Name:_____

Math 2030, Winter 2011, Quiz 3
26 January 2011
R. Bruner

No calculators needed or allowed.

Identify the type of the following surfaces as precisely as you can.

1. $2x^2 + 4x - y^2 + 4z^2 = 2$
2. $x^2 + 2x + y^2 - 6y + 4z^2 = 12$

Answers:

(1) $2(x^2+2x) - y^2 + 4z^2 = 2$

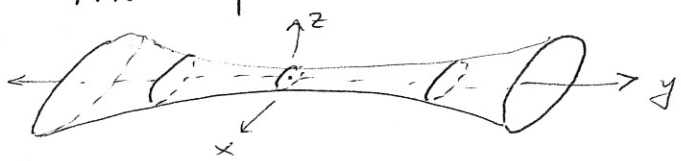
$2((x+1)^2 - 1) + 4z^2 = y^2 + 2$

$2(x+1)^2 - 2 + 4z^2 = y^2 + 2$

$2(x+1)^2 + 4z^2 = y^2 + 4$

Center $(-1, 0, 0)$

Axis parallel to y-axis



Hyperboloid (coeffs +,−,+ for x^2, y^2, z^2 say this)

One Sheet: $y^2 + 4 \geq 0$ for all y

(2) Coefficients of x^2, y^2, z^2 are all positive, so this is an ellipsoid

$x^2 + 2x + y^2 - 6y + 4z^2 = 12$

$(x+1)^2 - 1 + (y-3)^2 - 9 + 4z^2 = 12$

$(x+1)^2 + (y-3)^2 + 4z^2 = 22$

Center $(-1, 3, 0)$

Radii: $\sqrt{22}$ in x & y directions

$\frac{1}{2}\sqrt{22}$ in z-direction

Round horizontally
Flattened vertically

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1. Find the intersection of the plane $-x + y - z = 1$ with the line through $(0, 2, 1)$ and $(5, 4, -2)$.
2. Are the points $(0, 2, 1)$ and $(5, 4, -2)$ on the same or opposite sides of the plane?

Answers:

(1) The line is $(x,y,z) = (0,2,1) + t(5-0, 4-2, -2-1)$

$= (5t, 2+2t, 1-3t)$

It lies in the plane when

$-(5t) + (2+2t) - (1-3)t = 1$

i.e. $-5t + 2t + 3t + 2 - 1 = 1$

or $1 = 1$

This is always true, so the line lies in the plane. In retrospect this is clear:

at $(0,2,1)$ $\quad -x+y-z = 0+2-1 = 1$

at $(5,4,-2)$ $\quad -5+4+2 = -5+6 = 1$

so they both lie in the plane.

(2) Neither: they aren't on one side or the other, they are in it.