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A Generalization of Lemma 2 of Archimedes' Book of Lemmas

Lemma 2 of *Archimedes' book of Lemmas* states that if D is a point of a semicircle with diameter AB and the tangents at A and D meet at T, then BT bisects the perpendicular DE to AB. In this work we generalize Lemma 2 to hyperbolas with major axis AB and prove that if D is a point of the branch with vertex A and the tangents at D and A meet at T, then the ray $\overrightarrow{BT}$ bisects the perpendicular DE to AB at F and similarly if D is a point of the branch with vertex B and the tangents at D and B meet at T, then the ray $\overrightarrow{AT}$ bisects the perpendicular DE to BA at F. Also, we prove for parabolas that if D is a point of the parabola with vertex A and the tangents at D and A meet at T, then the ray $\overrightarrow{TF}$ parallel to the axis of symmetry AB of the parabola bisects the perpendicular DE to AB at F. Also it is proved that if the point D moves from a vertex of a hyperbola or a parabola on a branch of a hyperbola or on a parabola, then the locus of the midpoint F of DE is a branch of a hyperbola or is a parabola. Also, this generalization leads to a method to construct a tangent by compass and straight edge at any point of a hyperbola, parabola, or ellipse.

Keywords: Hyperbola, parabola, tangent, Archimedes' book of lemmas.

MSC: 51M04; 01A20, 01A30.