

Algebra.—For Senior Civil Service. Time allowed: 3 hours.

- Find the value of $\sqrt{\frac{x+y}{x-y}} - \sqrt{\frac{x-y}{x+y}}$, when $x=\frac{1}{4}$, $y=\frac{1}{5}$; and also when $x=a+b$, $y=a-b$.
- Multiply $\frac{1}{3}x^a - \frac{1}{2}x^b$ by $\frac{1}{2}x^a + \frac{1}{3}x^b$, and divide $25x^3 - 16x^2 - 8x - 1$ by $5x^{\frac{3}{2}} + 6x + 2x^{\frac{1}{2}} + 1$.
- Find the highest common measure and the lowest common multiple of the following expressions:—
 - $x^4 - xy^3$, $(x^3 - xy^2)^2$, and $(x^2 - xy)^3$
 - $25x^4 - 1$ and $20x^4 + x^2 - 1$
 - $a^2 + 2b^2 + (a+2b)\sqrt{ab}$ and $a^2 - b^2 + (a-b)\sqrt{ab}$
- Simplify the expressions—
 - $\left(\frac{a}{a+b} + \frac{b}{a-b}\right) \div \left(\frac{a}{a-b} - \frac{b}{a+b}\right)$
 - $\frac{3a}{(a-2x)^2} + \frac{2a+x}{(a+x)(a-2x)} - \frac{5a}{(a+x)^2}$
 - $\frac{\sqrt{x+1} + \sqrt{x-1}}{\sqrt{x+1} - \sqrt{x-1}}$
- Show that, if $x = \sqrt{a^2 - b^2}$, then $\sqrt{a+b} = \sqrt{\frac{a+x}{2}} + \sqrt{\frac{a-x}{2}}$, and $\sqrt{a-b} = \sqrt{\frac{a+x}{2}} - \sqrt{\frac{a-x}{2}}$.
- Extract the square root of $1-x$ to five terms.
- Solve the equations—
 - $\frac{a}{x} + \frac{b}{x+a} = \frac{b+a}{x+b}$
 - $\sqrt{x} - \sqrt{a+x} = \sqrt{\frac{a}{x}}$
 - $xy=a(x+y)$, $xz=b(x+z)$, $yz=c(y+z)$
- If A's money were increased by thirty shillings he would have three times as much as B; and if B's money were increased by thirty shillings he would have twice as much as A: find the sum possessed by each.
- A has performed $\frac{m}{n}$ of a piece of work in p days; B then comes to help him, and they finish it in q days: in how many days could each do it separately?

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

- What constructions does Euclid assume can be made?
Draw from a given point a straight line (a) equal to a given straight line, (b) equal to a given straight line and in a given direction.
- Show that if from the ends of a side of a triangle there be drawn two straight lines to a point within the triangle, then these straight lines shall be together less than the other two sides of the triangle, but shall contain a greater angle.
A square has a square grass-plot having its diagonals on the diagonals of the square. Draw in a figure the shortest path leading from one corner of the square to the opposite corner, without crossing the grass. Show that its length is greater than half the perimeter of the plot, and less than half the perimeter of the square.
- Show that two triangles are identically equal if they have two angles of the one equal to two angles of the other, each to each, and the side adjacent to the equal angles in one equal to the corresponding side in the other.
Show that the straight line drawn from the vertex of an isosceles triangle perpendicular to the base divides it into two identically equal triangles.
- Show that two triangles are equal in area—
 - If they are on equal bases and between the same parallels;
 - If the rectangle contained by the base and altitude of one is equal to that contained by the base and altitude of the other.
- Show that in a right-angled triangle the square described on the hypotenuse is equal to the sum of the squares described on the other two sides.
Having a given straight line one inch in length, construct, as simply as you can, one equal to $\sqrt{10}$ inches.
- Prove that the rectangle contained by two straight lines, each divided into any number of parts, is equal to the sum of all the rectangles severally contained by one part of the one and one part of the other. Show that this includes Euc. II., 1, 2, 3, 4.
- If a straight line is divided into two equal parts, and also into two unequal parts, prove that the sum of the squares on the two unequal parts is twice the sum of the squares on half the line and on the line between the points of section.
- The base of an isosceles triangle is divided *externally* at a point: show that the rectangle contained by the segments of the base, together with the square on one of the sides, is equal to the square on the straight line joining the vertex to the point of section of the base.
What corresponds to this theorem when the base is divided *internally*?

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

- Distinguish between a right angle and a rectangle, between a rhombus and a rhomboid, between a diameter and a diagonal, and between a segment and a sector of a circle.