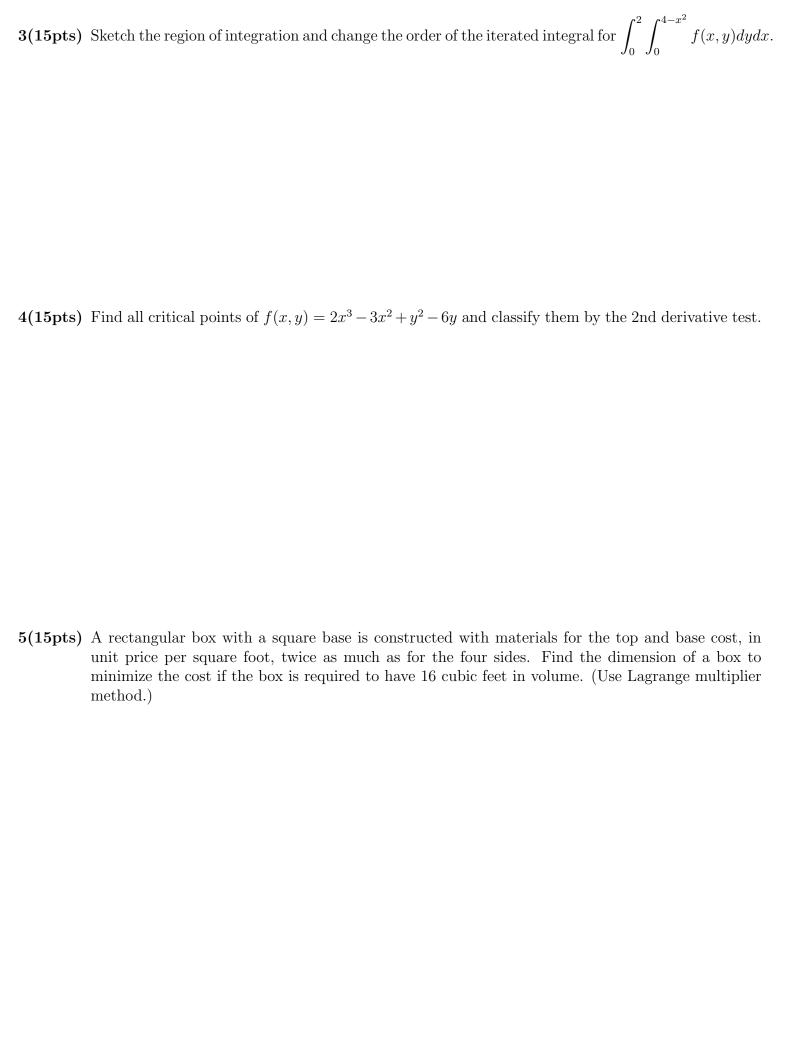
Instructions: You must show supporting work to receive full and partial credits. No text book, notes, formula sheets allowed.

**1(20pts)** (a) Find the directional derivative of function  $z = x^2 + y$  at the point (1,0) in the direction of (2,1).

(b) Find the tangent plane of the function at the point (1,0,1).

**2(20pts)** (a) It is given that y can be solved as a function of x, z from the equation  $2xe^{xy} + xz^2 + yz = 3$  at the point (1,0,-1). Use implicit differentiation to find  $\frac{\partial y}{\partial z}(1,-1)$ .

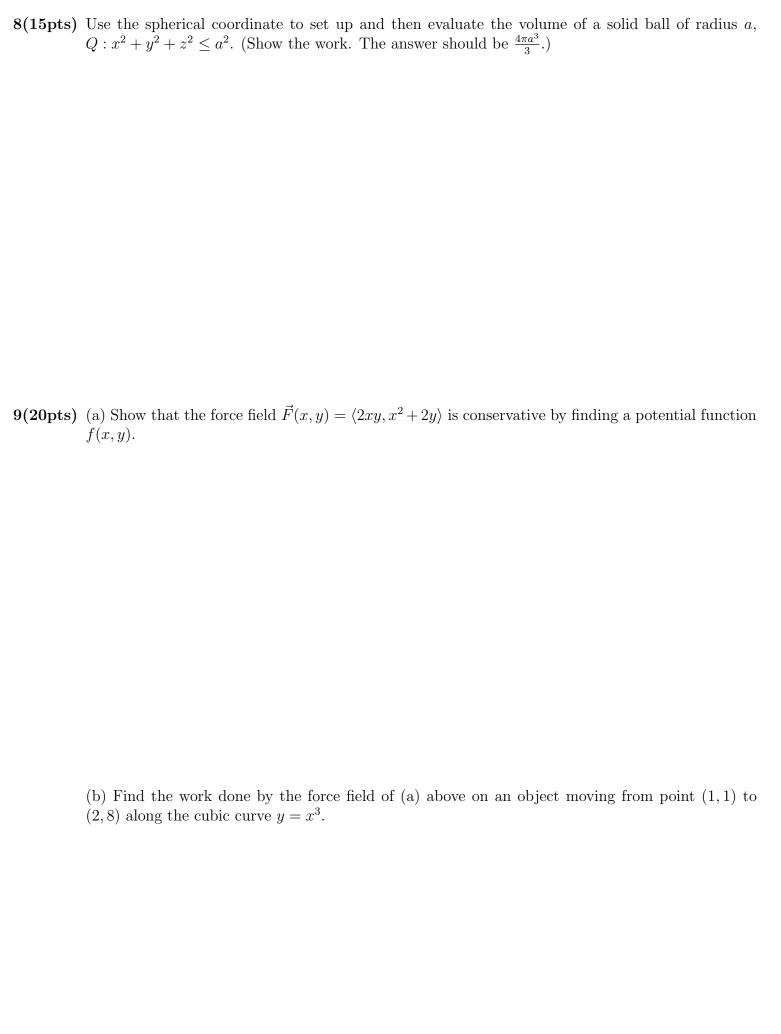
(b) Find the limit or show it does not exist for  $\lim_{(x,y)\to(0,0)} \frac{x^2y}{x^3+y^3}$ 

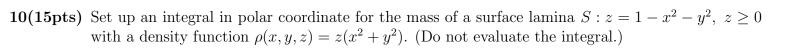


6(20pts)	At an instance the following are given for a particle in motion: its velocity $\vec{v} = \vec{r}' = (-1, 0, 1)$ and acceleration $\vec{a} = \vec{r}'' = (0, 3, 4)$ . Find the following: ( <i>Hint</i> : use the relation $\vec{a} = a_T \vec{T} + a_N \vec{N}$ .)  (a) The unit tangent vector $\vec{T}$ at the instance.
	$d^2 c$
	(b) The tangential component of the acceleration $\frac{d^2s}{dt^2}$ at the instance.
	(a) The principal permed unit vector $\vec{N}$ at the instance

(c) The principal normal unit vector N at the instance.

**7(15pts)** Set up an integral for the mass of a wire C which has the shape of a curve  $y=x^3$  between  $-2 \le x \le 2$  and has a density function given by  $\rho(x,y)=x^2+y^2$ . (Do not evaluate the integral.)





**11(15pts)** Let Q be the solid sphere  $x^2 + y^2 + z^2 \le 9$ . Use the Divergence Theorem to find the flux of a vector field  $\vec{F} = \langle z + x, x + y, y + z \rangle$ .

**12(15pts)** Let C be the triangle with vertexes (1,0,0),(0,2,0),(0,0,2) on the plane 2x+y+z=2, going counterclockwise when looking down. Use Stoke's Theorem to find the line integral  $\oint_C \vec{F} \cdot d\vec{r}$  for the vector field  $\vec{F} = \langle z, x+y \sin y, y \rangle$ .