(1.) $f(x) = \ln\left(\frac{\sin(4x+7)}{\sinh(2x)}\right)$

$$\boxed{f'(x) = \frac{\sinh(2x)}{\sin(4x+7)} \cdot \frac{\sinh(2x)\cdot\cos(4x+7)(4) - \sin(4x+7)\cosh(2x)\cdot 2}{\sinh^2(2x)}}$$

OR

$f(x) = \ln(\sin(4x+7)) - \ln(\sinh(2x))$

$$\boxed{f'(x) = \frac{1}{\sin(4x+7)}\cos(4x+7)\cdot 4 - \frac{1}{\sinh(2x)}\cosh(2x)\cdot 2}$$

(2.) $f(x) = \sinh^{-1}(\sqrt{2x+5})$

$$\boxed{f'(x) = \frac{1}{\sqrt{1+(\sqrt{2x+5})^2}} \cdot \frac{1}{2}(2x+5)^{-1/2}(2)}$$

(3.) $f(x) = \tan^{-1}(e^{4x}+8)\cdot\sec^2(10x)$

$$\boxed{\begin{aligned}f'(x) &= \tan^{-1}(e^{4x}+8)\cdot 2\sec(10x)\cdot\sec(10x)\tan(10x)\cdot 10 \\ &\quad + \sec^2(10x)\cdot\frac{1}{1+(e^{4x}+8)^2}\cdot e^{4x}\cdot 4\end{aligned}}$$

(4.) $f(x) = (\cos(x^2))^{\sin 3x}$

$\ln f(x) = \sin(3x)\cdot\ln(\cos(x^2))$

$\frac{1}{f(x)}\cdot f'(x) = \sin(3x)\cdot\frac{1}{\cos(x^2)}\cdot -\sin(x^2)\cdot 2x + \ln(\cos(x^2))\cos(3x)\cdot 3$

$$\boxed{f'(x) = \left[\sin(3x)\cdot\frac{1}{\cos(x^2)}\cdot -\sin(x^2)\cdot 2x + \ln(\cos(x^2))\cos(3x)\cdot 3\right]\cos(x^2)^{\sin 3x}}$$

(5.) $f(x) = e^{\sqrt{\tanh(3x)}}$

$$\boxed{f'(x) = e^{\sqrt{\tanh(3x)}}\cdot\frac{1}{2}(\tanh(3x))^{-1/2}\operatorname{sech}^2(3x)\cdot 3}$$

(6.) $f(x) = \log_5(\cos^{-1}(\pi x+\pi^2))$

$$\boxed{f'(x) = \frac{1}{\cos^{-1}(\pi x+\pi^2)\ln(5)}\cdot(\pi+0)}\cdot\boxed{\frac{-1}{\sqrt{1-(\pi x+\pi^2)^2}}}$$

7. $\lim_{x \to 5^+} \left(e^{\frac{3}{x-5}} \right) = e^{\frac{3}{5^+-5}} = e^{\frac{3}{0^+}} = e^{+\infty} = \boxed{\infty}$

8. $\lim_{x \to 2^-} \left(\ln(2-x) \right) = \ln(2-2^-) = \ln(0^+) = \boxed{-\infty}$

9. $\lim_{x \to 0} \left(\frac{\sin(4x)}{\tan(4x)} \right) = \frac{0}{0}$ (L) $\lim_{x \to 0} \left(\frac{\cos(4x) \cdot \cancel{4}}{\sec^2(4x) \cdot \cancel{4}} \right) = \frac{1}{1} = \boxed{1}$

OR $\lim_{x \to 0} \left(\frac{\sin(4x)}{\frac{\sin(4x)}{\cos(4x)}} \right) = \lim_{x \to 0} (\cos 4x) = \cos 0 = \boxed{1}$

10. $\lim_{x \to 0} \left(\frac{e^x - e^{-x} - 2x}{x - \sin x} \right) = \frac{e^0 - e^0 - 0}{0 - \sin 0} = \frac{0}{0}$

(L) $\lim_{x \to 0} \left(\frac{e^x + e^{-x} - 2}{1 - \cos x} \right) = \frac{e^0 + e^0 - 2}{1 - \cos 0} = \frac{0}{0}$

(L) $\lim_{x \to 0} \left(\frac{e^x - e^{-x}}{-\,-\sin x} \right) = \frac{e^0 - e^0}{\sin 0} = \frac{0}{0}$

(L) $\lim_{x \to 0} \left(\frac{e^x + e^{-x}}{\cos x} \right) = \frac{e^0 + e^0}{\cos 0} = \frac{1+1}{1} = \boxed{2}$

11. $\int \frac{\sin(\ln x)}{x}\, dx$ $\quad u = \ln x$, $\quad du = \frac{1}{x}\, dx$

$= \int \sin u \, du$

$= -\cos u = \boxed{-\cos(\ln x) + C}$

12. $\int \frac{e^{2x}}{\sqrt{1-e^{4x}}}\, dx = \int \frac{e^{2x}}{\sqrt{1-(e^{2x})^2}}\, dx$ $\quad u = e^{2x}$, $\quad du = 2e^{2x}\, dx$, $\quad \frac{du}{2} = e^{2x}\, dx$

$= \frac{1}{2} \int \frac{1}{\sqrt{1-u^2}}\, du = \frac{1}{2} \sin^{-1}(u) = \boxed{\frac{1}{2} \sin^{-1}(e^{2x}) + C}$

13 $\displaystyle\int \frac{1}{\sqrt{1+x^2}\,\sinh^{-1}(x)}\,dx$ $\quad u = \sinh^{-1}(x)$

$du = \dfrac{1}{\sqrt{1+x^2}}\,dx$

$$= \int \frac{1}{u}\,du = \ln|u| = \boxed{\ln\left|\sinh^{-1}(x)\right| + C}$$

14 $\displaystyle\int \frac{1}{9-x^2}\,dx = \int \frac{1}{9\left(1-\frac{x^2}{9}\right)}\,dx = \frac{1}{9}\int \frac{1}{1-\left(\frac{x}{3}\right)^2}\,dx$

$u = \dfrac{x}{3}$

$du = \dfrac{1}{3}\,dx$

$3du = dx$

$$= \frac{1}{\cancel{9}_{3}} \int \frac{1}{1-u^2}\cdot\cancel{3}\,du = \frac{1}{3}\int \frac{1}{1-u^2}\,du = \frac{1}{3}\tanh^{-1}u = \boxed{\frac{1}{3}\tanh^{-1}\left(\frac{x}{3}\right) + C}$$