



RESEARCH ARTICLE

RADIUS: AREA OF A CIRCLE AND DIAMETER: CIRCUMFERENCE

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ABSTRACT

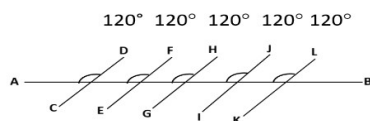
The relation between radius and the area of a circle is said to be $22/7$ times the radius square. Similarly the relation between diameter and the circumference is considered as $22/7$ times the diameter of a circle but actually it is not. For practical purposes to determine the area and circumference of a circle we use this with some deviation and variances. Here in this essay I have shown the actual relation with proof mathematical obviously.

INTRODUCTION

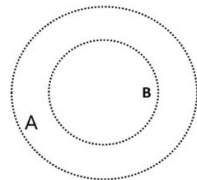
At the time of calculating the area of a circle and the relation between the radius and area of a circle as well as a circle and the square tangent inside and outside also the diameter and the circumference of a circle wrongly taken to be a constant of a value $22/7$ nomenclaturely π now in this essay we have tried and shown the actual value of the constants those satisfy.

A _____

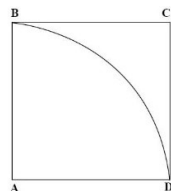
B _____ . Lines A and B are parallel to each other. It indicates parallel lines mean; with respect to a line, other line occurs again and again.



Here CD, EF, GH, IJ and KL are all parallel.

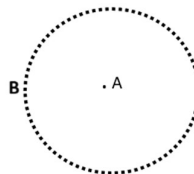


Here A and B are parallel.



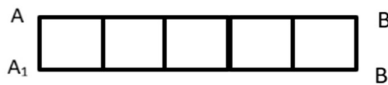
Here A is parallel to BD if BD moves in a circular way.

The most astonishing is point parallel line.



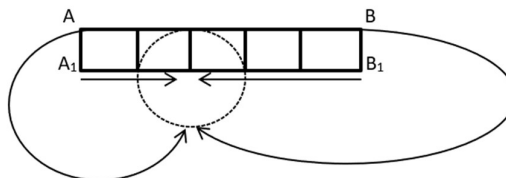
Here it is seen that any point B is parallel to point A. Because they (point B) are all through at a fixed distance.

Why is this like this? Because the central point is the shrinkage point of one of the parallel lines.

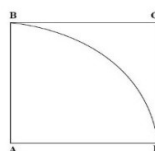


Here shrinkage of AB or A_1B_1 and this is why a

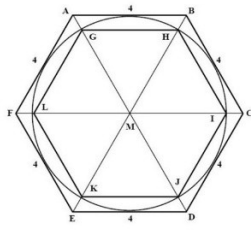
diameter is always in fixed relation to the circumference and also area of a circle is in fixed relation with the diameter.



If any of the lines of AB and A_1B_1 is shrinked then as these mid distances from AB to A_1B_1 is constant (equal) the other line turns to be a circle and the distance becomes radii.



Again, point B moving from point B to D in a circular way means if A is a point on a sphere and B and D are equidistant from A then BD circle are parallel to A.



The actual form is given here. Here it is seen that triangle ABM is equilateral. Such six triangles create a hexagon ABCDEFA. Now as the triangles are equilateral so there lies a 60° angle at the central joining point. Now if we reduce the lines/sides

MB to MH, MC to MI, MD to MJ, ME to MK, MF to ML, and MA to MG

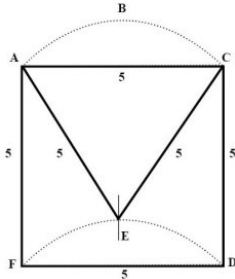
To the extent of $\sqrt{\frac{3}{4}}$ of $MB^2, MC^2, MD^2, ME^2, MF^2$ and MA^2 then sides AB, BC, CD, DE, EF, FA turns to be an arch of a perfect circle.

Hence the length of the circle (circumference) is six times AB, here 4 units, totaling 4×6 or 24 units.

Circumference is $24/2 \sqrt{\frac{3}{4}}$ of 4^2 or $\sqrt{12}$ times the diameter.

The Problem: Now suppose a parallel of length 5 and distance of one unit is drawn and a circle is created by shrinkage of the lower line to the mid point. Now to examine what is the relation between the arrived circle and the diameter (here the distance of the parallel lines $\times 2$). How could this be done? If we look at the concentric circles, we find that they are parallel. This indicates the circles are in proportion to diameters. If diameter is 1 and the circle is 4 then suppose a perfect circle is made. And due to curvature the length of a circumference is greater than the diameter. But what is the relation fixed between a diameter and a circumference and consequentially between the diameter and the area of the circle?

Let us examine

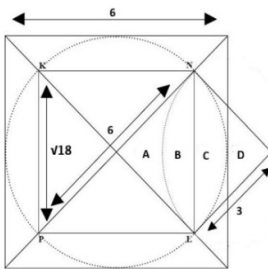


Here it is seen that ABC and FED are parallel so also are AC and FD as well as AF and CD. Now $ABCDEF = ACDF$ (ABC and FED parallel). $\frac{AF \times AC}{2} = \frac{AE \times CE}{2}$ or $\frac{(AE^2)}{2}$ (AE=CE)

Here the parallel relation between the central point and the circumference works as a result the area of part 60° of a circle containing a side measuring 5 units is $\frac{(5^2)}{2}$ or 12.5 square units (here a side = radius) Hence area of the whole circle = 12.5×6 or 75 square units.

Now it is established that the relation between radius and area of a circle is $75 \div 5^2$ or 3, means $3r^2 = \text{area of a circle}$ ($r = \text{radius}$)

In other way



Let $A+B+C+D=1$

$$\therefore A+B = C+D = \frac{1}{2}$$

$$\therefore A+B = B+D = \frac{1}{2} \quad (B=C)$$

$$\text{Or } A+2B+D = 1$$

$$\therefore A+D = 1 - 2B \quad (B=C)$$

$$\therefore 2B = 1 - 1/2 \quad (\text{the proof is given below})$$

$$\therefore B = 1/4^{\text{th}} \text{ of } ABCD$$

$$\text{Hence } A=B=C=D$$

From the above it is clear that the circle around the square KPLN = KPLN + $\frac{1}{2}$ KPLN

Hence the surrounding circle = $3/2$ KPLN

Again $3/2$ KPLN = $3/2(\sqrt{18})^2$ or 27^2 units, Now area of the surrounding square = 6^2 or 36^2 units.

Hence the circle is $\frac{27}{36}$ or $3/4^{\text{th}}$ of a surrounding square field.

And area of the circle = 3 times radius²

Let's place a visual proof

Area of the circle = 3 radius²

Now radius² = A+B+C+D

Now 3 radius² = 3(A+B+C+D)

Or $12A$ ($A=B=C=D$)

Again $1/4^{\text{th}}$ of a circle = $3A$

$\therefore$ Circle = $3A \times 4$ or $12A$

$\therefore 3 \text{ radius}^2 = \text{area of a circle}$

Another proof may be presented

A = corner between a circle and a covering square.

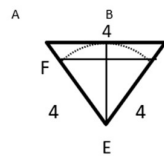
$\therefore 4A = A+B+C+D = 3^2$

Now $6^2 = (3 \times 2)^2 = 9 \times 4$

Or $\{2(A+B+C+D)\}^2$ or $4(A+B+C+D)^2$ or $16A$

Here circle space = $16A - 4A$ or $12A$

$12A = 3 \text{ radius}^2$



Here $ABC = FBD$ again: BE^2 or $ED^2 = EC^2 - BC^2$.

So $BE = \sqrt{4^2 - 2^2}$ or $\sqrt{12}$. Now circumference = 4×6 or 24 units.

So relation between diameter and circumference = $24/2 \sqrt{12}$ or $\sqrt{12}$.

Circumference is $\sqrt{12}$ times the diameter. The relation is such because the vertical distance between the vertex and the opposite side of an equilateral triangle is $\sqrt{\frac{3}{4}}$ of the length² of a side of such a triangle.

In other way when one side of such a triangle is bend at both the ends to the extent of the Length $\sqrt{\frac{3}{4}}$ of the length² of a side, the bend line turns to be an arch of a perfect circle.

Another proof

$A+B+C+D = \text{Let } 1$ (actually 9) [The proof is given below]

$$\therefore A+B = \frac{1}{2} \quad C+D = \frac{1}{2} \quad A=D, B=C$$

$$\therefore A = \frac{1}{2} - B$$

$$\text{and } B = \frac{1}{2} - A$$

$$\text{now } \frac{A}{B} = \frac{1/2-B}{1/2-A}$$

$$\text{Hence } 1/2A - A^2 = 1/2B - B^2$$

This is true if only if $A=B$

hence $A=B=C=D$

$$\therefore 12A = \text{the circle} = 27 \text{ square unit or } 27 = 3^2 (\text{radius})^2 \times 3$$

Hence area of a circle = 3 radius²

Another proof

Let a square is 6×6 unit and it has a circle inside of diameter 6 units and there is another square inside the 6×6 square. [See below]

Outer square measures 6×6

Inner square measures $\frac{6 \times 6}{2}$

Now let the corner gap between the outer square and the circle is 'x' and let the side gap between the circle and inner square is 'y'

$$\text{Hence } 36 - 4x = 18 + 4y$$

$$\therefore x = 4.5 - y \text{ and } y = 4.5 - x$$

$$\text{Now we get } \frac{x}{y} = \frac{4.5-y}{4.5-x} \text{ or } 4.5X - X^2 = 4.5Y - Y^2$$

Hence, $x = y$

$$4x = 4y$$

$$\therefore 4x = 4y = \frac{18}{2}$$

$$\therefore x = 2.25 \text{ and } y = 2.25$$

Hence the circle is = $18 + 4 \times 2.25 = 27$ and the outer square = 36

Hence a circle $\frac{3}{4}$ ($\frac{27}{36}$) of the outer square

Now the area of the circle = 27

Diameter = 6

$$\therefore \text{Area} = \left(\frac{6}{2}\right)^2 \times 3$$

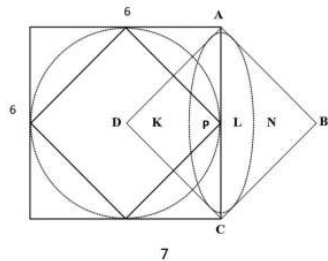
$$27 = 3^2 \times 3$$

Hence the area of a circle is 3 times the r^2 (radius²) and inner square $\frac{2}{3}$ ($\frac{18}{27}$) of the circle.

CONCLUSION

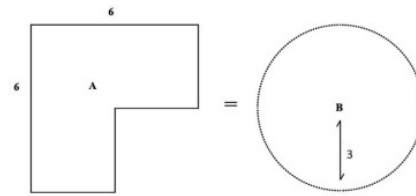
What do we derive from the above proof?

- The inner tangential circle within a square is $\frac{3}{4}$ of the area of the surrounding square.
- The inner tangential square of a circle is $\frac{2}{3}$ of the area of the surrounding circle.
- The four parts of a circle beyond the inner tangential square is equal to the four parts of a square beyond the inner tangential circle.
- The relation between the inner and outer square is 1:2.
- The relation between the inner and outer circle of the above squares is also 1:2 because the radii are 1: $\sqrt{2}$.
- The parts K P L and N of the square ABCD are all equal.
- 12 K or P or L or N is equal to the area of the circle radius of which is AB or AD.
- 8 K or P or L or N is equal to the area of the square-around the circle-sides of which is AC.



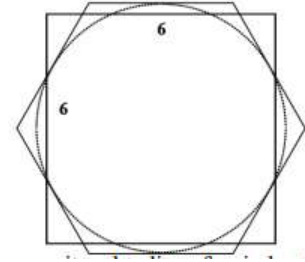
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Logically also the circle is tangent to both the inner and the outer squares if the side of the outer square is 6 then the area of the outer square is 36 square units and the inner square is of 18 square units but the circle is of 27 square units hence the distance between the circle and the outer square is 9 square units at the same time the difference between the circle and the inner square is also 9 square units. It indicates that the difference between the inner square to circle as well as circle to the outer square is equal hence the side gap between the inner square and the circle as well as the corner gaps between the circle and the outer square are all equal hence a circle is $\frac{3}{4}$ of the outer square that shows area of a circle is 3 times the radius.



Average area covered under 1° in a square field $36/360^\circ$ or $1/10$ units area covered under 1° in a circle within the above square is $27/360^\circ$ or $3/40$ units. But if a square field is 36 square units and a circle of same area is considered, we get the radius of the circle $36/3$ radius² or $\sqrt{12}$.

Now, when area of a square = area of a circle the circumference of the square = circumference of the circle.



Here area of the square is 36 square unit and radius of a circle of the same area is $36/3r^2$ or $\sqrt{12}$.

Now: if the sides of a square field is 6 units

Then: circumference is 24 units and: area is 36 square units.

Again: area of the circle of $\sqrt{12}$ radius is $3(\sqrt{12})^2$ or 36

Now: if radius is $\sqrt{12}$, Then: circumference of the circle is $2\sqrt{12} \times \sqrt{12}$ or 24. Hence circumference is $\sqrt{12}$ times the diameter.

Hence: Relation between the radii of equal area square and circle is $\sqrt{9}:\sqrt{12}$ or $\sqrt{3}:\sqrt{4}$.
