Ans. $\left\{(r+1)^2 - r^2\right\} \times \frac{22}{7}$

$$\times \frac{10 \times 1000 \times 114}{1728 \times 16 \times 10} = 25,$$

$$2r + 1 = 1\tfrac{971}{1045},$$

$\therefore$ outside diameter $= 2\tfrac{971}{1045}$.

9. A conical vessel 6 inches deep and 3 inches across the mouth is filled to 5 inches with water. Find the diameter of the sphere which, when dropped into the cylinder, will raise the water so as just to fill the vessel.

Ans. Radius of cone 5 in., in height is $\frac{5}{4}$ in., difference of vol. two cones,

$$= \frac{1}{3} \cdot \frac{22}{7} \cdot 6 \cdot \left(\frac{3}{2}\right)^2 - \frac{1}{3} \cdot \frac{22}{7} \cdot 5 \cdot \left(\frac{5}{4}\right)^2$$

$$= \frac{11 \times 91}{7 \times 24} = \text{vol. required sp.,}$$

$$= \frac{4}{3} \cdot \frac{22}{7} r^3;$$

$\therefore r = \frac{1}{4}\sqrt[3]{91}$ and diameter $\frac{1}{2}\sqrt[3]{91}$.

10. The diagonals of a quadrilateral plane figure are 10 and 12, and they intersect at an angle of 60°, to find the area of the figure.

Ans. $30\sqrt{3}$.

EUCLID.

1. The three angles of a triangle are together equal to two right angles.

If triangles be formed on the sides of a polygon of n sides by producing the alternate sides to meet, the sum of the vertical angles of these triangles is equal to $2n - 8$ right angles.

2. Establish the converse of the following: The complements of the parallelograms, which are about the diameter of any parallelograms, are equal to one another.

3. To divide a given straight line into two parts, so that the rectangle contained by the whole and one part may be equal to the square on the other part.

Point out all the lines in the figure that are divided similarly to the given line.

4. By the assistance of Prop. 12, Bk. II., when the sides of a triangle are 25, 45 and $20\sqrt{10}$, find its area.

5. If in a circle all possible chords be drawn passing through the same point in the circumference, and these chords be doubled in length by production, the locus of the extremities of the lines so formed is a circle.

6. The angles in the same segment of a circle are equal to one another.

If a line of constant length move with its extremities in two fixed lines, and at the ends of the first line lines be drawn perpendicular to the two fixed lines, the locus of the intersection of these lines is a circle.

7. ABC is a triangle, C being a right angle. On CA, CB are described segments of circles containing angles equal to CBA, CAB respectively. Show that the circles of which these segments are parts touch one another.

8. In a given triangle to inscribe a circle.

If the points of contact be joined show that the triangle thus formed can be equiangular to the original triangle only in the case in which both are equilateral.

9. Show, after the manner of Euclid, that triangles are to one another in the ratio compounded of the ratios of their bases and altitudes; and prove that this is algebraically equivalent to product of ratios.

10. Similar triangles are to one another in the duplicate ratio of their homologous sides.

Two circles touch, and through the point of contact lines are drawn cutting the circles, and the ends of these lines are joined. Prove that the triangles so formed are as the squares of the diameters of the circles.

ELEMENTARY MECHANICS.

1. Define the terms velocity, acceleration. Explain how a variable velocity is measured, and how that measure is expressed.

The velocity of a body falling freely receives each second an acceleration of 32 feet per second; express this acceleration, taking the mile as unit of length and the hour as unit of time.

2. If a particle move with uniformly accelerated motion, show that its average velocity during any given time will be equal to one-half of the sum of its velocity at the beginning and its velocity at the end of the given time. Hence show that, for a uniform acceleration equal to a, $s = ut + \frac{1}{2}at^2$.