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CALCULUS III
Exam 3
Fall 1995

TO RECEIVE CREDIT YOU MUST SHOW YOUR WORK.

(20) 1. Show that $(x, y) = (0, 1), (0, 3), (1, 2), (-1, 2)$ are critical points for the function

$$f(x, y) = x^3 + 3xy^2 - 12xy + 9x.$$

Use the 2nd derivative test to see if each of these points gives a local max., a local min. or a saddle point.

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(15) 2. Find the volume of the 3-dimensional region which is below the surface $z = 1+2xy$ and above the region of the xy-plane which is determined by $0 \leq x \leq 3$ and $1 \leq y \leq 2$.

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(10) 3. Evaluate $\int_0^2 \int_{x^2}^4 x\sqrt{1+y^2}\, dy\, dx$ by **first reversing the order of integration**.

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(15) 4. Use a double integral in polar coordinates to find the volume of 3-dimensional region which is below $z = 9 - x^2 - y^2$ and above the region of the xy-plane between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 4$.

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(15) 5. A mass distribution occupies the region in the 1st octant bounded by the surfaces $y = x^2$, $y = x$, $z = 0$, $z = 1 + x$. The mass density function is $\delta(x, y, z) = 12x$. Calculate the total mass.

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(15) 6. Use a triple integral in spherical coordinates to find the mass of a solid body which lies above the cone $z = \sqrt{x^2 + y^2}$ and inside the sphere $x^2 + y^2 + z^2 = 4$ if the mass density function is $\delta(x, y, z) = z^2$.

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(10) 7. Find the surface area of the part of the surface $z = 1 + x^2$ which lies above the region in the 1st quadrant of the xy-plane that is bounded by $y = x$, $y = 0$ and $x = 1$.