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fractional calculus is a branch of mathematical analysis that studies the several different possibilities of defining real number powers or complex number powers of the differentiation operator $d^f x / d x^f$ this paper begins with the basic concept of fractal gradient of temperature i e the temperature change between two points in a fractal medium to reveal the basic properties of fractal calculus the fractal velocity and fractal material derivative are then introduced to deduce laws for fluid mechanics and heat conduction in fractal space fractals are fundamental to understanding many chaotic systems and have many applications in sciences they are also beautiful and mesmerizing objects as we have seen with the mandelbrot and julia sets in this section we collect examples of fractals in all scales in nature fractional calculus is the eld of mathematical analysis which deals with the investigation and applications of integrals and derivatives of arbitrary order the term fractional is a misnomer but it is retained following the prevailing use the fractional calculus may be considered an old and yet novel topic it is an old topic fractal calculus is the simple constructive and algorithmic approach to natural processes modeling which is impossible using smooth differentiable structures and the usual modeling tools such as differential equations it is the calculus of the future and will have many applications as a new mathematical and mechanics method fractional calculus received extensive attention in the past decade and based on fractional calculus some results in the quantitative description of the physical and mechanics behavior of fractal geometry have yielded fractals are mathematical sets usually obtained through recursion that exhibit interesting dimensional properties we ll explore what that sentence means through the rest of this section for now we can begin with the idea of self similarity a characteristic of most fractals in mathematics a fractal is a geometric shape containing detailed structure at arbitrarily small scales usually having a fractal dimension strictly exceeding the

topological dimension many fractals appear similar at various scales as illustrated in successive magnifications of the mandelbrot set fractals are infinitely complex patterns that are self similar across different scales they are created by repeating a simple process over and over in an ongoing feedback loop driven by recursion fractals are images of dynamic systems the pictures of chaos establishing the accurate relationship between fractional calculus and fractals is an important research content of fractional calculus theory in the present paper we investigate the relationship between fractional calculus and fractal functions based only on fractal dimension considerations in this paper we delve into the fascinating realm of fractal calculus applied to fractal sets and fractal curves our study includes an exploration of the method analogues of the separable method and the integrating factor technique for solving α order differential equations notably we the study of an extension of derivatives and integrals to noninteger orders fractional calculus is based on the definition of the fractional integral as $d^{\nu} f(x) = \frac{1}{\Gamma(\nu)} \int_0^x f(\xi) d\xi$ where $\Gamma(\nu)$ is the gamma function use wolfram alpha to explore a vast collection of fractals and to visualize beautiful chaotic and regular behaviors examine named fractals visualize iteration rules compute fractal dimension and more fractal and fractional is an international scientific peer reviewed open access journal of fractals and fractional calculus and their applications in different fields of science and engineering published monthly online by mdpi open access free for readers with article processing charges apc paid by authors or their institutions fractals are complex never ending patterns created by repeating mathematical equations yuliya an undergrad in math at mit delves into their mysterious properties and how they can be found in technology and nature this tutorial review of fractal cantor space and fractional calculus begins with leibniz notation for derivative without limits which can be generalized to discontinuous media like fractal derivative and q derivative of quantum calculus the sierpinski triangle one of the fractals we saw in the previous chapter was the sierpinski triangle which is named after the polish mathematician waclaw sierpinski it can be created by starting with one large equilateral triangle and then repeatedly cutting smaller triangles out of its center waclaw sierpinski was the first the general relationship between fractional calculus and fractals is explored based on prior investigations dealing with random fractal processes the fractal dimension of the function is shown to be a linear function of the order of fractional integro differentiation fractal in mathematics any of a class of complex geometric shapes that commonly have fractional dimension a concept first introduced by the mathematician felix hausdorff in 1918 this paper presents a restricted overview of fractal physiology focusing on the complexity of the human body and the characterization of that complexity through fractal measures and their dynamics with fractal dynamics being described by the fractional calculus

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