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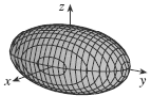
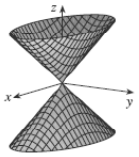
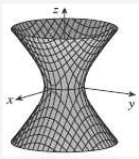
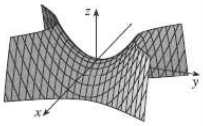
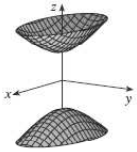
Alphs of Quadric Surfaces

Surface	Equation	Surface	Equation
Ellipsoid 	$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ All traces are ellipses. If $a=b=c$, the ellipsoid is a sphere.	Cone 	$\frac{z^2}{c^2}=\frac{x^2}{a^2}+\frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces in the planes $x=k$ and $y=k$ are hyperbolas if $k\neq 0$ but are pairs of lines if $k=0$.
Elliptic Paraboloid 	$\frac{z}{c}=\frac{x^2}{a^2}+\frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces are parabolas. The variable raised to the first power indicates the axis of the paraboloid.	Hyperboloid of One Sheet 	$\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$ Horizontal traces are ellipses. Vertical traces are hyperbolas. The axis of symmetry corresponds to the variable whose coefficient is negative.
Hyperbolic Paraboloid 	$\frac{z}{c}=\frac{x^2}{a^2}-\frac{y^2}{b^2}$ Horizontal traces are hyperbolas. Vertical traces are parabolas. The case where $c<0$ is illustrated.	Hyperboloid of Two Sheets 	$-\frac{x^2}{a^2}-\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ Horizontal traces in $z=k$ are ellipses if $k>c$ or $k<-c$. Vertical traces are hyperbolas. The two minus signs indicate two sheets.

1. Match the equation with its graph. Give reasons for your choice.

a) $x^2 + 4y^2 + 9z^2 = 1$

b) $x^2 - y2 + z^2 = 1$

c) $y = 2x^2 + z^2$

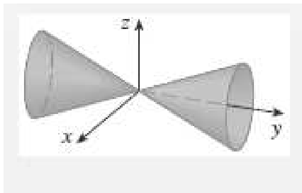
d) $x^2 + 2z^2 = 1$

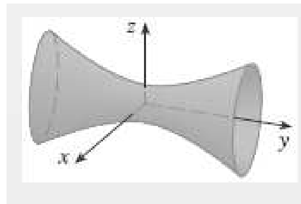
e) $9x^2 + 4y^2 + z^2 = 1$

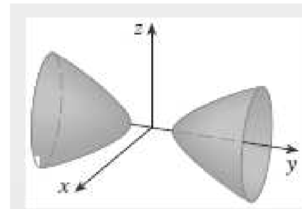
f) $-x^2 + y^2 - z^2 = 1$

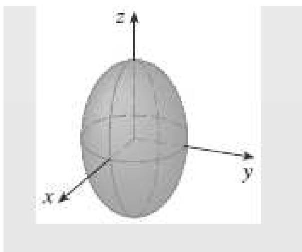
g) $y^2 = x^2 + 2z^2$

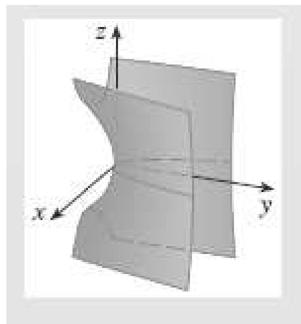
h) $y = x^2 - z^2$

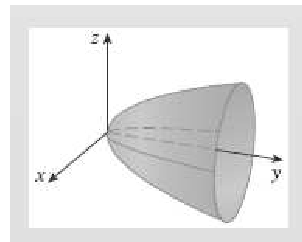


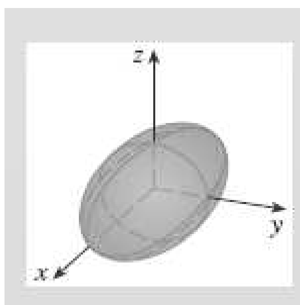


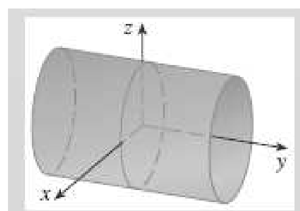












2. Use traces to sketch and identify the surface:

(a) $4x^2 + 9y^2 + 9z^2 = 36$

(b) $9y^2 + 4z^2 = x^2 + 36$

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

(d) $3x^2 - y^2 + 3z^2 = 0$

(e) $y = z^2 + x^2$

(f) $z = x^2 - y^2$

(g) $x^2 + z^2 = 1$

(h) $z = y^2$

(i) $xy = 1$

3. Reduce the equation to the standard form, classify the surface, and sketch it.

$$x^2 + y^2 - 2x - 6y - z + 10 = 0$$