

39. AB is the diameter of a semicircle, D and E any two points on its circumference. Shew that if the chords joining A and B with D and E , either way, intersect in F and G , the tangents at D and E meet in the middle point of the line FG , and that FG produced is at right angles to AB .

40. Shew that the square on the tangent drawn from any point in the outer of two concentric circles to the inner equals the difference of the squares on the tangents, drawn from any point, without both circles, to the circles.

41. If from a point without a circle, two tangents PT, PT' , at right angles to one another, be drawn to touch the circle, and if from T any chord TQ be drawn, and from T' a perpendicular $T'M$ be dropped on TQ , then $T'M = QM$.

42. Find the loci :

- (1.) Of the centres of circles passing through two given points.
- (2.) Of the middle points of a system of parallel chords in a circle.
- (3.) Of points such that the difference of the distances of each from two given straight lines is equal to a given straight line.
- (4.) Of the centres of circles touching a given line in a given point.
- (5.) Of the middle points of chords in a circle that pass through a given point.
- (6.) Of the centres of circles of given radius which touch a given circle.
- (7.) Of the middle points of chords of equal length in a circle.
- (8.) Of the middle points of the straight lines drawn from a given point to meet the circumference of a given circle.

43. If the base and vertical angle of a triangle be given, find the locus of the vertex.

44. A straight line remains parallel to itself while one of its extremities describes a circle. What is the locus of the other extremity ?