① a) $f(x) = \log_5(x^3) + e^{\sin 5x}$

$f'(x) = \dfrac{3x^2}{x^3 \ln 5} + e^{\sin 5x}(\cos 5x)(5)$

b) $y = \cos^{-1}(2\sqrt{x}) - \ln(\ln x^2)$

$y' = \dfrac{-1}{\sqrt{1-(2\sqrt{x})^2}}\left(x^{-1/2}\right) - \dfrac{1}{\ln x^2}\left(\dfrac{1}{x^2}\right)(2x)$

c) $h(t) = \dfrac{5^{\tan t}}{\ln(3t^4+5)}$

$h'(t) = \dfrac{\ln(3t^4+5)\left[5^{\tan t}(\ln 5)(\sec^2 t)\right] - 5^{\tan t}\left[\dfrac{1}{3t^4+5} \cdot 12t^3\right]}{\left[\ln(3t^4+5)\right]^2}$

d) $y = (5-2x^2)^x$

$\ln y = \ln(5-2x^2)^x$

$\ln y = x\ln(5-2x^2)$

$\dfrac{1}{y} \cdot y' = x\left(\dfrac{-4x}{5-2x^2}\right) + \ln(5-2x^2)$

$y' = \left[x\left(\dfrac{-4x}{5-2x^2}\right) + \ln(5-2x^2)\right](5-2x^2)^x$

① e) $y = \tan^{-1}(\ln^3(x^5-1))$

$$y = \tan^{-1}(\ln(x^5-1))^3$$

$$y' = \frac{1}{1+(\ln^3(x^5-1))^2}\left[3(\ln(x^5-1))^2\left(\frac{1}{x^5-1}\right)(5x^4)\right]$$

f) $g(x) = 4^{5x} e^{\sin^{-1}\sqrt{x}}$

$$g'(x) = 4^{5x}(e^{\sin^{-1}\sqrt{x}})\left(\frac{1}{\sqrt{1-x}}\right)\left(\frac{1}{2}x^{-1/2}\right) + 4^{5x}(\ln 4)(5)(e^{\sin^{-1}\sqrt{x}})$$

② $y = \dfrac{(x^2-2x)^3(8x^5)}{\sqrt{(5-x^2)^5}\,(e^{x^5+2})}$

$$\ln y = \ln\left[\frac{(x^2-2x)^3(8x^5)}{(5-x^2)^{5/2}(e^{x^5+2})}\right]$$

$$\ln y = 3\ln(x^2-2x) + \ln 8x^5 - \frac{5}{2}\ln(5-x^2) - (x^5+2)\overset{(1)}{\ln e}$$

$$\ln y = 3\ln(x^2-2x) + \ln 8x^5 - \frac{5}{2}\ln(5-x^2) - (x^5+2)$$

$$\frac{1}{y}\cdot y' = \left[3\left(\frac{2x-2}{x^2-2x}\right) + \frac{40x^4}{8x^5} - \frac{5}{2}\left(\frac{-2x}{5-x^2}\right) - 5x^4\right] y$$

$$y' = \left[\frac{6x-6}{x^2-2x} + \frac{5}{x} + \frac{5x}{(5-x^2)} - 5x^4\right]\left[\frac{(x^2-2x)^3(8x^5)}{\sqrt{(5-x^2)^5}\,(e^{x^5+2})}\right]$$

③ $e^{3x-y^5} = 5^{xy^3}$

$e^{3x-y^5}(3-5y^4y') = 5^{xy^3}(\ln 5)(3xy^2y' + y^3)$

$3e^{3x-y^5} - 5y^4y'e^{3x-y^5} = 5^{xy^3}\ln 5\, 3xy^2y' + 5^{xy^3}\ln 5\, y^3$

$3e^{3x-y^5} - 5^{xy^3}\ln 5\, y^3 = y'(5^{xy^3}\ln 5\, 3xy^2 + 5y^4e^{3x-y^5})$

$$\frac{3e^{3x-y^5} - 5^{xy^3}\ln 5\, y^3}{5^{xy^3}\ln 5\, 3xy^2 + 5y^4e^{3x-y^5}} = y'$$

④ $z = \sin^{-1}(y-3) - y^3 \qquad y = 3e^x + x^2$

$z = \sin^{-1}(3e^x + x^2 - 3) - (3e^x + x^2)^3$

$$z' = \frac{1}{\sqrt{1-(3e^x+x^2-3)^2}}(3e^x+2x) - 3(3e^x+x^2)^2(3e^x+2x)$$

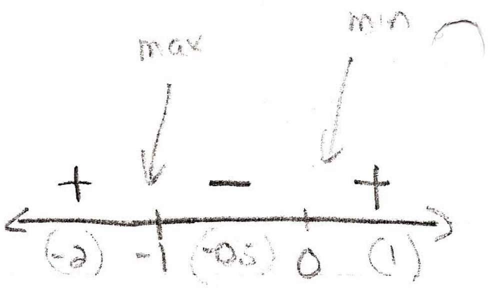
$$z' = \frac{3e^x+2x}{\sqrt{1-(3e^x+x^2-3)^2}} - 3(3e^x+x^2)^2(3e^x+2x)$$

$$z'(0) = \frac{3+0}{1} - 3(3+0)^2(3+0)$$

$z'(0) = 3 - 81$

$z'(0) = -78$

⑤ $F(x) = x^2 e^{2x}$



$$F'(x) = x^2(e^{2x})(2) + 2x e^{2x}$$
$$= 2x^2 e^{2x} + 2x e^{2x}$$
$$= 2x e^{2x}(x+1)$$

CV: $x = 0, -1$

$$F(-1) = (-1)^2 e^{2(-1)}$$
$$= 1 e^{-2}$$
$$= 1 \cdot \left(\frac{1}{e^2}\right)$$
$$= \frac{1}{e^2}$$

$\left(-1, \frac{1}{e^2}\right)$ Local max

$$F(0) = (0)^2 e^{2(0)}$$
$$= 0$$

$(0,0)$ Local min