## Equations of a Line in R3

- (1) Slope-Intercept: y = mx + bNo equivalent form in R3.
- (2) Vector form:  $\vec{r} = \vec{r_0} + t\vec{m}$   $t \in \mathbb{R}$  Each vector now has three components.

$$(x, y, z) = (x_0, y_0, z_0) + t(a, b, c)$$

(3) Parametric form:

$$x = x_0 + ta$$
  $y = y_0 + tb$   $z = z_0 + tc$ 

(4) Cartesian form: Ax + By + Cz + D = 0In R3, this form represents a plane, not a line.

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## (5) Symmetric form:

The parametric equations all have a common factor 't'.

$$x = x_0 + ta$$
  $y = y_0 + tb$   $z = z_0 + tc$ 

Rearranging each equation for 't' yields:

$$t = \frac{x - x_0}{a} \qquad t = \frac{y - y_0}{b} \qquad t = \frac{z - z_0}{c}$$

Since the values of 't' are all the same,

$$\frac{x - x_0}{a} = \frac{y - y_0}{b} = \frac{z - z_0}{c}$$
  $a, b, c \neq 0$ 

Ex.1 Determine vector, parametric, and symmetric equations for the line passing through 
$$P(-2, 3, 5)$$
 and  $Q(-2, 4, -1)$ .

(a)  $\overrightarrow{r} = \overrightarrow{r_0} + t\overrightarrow{m}$ ,  $t \in \mathbb{R}$ 
 $\overrightarrow{r_0} = \overrightarrow{OP}$  so  $\overrightarrow{OQ}$ 
 $\overrightarrow{r_0} = \overrightarrow{OP}$ 
 $\overrightarrow{r_0} = \overrightarrow{OP}$  so  $\overrightarrow{OQ}$ 
 $\overrightarrow{r_0} = \overrightarrow{PQ}$ 
 $\overrightarrow{r_0} = \overrightarrow{r_0}$ 
 $\overrightarrow$ 

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## Ex.2 Given the symmetric equation, determine vector and parametric equations.

and parametric equations. 
$$\frac{x-3}{5} = \frac{y+2}{3} = \frac{z+5}{7}$$

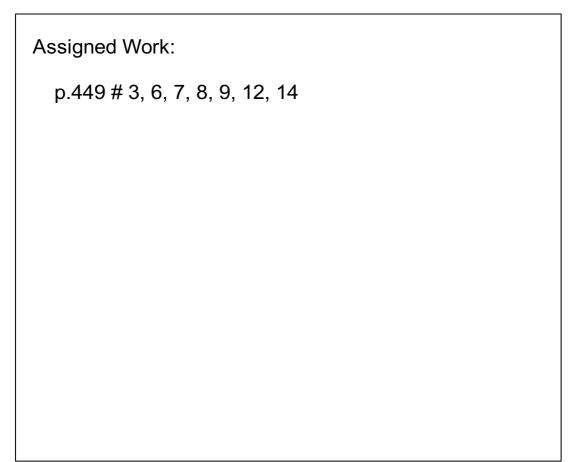
$$\frac{x-x_0}{a} = \frac{y-y_0}{b} = \frac{z-z_0}{c}$$

$$\overrightarrow{m} = (5,3,7) \quad \overrightarrow{r_0} = (3,-2,-5)$$

$$\overrightarrow{r} = (3,-2,-5) + t(5,3,7) \quad t \in \mathbb{R}$$

$$x = 3 + 5t \quad y = -2 + 3t \quad z = -5 + 7t$$

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