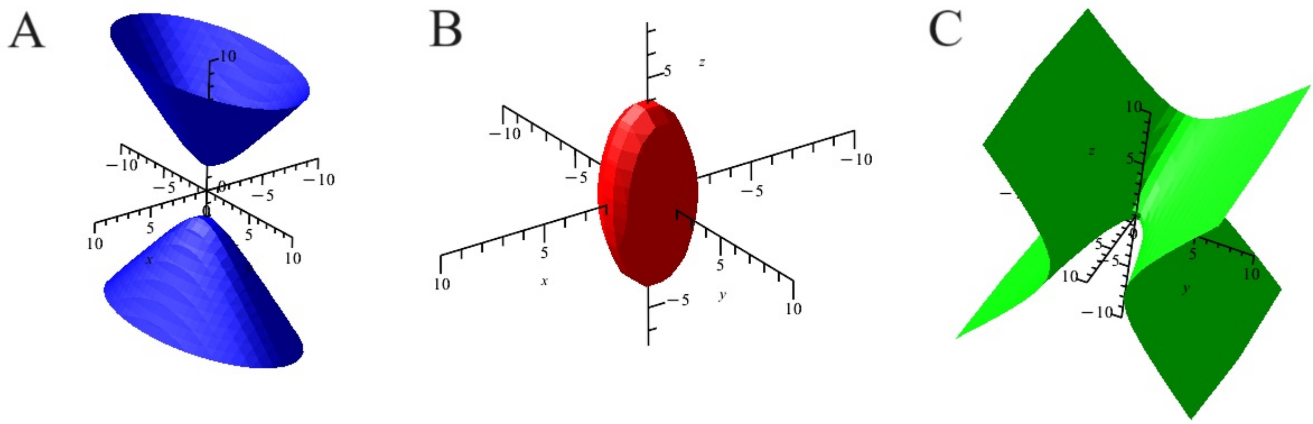
## Section 12.6: Cylinders& Quadric Surfaces

**Problem 1.** Use traces to sketch and identify the surface.

(a) $\dfrac{x^2}{2^2} + \dfrac{y^2}{2^2} + \dfrac{z^2}{4^2} = 1$ (b) $z^2 - 4x^2 - y^2 = 4$ (c) $x = y^2 - z^2$




## Section 13.1: Vector Functions & Space Curves

**Problem 2.** Vector functions are generally of the form

$$\mathbf{r}(t) = \langle\, f(t), g(t), h(t)\, \rangle,$$

where $f, g$, and $h$ are 1-variable functions (like the ones you dealt with in Calc I & II). These functions are called **component functions**.

**The domain of the vector function is the intersection, i.e., the "overlap", of the domains of the component functions $f$, $g$, and $h$.**

Find the domain of the vector function

$$\mathbf{r}(t) = \left\langle\, \ln(t+1), \frac{t}{\sqrt{9-t^2}}, 2^t \,\right\rangle.$$

**HINT:** Find the domains of $f(t) = \ln(t+1)$, $g(t) = \dfrac{t}{\sqrt{9-t^2}}$, and $h(t) = 2^t$ *first*, then find the common values of all three domains.

**Problem 3.** Let

$$\mathbf{r}(t) = te^{-t}\mathbf{i} + \frac{t^3+t}{2t^3-1}\mathbf{j} + \frac{t}{|t|}\mathbf{k}.$$

(a) Find $\lim\limits_{t\to\infty} \mathbf{r}(t)$. (b) Determine if $\mathbf{r}(t)$ continuous at $t = 0$.

**Problem 4.** Consider the following vector functions.

(i) $\mathbf{r}(t) = \langle 3, t, 2 - t^2 \rangle$ (ii) $\mathbf{r}(t) = 2t\mathbf{i} + 2\cos(t)\mathbf{j} + 3\sin(t)\mathbf{k}$

For each one:
(a) Determine its space curve **by hand** and use an arrow to indicate the direction in which $t$ increases.
(b) Verify that your sketch is correct using the *spacecurve( )* command **in Maple.**

**Problem 5.** Let $\mathbf{r}(t) = (t+1)\mathbf{i} + t\mathbf{j} + (2\cos(t+1))\mathbf{k}$.
(a) Determine and draw the projections of the space curve of $\mathbf{r}$ onto the three coordinate planes **by hand**.
(b) Draw a rough sketch of the space curve of $\mathbf{r}$ **by hand**.
(c) Verify your answers in (a) and (b) using the *plot( )* and *spacecurve( )* commands **in Maple.**

**Problem 6.**
(a) Find a vector function that represents the curve of intersection of the cylinder $x^2 + y^2 = 1$ and the plane $y + z = 2$.
**HINT:** $\cos^2(x) + \sin^2(x) = 1$.

(b) Plot the cylinder $x^2 + y^2 = 1$ and the plane $y + z = 2$ **in Maple** on the same plot using the *implicitplot3d( )* and the *display( )* commands. Give each surface a distinct color.

(c) Use **Maple** to plot the intersection of the cylinder and the plane using the *intersectplot( )* command.

(d) Use **Maple** to verify that the space curve of the vector function you defined in (a) matches your plot in (c). **Be sure to set the ranges for x, y, and z the same as for the plot in (d).**

**Problem 7.** Repeat parts (a)-(d) in Problem 5 for the intersection of the paraboloid $z = 4x^2 + y^2$ and the parabolic cilinder $y = x^2$.
**HINT:** As the first parametric equation of the curve of intersection, let $x = t$.