1. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-t+1}{-2t-5}$

2. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-3t+1}{-2t+1}$

3. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-4t+4}{t+4}$

4. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-2t+1}{-2t+3}$

5. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-4t+5}{-2t+5}$

6. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{t-1}{-t+1}$

7. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-5t+3}{t-2}$

8. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{-2t+2}{2t-2}$

9. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{3t+1}{-t+3}$

10. Find the velocity, acceleration, and jerk functions for the following position function:
$s(t) = \dfrac{3t+3}{2t-2}$

Answers:

1. $v(t) = \dfrac{7}{(-2t-5)^2}$ $a(t) = \dfrac{28}{(-2t-5)^3}$ $j(t) = \dfrac{168}{(-2t-5)^4}$

2. $v(t) = \dfrac{-1}{(-2t+1)^2}$ $a(t) = \dfrac{-4}{(-2t+1)^3}$ $j(t) = \dfrac{-24}{(-2t+1)^4}$

3. $v(t) = \dfrac{-20}{(t+4)^2}$ $a(t) = \dfrac{40}{(t+4)^3}$ $j(t) = \dfrac{-120}{(t+4)^4}$

4. $v(t) = \dfrac{-4}{(-2t+3)^2}$ $a(t) = \dfrac{-16}{(-2t+3)^3}$ $j(t) = \dfrac{-96}{(-2t+3)^4}$

5. $v(t) = \dfrac{-10}{(-2t+5)^2}$ $a(t) = \dfrac{-40}{(-2t+5)^3}$ $j(t) = \dfrac{-240}{(-2t+5)^4}$

6. $v(t) = \dfrac{0}{(-t+1)^2}$ $a(t) = \dfrac{0}{(-t+1)^3}$ $j(t) = \dfrac{0}{(-t+1)^4}$

7. $v(t) = \dfrac{7}{(t-2)^2}$ $a(t) = \dfrac{-14}{(t-2)^3}$ $j(t) = \dfrac{42}{(t-2)^4}$

8. $v(t) = \dfrac{0}{(2t-2)^2}$ $a(t) = \dfrac{0}{(2t-2)^3}$ $j(t) = \dfrac{0}{(2t-2)^4}$

9. $v(t) = \dfrac{10}{(-t+3)^2}$ $a(t) = \dfrac{20}{(-t+3)^3}$ $j(t) = \dfrac{60}{(-t+3)^4}$

10. $v(t) = \dfrac{-12}{(2t-2)^2}$ $a(t) = \dfrac{48}{(2t-2)^3}$ $j(t) = \dfrac{-288}{(2t-2)^4}$

Solutions:

1. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-t+1}{-2t-5}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2t-5)\frac{\mathrm{d}}{\mathrm{d}t}(-t+1) - (-t+1)\frac{\mathrm{d}}{\mathrm{d}t}(-2t-5)}{(-2t-5)^2} = \dfrac{(-2t-5)(-1) - (-t+1)(-2)}{(-2t-5)^2} = \dfrac{7}{(-2t-5)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[7(-2t-5)^{-2}]$ ◀ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= 7(-2)(-2t-5)^{-3}(-2) = \dfrac{28}{(-2t-5)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[28(-2t-5)^{-3}] = 28(-3)(-2t-5)^{-4}(-2) = \dfrac{168}{(-2t-5)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

2. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-3t+1}{-2t+1}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2t+1)\frac{\mathrm{d}}{\mathrm{d}t}(-3t+1) - (-3t+1)\frac{\mathrm{d}}{\mathrm{d}t}(-2t+1)}{(-2t+1)^2} = \dfrac{(-2t+1)(-3) - (-3t+1)(-2)}{(-2t+1)^2} = \dfrac{-1}{(-2t+1)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-1(-2t+1)^{-2}]$ ◀ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= -1(-2)(-2t+1)^{-3}(-2) = \dfrac{-4}{(-2t+1)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-4(-2t+1)^{-3}] = -4(-3)(-2t+1)^{-4}(-2) = \dfrac{-24}{(-2t+1)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

3. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-4t+4}{t+4}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(t+4)\frac{\mathrm{d}}{\mathrm{d}t}(-4t+4) - (-4t+4)\frac{\mathrm{d}}{\mathrm{d}t}(t+4)}{(t+4)^2} = \dfrac{(t+4)(-4) - (-4t+4)(1)}{(t+4)^2} = \dfrac{-20}{(t+4)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-20(t+4)^{-2}]$ ◀ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= -20(-2)(t+4)^{-3}(1) = \dfrac{40}{(t+4)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[40(t+4)^{-3}] = 40(-3)(t+4)^{-4}(1) = \dfrac{-120}{(t+4)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

4. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-2t+1}{-2t+3}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2t+3)\frac{\mathrm{d}}{\mathrm{d}t}(-2t+1) - (-2t+1)\frac{\mathrm{d}}{\mathrm{d}t}(-2t+3)}{(-2t+3)^2} = \dfrac{(-2t+3)(-2) - (-2t+1)(-2)}{(-2t+3)^2} = \dfrac{-4}{(-2t+3)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-4(-2t+3)^{-2}]$ ◀ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= -4(-2)(-2t+3)^{-3}(-2) = \dfrac{-16}{(-2t+3)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-16(-2t+3)^{-3}] = -16(-3)(-2t+3)^{-4}(-2) = \dfrac{-96}{(-2t+3)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

5. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-4t+5}{-2t+5}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2t+5)\frac{\mathrm{d}}{\mathrm{d}t}(-4t+5)-(-4t+5)\frac{\mathrm{d}}{\mathrm{d}t}(-2t+5)}{(-2t+5)^2} = \dfrac{(-2t+5)(-4)-(-4t+5)(-2)}{(-2t+5)^2} = \dfrac{-10}{(-2t+5)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-10(-2t+5)^{-2}]$ ◄ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= -10(-2)(-2t+5)^{-3}(-2) = \dfrac{-40}{(-2t+5)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-40(-2t+5)^{-3}] = -40(-3)(-2t+5)^{-4}(-2) = \dfrac{-240}{(-2t+5)^4}$ ◄ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

6. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{t-1}{-t+1}$ ◄ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x)-f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-t+1)\frac{\mathrm{d}}{\mathrm{d}t}(t-1)-(t-1)\frac{\mathrm{d}}{\mathrm{d}t}(-t+1)}{(-t+1)^2} = \dfrac{(-t+1)(1)-(t-1)(-1)}{(-t+1)^2} = \dfrac{0}{(-t+1)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[0(-t+1)^{-2}]$ ◄ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= 0(-2)(-t+1)^{-3}(-1) = \dfrac{0}{(-t+1)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[0(-t+1)^{-3}] = 0(-3)(-t+1)^{-4}(-1) = \dfrac{0}{(-t+1)^4}$ ◄ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

7. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-5t+3}{t-2}$ ◄ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x)-f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(t-2)\frac{\mathrm{d}}{\mathrm{d}t}(-5t+3)-(-5t+3)\frac{\mathrm{d}}{\mathrm{d}t}(t-2)}{(t-2)^2} = \dfrac{(t-2)(-5)-(-5t+3)(1)}{(t-2)^2} = \dfrac{7}{(t-2)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[7(t-2)^{-2}]$ ◄ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= 7(-2)(t-2)^{-3}(1) = \dfrac{-14}{(t-2)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-14(t-2)^{-3}] = -14(-3)(t-2)^{-4}(1) = \dfrac{42}{(t-2)^4}$ ◄ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

8. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{-2t+2}{2t-2}$ ◄ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x)-f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(2t-2)\frac{\mathrm{d}}{\mathrm{d}t}(-2t+2)-(-2t+2)\frac{\mathrm{d}}{\mathrm{d}t}(2t-2)}{(2t-2)^2} = \dfrac{(2t-2)(-2)-(-2t+2)(2)}{(2t-2)^2} = \dfrac{0}{(2t-2)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[0(2t-2)^{-2}]$ ◄ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= 0(-2)(2t-2)^{-3}(2) = \dfrac{0}{(2t-2)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[0(2t-2)^{-3}] = 0(-3)(2t-2)^{-4}(2) = \dfrac{0}{(2t-2)^4}$ ◄ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

9. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{3t+1}{-t+3}$ ◄ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x)-f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-t+3)\frac{\mathrm{d}}{\mathrm{d}t}(3t+1)-(3t+1)\frac{\mathrm{d}}{\mathrm{d}t}(-t+3)}{(-t+3)^2} = \dfrac{(-t+3)(3)-(3t+1)(-1)}{(-t+3)^2} = \dfrac{10}{(-t+3)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[10(-t+3)^{-2}]$ ◄ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= 10(-2)(-t+3)^{-3}(-1) = \dfrac{20}{(-t+3)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[20(-t+3)^{-3}] = 20(-3)(-t+3)^{-4}(-1) = \dfrac{60}{(-t+3)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

10. $v(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}\dfrac{3t+3}{2t-2}$ ◀ Apply: $v(t) = \frac{\mathrm{d}}{\mathrm{d}t}s(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}\frac{f(x)}{g(x)} = \frac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(2t-2)\frac{\mathrm{d}}{\mathrm{d}t}(3t+3) - (3t+3)\frac{\mathrm{d}}{\mathrm{d}t}(2t-2)}{(2t-2)^2} = \dfrac{(2t-2)(3) - (3t+3)(2)}{(2t-2)^2} = \dfrac{-12}{(2t-2)^2}$

$a(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[-12(2t-2)^{-2}]$ ◀ Apply: $a(t) = \frac{\mathrm{d}}{\mathrm{d}t}v(t)$ $\frac{\mathrm{d}}{\mathrm{d}x}[f(x)]^n = n[f(x)]^{n-1}\frac{\mathrm{d}}{\mathrm{d}x}f(x)$

$= -12(-2)(2t-2)^{-3}(2) = \dfrac{48}{(2t-2)^3}$

$j(t) = \dfrac{\mathrm{d}}{\mathrm{d}t}[48(2t-2)^{-3}] = 48(-3)(2t-2)^{-4}(2) = \dfrac{-288}{(2t-2)^4}$ ◀ Apply: $j(t) = \frac{\mathrm{d}}{\mathrm{d}t}a(t)$

