256. a. not parallel

$v_1 = \langle 0, 0, 1 \rangle$ $v_2 = \langle 0, 0, -3 \rangle$ $v_1 \neq v_2$

257. The lines are perpendicular.

$\vec{PQ} = \langle -2, 3, -3 \rangle$ $L = \langle 3, 8, 6 \rangle$

$\vec{PQ} \cdot L = (-2)(3) + (3)(8) + (-3)(6) = -6 + 24 - 18 = 0$

261. The lines are skew

$v_1 = \langle 1, 1, -1 \rangle$ $v_2 = \langle 1, -1, 2 \rangle$ $x = r$ $y = r + 1$ $z = -r$

$x = s + 2$ $y = -s$ $z = 2s$ $s + 2 = r$ $-s - 1 = r$ $-2s = r$

$s + 2 = -2s$ $-3s = 2$ $s = -\frac{2}{3}$ $r = \frac{4}{3}$ $-\frac{2}{3} + 2 = \frac{4}{3}$

$\frac{2}{3} - 1 \neq \frac{4}{3}$

264. The lines are parallel but not equal.

$v_1 = \langle \frac{1}{3}, 1, \frac{1}{2} \rangle$ $v_2 = \langle 2, 6, 3 \rangle$ $L_1: x = \frac{1}{3}s,\ y = s - 1,\ z = \frac{1}{2}s$

$L_2: x = 6 + 2t,\ y = 17 + 6t,\ z = 9 + 3t$ $v_2 = 6v_1$

268. a. $2(x-3) + 3(y-2) - (z-2) = 0$ b. $2x + 3y - z - 10 = 0$

$2x - 6 + 3y - 6 - z + 2 = 0$ $2x + 3y - z - 10 = 0$

270. a. $x + 2y + 3z = 0$ b. $x + 2y + 3z = 0$

281. a. $-2y+3z-1=0$ b. $\langle 0,-2,3\rangle \cdot \langle x-1, y-1, z-1\rangle = 0$
c. $x=0, y=-2t, z=3t, t \in \mathbb{R}$

$\overrightarrow{PQ} = \langle 1,3,2\rangle$ $\overrightarrow{QR} = \langle -3,-6,-4\rangle$

$n = \begin{vmatrix} i & j & k \\ 1 & 3 & 2 \\ -3 & -6 & -4 \end{vmatrix} = (-12+12)i - (-4+6)j + (-6+9)k = -2j+3k$ $n = \langle 0,-2,3\rangle$

$0(x-1) - 2(y-1) + 3(z-1) = 0$ $-2y+3z-1=0$

282. a. $20y-20=0$ b. $\langle 0,20,0\rangle \cdot \langle x+2, y-1, z-4\rangle = 0$
c. $x=0, y=20t, z=0, t \in \mathbb{R}$

$\overrightarrow{PQ} = \langle 5,0,-1\rangle$ $\overrightarrow{QR} = \langle -5,0,-3\rangle$

$n = \begin{vmatrix} i & j & k \\ 5 & 0 & -1 \\ -5 & 0 & -3 \end{vmatrix} = (0)i - (-15-5)j + (0)k = 20j$ $n = \langle 0,20,0\rangle$

$0(x+2) + 20(y-1) + 0(z-4) = 0$ $20y-20=0$

291. a. The planes are neither parallel nor orthogonal. b. $62°$

$n_1 = \langle 1,1,1\rangle$ $n_2 = \langle 2,-1,1\rangle$ $n_1 \cdot n_2 = 2-1+1 = 2$

$\cos\theta = \frac{2}{\sqrt{1+1+1}\sqrt{4+1+1}} = \frac{2}{\sqrt{3}\sqrt{6}} = \frac{\sqrt{2}}{3}$ $\theta = 62°$

292. a. The planes are orthogonal.

$n_1 = \langle 5,-3,1\rangle$ $n_2 = \langle 1,4,7\rangle$ $n_1 \cdot n_2 = 5-12+7 = 0$

2.7

381. $r^2+z^2=9$

$x=r\cos\theta \quad y=r\sin\theta \quad r^2\cos^2\theta+r^2\sin^2\theta+z^2=9$
$r^2(\cos^2\theta+\sin^2\theta)+z^2=9 \quad r^2+z^2=9$

383. $r=0,\ r=16\cos\theta$

$r^2\cos^2\theta+r^2\sin^2\theta-16r\cos\theta=0$
$r^2-16r\cos\theta=0 \quad r(r-16\cos\theta)=0 \quad r=0$
$r=16\cos\theta$

399. $\varphi=\frac{\pi}{3},\ \varphi=\frac{2\pi}{3}$; Elliptic cone

$x=\rho\sin\varphi\cos\theta \quad y=\rho\sin\varphi\sin\theta \quad z=\rho\cos\varphi$
$\rho^2\sin^2\varphi\cos^2\theta+\rho^2\sin^2\varphi\sin^2\theta-3\rho^2\cos^2\varphi=0$
$\rho^2(\sin^2\varphi(\cos^2\theta+\sin^2\theta)-3\cos^2\varphi)=0$
$\rho^2(\sin^2\varphi-3\cos^2\varphi)=0 \quad \sin^2\varphi-3\cos^2\varphi=0 \quad \sin^2\varphi=3\cos^2\varphi$
$\sin\varphi=\sqrt{3}\cos\varphi \quad \varphi=\frac{\pi}{3} \quad \varphi=\frac{2\pi}{3}$

400. $\rho=4\cos\varphi$; Sphere

$\rho^2=x^2+y^2+z^2 \quad z=\rho\cos\varphi \quad \rho^2-4\rho\cos\varphi=0$
$\rho(\rho-4\cos\varphi)=0 \quad \rho=4\cos\varphi$

9/20/23

2.5

Josiah Schmitz

243. a. $r = \langle -3, 5, 9\rangle + t\langle 7, -12, -7\rangle, t \in \mathbb{R}$ b. $x = -3 + 7t$, $y = 5 - 12t$, $z = 9 - 7t$, $t \in \mathbb{R}$ c. $\frac{x+3}{7} = \frac{y-5}{-12} = \frac{z-9}{-7}$, $t \in \mathbb{R}$
d. $x = -3 + 7t$, $y = 5 - 12t$, $z = 9 - 7t$, $t \in [0, 1]$

244. a. $r = \langle 4, 0, 5\rangle + t\langle -2, 3, -4\rangle, t \in \mathbb{R}$ b. $x = 4 - 2t$, $y = 3t$, $z = 5 - 4t$, $t \in \mathbb{R}$ c. $\frac{x-4}{-2} = \frac{y}{3} = \frac{z-5}{-4}$, $t \in \mathbb{R}$
d. $x = 4 - 2t$, $y = 3t$, $z = 5 - 4t$, $t \in [0, 1]$

251. a. $P(1, 3, 5)$, $v = \langle 1, 1, 4\rangle$ b. $\sqrt{3}$

$M = \langle 0, 0, 0\rangle$ $\overrightarrow{PM} = \langle 1, 3, 5\rangle$ $v = \langle 1, 1, 4\rangle$

$$\overrightarrow{PM} \times v = \begin{vmatrix} i & j & k \\ 1 & 3 & 5 \\ 1 & 1 & 4 \end{vmatrix} = (12-5)i - (4-5)j + (1-3)k = 7i + j - 2k$$

$$d = \frac{\sqrt{49+1+4}}{\sqrt{1+1+16}} = \frac{\sqrt{54}}{\sqrt{18}} = \sqrt{3}$$

252. a. $P(0, -1, 2)$, $v = \langle -1, 1, 0\rangle$ b. $\frac{3}{\sqrt{2}}$

$\frac{x}{-1} = \frac{y+1}{1}, z = 2$ $\overrightarrow{PM} = \langle 0, -1, 2\rangle$ $v = \langle -1, 1, 0\rangle$

$$\overrightarrow{PM} \times v = \begin{vmatrix} i & j & k \\ 0 & -1 & 2 \\ -1 & 1 & 0 \end{vmatrix} = -2i - 2j - k \quad d = \frac{\sqrt{4+4+1}}{\sqrt{1+1}} = \frac{3}{\sqrt{2}}$$

255. a. parallel b. $\frac{\sqrt{2}}{\sqrt{3}}$

$v_1 = \langle 1, 1, 1\rangle$ $v_2 = \langle 1, 1, 1\rangle$ $v_1 = v_2$ $P_1(1, 0, 2)$ $P_2(3, 1, 3)$

$\overrightarrow{P_1P_2} = \langle 2, 1, 1\rangle$

$$\overrightarrow{P_1P_2} \times v_1 = \begin{vmatrix} i & j & k \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{vmatrix} = 0i - j - k = -j - k$$

$$d = \frac{\sqrt{1+1}}{\sqrt{1+1+1}} = \frac{\sqrt{2}}{\sqrt{3}}$$