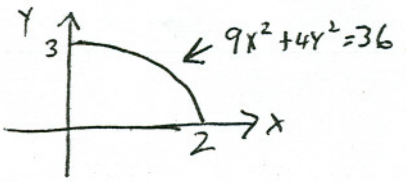
111 ~~76~~ 69

3. Find $\displaystyle\int_0^{\ln 3}\int_0^1 xye^{xy^2}\,dy\,dx = \int_0^{\ln 3} \frac{1}{2} e^{xy^2}\Big]_0^1 dx = \frac{1}{2}\int_0^{\ln 3} e^x - 1\,dx = \frac{1}{2}(e^x - x)\Big]_0^{\ln 3}$

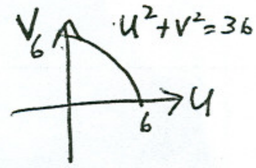
$$= \frac{1}{2}(3-\ln 3-1) = \frac{1}{2}(2-\ln 3)$$

4. Find the volume of the solid in the first octant bounded by $9z = 36 - 9x^2 - 4y^2$ and the coordinate planes.

$$\iint \frac{36-9x^2-4y^2}{9}\,\underbrace{dx\,dy}_{iso} = \iint \frac{36-u^2-v^2}{9}\begin{vmatrix}\frac{1}{3} & 0\\ 0 & \frac{1}{2}\end{vmatrix}\underbrace{du\,dv}_{iso}$$



$u = 3x$
$v = 2y$



$$\begin{vmatrix}\frac{\partial x}{\partial u} & \frac{\partial x}{\partial v}\\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v}\end{vmatrix}$$

$$= \int_0^{\pi/2}\int_0^6 \left(4-\frac{r^2}{9}\right) r\,\frac{1}{6}\,dr\,d\theta = \frac{1}{6}\int_0^{\pi/2}\int_0^6 4r - \frac{r^3}{9}\,dr\,d\theta = \frac{1}{6}\int_0^{\pi/2} 2r^2 - \frac{r^4}{36}\Big]_0^6\,d\theta$$

$u = r\cos\theta$
$v = r\sin\theta$

$$= \int_0^{\pi/2} \frac{1}{6}\left[2(36) - 36\right] d\theta = 6\theta\Big]_0^{\pi/2} = 3\pi$$