cases} kx^2 & \text{if } x < 2 \\ 2x + k & \text{if } x \geq 2 \end{cases}$$

$$2(2) + k = 4 + k$$

$$k(2)^2 = 4k$$

$$5) \lim_{x \rightarrow \frac{\pi}{3}} \csc x = \lim_{x \rightarrow \frac{\pi}{3}} \frac{1}{\sin x}$$

$$4 + k = 4k$$

$$4 = 3k$$

$$\frac{1}{\sin \frac{\pi}{3}} = \frac{1}{\frac{\sqrt{3}}{2}} = \frac{2}{\sqrt{3}}$$

$$k = \frac{4}{3}$$

$$6) \lim_{x \rightarrow \frac{1}{2}} \frac{4x^2 - 2x}{8x - 4}$$

$$\lim_{x \rightarrow \frac{1}{2}} \frac{2x(2x-1)}{4(2x-1)}$$

$$\lim_{x \rightarrow \frac{1}{2}} \frac{2x}{4} = \frac{2(\frac{1}{2})}{4} = \frac{1}{4}$$

$$15) f(k) = \begin{cases} 2x^2 - 5x - 12 & \text{if } x < 2 \\ k - 13 & \text{if } x \geq 2 \end{cases}$$

$$2(2)^2 - 5(2) - 12 = 8 - 10 - 12 = -14$$

$$k - 13 = -14$$

$$k = -1$$

$$10) f(x) = \frac{3x^4(2-x)}{3x^5} \Rightarrow \frac{6x^4 - 3x^5}{3x^5}$$

$$\text{H.A. } \frac{-3}{3} = -1 \quad y = -1 \leftarrow \lim_{x \rightarrow \infty}$$

$$\text{V.A. } 3x^5 = 0 \Rightarrow x = 0 \leftarrow \lim_{x \rightarrow 0^+} = \infty$$

$$\lim_{x \rightarrow 0^-} = -\infty$$

$$29) \quad uv' + vu' = 3(2) + 1(-4) \\ = 6 - 4$$

$$\left. \frac{d}{dx} [uv] \right|_{x=2} = 2$$

$$30) \quad \frac{vu' - uv'}{v^2} = \frac{1(-4) - (3)(2)}{1^2} \\ = \frac{-4 - 6}{1}$$

$$\left. \frac{d}{dx} \left[\frac{u}{v} \right] \right|_{x=2} = -10$$

$$31) \quad 3u' - 2v' + 2uv' + v2u' \\ = 3(-4) - 2(2) + 2(3)(2) + 1(2)(-4) \\ = -12 - 4 + 12 - 8$$

$$\left. \frac{d}{dx} (3u - 2v + 2uv) \right|_{x=2} = -12$$

$$32) \quad \frac{d}{dx} (F(x))^2 = 2(F(x))(F'(x)) \\ = 2(5)(4)$$

$$H'(3) = 40$$

$$33) \quad \frac{d}{dx} \frac{F(x)}{G(x)} = \frac{G(x)F'(x) - F(x)G'(x)}{(G(x))^2} \\ = \frac{2(4) - 5(7)}{2^2} \\ = \frac{8 - 35}{4}$$

$$H'(3) = \frac{-27}{4}$$

$$34) \quad \frac{d}{dx} F(x) \cdot G(x) = F(x)G'(x) + G(x)F'(x)$$

$$\frac{d^2}{dx^2} F(x) \cdot G(x) = [F(x)G''(x) + G'(x)F'(x)] + [G(x)F''(x) + F'(x)G''(x)]$$

$$= 5(-2) + 7(4) + 2(-3) + 4(4)$$

$$= -10 + 28 - 6 + 16$$

$$H''(3) = 40$$

$$35) \quad \frac{d}{dx} G(F(x)) = G'(F(x))(F'(x))$$

$$= G'(F(3))(F'(3))$$

$$= G'(5)(4)$$

$$= -4(4)$$

$$H'(3) = -16$$

$$36) \quad \frac{d^2}{dx^2} G(F(x)) = G'(F(x))(F''(x))$$

$$+ F'(x) G''(F(x))(F'(x))$$

$$= G'(F(3))F''(3)$$

$$+ F'(3)G''(F(3))(F'(3))$$

$$= G'(5)(-3) + 4(G''(5))(4)$$

$$= -4(-3) + 4(11)(4)$$

$$= 12 + 88$$

$$= 100$$

$$37) \quad \frac{d}{dx} \ln(F(x)) = \frac{1}{F(x)} F'(x)$$

$$= \frac{1}{5}(4)$$

$$= \frac{4}{5}$$

$$47) f'(x) = -\frac{4}{2}x^3 + 3\left(\frac{4}{x}\right) - 3$$

$$= -2x^3 - \frac{12}{x^4} - 3$$

$$48) f(x) = 2x - \frac{2x^2}{2\sqrt{x}} + x^{2/5}$$

$$2x - x^{3/2} + x^{2/5}$$

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

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

$$49) f'(x) = 2\sin x(-\sin x) + \cos x(2\cos x) + \cos x$$

$$= -2\sin^2 x + 2\cos^2 x + \cos x$$

$$= 2(\cos^2 x - \sin^2 x) + \cos x$$

$$= 2\cos(2x) + \cos x$$

$$50) g'(x) = \frac{(x^2-1)(-2-2x) - (3-2x-x^2)(2x)}{(x^2-1)^2}$$

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

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

$$51) f'(x) = x^2 \cos(4x)(4) + \sin(4x)(2x)$$

$$= 4x^2 \cos(4x) + 2x \sin(4x)$$

$$52) h'(x) = \frac{4x(-\sin(7x)(7) - \cos(7x)(4))}{(4x)^2}$$

$$= \frac{-28x \sin(7x) - 4 \cos(7x)}{16x^2}$$

$$= \frac{4[-7x \sin(7x) - \cos(7x)]}{4(4x^2)}$$

$$= \frac{7x \sin(7x) - \cos(7x)}{4x^2}$$

$$53) f'(x) = \frac{1}{2} (1-x^3)(3x^2) \\ = \frac{3x^2}{2} (1-x^3)$$

$$54) y' = 2(4) \cos^3(3x+1) (-\sin(3x+1)(3)) \\ = -24 \cos^3(3x+1) \sin(3x+1)$$

$$55) y' = x^2 (3(x^2-3)^2(2x)) + (x^2-3)^3 (2x) \\ = 6x^3(x^2-3)^2 + 2x(x^2-3)^3 = (x^2-3)^2 (6x^3 + 2x(x^2-3)) \\ (x^2-3)^2 (6x^3 + 2x^3 - 2x) \\ (x^2-3)^2 (8x^3 - 2x)$$

$$56) y' = 3 \csc^2(2x^2) (-\csc(2x^2) \cot(2x^2)) (4x) \\ = -12x \csc^2(2x^2) \csc(2x^2) \cot(2x^2) \\ = -12 \csc^3(2x^2) \cot(2x^2)$$

$$57) f'(x) = x^3 [2(\tan x)(\sec x)^2] + 3x^2 \tan^2 x \\ = 2x^3 \tan x (\sec x)^2 + 3x^2 \tan^2 x$$

$$58) f'(x) = \frac{1}{1+e^{3x}} (e^{3x})(3) \\ = \frac{3e^{3x}}{1+e^{3x}}$$

$$59) y' = \frac{1}{x^2+3} (2x) \\ = \frac{2x}{x^2+3}$$

$$60) y' = e^{x^2-3x} (2x-3) \\ = (2x-3)e^{x^2-3x}$$

$$\begin{aligned} 61) \quad g'(t) &= \frac{1}{1+(3t-4)} (3) \\ &= \frac{3}{1+3t-4} \\ &= \frac{3}{3t-3} \\ &= \frac{3}{3} \left(\frac{1}{t-1} \right) \\ &= \frac{1}{t-1} \end{aligned}$$

$$\begin{aligned} 62) \quad h'(x) &= x \frac{1}{\sqrt{1-x^2}} + \sin^{-1} x (1) \\ &= \frac{x}{\sqrt{1-x^2}} + \sin^{-1} x \end{aligned}$$

$$\begin{aligned} 63) \quad f'(x) &= \frac{1}{1+e^x} (e^x) \\ &= \frac{e^x}{1+e^x} \end{aligned}$$

$$\begin{aligned} 64) \quad y' &= \frac{1}{\sqrt{1-(5x)^2}} (5) \\ &= \frac{5}{\sqrt{1-25x^2}} \\ &= \frac{5}{\sqrt{1-25x^2}} \end{aligned}$$