20. \(|(−2, 4, 2)| = \sqrt{(-2)^2 + 4^2 + 2^2} = \sqrt{24} = 2\sqrt{6}\), so a unit vector in the direction of \((-2, 4, 2)\) is \(u = \frac{1}{2\sqrt{6}} (-2, 4, 2)\). A vector in the same direction but with length 6 is 
\[6u = \frac{6}{2\sqrt{6}} (-2, 4, 2) = \left(-\frac{6}{\sqrt{6}}, \frac{12}{\sqrt{6}}, \frac{6}{\sqrt{6}}\right) \text{ or } \left(-\sqrt{6}, 2\sqrt{6}, \sqrt{6}\right).
\]

34. Let \(P_1\) and \(P_2\) be the points with position vectors \(r_1\) and \(r_2\) respectively. Then \(|r - r_1| + |r - r_2|\) is the sum of the distances from \((x, y)\) to \(P_1\) and \(P_2\). Since this sum is constant, the set of points \((x, y)\) represents an ellipse with foci \(P_1\) and \(P_2\). The condition \(k > |r_1 - r_2|\) assures us that the ellipse is not degenerate.

18. \((-6, b, 2)\) and \((b, b^2, b)\) are orthogonal when \((-6, b, 2) \cdot (b, b^2, b) = 0 \iff (-6)(b) + (b)(b^2) + (2)(b) = 0 \iff b^3 - 4b = 0 \iff b(b+2)(b-2) = 0 \iff b = 0 \text{ or } b = \pm 2.
\]

34. \((r - a) \cdot (r - b) = 0\) implies that the vectors \(r - a\) and \(r - b\) are orthogonal. From the diagram (in which \(A, B\) and \(R\) are the terminal points of the vectors), we see that this implies that \(R\) lies on a sphere whose diameter is the line from \(A\) to \(B\). The center of this circle is the midpoint of \(AB\), that is, 
\[\frac{1}{2}(a + b) = \left(\frac{1}{2}(a_1 + b_1), \frac{1}{2}(a_2 + b_2), \frac{1}{2}(a_3 + b_3)\right),\] and its radius is 
\[\frac{1}{2}|a - b| = \frac{1}{2} \sqrt{(a_1 - b_1)^2 + (a_2 - b_2)^2 + (a_3 - b_3)^2}.
\]

Or: Expand the given equation, substitute \(r \cdot r = x^2 + y^2 + z^2\) and complete the squares.

16. The parallelogram is determined by the vectors \(\overrightarrow{KL} = (0, 1, 3)\)
and \(\overrightarrow{KN} = (2, 5, 0)\), so the area of parallelogram \(KLMN\) is
\[|\overrightarrow{KL} \times \overrightarrow{KN}| = \begin{vmatrix} 1 & 0 & 3 \\ 0 & 1 & 3 \\ 2 & 5 & 0 \end{vmatrix} = |(-15)1 + (-6)0 + (-2)2| = |-15 + 6 - 2| = \sqrt{265} \approx 16.28.
\]

18. (a) \(PQ = (1, 1, 3)\) and \(PR = (3, 2, 5)\), so a vector orthogonal to the plane through \(P, Q,\) and \(R\) is \(\overrightarrow{PQ} \times \overrightarrow{PR} = ((1)(3) - (5)(2), (3)(3) - (1)(5), (1)(2) - (1)(3)) = (-1, -4, -1)\) (or any scalar multiple thereof).

22. \(a \cdot (b \times c) = \begin{vmatrix} 2 & 3 & -2 \\ 1 & -1 & 0 \\ 2 & 0 & 3 \end{vmatrix} = 2(-1)0 + 3\cdot(-2)3 + (-2)10 = -6 - 9 - 6 = -19.\) So the volume of the parallelepiped determined by \(a, b\) and \(c\) is \(|-19| = 19\) cubic units.

20. \(j + 2k = (0, 1, 2)\) is a normal vector to the plane and \((4, 0, -3)\) is a point on the plane, so setting \(a = 0, b = 1, c = 2, x_0 = 4, y_0 = 0, z_0 = -3\) in Equation 6 gives \(0(x - 4) + 1(y - 0) + 2[z - (-3)] = 0\) or \(y + 2z = -6\) to be an equation of the plane.

36. The plane will contain all perpendicular bisectors of the line segment joining the two points. Thus, a point in the plane is \(P_0 = (-1, -1, 2)\), the midpoint of the line segment joining the two given points, and a normal to the plane is \(n = (6, -6, 2)\), the vector connecting the two points. So an equation of the plane is 
\[6(x + 1) - 6(y + 1) + 2(z - 2) = 0 \text{ or } 3x - 3y + z = 2.
\]

48. Put \(y = z = 0\) in the equation of the first plane to get the point \((\frac{3}{2}, 0, 0)\) on the plane. Because the planes are parallel the distance \(D\) between them is the distance from \((\frac{3}{2}, 0, 0)\) to the second plane. By Equation 8,
\[D = \frac{|\frac{3}{2} + 2(0) - 3(0) - 1|}{\sqrt{1^2 + 2^2 + (-3)^2}} = \frac{1}{\sqrt{14}}.
\]