MILITARY EXAMINATIONS. MATHEMATICAL EXAMINATION PAPERS, SET FOR ENTRANCE TO R. M. A., WOOLWICH, WITH ANSWERS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649499755

Military Examinations. Mathematical Examination Papers, Set for Entrance to R. M. A., Woolwich, with Answers by W. F. Austin

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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Trieste

MATHEMATICAL

EXAMINATION PAPERS.

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SET FOR

ENTRANCE TO R.M.A., WOOLWICH,

WITH ANSWERS.

BY

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LONDON:
EDWARD STANFORD, 55, CHARING CROSS, S.W.

1880.

PREFACE.

THE following papers, set at recent examinations for entrance to Woolwich Academy, have been issued, and Answers to the Examples annexed, from a feeling that such a publication would be useful to Military Tutors and Pupils, as well as to a large and increasing class of persons engaged in acquiring or imparting a knowledge of Pure and Mixed Mathematics. Much care has been bestowed upon the working out of the results; but the compiler cannot hope that his book is free from errors, and he will therefore feel very thankful for any corrections that may be sent to him.

ROCHESTER HOUSE, EALING, W.,
April, 1880.

SET I.

EUCLID.

1. Any two sides of a triangle are together greater than the third side.

   If D be a point on the base BC of the triangle ABC, prove that AD is less than the greater of the two sides AB and AC, and if E be a point on either of these two sides, prove that DE is less than the greatest side of the triangle.

2. The complements of the parallelograms which are about the diameter of any parallelogram, are equal to one another.

3. If a straight line be divided into two equal parts and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

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

5. The angle at the centre of a circle is double of the angle at the circumference on the same base, that is, on the same arc.

   A triangle ABC is inscribed in a circle of which O is the centre and the arc BC is bisected at D.

   Prove that the angle ADO is half the difference of the angles ABC and ACB.

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

7. Describe a circle about a given triangle.

   Given the radius of the circumscribing circle, the length of one of the sides, and the area of the triangle, construct the triangle.

8. Inscribe an equilateral and equiangular quindecagon in a given circle.

9. The sides about the equal angles of triangles which are equiangular to one another are proportionals; and those which are opposite to the equal angles are homologous sides, that is, are the antecedents or the consequents of the ratios.

The chords AB and CD in the circle ABCD are produced towards B and D respectively to meet in the point E, and through E, the line EF is drawn parallel to AD to meet CB produced in F.

Prove that EF is a mean proportional between FB and FC.

10. If four straight lines be proportionals the similar rectilinear figures similarly described upon them shall be proportionals.

ALGEBRA.

1. When (m) and (n) are whole numbers, express the result of the division of a^m by a^n; (1) when (m) is greater than (n); (2) when (m) is less than (n), and trace the steps in the theory of indices from which it is inferred that a^{-n} represents $\frac{1}{a^n}$, and that $a^{\frac{1}{n}}$ represents $\sqrt[n]{a}$.

   Express by an arithmetical fraction $(8^{\frac{2}{3}} + 4^{\frac{1}{2}}) \times 16^{-\frac{3}{4}}$.

2. Multiply $(x^{\frac{3}{2}} + 2y^{\frac{3}{2}} + 3z^{\frac{3}{2}})$ by $(x^{\frac{3}{2}} - 2y^{\frac{3}{2}} - 3z^{\frac{3}{2}})$.

3. Divide $(x + y)^2 + (x + z)^2 + (y + z)^2 + 2(x + y)(x + z) + 2(x + y)(y + z) + 2(x + z)(y + z)$ by $(x + y + z)$.

4. Express $a^2(c - b) + b^2(a - c) + c^2(b - a)$ as the product of three simple binomial factors.

5. Reduce to its lowest terms

$$\frac{(a^2 - b^2)(x^2 - y^2) - 4abxy}{(a^2 - b^2)(x^2 + y^2) + 2(a^2 + b^2)xy}$$

6. Prove

$$\frac{a}{(a - b)(c - a)(x + a)} + \frac{b}{(a - b)(b - c)(x + b)} + \frac{c}{(b - c)(c - a)(x + c)} = \frac{x}{(x + a)(x + b)(x + c)}$$

7. Show how to find a factor which will rationalise the surd quantity $a^{\frac{1}{p}} + b^{\frac{1}{q}}$, where (p) and (q) are any whole numbers.

   Express $\frac{5^{\frac{1}{2}} - 7^{\frac{1}{3}}}{5^{\frac{1}{2}} + 7^{\frac{1}{3}}}$ by an equivalent fraction with a rational denominator.

8. Solve the following equations :—

   (1.) $(x - a)(x - b) = (x - c)(x - d)$;

   (2.) $\left.\begin{aligned} \frac{3}{x} + \frac{5}{y} &= \frac{8}{15} \\ 9y - 22x &= \frac{3xy}{25} \end{aligned}\right\}$

   (3.) $\frac{x^2}{6} - \frac{1}{7} = \frac{43x - 8x^2}{42}$;

   (4.) $\left.\begin{aligned} x^2(x + y + z) &= 108 \\ y^2(x + y + z) &= 192 \\ z^2(x + y + z) &= 300 \end{aligned}\right\}$

9. What are the roots of a quadratic equation? If (α) and (β) are the roots of the equation $x^2 - px + q = 0$, and (α^4) (β^4) the roots of $x^2 - Px + Q = 0$; express P and Q in terms of (p) and (q).