MATH 140-02 FALL 2008 TEST 3

Calculators are NOT allowed for this examination. Show all work and justify your answers. Credit will be based primarily on your work and explanations, not just the final answer.

1. (16 pts.) Find the following integrals (you are not required to simplify):

\[ \int x \cos(2x) \, dx \]

\[ \int_{1}^{2} \ln(2x) \, dx \]

2. (10 pts.) Find the volume of the solid of revolution formed by rotating about the x-axis the region bounded by following function and the x-axis.

\[ f(x) = \sqrt{x - 1}, \quad 1 \leq x \leq 4 \]
3. (16 pts.) Find the value of each integral that converges:

\[ \int_{-\infty}^{0} e^{3x} \, dx \]

\[ \int_{1}^{\infty} \frac{2x}{x^2 + 1} \, dx \]

4. (16 pts.)

(a) Find \( f_x(x, y) \), \( f_y(x, y) \), \( f_{xx}(x, y) \), \( f_{xy}(x, y) \), and \( f_{yy}(x, y) \) for:

\[ f(x, y) = 2x^3y^2 - 3xy + y^4 + 2x + 1 \]

(b) Find \( f_x(x, y) \) and \( f_y(x, y) \) for:

\[ f(x, y) = \cos(y)e^{2x+y} \]
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5. (8 pts.) Find the total differential for

\[ f(x, y) = \sin(x)e^{y^2} \]

6. (14 pts.) Find and classify all critical points for

\[ f(x, y) = \frac{1}{2}x^2 + y^2 + xy - 5x - 7y + 10 \]
7. (20 pts.) Find the following double integrals (you are not required to simplify):

\[ \int_1^2 \int_0^2 (x + 2xy + y^2) \, dx \, dy \]

\[ \int_0^2 \int_0^1 ye^{y^2+x} \, dy \, dx \]

\[ \int_0^1 \int_y^{\sqrt{y}} x \, dx \, dy \]