§ 3.1.4

1 (1) $y = 2^x$

$\ln y = x \ln 2$ 양변 x 미분 $\frac{y'}{y} = \ln 2$ $\therefore y' = 2^x \times \ln 2$

(2) $y = \log_2 x = \frac{\ln x}{\ln 2}$ 양변 x 미분 $y' = \frac{1}{x \ln 2}$

(3) $y = \log_{10} x = \frac{\ln x}{\ln 10}$ 양변 x 미분 $y' = \frac{1}{x \ln 10}$

2 (1) $y = f(x)g(x)$

$\ln y = \ln f(x) + \ln g(x)$ 양변 x 미분 $\frac{y'}{y} = \frac{f'(x)}{f(x)} + \frac{g'(x)}{g(x)}$ $\therefore y' = f(x)g(x)\left\{\frac{f'(x)}{f(x)} + \frac{g'(x)}{g(x)}\right\} = f'(x)g(x) + f(x)g'(x)$

(2) $y = \frac{g(x)}{f(x)}$

$\ln y = \ln g(x) - \ln f(x)$ 양변 x 미분 $\frac{y'}{y} = \frac{g'(x)}{g(x)} - \frac{f'(x)}{f(x)}$ $\therefore y' = \frac{g(x)}{f(x)}\left\{\frac{g'(x)}{g(x)} - \frac{f'(x)}{f(x)}\right\}$

$= \frac{g(x)}{f(x)} \times \frac{f(x)g'(x) - f'(x)g(x)}{f(x)g(x)} = \frac{g'(x)f(x) - g(x)f'(x)}{\{f(x)\}^2}$

3 (1) $f = \frac{(x+1)^2}{(x-3)^3}$

$\ln f = 2\ln(x+1) - 3\ln(x-3)$ $\therefore \frac{f'}{f} = \frac{2}{x+1} - \frac{3}{x-3}$

$f' = \frac{(x+1)^2}{(x-3)^3}\left(\frac{2}{x+1} - \frac{3}{x-3}\right)$

(2) $f = (x+1)^2(x+2)^3$

$\ln f = 2\ln(x+1) + 3\ln(x+2)$

$\frac{f'}{f} = \frac{2}{x+1} + \frac{3}{x+2}$ $\therefore f' = (x+1)^2(x+2)^3\left(\frac{2}{x+1} + \frac{3}{x+2}\right)$

$= 2(x+1)(x+2)^3 + 3(x+1)^2(x+2)$