

$$4. \quad w = \frac{x^3}{y^2}, \quad x = t+3, \quad y = t^2, \quad t = 1$$

$$w = x^3 y^{-2}$$

$$\begin{aligned} \frac{dw}{dt} &= \frac{\partial w}{\partial x} \cdot \frac{dx}{dt} + \frac{\partial w}{\partial y} \cdot \frac{dy}{dt} \\ &= (3x^2 y^{-2})(1) + (-2x^3 y^{-3})(2t) \end{aligned}$$

$$\frac{dw}{dt} = \frac{3x^2}{y^2} - \frac{4tx^3}{y^3}$$

PLUG IN $x = t+3, y = t^2$

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

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

$$= \frac{3(t+3)^2}{t^4} - \frac{4(t+3)^3}{t^5}$$

$$= \frac{3t(t+3)^2}{t^5} - \frac{4(t+3)^3}{t^5}$$

$$= \frac{3t(t+3)^2 - 4(t+3)^3}{t^5}$$

$$= \frac{(t+3)^2 [3t - 4(t+3)]}{t^5}$$

$$= \frac{(t+3)^2 (3t - 4t - 12)}{t^5}$$

$$= \frac{(t+3)(t+3)(-t-12)}{t^5}$$

$$= \frac{(t^2 + 3t + 3t + 9)(-t-12)}{t^5}$$

$$\begin{aligned} \frac{dw}{dt} &= \frac{(t^2 + 6t + 9)(-t-12)}{t^5} \\ &= \frac{-t^3 - 6t^2 - 9t - 12t^2 - 72t - 108}{t^5} \end{aligned}$$

$$= \frac{-t^3 - 18t^2 - 81t - 108}{t^5}$$

$$= \frac{-t^3}{t^5} - \frac{18t^2}{t^5} - \frac{81t}{t^5} - \frac{108}{t^5}$$

$$= -\frac{1}{t^2} - \frac{18}{t^3} - \frac{81}{t^4} - \frac{108}{t^5}$$

$$= -t^{-2} - 18t^{-3} - 81t^{-4} - 108t^{-5}$$

$$\frac{d^2w}{dt^2} = 2t^{-3} + 54t^{-4} + 324t^{-5} + 540t^{-6}$$

$$= \frac{2}{t^3} + \frac{54}{t^4} + \frac{324}{t^5} + \frac{540}{t^6}$$

$$= \frac{2t^3}{t^6} + \frac{54t^2}{t^6} + \frac{324t}{t^6} + \frac{540}{t^6}$$

$$= \frac{2t^3 + 54t^2 + 324t + 540}{t^6}$$

PLUG IN $t = 1$

$$= 2 + 54 + 324 + 540$$

$$= 56 + 864$$

$$= \boxed{920}$$