① Definition $y=3x^2-2x+4$

$$y'=\lim_{h\to 0}\frac{3(x+h)^2-2(x+h)+4-3x^2+2x-4}{h}$$

$$=\lim_{h\to 0}\frac{\cancel{3x^2}+6xh+3h^2-\cancel{2x}-2h+\cancel{4}-\cancel{3x^2}+\cancel{2x}-\cancel{4}}{h}$$

$$=\lim_{h\to 0}\frac{6x\cancel{h}+3h^{\cancel{2}}-2\cancel{h}}{\cancel{h}}$$

$$\boxed{y'=6x-2}$$

② $y=\dfrac{1}{\sqrt{x}-1}$

$$y'=\frac{(\sqrt{x}-1)(0)-1\left(\frac{1}{2\sqrt{x}}\right)}{(\sqrt{x}-1)^2}$$

$$=\frac{\frac{-1}{2\sqrt{x}}}{(\sqrt{x}-1)^2}$$

$$y'=\frac{-1}{2\sqrt{x}(\sqrt{x}-1)^2}$$

③ $y=x^7+\sqrt{7}x-\dfrac{1}{1+\pi}$

$$y'=7x^6+\sqrt{7}$$

④ $y=x^2\cot(5x)$

$$y'=2x\cot(5x)+x^2(-\csc^2(5x)\cdot 5)$$

$$y'=2x\cot(5x)-5x^2\csc^2(5x)$$

⑤ $y=2^{3x^2}$

$$y'=2^{3x^2}(\ln 2)(6x)$$

⑥ $y=\ln(\sec(x))$

$$y'=\frac{\cancel{\sec x}\tan x}{\cancel{\sec x}}$$

$$y'=\tan x$$

(7) $x^2y^2 = e^{2x} + y$

$2xy^2 + x^2\left(2y\frac{dy}{dx}\right) = 2e^{2x} + \frac{dy}{dx}$

$2x^2y\frac{dy}{dx} - \frac{dy}{dx} = 2e^{2x} - 2xy^2$

$$\frac{dy}{dx} = \frac{2e^{2x} - 2xy^2}{2x^2y - 1}$$

(8) $y = (1+x^2)e^{\tan^{-1}x}$

$\ln y = \ln\left[(1+x^2)e^{\tan^{-1}x}\right]$

$\ln y = \ln(1+x^2) + \tan^{-1}x$

$\frac{1}{y}\frac{dy}{dx} = \frac{2x}{1+x^2} + \frac{1}{1+x^2}$

$\frac{dy}{dx} = \left(\frac{2x+1}{\cancel{1+x^2}}\right)\cancel{(1+x^2)}e^{\tan^{-1}x}$

$$y' = (2x+1)e^{\tan^{-1}x}$$

$\boxed{OR}$

$y = (1+x^2)e^{\tan^{-1}x}$

$y' = \cancel{(1+x^2)}e^{\tan^{-1}x}\left(\frac{1}{\cancel{1+x^2}}\right) + 2xe^{\tan^{-1}x}$

$$y' = (1+2x)e^{\tan^{-1}x}$$

(9) $y = \log_2\left(\frac{x^2}{2}\right)$

$y' = \frac{x}{\left(\frac{x^2}{2}\right)\ln 2}$

$$\boxed{y' = \frac{2}{x\ln 2}}$$

(10) $y = \left(\frac{1+\sin x}{1-\cos x}\right)^2$

$y' = 2\left(\frac{1+\sin x}{1-\cos x}\right)\left[\frac{(1-\cos x)(\cos x) - (1+\sin x)(-\sin x)}{(1-\cos x)^2}\right]$

$$\boxed{y' = \frac{2(1+\sin x)(\cos x - \cos^2 x + \sin x + \sin^2 x)}{(1-\cos x)^3}}$$

$\boxed{OR}$

$\ln y = 2\left[\ln(1+\sin x) - \ln(1-\cos x)\right]$

$\frac{1}{y}\frac{dy}{dx} = 2\left[\frac{\cos x}{1+\sin x} - \frac{\sin x}{1-\cos x}\right]$

$$\boxed{\frac{dy}{dx} = 2\left[\frac{\cos x}{1+\sin x} - \frac{\sin x}{1-\cos x}\right]\left(\frac{1+\sin x}{1-\cos x}\right)^2}$$

(11) $\log_4(3x^2+3)+4xy=\cos(3y^2)-7^x$

$$\frac{6x}{(3x^2+3)\ln 4}+4y+4x\frac{dy}{dx}=-\sin(3y^2)\cdot 6y\frac{dy}{dx}-7^x\ln 7$$

$$4x\frac{dy}{dx}+6y\sin(3y^2)\frac{dy}{dx}=-7^x\ln 7-4y-\frac{6x}{(3x^2+3)\ln 4}$$

$$\boxed{\frac{dy}{dx}=\frac{-7^x\ln 7-4y-\frac{6x}{(3x^2+3)\ln 4}}{4x+6y\sin(3y^2)}}$$

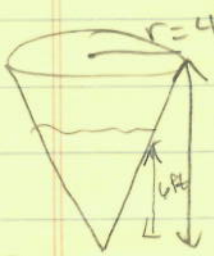
(12) $y=\sqrt[3]{\dfrac{x(x+1)^2(x-2)}{5(x^2+1)(2x+3)^3}}$

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

$$\frac{1}{y}\frac{dy}{dx}=\frac{1}{3}\left[\frac{1}{x}+\frac{2}{x+1}+\frac{1}{x-2}-\frac{2x}{x^2+1}-\frac{6}{2x+3}\right]$$

$$\frac{dy}{dx}=\frac{1}{3}\left[\frac{1}{x}+\frac{2}{x+1}+\frac{1}{x-2}-\frac{2x}{x^2+1}-\frac{6}{2x+3}\right]\sqrt[3]{\frac{x(x+1)^2(x-2)}{5(x^2+1)(2x+3)^3}}$$

(13)



$\frac{dh}{dt}=?$ $\quad \frac{dV}{dt}=-5\ ft^3/min$

$$\frac{r}{h}=\frac{4}{10}$$

$$r=\frac{2}{5}h$$

$$V=\frac{1}{3}\pi r^2 h$$

$$V=\frac{1}{3}\pi\left(\frac{2}{5}h\right)^2 h$$

$$V=\frac{1}{3}\pi\left(\frac{4}{25}h^2\right)h$$

$$V=\frac{4}{75}\pi h^3$$

$$\frac{dV}{dt}=\frac{4}{25}\pi h^2\frac{dh}{dt}$$

$$-5=\frac{4}{25}\pi(6)^2\frac{dh}{dt}$$

$$\frac{dh}{dt}=-.2763\ ft/min$$

(14) Eqn of tangent line

$$y = 1 + \cos x$$

$$\frac{dy}{dx} = -\sin x$$

$$\left.\frac{dy}{dx}\right|_{\pi/2} = -1$$

$$y - 1 = -1(x - \pi/2)$$

$$y = -x + \pi/2 + 1$$