

I'm not a robot

































Now let's work out the equation of the plane in component form. Suppose that, in some coordinates system, the normal vector is  $n = ai + bj + ck$  and the initial point has position vector  $r_0 = x_0i + y_0j + z_0k$ . For a generic point on the plane with position vector  $r = xi + yj + zk$ ,  $r - r_0 = (x - x_0)i + (y - y_0)j + (z - z_0)k$  so the point-normal equation  $n \cdot (r - r_0) = 0$  transforms into  $a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$ . This equation is known as the standard form of the equation of the plane. If you expand it and simplify, you get  $ax + by + cz = d$  where  $d = n \cdot r_0 = ax_0 + by_0 + cz_0$ . If you work with the unexpanded form of the standard equation, it's easy to see where the initial point and normal vector occur: the coordinates of the point are subtracted from  $x$ ,  $y$  and  $z$  inside the brackets and the components of the normal vector multiply the brackets. Thus the plane through the point  $(1, 0, -2)$  with normal vector  $(3, -1, -5)$  has standard equation  $3(x - 1) + (-5)(y - 0) + 1(z - (-2)) = 0$ , which can be simplified to  $3x - 5y + z = 1$ . Any equation in the form  $ax + by + cz = d$  represents a plane with normal vector  $n = ai + bj + ck$ , so, for example, the equation  $2x - 5y + 7z = 11$  represents a plane with normal vector  $n = 2i - 5j + 7k$ . Suppose you are given a plane with standard equation  $3x \cdot 4y + z = 5$ . How would you describe the plane  $6x \cdot 8y + 2z = 10$  relative to the original plane? The plane  $3x \cdot 4y + z = 6^2$  the plane  $3x \cdot 4y + z = 0^2$  standard equations for some special planes. Planes through the origin must have standard equations of the form  $ax + by + cz = 0$ , since the values  $x = 0, y = 0, z = 0$  must satisfy the equation. The  $x$ - $y$ -plane passes through the origin and has normal vector  $k$ , so its standard equation is  $0(x - 0) + 0(y - 0) + 1(z - 0) = 0$ , i.e.  $z = 0$ . Similarly, the  $y$ - $z$ -plane has standard equation  $x = 0$  and the  $x$ - $z$ -plane has standard equation  $y = 0$ . A plane parallel to the  $x$ - $y$ -plane must have a standard equation  $z = d$  for some  $d$ , since it has normal vector  $k$ . A plane parallel to the  $y$ - $z$ -plane has equation  $x = d$ , and one parallel to the  $x$ - $z$ -plane has equation  $y = d$ . The normal of a plane parallel to the  $z$ -axis must be perpendicular to  $k$ , so the  $k$ -component of the normal vector is 0. The plane thus has the form  $ax + by = d$ . Similarly, a plane parallel to the  $y$ -axis has equation  $ax + cz = d$ , and one parallel to the  $x$ -axis has equation  $by + cz = d$ . Using Vectors to Describe Planes The axis in three-dimensional Cartesian coordinates which is usually oriented vertically. Cylindrical coordinates are defined such that the  $z$ -axis is the axis about which the azimuthal coordinate is measured. Doubtful is No.1 Study App and Learning App with Instant Video Solutions for NCERT Class 6, Class 7, Class 8, Class 9, Class 10, Class 11 and Class 12, IIT JEE prep, NEET preparation and CBSE, UP Board, Bihar Board, Rajasthan Board, MP Board, Telangana Board etc NCERT solutions for CBSE and other state boards is a key requirement for students. DoubtNut helps with homework, doubts and solutions to all the questions. It has helped students get under AIR 100 in NEET & IIT JEE. Get PDF and video solutions of IIT JEE Mains & Advanced previous year papers, NEET previous year papers, NCERT books for classes 6 to 12, CBSE, Pathfinder Publications, RD Sharma, RS Aggarwal, Manohar Ray, Cengage books for boards and competitive exams. DoubtNut is the perfect NEET and IIT JEE preparation App. Get solutions for NEET and IIT JEE previous year papers, along with chapter wise NEET MCQ solutions. Get all the study material in Hindi medium and English medium for IIT JEE and NEET preparation Cylindrical coordinates are a generalization of two-dimensional polar coordinates to three dimensions by superposing a height ( $z$ ) axis. Unfortunately, there are a number of different notations used for the other two coordinates. Either or is used to refer to the radial coordinate and either or to the azimuthal coordinates. Arfken (1985), for instance, uses  $\rho$ , while Beyer (1987) uses  $\rho$ . In this work, the notation is used. The following table summarizes notational conventions used by a number of authors. (radial, azimuthal, vertical)referencethis work, Beyer (1987, p. 212)( $r, \theta, z$ )ZzSetCoordinates(Cylindrical) in the Wolfram Language package VectorAnalysis' Arfken (1985, p. 95)Moon and Spencer (1988, p. 12)Korn and Korn (1968, p. 60)Morse and Feshbach (1953) In terms of the Cartesian coordinates  $(x, y, z)$ , and the inverse tangent must be suitably defined to take the correct quadrant of into account. In terms of  $(r, \theta, z)$  and Note that Morse and Feshbach (1953) define the cylindrical coordinates by where and  $\rho$ . The metric elements of the cylindrical coordinates are so the scale factors are The line element is and the volume element is The Jacobian is A Cartesian vector is given in cylindrical coordinates by To find the unit vectors, Derivatives of unit vectors with respect to the coordinates are The gradient operator in cylindrical coordinates is given by so the gradient components become The Christoffel symbols of the second kind in the definition of Misner et al. (1973, p. 209) are given by The Christoffel symbols of the second kind in the definition of Arfken (1985) are given by (Walton 1967; Arfken 1985, p. 164, Ex. 3.8.10; Moon and Spencer 1988, p. 12a). The covariant derivatives are then given by are Cross products of the coordinate axes are The commutation coefficients are given by But so, where  $\epsilon_{ijk}$  is the Levi-Civita symbol. Finally, Summarizing, Time derivatives of the vector are Speed is given by Time derivatives of the unit vectors are The convective derivative is To rewrite this, use the identity and set, to obtain so Then the curl in the above expression gives so We expect the gradient term to vanish since speed does not depend on position. Check this using the identity  $\nabla \cdot \nabla = \nabla^2$ . Examining this term by term, so, as expected, We have already computed, so combining all three pieces gives The divergence is or, in vector notation The curl is The scalar Laplacian is The vector Laplacian is The Helmholtz differential equation is separable in cylindrical coordinates and has Stäckel determinant (for  $(r, \theta, z)$  or (for Morse and Feshbach's  $(\rho, \phi, z)$ ). Cartesian Coordinates, Elliptic Cylindrical Coordinates, Helmholtz Differential Equation-Circular Cylindrical Coordinates, Polar Coordinates, Spherical Coordinates Arfken, G. "Circular Cylindrical Coordinates." §2.4 in Mathematical Methods for Physicists, 3rd ed. Orlando, FL: Academic Press, pp. 95-101, 1985.Beyer, W. H. CRC Standard Mathematical Tables, 28th ed. Boca Raton, FL: CRC Press, 1987.Korn, G. A. and Korn, T. M. Mathematical Handbook for Scientists and Engineers. New York: McGraw-Hill, 1968.Misner, C. W.; Thorne, K. S.; and Wheeler, J. A. Gravitation. San Francisco: W. H. Freeman, 1973.Moon, P. and Spencer, D. E. "Circular-Cylinder Coordinates." Table 1.02 in Field Theory Handbook, Including Coordinate Systems, Differential Equations, and Their Solutions, 2nd ed. New York: Springer-Verlag, pp. 12-17, 1988.Morse, P. M. and Feshbach, H. Methods of Theoretical Physics, Part I. New York: McGraw-Hill, p. 657, 1953.Walton, J. J. "Tensor Calculations on Computer: Appendix." Comm. ACM 10, 183-186, 1967.Cylindrical Coordinates Weisstein, Eric W. "Cylindrical Coordinates." From MathWorld--A Wolfram Web Resource. Subject classifications Start JEE / NEET / Foundation preparation at rupees 99/day 121% of IITians & 23% of AIIMS delhi doctors are from Sri Chaitanya institute !An Initiative by Sri Chaitanya Write parametric and symmetric equations for the  $z$ -axis. I'm not sure I am on the right track; here is my attempt to an answer:  $(0, 0, z)$  where  $z$  can equal any number,  $a = (0, 0, 1)$   $b = (0, 0, z)$  Parametric equations  $x = 0 = 0z = 1 + tz$  Symmetric equations  $\frac{x - 0}{0} = \frac{y - 0}{0} = \frac{z - 1}{z}$   $\frac{z - 1}{z} = 1 - \frac{1}{z}$  I'm not certain that my attempt to this question is correct; if anyone can guide me in the right direction if needed I would be grateful! Thanks  $z = 0 = 1 + tz$  Symmetric equations  $\frac{x - 0}{0} = \frac{y - 0}{0} = \frac{z - 1}{z}$   $\frac{z - 1}{z} = 1 - \frac{1}{z}$  I'm not certain that my attempt to this question is correct; if anyone can guide me in the right direction if needed I would be grateful! 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