Assignment using Chain Rule:

Given, $f(z) = e^{-z/2}$

Where, $z = g(y)$, $g(y) = y^T s^{-1} y$

$y = h(x)$

$h(x) = x - \mu$

According to chain Rule:

$$\frac{d}{dx}(f(z)) = \frac{d(f(z))}{dz} \times \frac{dz}{dy} \times \frac{dy}{dx}$$

$$= \frac{d}{dz}\left(e^{-z/2}\right) \cdot \frac{d}{dy}\left(y^T s^{-1} y\right) \cdot \frac{d}{dx}(x-\mu)$$

$$= \left(-\frac{1}{2}e^{-z/2}\right) \cdot \left(s^{-1}\frac{d}{dy}\left(y^T y\right)\right)$$

$$= \left(-\frac{e^{-z/2}}{2}\right) \cdot 2ys^{-1} \quad \left[\because \frac{d}{dx}\left(x^T \cdot x\right) = 2x\right]$$

$$= -e^{-z/2}(x-\mu)s^{-1} \qquad \text{(Solved)}$$

Assignment using Chain Rule:

Given

$$f(Z) = \ln(1+Z)$$

By chain rule,

$$\frac{d}{dx}\left(f(z)\right) = \frac{d}{dZ}\left(f(x)\right)\frac{dz}{dx}$$

$$= \frac{d}{dZ}\left(\ln(1+Z) \cdot \frac{d}{dx}\left(x^T x\right)\right)$$

$$= \frac{1}{1+Z} \cdot \frac{dZ}{dZ} \cdot 2x \quad \left[\because \frac{d}{dx}\left(x^T \cdot x\right) = 2x\right]$$

$$= \frac{2x}{1+x^T x} \quad \text{(Solved)}$$