

4. Show that the point $(3, 2, 1)$ lies on the surface $x^2 - xyz = 3$ then find a vector normal to this surface at the given point.

5. Find both $\frac{\partial f}{\partial u}$ and $\frac{\partial f}{\partial v}$ for the following functions.

(a) $z = (x + y)e^y$ with $x = \ln(u)$ and $y = v$.

(b) $z = \tan^{-1}\left(\frac{x}{y}\right)$ with $x = u^2 + v^2$ and $y = u^2 - v^2$.

6. The temperature at a point (x, y) is $T(x, y)$, measured in degrees Celsius. A bug crawls so that its position after t seconds is given by $x = \sqrt{1+t}$, $y = 2 + \frac{1}{3}t$, where x and y are measured in centimeters. The temperature function satisfies $T_x(2, 3) = 4$ and $T_y(2, 3) = 3$. How fast is the temperature rising on the bug's path after 3 seconds?

7. For the function $f(x, y) = e^{-2x^2-y^2}$ find f_{xx} , f_{yy} and f_{xy} .

8. Let $z = h(y) + x^2g(y)$. Can you find z_{xx} ? If not explain why not, if so find it.

9. For the following equations find all critical points and classify them as local maxima, local minima, saddle points, or none of these.

(a) $f(x, y) = (x + y)(xy + 1)$

(b) $E(x, y) = 1 - \cos(x) + \frac{y^2}{2}$

10. Find the global maximum and minimum (if they exist) for $f(x, y) = y\sqrt{x} - y^2 - x + 6y$ on the domain D , where D is the rectangle $0 \leq x \leq 9$ and $0 \leq y \leq 5$.

11. Find the quadratic Taylor polynomial about $(0, 0)$ for $\cos(x + 3y)$ and use it to estimate the function at $(1, 1)$. (This should give you an estimate for $\cos 4$.)

12. Evaluate the following integrals. (You must show work here, it is not enough to get the answer from your calculator or Maple.)

(a) $\int_0^1 \int_y^1 e^{x^2} dx dy$

(b) $\int_0^1 \int_{e^y}^e \frac{x}{\ln x} dx dy$

(c) $\int_0^1 \int_0^z \int_0^{x+z} 6xz dy dx dz$

13. Sketch the region of integration for $\int_0^1 \int_{-1}^1 \int_0^{\sqrt{1-x^2}} f(x, y, z) dz dx dy$. (I suggest you use Maple but if you wish to draw this on graph paper I will accept it.)

14. Find the average value of the sum of the squares of three numbers x, y, z , where each number is between 0 and 2.

15. Find the volume of the solid bounded by the parabolic cylinder (or trough) $x = y^2$ and the planes $z = 0$ and $x + z = 1$. (Maple? It's up to you but I suggest it. However, I will need to see the triple integral and some work in solving said integral.)