

(v.) If constant charges of electricity be condensed at n points, and the distance between them varied, the force of attraction or repulsion is found to vary inversely as the square of the distance.

12. Describe the Daniell's cell, and state its respective advantages and disadvantages. How is it proved that the electricity produced by a galvanic battery is the same in kind as that produced by friction? Explain the relation between them, illustrating your answer by examples of the effects they produce.

13. Twelve cells of a battery, consisting of zinc and carbon in dilute sulphuric acid are joined up in series, and the current is sent through a voltmeter containing acidulated water, and through a solution of cupric-sulphate; what are the laws of decomposition by the current both within and without the cells of the battery? If the resistance of the voltmeter and cupric-sulphate solution be equal to three cells of the battery, what arrangement of the cells of the battery will produce the greatest amount of decomposition in a given time?

14. Define electromotive force.

Find the current-strength when n cells each of resistance r and the electromotive force E are arranged (i.) in simple circuit; (ii.) in compound circuit.

Find the current-strength due to mn cells arranged in m rows of n cells, the cells in each row being in compound circuit, and the successive rows in simple circuit.

Find the current-strength and the whole resistance in any divided circuit.

NATURAL PHILOSOPHY.

N.B.—Forty marks to each question; 225 marks to count a full paper.

1. Deduce the parallelogram of forces from the principle of virtual velocities. (Virtual Work.)

At the point O of intersection of diagonals of a square $ABCD$, two forces of 8 ounces and 12 ounces respectively act along the semi-diagonals OA , OB , and two forces of 10 ounces and 2 ounces respectively act in a direction perpendicular to the sides AB and

BD , and towards those sides: required the magnitude of the resultant.

2. If two forces acting at a point O be represented in magnitude and direction by OB and $n.OA$, their resultant will be represented in magnitude and direction by $(n+1).OG$, the point G being taken on AB so that $BG = n.AG$.

If n forces acting at a point O be represented in magnitude and direction by OP_1 , OP_2 , OP_3 , ... OP_n , their resultant will be represented in magnitude and direction by $n.OG$, the point G being the centre of gravity of particles of equal mass placed at the points P_1 , P_2 , P_3 , ... P_n .

3. The sum of the moments of two forces with respect to any point in their plane, is equal to the moment of their resultant with respect to the same point.

A beam AB , 15 ft. long and weighing 25 lbs., rests against a smooth horizontal plane CA and a smooth vertical wall CB , the lower extremity A being attached to a string which passes over a smooth pulley at C and sustains a weight of 40 lbs. Find the length of the string between C and A when the beam is in equilibrium, the centre of weight of the beam being 7 ft. from the extremity A .

4. Given the centres of gravity of a body and of any part of it, show how to find the centre of gravity of the remainder.

From a rectangle six inches wide there is cut an isosceles triangle, having one of the longer sides of the rectangle for its base, the centre of gravity of the remaining piece of the rectangle is at the summit of the triangle; find the height of the triangle.

5. State the rule for the composition of velocities, and give an instance showing the truth of the rule.

Explain how a body can be made to describe the sides of a regular polygon with constant velocity by having a certain velocity impressed on it at each angular point; and calculate the magnitude of the velocity impressed on a body at each angular point of an octagon which the body describes with a constant velocity of two feet per second.

6. State Newton's laws of motion, and ex-