Partial list of formulas

Chapter 10 Analytic Geometry (Polar Coordinates)
No questions just about chapter 10.

Chapter 11 Three dimensional Space; Vectors
Rectangular to cylindrical: (x, y, z) to (r, θ, z), $r^2 = x^2 + y^2, \quad x = r\cos\theta, \quad y = r\sin\theta$

Rectangular to spherical: (x, y, z) to (ρ, θ, φ), $\rho^2 = x^2 + y^2 + z^2, \cos\varphi = \frac{z}{\rho}$

Chapter 13 Partial Derivatives

Total Differential $dz = f_x dx + f_y dy \qquad f(x_0 + dx, y_0 + dy) \approx f(x_0, y_0) + dz$

Chain Rules $z = f(x, y), \quad x = x(t), \quad y = y(t) \qquad \frac{dz}{dt} = \frac{\partial z}{\partial x}\frac{dx}{dt} + \frac{\partial z}{\partial y}\frac{dy}{dt}$ "Rate of Change"

$z = f(x,y), \quad x = x(u,v), \quad y = y(u,v) \qquad \frac{\partial z}{\partial u} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial z}{\partial y}\frac{\partial y}{\partial u}$

If F(x,y) = constant, so implicitly y = y(x) therefore $\frac{dy}{dx} = -\frac{\frac{\partial F}{\partial x}}{\frac{\partial F}{\partial y}} = -\frac{F_x}{F_y}$

Directional Derivative: $\mathbf{D_u f} = \nabla \mathbf{f} \bullet \mathbf{u}, \quad \nabla \mathbf{f} = \mathbf{f_x i} + \mathbf{f_y j}$, $\nabla \mathbf{f}$ is normal to the level curve f(x,y) = constant.

Second Partial Test (x_0, y_0) is a critical point. $D = f_{xx} f_{yy} - f_{xy}^2$

1. D > 0, $f_{xx} > 0$ then rel. min. at (x_0, y_0)
2. D > 0, $f_{xx} < 0$ then rel. max. at (x_0, y_0)
3. D < 0, saddle point at (x_0, y_0)
4. D = 0, test inconclusive

Chapter 14 Multiple Integrals

Polar form $\int_\alpha^\beta \int_{r_1(\theta)}^{r_2(\theta)} f(r,\theta)\, r dr d\theta$

Surface Area $\iint_R \sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1}\; dA$