6.1 Equations of Lines in Two-Space Worksheet with solutions

This document was composed and formatted by Annie Bernatchez.

The course material originated from www.jensenmath.ca

1) Write a vector equation for a line given each direction vector $\vec{m}$ and point P_0.

a) $\vec{m} = [2, -7]$, $P_0(9, 4)$ $[x, y] = [9, 4] + t[2, -7]$	b) $\vec{m} = [-1, 5]$, $P_0(3, 7)$ $[x, y] = [3, 7] + t[-1, 5]$

2) Write the vector equation of the line that passes through each pair of points.

a) $A(2, 3)$, $B(7, 1)$ $\vec{m} = [7-2, 1-3]$ $\vec{m} = [5, -2]$ $[x, y] = [2, 3] + t[5, -2]$	b) $A(5, -1)$, $B(-2, 7)$ $\vec{m} = [-2-5, 7-(-1)]$ $\vec{m} = [-7, 8]$ $[x, y] = [5, -1] + t[-7, 8]$

3) Write the parametric equations for each vector equation.

a) $[x, y] = [7, 3] + t[2, 5]$ $\ell : \begin{cases} x = 7 + 2t \\ y = 3 + 5t \end{cases}$	b) $[x, y] = [-1, 4] + t[8, -9]$ $\ell : \begin{cases} x = -1 + 8t \\ y = 4 - 9t \end{cases}$

4) Determine if each point P is on the line $[x, y] = [3, 1] + t[-2, 5]$

a) $P(12, 36)$ $12 = 3 - 2t \;\; 36 = 1 + 5t$ $t = -\frac{9}{2} \;\; t = 7$ t-values are not equal, so $P(12, 36)$ is NOT on the line.	b) $P(-7, 26)$ $-7 = 3 - 2t \;\; 26 = 1 + 5t$ $t = 5 \;\; t = 5$ t-values are equal, so $P(-7, 26)$ IS on the line.
c) $P(1, 6)$ $1 = 3 - 2t \;\; 6 = 1 + 5t$ $t = 1 \;\; t = 1$ t-values are equal, so $P(1, 6)$ IS on the line.	d) $P(-3, 15)$ $-3 = 3 - 2t \;\; 15 = 1 + 5t$ $t = 3 \;\; t = \frac{14}{5}$ t-values are not equal, so $P(-3, 15)$ is NOT on the line.

5) Write a vector equation for each line, given the parametric equations.

a) $\ell : \begin{cases} x = 2 - 4t \\ y = 1 - 5t \end{cases}$ $[x, y] = [2, 1] + t[-4, -5]$	b) $\ell : \begin{cases} x = 8 - 9t \\ y = 3 \end{cases}$ $[x, y] = [8, 3] + t[-9, 0]$

6) Given each set of parametric equations, write the scalar equation.

a) $\ell : \begin{cases} x = 3 + 4t \\ y = -1 - 5t \end{cases}$ $t = \frac{x-3}{4} \;\; t = \frac{y+1}{-5}$ $\frac{x-3}{4} = \frac{y+1}{-5}$ $-5x + 15 = 4y + 4$ $5x + 4y - 11 = 0$	b) $\ell : \begin{cases} x = 2 + 8t \\ y = -5 + 7t \end{cases}$ $t = \frac{x-2}{8} \;\; t = \frac{y+5}{7}$ $\frac{x-2}{8} = \frac{y+5}{7}$ $7x - 14 = 8y + 40$ $-7x + 8y + 54 = 0$

7) Write the scalar equation of each line given the normal vector $\vec{n}$ and point P_0.

a) $\vec{n} = [4, 1]$, $P_0(3, -5)$ $Ax + By + C = 0$ $4(3) + 1(-5) + C = 0$ $C = -7$ $4x + y - 7 = 0$	b) $\vec{n} = [1, -3]$, $P_0(4, 3)$ $Ax + By + C = 0$ $1(4) + (-3)(3) + C = 0$ $C = 5$ $x - 3y + 5 = 0$

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8) Determine the vector equation of each line.

a) parallel to the y-axis and through $P_0(2, -7)$

$\vec{m} = [0, 1]$

$[x, y] = [2, -7] + t[0, 1]$

b) parallel to $[x, y] = [3, -1] + t[3, 4]$ and through $P_0(-2, 4)$

$\vec{m} = [3, 4]$

$[x, y] = [-2, 4] + t[3, 4]$

c) perpendicular to $[x, y] = [2, -1] + t[5, 3]$ with x-intercept 3

$\vec{m} = [-3, 5]$

$\vec{r_0} = [3, 0]$

$[x, y] = [3, 0] + t[-3, 5]$

9) Given each scalar equation, write a vector equation and the parametric equations.

a) $x + 2y = 6$ $\vec{m} = [-2, 1]$ Point $(2, 2)$ is on the line $[x, y] = [2, 2] + t[-2, 1]$ $\ell : \begin{cases} x = 2 - 2t \\ y = 2 + t \end{cases}$	b) $5x - 2y = 13$ $\vec{n} = [5, -2]$, $\vec{m} = [2, 5]$ Point $(3, 1)$ is on the line $[x, y] = [3, 1] + t[2, 5]$ $\ell : \begin{cases} x = 3 + 2t \\ y = 1 + 5t \end{cases}$

10) In each case, determine if ℓ_1 and ℓ_2 are parallel, perpendicular, or neither. Explain.

a) $\ell_1 : 4x - 6y = 9$

$\ell_2 : [x, y] = [6, 3] + t[3, 2]$

$\vec{n_1} = [4, -6]$

$\vec{m_1} = [6, 4] = 2[3, 2]$

$\vec{m_2} = [3, 2]$

Since $\vec{m_1} = 2\vec{m_2}$, ℓ_1 and ℓ_2 are parallel.

b) $\ell_1 : x + 9y = 2$

$\ell_2 : \begin{cases} x = t \\ y = 15 + 9t \end{cases}$

$\vec{n_1} = [1, 9]$

$\vec{m_1} = [-9, 1]$

$\vec{m_2} = [1, 9]$

$\vec{m_1} \cdot \vec{m_2} = [-9, 1] \cdot [1, 9]$

$= -9(1) + 1(9)$

$= 0$

Since $\vec{m_1} \neq k\vec{m_2}$ but $\vec{m_1} \cdot \vec{m_2} = 0$, ℓ_1 and ℓ_2 are perpendicular.

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