6.4 Equations of Planes in Scalar Form Worksheet

This document was composed and formatted by Annie Bernatchez.

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1) Write the scalar equation of each plane given the normal $\vec{n}$ and a point P on the plane.

a) $\vec{n} = [1, -3, -4]$, $P(-2, 5, 7)$	b) $\vec{n} = [0, -3, 5]$, $P(8, -7, 3)$

2) Write a scalar equation of each plane, given its vector or parametric equation.

a) $[x, y, z] = [7, -3, 4] + s[1, -2, -3] + t[4, -3, 1]$	b) $\pi_1 : \begin{cases} x = 4 + t + 2s \\ y = 3 - 2t - 3s \\ z = -1 + 3t + s \end{cases}$

3) For each situation, write the scalar equation of the plane.

a) has normal $\vec{n} = (7, 9, -1)$ and includes the point $(3, -2, 4)$	b) contains direction vectors $\vec{a} = [-1, 2, 8]$ and $\vec{b} = [2, -1, 3]$ and includes the point $(2, -7, 8)$
c) parallel to the xz-plane and includes the point $(7, 8, -1)$	d) contains the points $(3, 8, -1)$, $(-8, 9, -4)$, and $(1, -3, 2)$
e) contains the line $[x, y, z] = [4, -3, -2] + s[3, -2, 1]$ and parallel to the line defined by the parametric equations $\ell : \begin{cases} x = 5 + 3s \\ y = 1 - s \\ z = 2 + 4s \end{cases}$	f) contains the point $(2, -1, 8)$ and perpendicular to the line $[x, y, z] = [1, -2, -3] + s[5, -4, 7]$
g) parallel to the plane $-3x + 2y + 5z + 8 = 0$ and includes the point $(5, -7, 8)$	h) contains the lines $[x, y, z] = [4, -1, 0] + s[-2, 1, 3]$ and $[x, y, z] = [-2, 4, 3] + s[-6, 5, 7]$

4) Determine the angle between the planes $x + 2y - 3z - 4 = 0$ and $x + 2y - 1 = 0$. *(Hint: the angle between 2 intersecting planes should be equal to the angle between their normals)*

5) Write the vector equation and parametric equations of the plane: $3x - y + 2z - 4 = 0$

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6) Find a vector that is normal and one that is parallel to each plane.

a) $x + 2y + 2z - 5 = 0$	b) $5x + 2z = 7$	c) $5y = 8$

7) Consider the plane $-x + 4y + 2z + 6 = 0$

a) Determine a normal vector, $\vec{n}$, to the plane.

b) Determine the coordinates of two points, S and T, on the plane.

c) Determine $\overrightarrow{ST}$

d) Show that $\overrightarrow{ST}$ is perpendicular to $\vec{n}$.

8) State the scalar equation of each of the following

a) the xy-plane	b) the xz-plane	c) the yz-plane

Answer Key

1. a) $x - 3y - 4z + 45 = 0$ b) $-3y + 5z - 36 = 0$

2. a) $-11x - 13y + 5z + 18 = 0$ b) $7x + 5y + z - 42 = 0$

3. a) $7x + 9y - z + 1 = 0$ b) $14x + 19y - 3z + 129 = 0$ c) $y - 8 = 0$ d) $-30x + 39y + 123z - 99 = 0$ e) $-7x - 9y + 3z + 7 = 0$ f) $5x - 4y + 7z - 70 = 0$ g) $-3x + 2y + 5z - 11 = 0$ h) $2x + y + z - 7 = 0$

4. $53.3°$

5. $[x, y, z] = [0, 0, 2] + t[1, 3, 0] + s[0, 2, 1]$, parametric: $x = t,\ y = 3t + 2s,\ z = 2 + s$

6. a) perpendicular: $[1, 2, 2]$; parallel: $[-2, 1, 0]$ b) perpendicular: $[5, 0, 2]$; parallel: $[-2, 0, 5]$ c) perpendicular: $[0, 5, 0]$; parallel: $[2, 0, 7]$

7. a) $\vec{n} = [-1, 4, 2]$ b) $S(6, 0, 0)$, $T(0, 0, -3)$ c) $\overrightarrow{ST} = [-6, 0, -3]$ d) $\overrightarrow{ST} \cdot \vec{n} = 0$

8. a) $z = 0$ b) $y = 0$ c) $x = 0$

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