SOLUTIONS TO PROBLEM SET 9.4, page 380

4. Straight lines through the origin (planes through the z-axis) \( y/z = \text{const.} \)
14. Congruent parabolic cylinders with vertical generators and the \( xy \)-plane as plane of symmetry.
10. Ellipsoids of revolution. The ellipsoid

\[ 9x^2 + 9y^2 + z^2 = c^2 \]

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2. Straight line through \((a, b, c)\) in the direction of the vector \([1, 3, -5]\).
4. Circle of radius 5 and center \((2, -1)\) in the plane \(x = -2\), which is parallel to the \(yz\)-plane.
6. This is an ellipse with center \((a, b)\) and semi-axes 3 and 2, oriented clockwise because of the minus sign. Because of the factor \(\pi\) the whole curve is obtained if we let \(t\) vary from 0 to \(2\pi/\pi = 2\).

24. \(P\) corresponds to \(t = 2\); indeed, \(r(2) = [2, 2, 1]\). Differentiation gives

\[ r'(t) = [1, t, 0] \quad \text{and at} \quad P, \quad r'(2) = [1, 2, 0]. \]

The unit tangent vector in the direction of \(r'(t)\) is

\[ u'(t) = (1 + t^2)^{-1/2}[1, t, 0] \quad \text{and at} \quad P, \quad u'(2) = [1/\sqrt{3}, 2/\sqrt{3}]. \]

This gives the representation of the tangent of \(C\) at \(P\) in the form

\[ q(u) = r(2) + wu'(2) = [2 + w, 2 + 2w, 0]. \]

The tangent at \(P\) has a positive slope, as expected.
26. Differentiation gives a tangent vector

\[ r'(t) = [-\sin t, \cos t, 9]. \]