6. Show that in a right-angled triangle the square on the hypotenuse is equal to the sum of the squares on the other two sides.

7. Enunciate the first three propositions of Book II., and prove one of them.

8. Show how to divide a given finite line into two segments such that the rectangle contained by the whole line and one segment may be equal to the square on the other segment.

9. If a line AB is divided in C so that the square on AC is twice that on BC, prove that the sum of the squares on AB, BC is twice the rectangle contained by AB, AC.

Euclid Books (I.–IV.).—For Senior Civil Service: Time allowed: 3 hours.

1. Explain the terms *axiom, theorem, hypothesis, corollary.* Distinguish between a *direct* and an *indirect* demonstration, and between a *converse* and a *contrary* proposition.

2. If a parallelogram and a triangle be on the same base and between the same parallels, the parallelogram shall be double of the triangle.

Two triangles are formed by drawing lines from the extremities of two opposite sides of a parallelogram to any point without it: show that half the parallelogram is equal to the sum or difference of the two triangles according to the position of the point.

3. On a given straight line to describe a parallelogram which shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

4. If a straight line be divided into two equal and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line and of the square on the line between the points of section.

5. To describe a square that shall be equal to a given rectilineal figure.

Show how to describe a rectangle that shall be equal to a given square, and shall have one of its sides equal to a given straight line.

6. If one circle touch another internally at any point, the straight line which joins their centres being produced shall pass through that point.

If through the point of contact any two straight lines be drawn cutting the circles, show that the chords of the intercepted arcs will be parallel to one another.

7. If from any point without a circle two straight lines be drawn, one of which cuts the circle and the other touches it, the rectangle contained by the whole line which cuts the circle and the part of it without the circle shall be equal to the square on the line which touches it.

8. Two equal circles touch each other externally, and through the point of contact chords are drawn, one to each circle, at right angles to one other: show that the straight line joining the other extremities of these chords is equal and parallel to the straight line joining the centres of the circles.

9. In a given circle to inscribe a triangle equiangular to a given triangle.

If a triangle be inscribed in a circle, the sum of the angles in the three segments exterior to the triangle will be equal to four right angles.

10. To inscribe a regular pentagon in a given circle.

Show that the lines joining the angular points of a regular pentagon are parallel to sides of the pentagon.

Mechanics.—For Class D, and for Senior and Junior Civil Service. Time allowed: 3 hours.

1. Define *velocity, acceleration, mass, force, energy, power.* In what units are they respectively measured?

2. Explain what is meant by the *composition* and *resolution* of velocities.

A stone being thrown horizontally from a train at right angles to the rails, its actual course makes an angle of 60° with the rails, and its actual velocity is 80ft. per second, find the speed of the train.

3. Enunciate Newton's laws of motion.

A force equal to the weight of 1lb. acts upon a mass of 2oz., find the acceleration and the momentum generated in two minutes.

4. A balloon is at a height of 2,000ft., and is ascending vertically, with a velocity of 200ft. per second, when a stone is dropped from it: find the time that elapses before the stone reaches the ground, and the velocity which it acquires, leaving out of account the resistance of the air.

5. When three forces acting at a point are in equilibrium, show that they are proportional each to the sine of the angle between the other two.

Forces of 12lb., 12lb., and 20lb. act at a point, and are inclined to one another at angles of 120°: find their resultant.

6. A uniform bar, 6ft. in length, has a weight of 20lb. suspended at one end and a weight of 30lb. at the other end: where must an additional weight of 40lb. be suspended in order that the bar may balance about its middle point?

7. Find the relation of the power to the weight in the inclined plane, neglecting friction.

A horizontal force of 60lb. supports a weight on an inclined plane 26ft. in length and 10ft. in height: find the weight and the pressure on the plane.

8. Find the conditions of equilibrium of a floating body.

The specific gravity of lead is 11·5 and that of cork is 0·25: find the greatest weight of lead which can be floated in water by being attached to half a cubic foot of cork.

9. What is meant by the *whole pressure* of a liquid on a surface? Is there any case in which the *whole pressure* is equal to the *resultant pressure?*

The water in a dock rises to the height of 16ft. against a gate, the breadth of which 28ft.: find the pressure upon the gate in tons.

10. Describe the common pump and the condensing syringe.