Supplement to Section 10.4

1. Find two unit vectors that are orthogonal to the plane determined by the points $A(0, -2, 1)$, $B(1, -1, -2)$, and $C(-1, 1, 0)$. (Vectors orthogonal to a plane are also said to be *normal* to the plane.)

2. What can you say about the angle between non-zero vectors $\vec{\mathbf{u}}$ and $\vec{\mathbf{v}}$ if $\vec{\mathbf{u}} \cdot \vec{\mathbf{v}} = \|\vec{\mathbf{u}} \times \vec{\mathbf{v}}\|$?

3. Show that if $\vec{\mathbf{u}}$ and $\vec{\mathbf{v}}$ are vectors in 3-space, then
$$||\vec{\mathbf{u}} \times \vec{\mathbf{v}}\|^2 = \|\vec{\mathbf{u}}\|^2 \|\vec{\mathbf{v}}\|^2 - \left(\vec{\mathbf{u}} \cdot \vec{\mathbf{v}}\right)^2.$$

4. Prove that if $\vec{\mathbf{a}}$, $\vec{\mathbf{b}}$, $\vec{\mathbf{c}}$, and $\vec{\mathbf{d}}$ lie in the same plane when positioned with a common initial point, then
$$\left(\vec{\mathbf{a}} \times \vec{\mathbf{b}}\right) \times \left(\vec{\mathbf{c}} \times \vec{\mathbf{d}}\right) = 0.$$

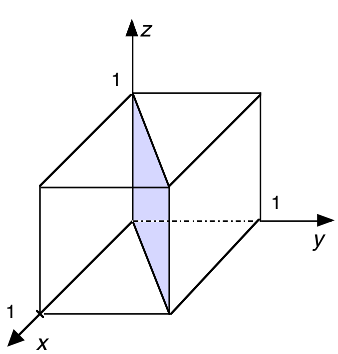
Supplement to Section 10.5

5. Determine whether the points $P_1(6, 9, 7)$, $P_2(9, 2, 0)$, and $P_3(0, -5, -3)$ lie on the same line.

6. Find parametric equations for the line *segment* joining $P_1(5, -2, 1)$ and $P_2(2, 4, 2)$.

7. Find the equations of the planes P_1, P_2, and P_3 that are parallel to the coordinate planes and that pass through the point $(3, 4, 5)$.

8. Find an equation of the shaded plane in the figure below.



9. Determine whether the given planes are parallel, perpendicular, or neither.

(a) $P1 : 2x - 8y - 6z - 2 = 0,\ P_2 : -x + 4y + 3z - 5 = 0$

(b) $P1 : x - y + 3z - 2 = 0,\ P_2 : 2x + z = 1$

10. Find an equation of the plane that consists of all points equidistant from $(2, -1, 1)$ and $(3, 1, 5)$.

11. Determine whether the line $L : x = 4 + 2t, y = -t, z = -1 - 4t$ and plane $P : 3x + 2y + z - 7 = 0$ are parallel, perpendicular, or neither.

Supplement to Section 11.1

12. Express the parametric equations as a single vector equation of the form $\vec{\mathbf{r}}(t) = x(t)\vec{\mathbf{i}} + y(t)\vec{\mathbf{j}}$ or $\vec{\mathbf{r}}(t) = x(t)\vec{\mathbf{i}} + y(t)\vec{\mathbf{j}} + z(t)\vec{\mathbf{k}}$.

    (a) $x = t^2 + 1,\ y = e^{-2t}$.

    (b) $x = t\sin(t),\ y = \ln(t),\ z = \cos^2(t)$.

13. Find the parametric equations that correspond to the given vector equation.

    (a) $\vec{\mathbf{r}}(t) = 3t^2\vec{\mathbf{i}} - 2\vec{\mathbf{j}}$

    (b) $\vec{\mathbf{r}}(t) = te^{-t}\vec{\mathbf{i}} - 5t^2\vec{\mathbf{k}}$