THE UNIVERSITY OF MANITOBA

DATE: December 14, 2012 **FINAL EXAMINATION**

DEPARTMENT & NO: MATH2130 **TIME**: 3 hours

EXAMINATION: Engineering Mathematical Analysis 1 **EXAMINER**: M. Davidson, D. Trim

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INSTRUCTIONS:

1. No aids permitted.
2. Attempt all questions.
3. If insufficient space is provided for a solution to a problem, continue your work on the back of the previous page.
4. Check that your examination booklet contains questions numbered from 1 to 12.
5. Fill in the information requested below.

Student Name (Print): _____

Student Signature: _____

Student Number: _____

Seat Number: _____

Circle your instructor's name: M. Davidson D. Trim

Question	Maximum Mark	Assigned Mark	Question	Maximum Mark	Assigned Mark
1	8		7	6	
2	6		8	7	
3	5		9	8	
4	9		10	8	
5	8		11	12	
6	14		12	9	
Total	50		Total	50	

Examination Total /100

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8 **1.** Find parametric equations for the tangent line to the curve

$$x^2y + z^3 + xz = 9, \quad xy + y^4z = 1,$$

at the point $(1, -1, 2)$.

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6 **2.** Set up, but do **NOT** evaluate a definite integral for the length of the curve

$$z = x^2 + y^2, \quad 2x - 4y + z = 4.$$

You need not simplify the integral.

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5 **3.** Find the equation of the plane that passes through the point $(4, -3, 5)$ and is perpendicular to the line

$$\frac{2x-1}{10} = \frac{y+5}{-7} = \frac{1-z}{3}.$$

Simplify the equation as much as possible.

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9 **4.** The equations

$$x = u^2 + v^3, \quad y = 3uv + u^2v^2$$

explicitly define x and y as functions of u and v. They also implicitly define u and v as functions of x and y. Show that

$$\frac{\partial u}{\partial x}\Big)_y \neq \frac{1}{\dfrac{\partial x}{\partial u}\Big)_v}.$$

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8 **5.** Show that for any differentiable function f whatsoever, the function $u(x, y) = f(x^2 - 2y^2) + x^4$ satisfies the equation

$$2y\frac{\partial u}{\partial x} + x\frac{\partial u}{\partial y} = 8x^3y.$$

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14 **6.** Find the maximum and minimum values of the function

$$f(x, y) = xy(1 - 2x - 2y)$$

on the region consisting of the triangle enclosed by the lines

$$x + y = 1, \quad x = 0, \quad y = 0$$

and its edges.

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6 **7.** Evaluate the double iterated integral

$$\int_0^4 \int_{\sqrt{x}}^2 e^{y^3}\, dy\, dx.$$

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7 **8.** Set up, but do **NOT** evaluate a double iterated integral for the volume of the solid of revolution when the area bounded by the curves

$$y = x^2 - x - 6, \quad y = 0,$$

is rotated about the line $x + y = 3$. Simplify the integrand as much as possible.

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8 **9.** Pictured below is a semi-elliptic plate submerged vertically in water. All dimensions are in metres. Set up, but do **NOT** evaluate, a double iterated integral for the force on each side of the plate due to the water.

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8 10. Set up, but do **NOT** evaluate, a double iterated integral for the surface area of that portion of the surface $ze^{2x+3y} = 1$ that is enclosed by the surfaces $x = 1 - y^2$ and $x = y^2 - 1$.

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12 **11.** Evaluate the triple integral of the function $f(x, y, z) = 2(x^2 + y^2)$ over the volume bounded by the surfaces

$$z = x^2 + y^2, \quad z = 4.$$

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9 12. Set up, but do **NOT** evaluate, a triple iterated integral in spherical coordinates for the triple integral

$$\iiint_V (x^2 + y^2)\, dV$$

where V is the region bounded by the surfaces

$$z^2 = 3x^2 + 3y^2, \quad z = \sqrt{9 - x^2 - y^2}.$$