1. [12 points] The table below gives several values of a differentiable function $f(x)$. Assume that both $f(x)$ and $f'(x)$ are invertible. Do not give approximations. If it is not possible to find the value exactly, write NOT POSSIBLE.

x	-3	-2	-1	0	1	2	3
$f(x)$	-8	-4	-1.2	0.5	1.4	1.8	2
$f'(x)$	5	3	2	1.2	0.5	0.3	0.1

a. [2 points] Let $g(x) = 3f(x) + 4$. Find $g'(1)$.

Solution: $g'(x) = 3f'(x)$, so $g'(1) = 3 \cdot 0.5 = 1.5$

Answer: $g'(1) =$ 1.5

b. [2 points] Find $(f^{-1})'(2)$.

Solution: $(f^{-1})'(x) = \dfrac{1}{f'(f^{-1}(x))}$, so $(f^{-1})'(2) = \dfrac{1}{f'(f^{-1}(2))} = \dfrac{1}{f'(3)} = \dfrac{1}{0.1} = 10.$

Answer: $(f^{-1})'(2) =$ 10

c. [2 points] Let $h(x) = f(e^x)$. Find $h'(\ln 2)$.

Solution: $h'(x) = f'(e^x) \cdot e^x$, so $h'(\ln 2) = f'(e^{\ln 2}) \cdot e^{\ln 2} = f'(2) \cdot 2 = 0.3 \cdot 2 = 0.6.$

Answer: $h'(\ln 2) =$ 0.6

d. [2 points] Let $j(x) = e^{f(x)}$. Find $j'(-2)$.

Solution: $j'(x) = e^{f(x)} \cdot f'(x)$, so $j'(-2) = e^{f(-2)} \cdot f'(-2) = e^{-4} \cdot 3.$

Answer: $j'(-2) =$ $3e^{-4}$

e. [2 points] Let $k(x) = f(x)f(x-2)$. Find $k'(1)$.

Solution: $k'(x) = f'(x)f(x-2) + f(x)f'(x-2)$, so
$k'(1) = f'(1)f(1-2) + f(1)f'(1-2) = f'(1)f(-1) + f(1)f'(-1) = 0.5 \cdot (-1.2) + 1.4 \cdot 2 = -0.6 + 2.8 = 2.2.$

Answer: $k'(1) =$ 2.2

f. [2 points] Let $\ell(x) = \frac{f(x)}{f(x+3)}$. Find $\ell'(0)$.

Solution: $\ell'(x) = \dfrac{f'(x)f(x+3) - f'(x+3)f(x)}{(f(x+3))^2}$, so

$$\ell'(0) = \frac{f'(0)f(3) - f'(3)f(0)}{(f(3))^2} = \frac{1.2 \cdot 2 - 0.5 \cdot 0.1}{2^2} = \frac{2.4 - 0.05}{4} = \frac{2.35}{4} = 0.5875.$$

Answer: $\ell'(0) =$ 0.5875