22. $9x^2 + 4y^2 + z^2 = 1$ (IV)

24. $-x^2 + y^2 - z^2 = 1$ (III)

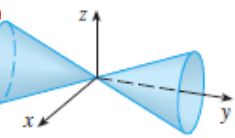
26. $y^2 = x^2 + 2z^2$ (I)

28. $y = x^2 - z^2$

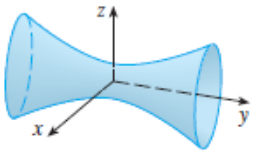
$y^2 = x^2 + z^2 + 1$

$x^2 = z^2$

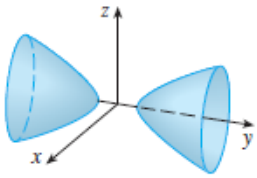
I



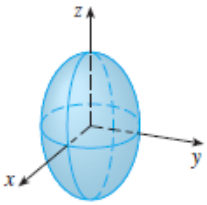
II



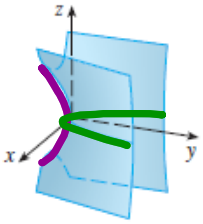
III



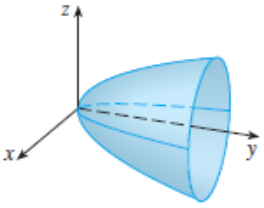
IV



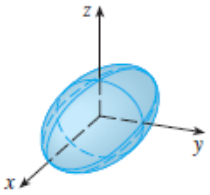
V



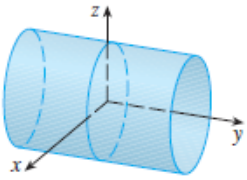
VI



VII



VIII



69–70 Find the distance from the point to the given plane.

69. $(1, -2, 4)$, $3x + 2y + 6z = 5$

$$d = \frac{|Ax_0 + By_0 + Cz_0 + D|}{\sqrt{A^2 + B^2 + C^2}}$$

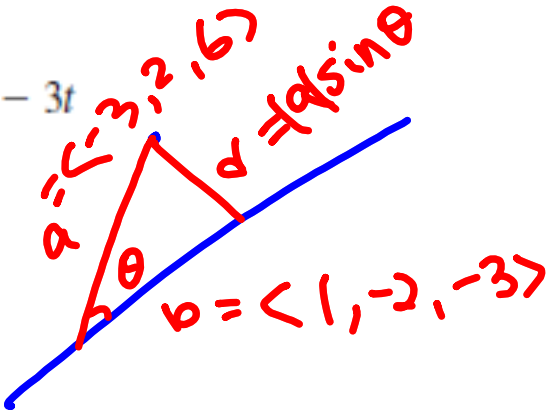
$$\frac{|3(1) + 2(-2) + 6(4) - 5|}{\sqrt{3^2 + 2^2 + 6^2}} = \frac{18}{7}$$

67–68 Use the formula in Exercise 43 in Section 12.4 to find the distance from the point to the given line.

67. $(4, 1, -2)$; $x = 1 + t,\ y = 3 - 2t,\ z = 4 - 3t$

$$\frac{\sqrt{61}}{\sqrt{14}} = \frac{|a \times b|}{|b|}$$

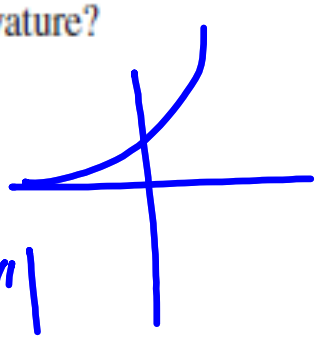
$$\begin{matrix} -3 & 2 & 6 \\ 1 & -2 & -3 \end{matrix}$$



$$a \times b = \langle 6, -3, 4 \rangle$$

30–31 At what point does the curve have maximum curvature? What happens to the curvature as $x \to \infty$?

30. $y = \ln x$ **31.** $y = e^x$



$$\kappa = \left|\frac{dT}{ds}\right| = \frac{|T'|}{|r'|} = \frac{|r' \times r''|}{|r'|^3}$$

$$= \frac{|f''|}{(1+f'^2)^{3/2}}$$

$$\kappa = \frac{e^x}{(1+e^{2x})^{3/2}}$$

$$\lim_{x \to \infty} \kappa = 0$$

$$\frac{d\kappa}{dx} = \frac{e^x(1+e^{2x})^{-\frac{3}{2}} - \frac{3}{2}\sqrt{1+e^{2x}} \cdot 2e^{2x} \cdot e^x}{(1+e^{2x})^{3.5/2}}$$

$e^{2x} = \frac{1}{2}$

$x = -\frac{\ln 2}{2}$

$$= \frac{e^x + e^{3x} - 3e^{3x}}{\sim} = \frac{e^x(1-2e^{2x})}{\sim}$$