Q4:
Given that $f(x,y) = \int_x^x g_1(t,0)dt + \int_0^y g_2(x,t)dt$, we will compute $D_1 f$ and $D_2 f$. First, $D_1 f$

$$\begin{aligned}
D_1 f &= D_1 \int_0^x g_1(t,0)dt + D_1 \int_0^y g_2(x,t)dt \\
&= g_1(x,0) + D_1 \int_0^y g_2(x,t)dt && \text{(by FTC)} \\
&= g_1(x,0) + \int_0^y D_1 g_2(x,t)dt && \text{(by the Leibniz Rule)} \\
&= g_1(x,0) + \int_0^y D_2 g_1(x,t)dt && \text{(by assumption)} \\
&= g_1(x,0) + g_1(x,y) - g(x,0) && \text{(by FTC)} \\
&= g_1
\end{aligned}$$

As desired. We now will compute $D_2 f$

$$\begin{aligned}
D_2 f &= D_2 \int_0^x g_1(t,0)dt + D_2 \int_0^y g_2(x,t)dt \\
&= D_2 \int_0^x g_1(t,0)dt + g_2(x,y) && \text{(by FTC)} \\
&= 0 + g_2(x,y) && \text{(since first integral contstant in y)} \\
&= g_2(x,y)
\end{aligned}$$

As expected.