

UNIVERSITY WORK.

MATHEMATICS.

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EUCLID.

1. The straight lines which join the extremities of two equal and parallel straight lines towards the same parts, are also themselves equal and parallel.

If $ABCD$ be a parallelogram and AP , BQ be one pair of parallel straight lines and CQ , DP another pair of parallel straight lines, then PQ will be equal and parallel to AB and DC .

2. In obtuse-angled triangles, if a perpendicular be drawn from either of the acute angles to the opposite side produced, the square on the side subtending the obtuse angle will be greater than the squares on the sides containing the obtuse angle, by twice the rectangle contained by the side on which, when produced, the perpendicular falls, and the straight line intercepted without the triangle, between the perpendicular and the obtuse angle.

If $ABCD$ be a quadrilateral and P , Q , R , S be the middle points of AB , BC , CD , DA respectively, then

2 sq. on PR + sqs. on AB , CD

= 2 sq. on QS + sqs. on BC , DA .

3. If a straight line drawn through the centre of a circle bisect a straight line in it which does not pass through the centre, it will cut it at right angles.

If two pairs of opposite sides of a hexagon inscribed in a circle be parallel, the third pair of opposite sides will be parallel.

4. If from any point without a circle two

straight lines be drawn, one of which cuts the circle, and the other touches it; the rectangle contained by the whole line which cuts the circle, and the part of it without the circle, will be equal to the square on the line which touches it.

Draw through a given point P a straight line PQR to meet two given straight lines in Q , R , so that the rect. PQ , PR shall be equal to a given quantity.

5. The rectangle contained by the diagonals of a quadrilateral figure inscribed in a circle is equal to the sum of the rectangles contained by its opposite sides.

If ABC be an equilateral triangle and P a point on the circumscribing circle on the side of BC remote from A , then

sq. on PA = rect. PB , PC + sq. on BC .

ALGEBRA AND TRIGONOMETRY.

1. Show that the figure nine cannot occur in the decimal part of a fraction whose denominator is less than ten. In the scale whose radix is r , what figures, if any, cannot occur in the decimal part of a fraction whose denominator is less than r ?

2. Show that the following expression is a perfect cube :

$$a^3b^3(a-c)^3(b-c)^3 + b^3c^3(b-a)^3(c-a)^3 + c^3a^3(c-b)^3(a-b)^3 + 3a^2b^2c^2(a-b)^2(b-c)^2(c-a)^2.$$

Prove the identity :

$$(ax+by+cz)^3 + (ay+bz+cx)^3 + (az+bx+cy)^3 - 3(ax+by+cz)(ay+bz+cx)(az+bx+cy) = (a^3+b^3+c^3-3abc)(x^3+y^3+z^3-3xyz).$$

3. Find the sum of n terms of a series in geometrical progression.

Show that, if the sum of the m^{th} powers of the several terms of an infinite geometrical progression whose first term is a and common ratio is r be denoted by s_m , then