

$$\textcircled{1} \quad b = \langle 2, 4, -1 \rangle \quad a = \langle 3, -3, 1 \rangle \quad \text{scal}_a b = \frac{a \cdot b}{|a|} = \frac{(6 - 12 - 1)}{\sqrt{3^2 + 3^2 + 1}} = \boxed{\frac{-7}{\sqrt{19}}}$$

$$\textcircled{2} \quad r(t) = \langle t^2 + 1, t^3, 0 \rangle$$

$$r'(t) = v(t) = \langle 2t, 3t^2, 0 \rangle \quad |r'(t)| = \sqrt{4t^2 + 9t^4} = t\sqrt{4 + 9t^2}$$

$$r''(t) = a(t) = \langle 2, 6t, 0 \rangle$$

$$v(t) \cdot a(t) = 4t + 18t^3$$

$$|v(t) \times a(t)| = \left| \begin{vmatrix} 3t^2 & 0 \\ 6t & 0 \\ 2 & 6t \end{vmatrix} \right| = \left| \begin{vmatrix} 2t & 0 \\ 2 & 6t \end{vmatrix} \right| = \left| \begin{vmatrix} 2t & 3t^2 \\ 2 & 6t \end{vmatrix} \right|$$

$$= |\langle 0, 0, 6t^2 \rangle| = \sqrt{36t^4} = 6t^2$$

$$a_T = \frac{v(t) \cdot a(t)}{|v(t)|} = \frac{4t + 18t^3}{t\sqrt{4 + 9t^2}} = \boxed{\frac{4 + 18t^2}{\sqrt{4 + 9t^2}}} = a_T \quad a_N = \frac{|v(t) \times a(t)|}{|v(t)|} = \boxed{\frac{6t}{\sqrt{4 + 9t^2}}} = a_N$$

$$\textcircled{3} \quad f(x, y) = 1 + x \ln(xy - 5) \quad (2, 3) \quad f(2, 3) = 1 + 2 \ln(6 - 5) = 1$$

$$f_x = \ln(xy - 5) + \frac{xy}{xy - 5}$$

$$f_y = \frac{x^2}{xy - 5}$$

$$f_x(2, 3) = 0 + \frac{6}{6 - 5} = 6$$

$$f_y(2, 3) = \frac{4}{1} = 4$$

$$L(x, y) = 1 + 6(x - 2) + 4(y - 3) = 6x + 4y - 24 + 1$$

$$\boxed{L(x, y) = 6x + 4y - 23}$$