"The Big 5"

1. $f'(x) = 0$

2. $f'(t) = -4$

$y = (3x)^{1/2}$

3. $f'(y) = 8y - 3$

4. $\frac{dy}{dx} = \frac{1}{2}(3x)^{-1/2} \cdot 3$

$$= \frac{3}{2\sqrt{3x}}$$

5. $\frac{dr}{d\theta} = -3 \sin 3\theta$

6. $\frac{dr}{d\theta} = -3 \sin \theta$

$r = (\cos \theta)^3$

7. $$\frac{dr}{d\theta} = \underbrace{3\cos^2\theta}_{\text{power rule}} \cdot \underbrace{(-\sin\theta)}_{\text{chain rule}} = -3\cos^2\theta \sin\theta$$

$(\cos\theta)^3$

inner outer

8. $$\frac{dr}{d\theta} = -\sin(\theta^3) \cdot 3\theta^2$$

$\cos(\theta^3)$

outer inner

(9) $\frac{dr}{d\theta} = 3\cos^2\theta^2 \cdot (-\sin\theta^2) \cdot 2\theta$

$= -6\theta\cos^2\theta^2 \cdot \sin\theta^2$

θ^2

cos

cube

(10) quotient rule: $\frac{dr}{d\theta} = \frac{0 - 1(\cos\theta - \sin\theta)}{(\sin\theta + \cos\theta)^2}$

$= \frac{-\cos\theta + \sin\theta}{(\sin\theta + \cos\theta)^2}$

chain rule: $r = (\sin\theta + \cos\theta)^{-1}$

$\frac{dr}{d\theta} = -(\sin\theta + \cos\theta)^{-2}(\cos\theta - \sin\theta)$

(11) $v'(t) = \frac{(5t+1)(3) - (3t-4)(5)}{(5t+1)^2}$

$= \frac{23}{(5t+1)^2}$

(12) $$\frac{dv}{dt} = \frac{(3t+1)^3 \cdot 4(2t+3)^3 \cdot 2 - (2t+3)^4 \cdot 3(3t+1)^2 \cdot 3}{(3t+1)^6}$$

$$= \frac{\cancel{(3t+1)}^{2}(2t+3)^3\left[8(3t+1) - 9(2t+3)\right]}{(3t+1)^{\cancel{6}\,4}}$$

$$= \frac{(2t+3)^3(6t-19)}{(3t+1)^4}$$

(13) $$a'(t) = \frac{-t \cdot e^t \cdot \sin t - \cos t\,\underbrace{(t\,e^t + e^t \cdot 1)}_{\text{product rule}}}{t^2 e^{2t}}$$

jerk

$$= \frac{\cancel{e^t}(-t\sin t - t\cos t - \cos t)}{t^2\,\cancel{e^{2t}}\,e^t}$$

(14) $$A'(y) = \underbrace{y^2 \cdot 2\sec y \cdot \sec y \tan y}\, + \underbrace{\sec^2 y \cdot 2y}$$

$$= 2y \cdot \sec^2 y\,(y \cdot \tan y + 1)$$

(15) $$f'(z) = \frac{\pi}{2} \cdot e^{-\frac{1}{2}z^2} \cdot (-z) = -\frac{\pi}{2} z\, e^{-\frac{1}{2}z^2}$$

(16) $x(t) = (t^2+t+1)^{-1/2}$

$$x'(t) = -\tfrac{1}{2}(t^2+t+1)^{-3/2}(2t+1)$$

$$= \frac{-(2t+1)}{2(t^2+t+1)^{3/2}}$$

16 - by the Quotient rule:

$$x'(t) = \frac{0 - \overbrace{\tfrac{1}{2}(t^2+t+1)^{-1/2}(2t+1)}^{\text{deriv. of denom.}}}{(t^2+t+1)^1}$$

$$= \frac{-(2t+1)}{2(t^2+t+1)^{3/2}} \leftarrow 1-(-1/2)$$

(17) $\frac{dy}{dt} = \sec^2(e^{2t}) \cdot e^{2t} \cdot 2$

(18) $f'(x) = 0$

$\tan^2\theta + 1 = \sec^2\theta$

$1 = \sec^2\theta - \tan^2\theta$

19 $y'(t) = \sin t \cdot e^{\sin t} \cdot \cos t + e^{\sin t} \cdot \cos t$

$= e^{\sin t} \cdot \cos t \, (\sin t + 1)$

20 $f'(x) = x^5 \cdot 6(2x+4)^5 \cdot 2 + (2x+4)^6 \cdot 5x^4$

$= x^4 (2x+4)^5 \left[12x + 5(2x+4)\right]$

$= x^4 (2x+4)^5 (22x + 20)$