

erations by his pure sentiments towards the commonwealth; by his zeal for the civil and religious rights of all men; by his liberal principles favorable to mild government, to the unfettered exercise of the human faculties, and to the progressive civilization of mankind; by his ardent love for a country of which the well-being and greatness were indeed inseparable from his own glory; and by his profound reverence for that free constitution which he was universally admitted to understand better than any other man of his age, both in an exactly legal and in a comprehensively philosophical sense."

NATURAL PHILOSOPHY.

Value 175.

15. 1. A straight lever ACB, without weight, the fulcrum being C, is in equilibrium, in a horizontal position, under the influence of two weights, namely, P acting at A, and W at B. If  $AC=3\frac{1}{2}$  feet, and  $BC=4\frac{2}{3}$  feet, and if the pressure on the fulcrum is 24 lbs., find P and W.
16. 2. Assuming the principle of Virtual Velocities, apply it to determine the mechanical efficiency  $\left(\frac{W}{P}\right)$  of the Screw, the Power being supposed to act in a plane at right angles to the direction of the screw.
16. 3. A weight W is kept at rest on an inclined plane by a power P acting parallel to the base. Does such a machine ever act a mechanical disadvantage? If so, when? Illustrate by an example.
16. 4. If a pupil should say, that, in the case of a body at rest on an inclined plane under the influence of a Power P acting parallel to the plane, the weight of the body and the force P, being neither equal nor directly opposite, cannot possibly counterbalance one another; and should ask what force,

additional to these, acts on the body so as to keep it at rest; what would you reply?

16. 5. What is meant by the *Resultant* of a number of forces acting at a point? Draw any lines AB, BC, CD; and let a particle at A be acted on by forces parallel to the lines AB, BC, CD, taken in order, and represented by them in magnitude. Prove (assuming the principle of the Parallelogram of Forces) that the resultant of these three forces as represented in direction and magnitude by AD.
16. 6. ABC is an equilateral triangle, of which the side is one foot. A particle at A is acted on by a force represented in magnitude and direction by AB. Let the force be resolved into two forces, one in a direction parallel to BC, the other in a direction perpendicular to BC. Find the lengths of the lines representing these forces respectively.
16. 7. A hollow cylinder, whose height is 6 feet, while the radius of the base is 1 foot, is filled with water. Find the pressure of the water on the interior of the vessel, *first*, when the vessel stands on its base on a horizontal floor, and *secondly*, when it lies on its side on a horizontal floor. (The weight of a cubic foot of water is 1,000 ounces; and the solid content of a cylinder is found by multiplying the area of the base by the height.)
16. 8. The height of the barometric column being 30 inches, find the pressure of the atmosphere on an area of one square foot, the sp. gr. of mercury being 13.6, and the weight of a cubic foot of water (sp. gr. = 1) 1,000 ounces.
16. \*9. Describe the Air Pump.
16. \*10. Describe the Syphon.
16. \*11. Describe the Common Pump.

\*In describing these instruments, the candidate should bring clearly out the principles involved in their construction and use.