

ADVANCED ALGEBRA

Monday, January 22, 1917—9.15 a. m. to 12.15 p. m., only

Write at top of first page of answer paper (a) name of school where you have studied, (b) number of weeks and recitations a week in (1) elementary algebra, (2) intermediate algebra, (3) advanced algebra. The minimum time requirement is five recitations a week in algebra for two school years.

Answer eight questions, including four from group I and four from group II. Each answer should be reduced to its simplest form.

Group I

Answer four questions from this group.

1 Prove by Descartes' rule that the equation

$$3x^7 - x^4 + 5x^3 - 9 = 0$$

has at least four imaginary roots. [15]

2 Find by Horner's method the negative root of the equation $x^3 - 3x^2 - 4x + 11 = 0$ correct to two decimal places. [15]

3 Plot the graph of $x^4 + 4x^3 + 20 = 0$ and from the graph find the values of the real roots correct to tenths. [15]

4 Without using Horner's method, find the rational roots of the equation $x^4 + 2x^3 - x - 2 = 0$ [15]

5 a Form the equation in x whose roots shall be 2, -2, $3 + \sqrt{-1}$, and $3 - \sqrt{-1}$ [7]

b Determine the real values of k so that the roots of the equation $x^2 + 3kx + k + 7 = 0$ may be equal. [8]

Group II

Answer four questions from this group.

6 Find two roots of the equation

$$\sqrt{3x^2 - 2x + 4} - 3x^2 + 2x = -16 \quad [10]$$

7 Artists say that the rectangle most pleasing to the eye is that in which the sum of the two dimensions is to the larger dimension as the larger is to the smaller; if the area of a page of a book is 44 square inches, what must be the dimensions of the page in order that it may conform to the artists' rule? Find the result correct to one decimal place. [10]

8 a In how many ways can a committee of 3 Republicans and 3 Democrats be selected from 10 Republicans and 8 Democrats? [5]

b Prove that the combinations of n things taken r at a time is equal to the combination of n things taken $n-r$ at a time. [5]

9 Solve the equation $x^2 + 2x + 2 = 0$. Draw the graph of the two roots and on this graph represent the difference of the roots. [10]

10 Prove that if a complex number $a + bi$ is a root of an equation $f(x) = 0$ with real coefficients, the conjugate complex number $a - bi$ is also a root. [10]

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DIRECTIONS FOR RATING

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The direction, "Less than 60% of the credit should be granted when an error in computation occurs," should be followed in rating all incorrect answers to questions which fall under the topics mentioned in "Suggestions on the Rating of Regents Examination Papers in Mathematics" under "General 3."

In all problems solved with two unknowns no credit should be given for one equation correctly formed if the other is not given or is inaccurate.

Except in schools where the "committee system" is used, teachers are urged to mark papers cumulatively, that is, to add the credits earned by each answer to the total credits earned by preceding answers so that the mark given to the last answer is the per cent to which the paper is entitled, e. g. consecutive answers earning 5, 7, 4 etc. respectively should be marked 5, 12, 16 etc. respectively.

1 15 credits

Allow 5 credits for proving that the equation has not more than 3 positive roots.

Allow 5 credits for proving that the equation has no negative roots.

Allow 5 credits for proving that the equation has 4 imaginary roots.

2 15 credits

If the equation is transformed to one whose roots are opposite in sign, allow 2 credits for this work and allow 2 credits for changing sign of root.

Allow 2 credits for finding first figure of root correctly.

Allow 4 credits for finding second figure of root correctly.

Allow 5 credits for finding third figure of root correctly.

3 15 credits

Allow 9 credits for correct graph.

Allow 6 credits for correct roots to nearest tenth.

4 15 credits

Allow 7 credits for first correct rational root.

Allow 8 credits for second correct rational root.

DIRECTIONS FOR RATING—concluded

5 15 credits

a 7 credits. Allow 3 credits if one mechanical error is made.

Allow no credit if more than one mechanical error is made.

Allow 5 credits if correct product is not written equal to 0.

b 8 credits

Allow 4 credits for forming correct equation.

Allow 2 credits for each correct value of k .

6 10 credits

Allow 6 credits for first correct value of unknown.

Allow 4 credits for second correct value of unknown.

7 10 credits

Allow 5 credits for correct equations.

Allow 5 credits for correct solution.

Allow 7 credits if correct values are found but not to one decimal place.

8 10 credits

a 5 credits. Allow no partial credit.

b 5 credits. See "General Suggestion 2."

9 10 credits

Allow 3 credits for correct solution.

Allow 3 credits for correct graph of roots.

Allow 4 credits for representing difference correctly.

10 10 credits

See "General Suggestions 2 and 22."