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September 18, 20251. In this problem $y = x^3 + \frac{1}{x} = x^3 + x^{-1}$

$$(a) \frac{dy}{dx} = 3x^2 - x^{-2} = \boxed{3x^2 - \frac{1}{x^2}}$$

$$(b) \frac{d^2y}{dx^2} = 6x + 2x^{-3} = \boxed{6x + \frac{2}{x^3}}$$

$$(c) \frac{d^3y}{dx^3} = 6 - 6x^{-4} = \boxed{6 - \frac{6}{x^4}}$$

$$2. D_x [\cos(e^x)] = \boxed{-\sin(e^x)e^x}$$

$$3. D_x \left[\tan \left(\frac{x^5+1}{5x} \right) \right] = \sec^2 \left(\frac{x^5+1}{5x} \right) \frac{(5x^4+0)5x - (x^5+1) \cdot 5}{(5x)^2}$$

$$= \sec^2 \left(\frac{x^5+1}{5x} \right) \frac{25x^5 - 5x^5 - 5}{25x^2} = \boxed{\sec^2 \left(\frac{x^5+1}{5x} \right) \frac{4x^5 - 1}{5x^2}}$$

$$4. D_x [\sec(x^5+x)] = \boxed{\sec(x^5+x) \tan(x^5+x) (5x^4+1)}$$

1. In this problem $y = x^2 + \frac{1}{x^2} = x^2 + x^{-2}$

$$(a) \frac{dy}{dx} = 2x - 2x^{-3} = \boxed{2x - \frac{2}{x^3}}$$

$$(b) \frac{d^2y}{dx^2} = 2 + 6x^{-4} = \boxed{2 + \frac{6}{x^4}}$$

$$(c) \frac{d^3y}{dx^3} = -24x^{-5} = \boxed{-\frac{24}{x^5}}$$

$$2. D_x [\csc(e^x)] = \boxed{-\csc(e^x) \cot(e^x) e^x}$$

$$3. D_x [\cot(x^5 + x)] = \boxed{-\csc^2(x^5 + x) (5x^4 + 1)}$$

$$4. D_x \left[\sin \left(\frac{x^5 + 1}{5x} \right) \right] = \cos \left(\frac{x^5 + 1}{5x} \right) \frac{(5x^4 + 0)5x - (x^5 + 1)5}{(5x)^2}$$

$$= \cos \left(\frac{x^5 + 1}{5x} \right) \frac{25x^5 - 5x^5 - 5}{25x^2} = \boxed{\cos \left(\frac{x^5 + 1}{5x} \right) \frac{4x^5 - 1}{5x^2}}$$