e) $(f \cdot g)' = f'g + fg'$

$$(f(a) \cdot g(a))' = \lim_{h \to 0} \frac{f(a+h) \cdot g(a+h) - f(a)g(a)}{h}$$

$$= \lim_{h \to 0} \frac{f(a+h) \cdot g(a+h) + 0 - f(a)g(a)}{h}$$

$$= \lim_{h \to 0} \frac{f(a+h) \cdot g(a+h) - f(a)g(a+h) + f(a).g(a+h) - f(a)g(a)}{h}$$

$$= \lim_{h \to 0} \frac{f(a+h) \cdot g(a+h) - f(a)g(a+h) + f(a)g(a+h) - f(a)g(a)}{h}$$

$$= \lim_{h \to 0} \frac{(f(a+h) - f(a)) \cdot g(a+h) + f(a)(g(a+h) - g(a))}{h}$$

$$= \lim_{h \to 0} \frac{(f(a+h) - f(a) \cdot g(a+h)}{h} + \lim_{h \to 0} \frac{f(a)(g(a+h) - g(a))}{h}$$

$$= \lim_{h \to 0} \frac{(f(a+h) - f(a)}{h} \cdot \lim g(a+h) + f(a) \lim_{h \to 0} \frac{g(a+h) - g(a))}{h}$$

$$= f'(a) \cdot g(a) + f(a) \cdot g'(a)$$