**Rapid Review**

(1) A vector $\mathbf{v} = \overrightarrow{PQ}$ is determined by a basepoint $P$ and a terminal point $Q$.

(2) Components of $\mathbf{v} = \overrightarrow{PQ}$, where $P = (a_1, b_1)$ and $Q = (a_2, b_2)$:

$$\mathbf{v} = \langle a, b \rangle$$

with $a = a_2 - a_1$ and $b = b_2 - b_1$.

(3) The length $\|\mathbf{v}\|$ of $\mathbf{v}$ is equal to $\|\mathbf{v}\| = \sqrt{a^2 + b^2}$.

(4) Vector addition: $\langle v_1, v_2 \rangle + \langle w_1, w_2 \rangle = \langle v_1 + w_1, v_2 + w_2 \rangle$.

(5) Scalar multiplication: $\|\lambda \mathbf{v}\| = |\lambda| \|\mathbf{v}\|$ for $\lambda$ real.

(6) $\mathbf{v}$ and $\mathbf{w}$ are parallel if, for some scalar $\lambda$.

(7) If $\mathbf{v} = \langle v_1, v_2 \rangle$ makes an angle $\theta$ with the positive $x$-axis, then $v_1 = \cos \theta$ and $v_2 = \sin \theta$.

(8) Triangle inequality: $\|\mathbf{v} + \mathbf{w}\| \leq \|\mathbf{v}\| + \|\mathbf{w}\|$.

(9) Equation of the sphere of radius $R$ and center $(a, b, c)$:

$$\sqrt{(x-a)^2 + (y-b)^2 + (z-c)^2} = R$$

(10) Equation of the cylinder of radius $R$ and vertical axis through $(a, b, 0)$:

$$\sqrt{(x-a)^2 + (y-b)^2} = R$$

(11) Equations for the line passing through $P_0 = (x_0, y_0, z_0)$ with direction vector $\mathbf{v} = (a, b, c)$:

(a) Vector parametrization: $\mathbf{r}(t) = \overrightarrow{OP_0} + t\mathbf{v} = \langle x_0 + at, y_0 + bt, z_0 + ct \rangle$.

(b) Parametric equation: $x = x_0 + at$ (10), $y = y_0 + bt$ (11), $z = z_0 + ct$ (12).
Problems

(1) Let \( R = (-2, 7) \). Calculate the following:

(a) The length of \( \overrightarrow{OR} \).

(b) The components of \( \mathbf{u} = \overrightarrow{PR} \), where \( P = (1, 2) \).

(c) The point \( P \) such that \( \overrightarrow{PR} \) has components \( (-2, 7) \).

(d) The point \( Q \) such that \( \overrightarrow{RQ} \) has components \( (8, -3) \).

(2) Find the given vector:

(a) Unit vector \( \mathbf{e}_v \) where \( \mathbf{v} = \langle 3, 4 \rangle \).

(b) Vector of length 4 in the direction of \( \mathbf{u} = \langle -1, 1 \rangle \).

(c) Vector of length 2 in the direction of \( \mathbf{v} = \mathbf{i} - \mathbf{j} \).

(d) Unit vector in the direction opposite to \( \mathbf{v} = \langle -2, 4 \rangle \).

(e) Vector \( \mathbf{v} \) of length 2 making an angle of 30° with the \( x \)-axis.

(3) Determine whether or not the two vectors are parallel:

(a) \( \mathbf{u} = \langle 1, -2, 5 \rangle \), \( \mathbf{v} = \langle -2, 4, -10 \rangle \).

(b) \( \mathbf{u} = \langle 4, 2, -6 \rangle \), \( \mathbf{v} = \langle 2, 1, 3 \rangle \).

(4) Find a vector parametrization for the line with the given description:

(a) Passes through \( P = (1, 2, -8) \), direction vector \( \mathbf{v} = \langle 2, 1, 3 \rangle \).

(b) Passes through \( (-2, 0, -2) \) and \( (4, 3, 7) \).

(c) Passes through \( (1, 1, 1) \) parallel to the line through \( (2, 0, -1) \) and \( (4, 1, 3) \).

(5) Show that the lines \( \mathbf{r}_1(t) = \langle -1, 2, 2 \rangle + t\langle 4, -2, 1 \rangle \) and \( \mathbf{r}_2(s) = \langle 0, 1, 1 \rangle + s\langle 2, 0, 1 \rangle \) do not intersect.

(6) Find the intersection of the lines \( \mathbf{r}_1(t) = \langle -1, 1 \rangle + t\langle 2, 4 \rangle \) and \( \mathbf{r}_2(s) = \langle 2, 1 \rangle + s\langle -1, 6 \rangle \) in the plane.