

## 16. Higher derivatives

1b)

$$\frac{d}{dx} \left( \frac{x}{x+5} \right) = \frac{1(x+5) - 1 \cdot x}{(x+5)^2} = \frac{5}{(x+5)^2}$$

$$\frac{d^2}{dx^2} \left( \frac{x}{x+5} \right) = \frac{d}{dx} \left( \frac{5}{(x+5)^2} \right) = \boxed{\frac{-10}{(x+5)^3}}$$

1c)

$$\frac{d}{dx} \left( \frac{-5}{x+5} \right) = \frac{d}{dx} \left( -5(x+5)^{-1} \right) = 5(x+5)^{-2}$$

$$\frac{d^2}{dx^2} \left( \frac{-5}{x+5} \right) = \frac{d}{dx} \left( 5(x+5)^{-2} \right) = \boxed{\frac{-10}{(x+5)^3}}$$

5a)

$$y = u(x)v(x) = uv$$

$$y' = \boxed{u'v + uv'}$$

$$y'' = u''v + u'v' + u'v' + uv'' = \boxed{u''v + 2u'v' + uv''}$$

$$y''' = u'''v + u''v' + 2u''v' + 2u'v'' + u'v'' + uv''' \\ = \boxed{u'''v + 3u''v' + 3u'v'' + uv'''}$$