1. **(25 points)** The dimensions of a rectangular box without a lid are 80 cm, 60 cm, and 50 cm, respectively, with a possible error of 0.2 cm in each dimension. Use differentials to estimate the maximum error in calculating the surface area of the box. (See illustration)

(Solution: \( A = xy + 2yz + 2zx \Rightarrow \Delta A \approx A_x \Delta x + A_y \Delta y + A_z \Delta z \))

\( A_x(x, y, z) = y + 2z \Rightarrow A_x(80, 60, 50) = 60 + 100 = 160. \)

Similarly we have \( A_y(80, 60, 50) = 180, \) and \( A_z(80, 60, 50) = 280. \)

With \( \Delta x = 0.2 = \Delta y = \Delta z \) we get \( \Delta A \approx (160 + 180 + 280)(0.2) = 124 \text{ cm}^2 \)

![Image](image_url)

2. **(25 points)** If \( u = x^3y + y^2z, \) where \( x = rse^t, y = r^2se^t, z = rs^2 \sin(t). \) Find the value of \( \frac{\partial u}{\partial t} \) when \( r = 1, s = 2, t = 0. \)

(Solution: The chain rule gives \( \frac{\partial u}{\partial t} = \frac{\partial u}{\partial x} \frac{\partial x}{\partial t} + \frac{\partial u}{\partial y} \frac{\partial y}{\partial t} + \frac{\partial u}{\partial z} \frac{\partial z}{\partial t} \))

\( = (3x^2y)(rse^t) + (x^3 + 2yz)(r^2se^t) + (y^2)(rs^2 \cos(t)). \)

When \( r = 1, s = 2, t = 0 \Rightarrow x = 2, y = 2, z = 0. \) We plug these values in the above equation. Thus \( \frac{\partial u}{\partial t} \bigg|_{r=1,s=2,t=0} = (24)(2) + (8 + 0)(2) + (4)(4) = 80. \)