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September 25, 2025

$$1. D_x [\ln |\cos(x)|] = \frac{1}{\cos(x)} D_x [\cos(x)] = -\frac{\sin(x)}{\cos(x)} = \boxed{-\tan(x)}$$

$$\begin{aligned} 2. D_x \left[ \left( \ln |\sec(x)| \right)^5 \right] &= 5 \left( \ln |\sec(x)| \right)^4 D_x [\ln |\sec(x)|] \\ &= 5 \left( \ln |\sec(x)| \right)^4 \frac{\sec(x) \tan(x)}{\sec(x)} \\ &= \boxed{5 \left( \ln |\sec(x)| \right)^4 \tan(x)} \end{aligned}$$

$$3. D_x [4xe^{\sqrt{3x+1}}] = 4e^{\sqrt{3x+1}} + 4x D_x [e^{\sqrt{3x+1}}] \quad \leftarrow \boxed{\text{product rule}}$$

$$= 4e^{\sqrt{3x+1}} + 4x e^{\sqrt{3x+1}} D_x [\sqrt{3x+1}]$$

$$= 4e^{\sqrt{3x+1}} + 4x e^{\sqrt{3x+1}} \frac{1}{2\sqrt{3x+1}} D_x [3x+1]$$

$$= \boxed{4e^{\sqrt{3x+1}} \left( 1 + \frac{3x}{2\sqrt{3x+1}} \right)}$$

4. Find the equation of the tangent line to  $f(x) = \frac{1}{2} \ln |x|$  at the point  $(1, f(1))$ .

$$f'(x) = \frac{1}{2} \cdot \frac{1}{x} = \frac{1}{2x}$$

$$\text{Point: } (1, f(1)) = \left( 1, \frac{1}{2} \ln(1) \right) = (1, 0)$$

$$\text{Slope } f'(1) = \frac{1}{2 \cdot 1} = \frac{1}{2}$$

Point slope formula:

$$y - y_0 = m(x - x_0)$$

$$y - 0 = \frac{1}{2}(x - 1)$$

$$\boxed{y = \frac{1}{2}x - \frac{1}{2}}$$

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$$1. D_x \left[ \ln |x^6 - 5x^2 + 1| \right] = \frac{1}{x^6 - 5x^2 + 1} \cdot D_x [x^6 - 5x^2 + 1] = \boxed{\frac{6x^5 - 10x}{x^6 - 5x^2 + 1}}$$

$$2. D_x [4xe^{\sqrt{3x+1}}] = 4e^{\sqrt{3x+1}} + 4x D_x [e^{\sqrt{3x+1}}]$$

$$= 4e^{\sqrt{3x+1}} + 4xe^{\sqrt{3x+1}} D_x [\sqrt{3x+1}] = 4e^{\sqrt{3x+1}} \left( 1 + x \cdot \frac{1}{2\sqrt{3x+1}} \cdot 3 \right)$$

$$= \boxed{4e^{\sqrt{3x+1}} \left( 1 + \frac{3x}{2\sqrt{3x+1}} \right)}$$

$$3. D_x \left[ (\sec(\ln(x)))^3 \right] = 3(\sec(\ln(x)))^2 \cdot D_x [\sec(\ln(x))]$$

$$= \boxed{3(\sec(\ln(x)))^2 \sec(\ln(x)) + \tan(\ln(x)) \frac{1}{x}}$$

$$= \boxed{\frac{3(\sec(\ln(x)))^3 \tan(\ln(x))}{x}}$$

4. Let  $f(x) = \ln(x)$ . Sketch and label the graphs of both  $y = f(x)$  and  $y = f'(x)$ .

