AN ELEMENTARY TREATISE ON KINEMATICS AND KINETICS

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AN ELEMENTARY TREATISE

ON

KINEMATICS AND KINETICS

BY

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PREFACE.

THIS Treatise is intended to contain as much as is required, under the head of Dynamics, of Candidates for Honours in the First Three Days of the Mathematical Tripos. I hope that it will also be of use to Students in their preparation for other Examinations, where questions are set which may be treated without Analytical Geometry and the Differential Calculus.

A beginner, who wishes to become acquainted with the principles of Dynamics before advancing far in the Kinematical portion of the book, will find that Chapters VII. and VIII. may be read immediately after Chapter I.

My thanks are due to Mr. Hamblin Smith for having kindly examined most of the proof sheets as they passed through the press.

I shall be very grateful for any corrections, or suggestions for the improvement of the work, which may be sent me by any one using it.

E. J. GROSS.

GONVILLE AND CAIUS COLLEGE,
November 23, 1875.

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KINETICS.

ERRATA.

Page 32, line 17 from top (8), *for* 'space varies' *read* 'acceleration varies.'

Page 84, line 2 from top, *for* '6928' *read* '7728.'

Page 114, line 7 from top, *for* 'chord' *read* 'cord.'

Page 133, line 6 from bottom (20), *for* 'above' *read* 'below.'

Page 137, line 4 from bottom (5), *for* 'one-third' *read* 'two-thirds.'

Page 155, line 18 from bottom (32), *for* '$e\cos\alpha+\sin\alpha$' *read* '$\sqrt{e\cos^2\alpha+\sin^2\alpha}$.'

KINEMATICS.

I.—VELOCITY.

1. When the position of a point is being changed continuously, the point is said to be in *motion*.

2. *Velocity* is the name given to the *rate* of motion of the point, or the *degree of quickness* or *slowness* with which the point is moving, at any instant.

3. By observing a body, such as a train, in motion, we perceive sometimes that it is moving faster at one instant than at another.

Again, we see sometimes, when two bodies are in motion, that one is moving faster than the other.

We can express these facts by saying that the velocity of the train is greater at one instant than at another; and that, in the second case, the velocity of one body is greater than that of the other.

We thus become familiar with the idea of velocities differing from one another in *magnitude*, or *intensity*.

And we see that the velocity of a point is a property, which the point has at each individual instant of its motion, and that the magnitude of this property may be different at different instants.

4. If during any interval of time the magnitude of the velocity of a point is the same at every instant, the velocity is said to be *uniform*. If the magnitude at one instant is different from what it is at another, the velocity is said to vary, or to be a *variable* velocity.

5. If a point always moves uniformly, it is easy to see that it will pass over equal distances, or spaces, in equal intervals of time. But the converse of this, viz., that, if equal spaces are passed over in equal times, the velocity is uniform, is not necessarily true. Thus, if the velocity of a train is uniform and of the proper magnitude, it will pass over 30 miles in every hour. But, if it passes over 30 miles in every hour, it does not by any means follow that its velocity is uniform throughout an hour; for at one part of that time it may be moving faster than at another, if only it manage upon the whole to go exactly 30 miles in the hour. If, however, it went $\frac{1}{2}$ mile in every minute, we should feel more confident that it was moving uniformly, and still more so, if it went $\frac{1}{1800}$ mile in every second. And if, on dividing the time into equal intervals as small as we pleased, we found that it went an equal space in each interval, we should conclude that the velocity was uniform throughout the whole time. We thus arrive at the following *test* for uniformity of velocity:—

A velocity of a point is said to be uniform when equal spaces are passed over in equal intervals of time, *however small*.

6. Our ideas of the velocities of points are closely connected with those of the spaces, over which the points will go in any specified time.

Thus, in *ordinary language*, we indicate any particular velocity by mentioning the space traversed in some given length of time by a point moving uniformly with that velocity during this time.

For example, we talk of a velocity of 40 miles an hour; meaning such a velocity that, if a point travel uniformly with *it for* an hour, the point will pass over 40 miles.