1. If f is the absolute-value function $f(x) = |x|$, show that f is continuous but not differentiable at the number 0 (15%).

2. $f(x,y) = 2x^2 + xy$, $1 \leq x \leq 3$, and $1 \leq y \leq 20$. Find the minimum value of $f(x,y)$ and its associated value of x for each possible y (15%).

3. Solve the equation $y'' - 5y' + 6y = 0$ which satisfies $y = 1$, $y' = 1$ when $x = 1$ (15%).

4. Find the volume of the solid under the plane $z = 3x + y$ and above the part of the ellipse $4x^2 + 9y^2 \leq 36$ in the first quadrant (15%).

5. Find the following integrals (30%):

(a) $\int e^{2x}\sin 3x\,dx$

(b) $\int \frac{2x^3+x^2+5x+4}{x^4+8x^2+16}dx$

6. If $z = F(x,y)$, $x = f(u,v)$, and $y = g(u,v)$, show that

$$\frac{\partial^2 z}{\partial u^2} = \frac{\partial^2 z}{\partial x^2}\left(\frac{\partial x}{\partial u}\right)^2 + 2\frac{\partial^2 z}{\partial x \partial y}\frac{\partial x}{\partial u}\frac{\partial y}{\partial u} + \frac{\partial^2 z}{\partial y^2}\left(\frac{\partial y}{\partial u}\right)^2 + \frac{\partial z}{\partial x}\frac{\partial^2 x}{\partial u^2} + \frac{\partial z}{\partial y}\frac{\partial^2 y}{\partial u^2}$$

(10%)

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(題目將用本張複印製版請以黑色正楷書寫或打字並請勿超出此線)