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EDITED BY

WILLIAM THOMSON, M.A.,

PROFESSOR OF NATURAL PHILOSOPHY IN THE UNIVERSITY OF GLASGOW, AND LATE FELLOW OF ST. PETER'S COLLEGE, CAMBRIDGE, F.R.S., F.R.S.E., FOREIGN MEMBER OF THE ROYAL SWEDISH ACADEMY OF SCIENCES, HONORARY MEMBER OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY;

AND

N. M. FERRERS, B.A.,

FELLOW OF GONVILLE AND CAIUS COLLEGE, CAMBRIDGE.

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PROBLEMS.

1. Given two conics in the same plane such that the normal distance of the point of intersection of their transverse or major axes from each of the conics is one and the same pure imaginary quantity; shew that the conics may be projected into small circles of the same sphere.

2. If from a point in the circumference of a vertical circle two heavy particles be successively projected along the curve, then initial velocities being equal and either in the same or in opposite directions, the subsequent motion will be such that a straight line joining the particles at any instant will touch a given circle.

Note. The particles are supposed not to interfere with each other's motion.

3. A transparent medium is such that the path of a ray of light within it is a given circle, the index of refraction being a function of the distance from a given point in the plane of the circle.

Find the form of this function and shew that for light of the same refrangibility—

(1) The path of *every ray within the medium* is a circle.

(2) All the rays proceeding from any point in the medium will meet accurately in another point.

(3) If rays diverge from a point without the medium and enter it through a spherical surface having that point for its centre, they will be made to converge accurately to a point within the medium.

4. A series of waves, which at sea are twenty feet long from crest to crest, and three feet high from hollow to crest, break on a shore which is parallel to their breadth. How much heat is developed per hour on each foot of the shore, and how much would the temperature of 180 cubic feet of fresh water be raised by receiving an equal quantity? [The form of a wave at sea, of which the height is a small fraction of l, its length, is approximately the curve of sines; its velocity of propagation is $\sqrt{\frac{gl}{2\pi}}$; and its mechanical energy is half that of a double elevation and depression of the same form without velocity.]