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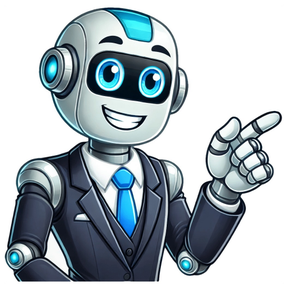

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Explore our latest gallery of EditorsPicks.Browse Editors' Favorites Curriculum Resources Company Shop Support Platform Login Curriculum Resources Company Pi appears in calculations involving the circumference and thearea of a circle; in problems involving the area and the volume ofa sphere; in the volume of an ellipsoid; and in all sorts ofproblems that are not obviously related to circles and spheres.Pi appears in calculations involving the circumference and thearea of a circle; in problems involving the area and the volume ofa sphere; in the volume of an ellipsoid; and in all sorts ofproblems that are not obviously related to circles and spheres.Happy Pi Day! For decades, math lovers have been honoring this crucial irrational constant on March 14 (or 3/14, the first three digits of the ratio of a circle's circumference to its diameter) every year. The U.S. House of Representatives even passed a non-binding resolution in 2009 to recognize the date. Join the celebration by solving (or at least puzzling over) these problems from a varied collection of pi enthusiasts.PI IN SPACEBlue-tinted stars in galaxy. | iStockPi is a vital number for NASA engineers, who use it to calculate everything from trajectories of spacecraft to densities of space objects. NASA's Jet Propulsion Laboratory, located in Pasadena, California, has celebrated Pi Day for a few years with a Pi in the Sky challenge, which gives non rocket engineers a chance to solve the problems they solve every day. The following problems are from Pi in the Sky 3 (and you can find more thorough solutions and tips there). JPL has brand-new problems for this year's event, Pi in the Sky 5.1. HAZY HALOThis undated NASA handout shows Saturn's moon, Titan, in ultraviolet and infrared wavelengths. The Cassini spacecraft took the image while on its mission to gather information on Saturn, its rings, atmosphere and moons. The different colors represent various atmospheric content on Titan. | NASA, Getty ImagesGiven that Saturn's moon Titan has a radius of 2575 kilometers, which is covered by a 600-kilometer atmosphere, what percentage of the moon's volume is atmospheric haze? Also, if scientists hope to create a global map of Titan's surface, what is the surface area that a future spacecraft would have to map?[Answer: 47 percent; 83,322,891 square kilometers]2. ROUND RECONNASA's Earth-orbiting Hubble Space Telescope took this picture June 26, 2003 of Mars. | NASA, Getty ImagesGiven that Mars has a polar diameter of 6752 kilometers, and the Mars Reconnaissance Orbiter comes as close to the planet as 255 kilometers at the south pole and 320 kilometers at the north pole, how far does MRO travel in one orbit? (JPL advises, "MRO's orbit is near enough to circular that the formulas for circles can be used.")[Answer: 23,018 km]3. SUN SCREENIn this handout provided by NASA, the planet Mercury is seen in silhouette, lower left of image, as it transits across the face of the sun on May 9, 2016 as viewed from Boyertown, Pennsylvania. Mercury passes between Earth and the sun only about 13 times a century, with the previous transit taking place in 2006. | NASA/Bill Ingalls, Getty ImagesIf 1360.8 w/m^2of solar energy reaches the top of Earth's atmosphere, how many fewer watts reach Earth when Mercury (diameter = 12 seconds) transits the Sun (diameter = 1909 seconds)?[Answer: 0.05 w/m^2]PUTTING THE PI IN PIZZAPizza on wooden table | iStockPeople often celebrate Pi Day by eating pie, but what is considered a "pie" is subjective. Pizza Hut considers its main offerings pies, and got into the spirit of Pi Day in 2016 by asking their customers to solve several math problems from English mathematician and Princeton professor John Conway, with promises of free pizza for winners for 3.14 years. Below are two of his fiendishly tricky problems. Unfortunately, even if you solve them, your chance at free pizza is long gone.4. 10-DIGIT GUESSFloating blue numbers | iStockI'm thinking of a 10-digit integer whose digits are all distinct. It happens that the number formed by the first n of them is divisible by n for each n from 1 to 10. What is my number?[Answer: 3,816,547,290]5. PUZZLE CLUBOld door | iStockOur school's puzzle club meets in one of the classrooms every Friday after school.Last Friday, one of the members said, "I've hidden a list of numbers in this envelope that add up to the number of this room." A girl said, "That's obviously not enough information to determine the number of the room. If you told us the number of numbers in the envelope and their product, would that be enough to work them all out?"He (after scribbling for some time): "No." She (after scribbling for some more time): "Well, at least I've worked out their product."What is the number of the school room we meet in?[Answer: Room #12 (The numbers in the envelope are either: 6222 or 4431, which both add up to 12 and the product is 48.)]COM-PI-TITIVE MATHBlackboard with math and science equations on it | iStockPo-Shen Loh coached the U.S. Mathematical Olympiad team to victory in 2015 and 2016. The back-to-back win was particularly impressive considering Team USA had not won the International Mathematical Olympiad (or IMO) in 21 years. When not coaching, Loh is an associate math professor at Carnegie Mellon University. His website, Expii, challenges readers weekly with a large range of problems. Expii hascelebrated Pi Day for several years nowthis year it published a video that uses an actual pie to help us visualize pi betterand the following problems are from its past challenges.6. PIESTIMATEPi on blackboard | iStockPi has long been noted as one of the most useful mathematical constants. Yet, due to the fact that it is an irrational number, it can never be expressed exactly as a fraction, and its decimal representation never ends. We have come to estimate often, and all of these have been used as approximations to in the past. Which is the closest one?A) 3B) 3.14C) 22/7D) 4E) Square root of 10[Answer: C]7. PHONE TAGYellow rotary phone. | iStockWhen Expii's founding team registered the organization in the United States, they needed to select a telephone number. As math enthusiasts, they claimed pi in the new 844 toll-free area code. What is Expii's seven-digit telephone number? (Excluding the area code.)[Answer: 314-1593; in case you forget to round, you get their FAX number!]8. PI COINCIDENCEMetal pentagon | iStockThe number pi is defined to be the ratio circumference/diameter for any circle. We also all know that the area of a circle is pir^2. Is it a sheer coincidence that they are both the same pi, even though one concerns the circumference and one concerns the area? No!Let's do it for a regular pentagon. It turns out that for the appropriate definition of the "diameter" of a regular pentagon, if we define the number theta to be the ratio of the perimeter/diameter of any regular pentagon, then its area is always thetar^2, where r is half of the diameter. For this to be true, what should be the "diameter" of a regular pentagon?A) The distance between the farthest corners of the pentagon.B) The diameter of the largest circle that fits inside the pentagon.C) The diameter of the smallest circle that fits around the pentagon.D) The distance from the base to the opposite corner of the pentagon.E) Other, not easy to describe.F) It's a trick question.[Answer: B]9. WHAT'S IN A NAME?Globe on chalkboard | iStock"Expii" brings to mind a number of nice words like "experience," "explore," "explain," "expand," "express," and more. The truth behind the name, however, is based on the most beautiful equation in mathematics:e^pii + 1 = 0What is (-1)^-i/pi?Round your answer to the nearest thousandth.[Answer: Euler's number, also known ase, or 2.718 (rounded off)]GETTING EXCITED FOR PI DAYCalculator and blocks that read | iStockThe Mathematical Association of America was founded in 1915 to promote and celebrate all things mathematical. It has thousands of members, including mathematicians, math educators, and math enthusiasts, and of course they always celebrate Pi Day. The first two problems are by Lafayette College professor Gary Gordon, while the following four have been sprung on the 300,000+ middle and high school students who participate in the association's annual American Mathematics Competitions. Top scorers in these competitions will sometimes go on to compete on theMAA-sponsored Team USA at the IMO.10. FLIPPING A COINThumb flipping a coin. | iStockAlice and Bob each have a coin. Suppose Alice flips hers 1000 times, and Bob flips his 999 times. What is the probability that the number of heads Alice flips will be greater than the number Bob flips?[Answer: 50 percent. Alice must have either more heads or more tails than Bob (since she has one additional flip), but not both. These two possibilities are symmetric, so each has a 50 percent probability.]11. CUTTING CHEESEWheel of gouda | iStockYou are given a cube of cheese (or tofu, for our vegan readers) and a sharp knife. What is the largest number of pieces one may decompose the cube using n straight cuts? You may not rearrange the pieces between cuts![Answer: ((n^3)+5n+6)/6). The trick is that the sequence starts 1, 2, 4, 8, 15, so stopping before the fourth cut will give the wrong impression.]12. BUYING SOCKSSocks hanging on a line | iStockRalph went to the store and bought 12 pairs of socks for a total of $24. Some of the socks he bought cost $1 a pair, some $3 a pair, and some $4 a pair. If he bought at least one pair of each kind, how many pairs of $1 socks did Ralph buy?A) 4B) 5C) 6D) 7E) 8[Answer: D]13. THE COLOR OF MARBLESBlue and red marbles. | iStockIn a bag of marbles, 3/5 of the marbles are blue, and the rest are red. If the number of red marbles is doubled, and the number of blue marbles stays the same, what fraction of the marbles will be red?A) 2/5B) 3/7C) 4/7D) 3/5E) 4/5[Answer: C]14. SODA CANSTops of soda cans. | iStockIf one can holds 12 fluid ounces of soda, what's the minimum number of cans required to provide a gallon (128 ounces) of soda?[Answer: 11 (you can't have a fraction of a can)]15. CARPET COVERAGEFeet on a pink rug | iStockHow many square yards of carpet are required to cover a rectangular floor that is 12 feet long and 9 feet wide?A) 12B) 36C) 108D) 324E) 972[Answer: A]For 0 < x < pi. sin(x) is positive,for pi < x <2*pi, sin(x) is negativeand these intervals can be left or right-shifted by any multipleof 2*pi radians.Uses of the constantPart of a series of articles on themathematical constant 3.14159265358979323846264 33...UsesArea of a circleCircumferenceUse in other formulaePropertiesIrrationalityTranscendenceValueLess than 22/7ApproximationsMilMadhava's correction termMemorizationPeopleArchimedesLiu HuiZu ChongzhiAryabhataMadhavaJamshd al-KshLudolph van CeulenFranois ViteSeki Takakazu Takebe KenkoWilliam JonesJohn MachinWilliam ShanksSrinivasa RamanujanJohn WrenchChudnovsky brothersYasumasa KanadaHistoryChronologyA History of PiIn cultureIndiana pi billPi DayRelated topicsSquaring the circleBasel problemSix nines in Other topics related to vteThe following is a list of significant formulae involving the mathematical constant . Many of these formulae can be found in the article Pi, or the article Approximations of . = C d = C 2 r {\displaystyle \pi ={\frac {C}{d}}={\frac {C}{2r}}} where C is the circumference of a circle, d is the diameter, and r is the radius. More generally, = L w {\displaystyle \pi ={\frac {L}{w}}} where L and w are, respectively, the perimeter and the width of any curve of constant width. A = r 2 {\displaystyle A=\pi r^{2}} where A is the area of a circle. More generally, A = a b {\displaystyle A=\pi ab} where A is the area enclosed by an ellipse with semi-major axis a and semi-minor axis b. C = 2 agm (a , b) (a 1 2 n = 2 2 n 1 (a n 2 b n 2)) {\displaystyle C={\frac {2\pi }{\operatorname {agm} (a,b)}}\left(a_{1}^{2}-\sum _{n=2}^{\infty }2^{n-1}(a_{n}^{2}-b_{n}^{2})\right)} where C is the circumference of an ellipse with semi-major axis a and semi-minor axis b and a n , b n {\displaystyle a_{n},b_{n}} are the arithmetic and geometric iterations of agm (a , b) {\displaystyle \operatorname {agm} (a,b)} , the arithmetic-geometric mean of a and b with the initial values a 0 = a {\displaystyle a_{0}=a} and b 0 = b {\displaystyle b_{0}=b} . A = 4 r 2 {\displaystyle A=4\pi r^{2}} where A is the area between the witch of Agnesi and its asymptotic line; r is the radius of the defining circle. A = (1 / 4) 2 2 r 2 = r 2 agm (1 , 1 / 2) {\displaystyle A={\frac {\Gamma (1/4)^{2}}{2{\sqrt {\pi }}}}r^{2}={\frac {\pi r^{2}}{\operatorname {agm} (1,1/{\sqrt {2}})}}} where A is the area of a squircle with minor radius r, {\displaystyle \Gamma } is the gamma function. A = (k + 1) (k + 2) r 2 {\displaystyle A=(k+1)(k+2)\pi r^{2}} where A is the area of an epicycloid with the smaller circle of radius r and the larger circle of radius kr (k N {\displaystyle k\in \mathbb {N} }), assuming the initial point lies on the larger circle. A = (1) k + 3 8 a 2 {\displaystyle A={\frac {(-1)^{k}+3}{8}}\pi a^{2}} where A is the area of a rose with angular frequency k (k N {\displaystyle k\in \mathbb {N} }) and amplitude a. L = (1 / 4) 2 c = 2 c agm (1 , 1 / 2) {\displaystyle L={\frac {\Gamma (1/4)^{2}}{\sqrt {\pi }}}c={\frac {2\pi c}{\operatorname {agm} (1,1/{\sqrt {2}})}}} where L is the perimeter of the lemniscate of Bernoulli with focal distance c. V = 4 3 r 3 {\displaystyle V={4 \over 3}\pi r^{3}} where V is the volume of a sphere and r is the radius. S A = 4 r 2 {\displaystyle SA=4\pi r^{2}} where SA is the surface area of a sphere and r is the radius. H = 1 2 2 r 4 {\displaystyle H={1 \over 2}\pi ^{2}r^{4}} where H is the hypervolume of a 3-sphere and r is the radius. S V = 2 2 r 3 {\displaystyle SV=2\pi ^{2}r^{3}} where SV is the surface volume of a 3-sphere and r is the radius.Sum S of internal angles of a regular convex polygon with n sides: S = (n 2) {\displaystyle S=(n-2)\pi } Area A of a regular convex polygon with n sides and side length s: A = n s 2 4 cot n {\displaystyle A={\frac {ns^{2}}{4}}\cot {\frac {\pi }{n}}} Inradius r of a regular convex polygon with n sides and side length s: r = s 2 cot n {\displaystyle r={\frac {s}{2}}\cot {\frac {\pi }{n}}} Circumradius R of a regular convex polygon with n sides and side length s: R = s 2 csc n {\displaystyle R={\frac {s}{2}}\csc {\frac {\pi }{n}}} The cosmological constant: = 8 G 3 c 2 {\displaystyle \Lambda ={{8\pi G} \over {3c^{2}}}\rho } Heisenberg's uncertainty principle: x p h 4 {\displaystyle \Delta x\,\Delta p\geq {\frac {h}{4\pi }}} Einstein's field equation of general relativity: R 1 2 g R + g = 8 G c 4 T {\displaystyle R_{\mu u }-{\frac {1}{2}}g_{\mu u }R+\Lambda g_{\mu u }={8\pi G \over c^{4}}T_{\mu u }} Coulomb's law for the electric force in vacuum: F = | q 1 q 2 | 4 0 r 2 {\displaystyle F={\frac {|q_{1}q_{2}|}{4\pi \varepsilon _{0}r^{2}}}} Magnetic permeability of free space:[note 1] 0 4 10 7 N / A 2 {\displaystyle \mu _{0}\approx 4\pi \cdot 10^{-7}\,\mathrm {N} /\mathrm {A} ^{2}} Approximate period of a simple pendulum with small amplitude: T 2 L g {\displaystyle T\approx 2\pi {\sqrt {\frac {L}{g}}}} Exact period of a simple pendulum with amplitude 0 {\displaystyle \theta _{0}} (agm {\displaystyle \operatorname {agm} } is the arithmeticgeometric mean): T = 2 agm (1 , cos (0 / 2)) L g {\displaystyle T={\frac {2\pi }{\operatorname {agm} (1,\cos(\theta _{0}/2))}}{\sqrt {\frac {L}{g}}}} Period of a spring-mass system with spring constant k {\displaystyle k} and mass m {\displaystyle m} : T = 2 m k {\displaystyle T=2\pi {\sqrt {\frac {m}{k}}}} Kepler's third law of planetary motion: R 3 T 2 = G M 4 2 {\displaystyle {\frac {R^{3}}{T^{2}}}={\frac {GM}{4\pi ^{2}}}} The buckling formula: F = 2 E I L 2 {\displaystyle F={\frac {\pi ^{2}EI}{L^{2}}}} A puzzle involving "colliding billiard balls": b N {\displaystyle \lfloor {b^{N}}\ }\rfloor } is the number of collisions made (in ideal conditions, perfectly elastic with no friction) by an object of mass m initially at rest between a fixed wall and another object of mass b2Nm, when struck by the other object.[1] (This gives the digits of in base b up to N digits past the radix point.) 2 1 1 1 x 2 d x = {\displaystyle 2\int _{-1}^{1}{\sqrt {1-x^{2}}}\,dx=\pi } (integrating two halves y (x) = 1 x 2 {\displaystyle y(x)={\sqrt {1-x^{2}}}} to obtain the area of the unit circle) 0 2 4 x 2 d x = {\displaystyle \int _{0}^{2}{\sqrt {4-x^{2}}}\,dx=\pi } (integrating a quarter of a circle with a radius of two x 2 + y 2 = 4 {\displaystyle x^{2}+y^{2}=4} to obtain 4 / 4 {\displaystyle {4\pi }/4}) sech x d x = {\displaystyle \int _{-\infty }^{\infty }\operatorname {sech} x\,dx=\pi } t e 1 / 2 t 2 x 2 + x t d x d t = t e t 2 1 / 2 x 2 + x t d x d t = {\displaystyle \int _{-\infty }^{\infty }\int _{t}^{\infty }e^{-1/2t^{2}-x^{2}+xt}\,dx\,dt=\int _{-\infty }^{\infty }\int _{t}^{\infty }e^{-t^{2}-1/2x^{2}+xt}\,dx\,dt=\pi } 1 1 d x 1 x 2 = {\displaystyle \int _{-1}^{1}{\frac {dx}{\sqrt {1-x^{2}}}}=\pi } d x 1 + x 2 = {\displaystyle \int _{-\infty }^{\infty }{\frac {dx}{1+x^{2}}}=\pi } [2][note 2] (see also Cauchy distribution) sin x x d x = {\displaystyle \int _{-\infty }^{\infty }{\frac {\sin x}{x}}\,dx=\pi } (see Dirichlet integral) e x 2 d x = {\displaystyle \int _{-\infty }^{\infty }e^{-x^{2}}\,dx={\sqrt {\pi }}} (see Gaussian integral). d z z = 2 i {\displaystyle \oint {\frac {dz}{z}}=2\pi i} (when the path of integration winds once counterclockwise around 0. See also Cauchy's integral formula). 0 ln (1 + 1 x 2) d x = {\displaystyle \int _{0}^{\infty }\ln \left(1+{\frac {1}{x^{2}}}\right)\,dx=\pi } [3] 0 1 x 4 (1 x) 4 1 + x 2 d x = 22 7 {\displaystyle \int _{0}^{1}{x^{4}(1-x)^{4} \over 1+x^{2}}\,dx={22 \over 7}-\pi } (see also Proof that 22/7 exceeds). 0 1 x 2 (1 + x) 4 1 + x 2 d x = 17 15 {\displaystyle \int _{0}^{1}{x^{2}(1+x)^{4} \over 1+x^{2}}\,dx=\pi -{17 \over 15}} 0 x 1 x + 1 d x = sin , 0 < < 1 {\displaystyle \int _{0}^{\infty }{\frac {x^{\alpha -1}}{x+1}}\,dx={\frac {\pi }{\sin \pi \alpha }},\quad 0