Math 253 – Fall 2008   Test 2 (14.3 – 15.3)   Name:_____
You must show appropriate work for credit.

1) The electrical potential V is given by $V = f(x, y, z) = 5x^2 y + xyz$.
   a) Find the rate of change of the potential at (1, 2, 3) in the direction of $\mathbf{v} = 4\mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$.
   b) In which direction does V change most rapidly at this point?
   c) What is the most rapid rate of change at this point?

2) The pressure P (in kiloPascals), volume V (in liters) and temperature T (in Kelvins) of a mole of an ideal gas are related by the equation $PV = 8.31T$. The pressure is increasing at a rate of 0.05 kPa/s and the temperature is increasing at a rate of 0.15 K/s. Find the rate of change of volume when the pressure is 20 kPa and the temperature is 320 K.

3) Find the point on the plane $x - y + z = 4$ that is closest to the point (1, 2, 3). (hint: minimize the *square* of the distance).

4) Use the method of Lagrange Multipliers to find the extrema of $f(x, y) = x^2 y$ on the ellipse $x^2 + 2y^2 = 6$. Make sure that you show that you have considered all relevant cases.