① $g(x) = 12\sqrt{x}\,e^x$

$\quad f'(x) = \frac{6}{\sqrt{x}}e^x + 12\sqrt{x}\,e^x$

$\quad$ where $f' = 6/\sqrt{x}$ and

$\qquad g' = e^x$

② $g(x) = (x^2 + x - 1)e^x$

$\quad f'(x) = (2x+1)e^x + (x^2 + x - 1)e^x$

$\quad$ where $f' = 2x+1$ and

$\qquad g'(x) = e^x$

③ $f(x) = (4x^2 - 4)(6x + 3)$

$\quad f'(x) = 8x(6x+3) + 6(4x^2 - 4)$

$\quad$ where $f' = 8x$ and

$\qquad g'(x) = 6$

④ $f(t) = (t^2 + 7t + 5)(5t^{-2} + 5t^{-3})$

$\quad f'(x) = (2t+7)(5t^{-2} + 5t^{-3}) + (-10t^{-3} - 15t^{-4})$

$\qquad\qquad (t^2 + 7t + 5)$

$\quad$ where $f' = 2t + 7$; $g' = \frac{-10}{t^3} - \frac{15}{t^4}$

⑤ $R(t) = (3t + e^t)(2 - t^{1/2})$

$\quad R'(t) = (3 + e^t)(2 - t^{1/2}) - \frac{1}{2\sqrt{t}}(3t + e^t)$

$\quad$ where $f' = (3 + e^t)$

$\qquad$ and $g' = \frac{-1}{2\sqrt{t}}$

⑥ $h(x) = g(x)f(x)$:

$\quad h'(x) = g'(x)f(x) + f'(x)g(x)$

$\quad h'(0) = -3(6) + -6(5) = -18 - 30$

⑦ $f(x) = x^5 u(x)$; $f'(x) = 5x^4 u(x) + x^5 u'(x)$

$\qquad u(-1) = 3$; $u'(-1) = 6$

$\quad f'(-1) = 5(3) + (-1)(6) = 15 - 6 = 9$

⑧ $g(x) = \frac{e^x}{3x - 1}$; $g'(x) = \frac{e^x(3x-1) - 3e^x}{(3x-1)^2}$

$\quad g'(x) = (f'g - g'f) \div g^2$

⑨ $g(x) = \frac{1}{4x^4 - 8x^2 - x}$; $f'(x) = 0$; $g'(x) = 16x^3 - 16x$

$\quad g'(x) = -16x^3 + 16x / (4x^4 - 8x^2 - 4)^2$

⑩ $f(x) = \frac{x}{x + 5/x}$; $f'(x) = 1$; $g'(x) = 1 - \frac{5}{x^2}$

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

⑪ $f(x) = \frac{u(x)}{x}$; $f'(x) = \frac{u'(x)x - u(x)}{x^2}$

$\quad f'(3) = \frac{2(3) + 7}{9} = \boxed{\frac{13}{9}}$

Continued

⑫ $f'(x) = \dfrac{8 - xe^x}{x + e^x}$

$\dfrac{dy}{dx} = \dfrac{-e^x - xe^x(x + e^x) - (1 + e^x)(8 - xe^x)}{(x + e^x)^2}$

⑬ $f(2) = 1 \; ; \; f'(2) = -1$

$g(2) = -1 \; ; \; g'(2) = 4$

$(f + g)'(2) = (-1 + 4) = ③$

$(f - g)'(2) = (-1 - 4) = ⑤$

$f \cdot g'(2) = f'g + g'f = -1(-1) + 4(1)$

$\Rightarrow 1 + 4 = ⑤$

$(f \div g)'(2) = \dfrac{f'g \mp g'f}{g^2} = \dfrac{1 - 4}{1} = ⑳$