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MATH 253 Exam 2 Spring 2003

Sections 501-503 P. Yasskin

Multiple Choice: (5 points each) Work Out: (15 points each)

1. The density of the air in a room is given by $\rho = x^2z + y^2z$. At $t = 3$, a fly's position is $\vec{r} = (3,3,4)$ and its velocity is $\vec{v} = (2,3,-1)$. Find $\dfrac{d\rho}{dt}$ as seen by the fly at $t = 3$.

a. -39
b. -11
c. 11
d. 39
e. 102

2. The altitude on a mountain is $z = 27 - 3x^2 - 5y^2 + xy$. A hiker is currently on the mountain at the point $(x,y) = (2,1)$. In what direction should the hiker walk to come down as quickly as possible?

a. $(8,-11)$
b. $(8,11)$
c. $(11,8)$
d. $(11,-8)$
e. $(-11,-8)$

3. (Extra Credit) The altitude on a mountain is $z = 27 - 3x^2 - 5y^2 + xy$. A hiker is currently on the mountain at the point $(x,y) = (2,1)$. In what direction should the hiker walk to stay at exactly the same altitude?

a. $(8,-11)$
b. $(8,11)$
c. $(11,8)$
d. $(11,-8)$
e. $(-11,-8)$

4. Suppose $f(x,y) = x^2y^3$ where $x = x(u,v)$ and $y = y(u,v)$. Compute $\left.\frac{\partial f}{\partial v}\right|_{(u,v)=(3,4)}$ if

$$x(3,4) = 2 \qquad \left.\frac{\partial x}{\partial u}\right|_{(u,v)=(3,4)} = 4 \qquad \left.\frac{\partial x}{\partial v}\right|_{(u,v)=(3,4)} = 6$$

$$y(3,4) = 1 \qquad \left.\frac{\partial y}{\partial u}\right|_{(u,v)=(3,4)} = 3 \qquad \left.\frac{\partial y}{\partial v}\right|_{(u,v)=(3,4)} = 5$$

a. 17
b. 39
c. 72
d. 84
e. 4464

5. Find the equation of the plane tangent to the surface $xz^2 + yz^3 = 5$ at the point $(x,y,z) = (2,3,1)$.

a. $x + y + 13z = 18$
b. $2x + 3y + z = 18$
c. $2x + 9y + 5z = 36$
d. $2x + 3y + z = 36$
e. $2x + 3y + z = 14$

6. Which of the following is NOT a critical point of the function $g = xy^3 + x^3y - 9xy$?

a. $(0,0)$
b. $(-3,0)$
c. $(0,3)$
d. $(0,-3)$
e. $(-3,3)$

7. The function $f = xy^3 + x^3y - 4xy$ has a critical point at the point $(x, y) = (1, -1)$. Use the Second Derivative Test to classify this critical point.

a. Local Minimum
b. Local Maximum
c. Saddle Point
d. Test Fails

8. Compute $\int_0^2 \int_y^{y^2} 2xy\, dx\, dy$.

a. $\frac{56}{15}$
b. $\frac{10}{3}$
c. $\frac{20}{3}$
d. $\frac{32}{3}$
e. $\frac{56}{3}$

9. Compute $\int_0^2 \int_0^3 \int_{x^2+y^2}^{2x^2+2y^2} 1\, dz\, dy\, dx$.

a. 13
b. 26
c. 31
d. 32
e. 62

10. Find the length $L,$ width W and height H of the rectangular box with maximum volume such that $L + 2W + 3H = 36.$ You must solve by **eliminating a variable**. (Do not solve by Lagrange multipliers.)

11. A styrofoam cup in the shape of a cylinder without a lid is to hold 64π cm^3 of coffee. Find the radius r and height h of the cup which uses the least styrofoam. Ignore the thickness of the styrofoam. You must solve by **Lagrange multipliers**. (Do not solve by eliminating a variable.)

12. Find the volume below surface $z = 2xy$ above the triangle with vertices $(0,0)$, $(1,0)$ and $(0,2)$ in the xy-plane.

13. Compute $I = \int_0^1 \int_{\sqrt{y}}^1 e^{x^3}\, dx\, dy$ by interchanging the order of integration.