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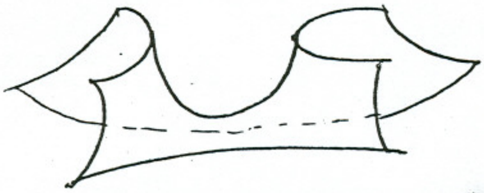
7. Describe and graph $z = x^2 - y^2$.



a hyperbolic paraboloid

8. Find the equations of the line tangent to $\vec{r}(t) = e^2 t\,\vec{i} + t\,\vec{j} - \sqrt{4t^2 - 1}\,\vec{k}$ at $t = 1$.

$\vec{r}\,'(t) = e^2\vec{i} + \vec{j} - \frac{8t}{2\sqrt{4t^2-1}}\vec{k}$

$\vec{r}\,'(1) = e^2\vec{i} + \vec{j} - \frac{4}{\sqrt{3}}\vec{k}$

$\vec{r}(1) = e^2\vec{i} + \vec{j} - \sqrt{3}\vec{k}$

$x = e^2 t + e^2$

$y = t + 1$

$z = -\frac{4}{\sqrt{3}}t - \sqrt{3}$

9. Find the equation of the plane tangent to $z = 2x^2 + y^2$ at the point where $x = 3$ and $y = 2$.

$\vec{\nabla} \perp$ levelsets

the surface is $0 = -z + 2x^2 + y^2$

$\vec{\nabla} = 4x\vec{i} + 2y\vec{j} - \vec{k}$

$\vec{\nabla}\big|_{\substack{x=3\\y=2}} = 12\vec{i} + 4\vec{j} - \vec{k}$

The z-coordinate $= 2\cdot 9 + 4 = 22$

$12(x-3) + 4(y-2) - (z-22) = 0$