MATHEMATICS.

ALGEBRA.

PART I—ALGEBRA TO QUADRATICS.

(Those who will take Part II may omit all but VI and VII. Others may omit any two questions.)

I. $(+4) \times (+3) = +12$; $(+4) \times (-3) = -12$; $(-4) \times (+3) = -12$; $(-4) \times (-3) = +12$. } Give reasons for signs in each product.

II. Factor the following: $(a+b)^3 - (a-b)^3$;

$a^2 + 25b^2 - 16c^2 - 9d^2 - 10ab - 24cd$;

$(1+a^3) + 2(1-a)(1+a)^2$.

III. Simplify the following:

$$\frac{1}{(x-y)(y-z)} - \frac{1}{(y-x)(x-z)} + \frac{1}{(z-x)(z-y)}$$

IV.
$$\begin{cases} \frac{x}{a} + \frac{y}{c} = 2b \\ \frac{x}{b} + \frac{z}{c} = 2a \\ \frac{y}{b} + \frac{z}{a} = 2c \end{cases}$$

Find any two values

V. A and B run a race of 336 yards. The first heat A gives B a start of 28 yards, and beats him by 2 seconds; the second heat, A gives B a start of 12 seconds, and is beaten by 48 yards. How many yards can each run in a second? (Two unknown quantities.)

VI. Prove $(a^m)^{\frac{n}{=}} a^{mn}$ { 1. n, a positive integer.
m any value { 2. $n = \frac{p}{q}$, p and q being positive integers.
{ 3. $n = -s$ when s is an integer or fraction.

VII. Simplify the following: $(2^{n+4} \pm 2 \times 2^n) \times (2^{-2} \times 2^{-n-2})$

VIII. Multiply the following: $6\sqrt[3]{\frac{a}{b}} - 9\sqrt[3]{\frac{b}{a}} + 10\sqrt[3]{\frac{1}{ab}}$ and $2\sqrt[3]{\frac{a}{b}} + 3\sqrt[3]{\frac{b}{a}} - 5\sqrt[3]{\frac{1}{ab}}$. Express result in simplest form.

IX. Solve the following; $\sqrt{(x + 2a\sqrt{4x + 3a^2})} = \sqrt{x} - 2a$.

PART II—ALGEBRA, BEYOND QUADRATICS.

(Omit any two, but give Nos. VI and VII of Part I.)

I. If $ax^2 + bx = c$, (a) Prove $x = \frac{-b \pm \sqrt{b^2 + 4ac}}{2a}$ (b) Solve the following equation, using principles of affected quadratics:

$$\sqrt[3]{3x - 2x^2} - \sqrt[6]{3x - 2x^2} = 2.$$

II. A courier travels from P to Q in 12 hours. Another courier starts at the same time from a place 24 miles the other side of P, and arrives at Q at the same time as the first courier. The second courier finds that he takes half an hour less than the first to accomplish 12 miles. Find the distance from P to Q. (Simply determine equation.)

III. Solve the following equations: $\begin{cases} xy - (x - y) = 1. \\ x^2y^2 + (x - y)^2 = 13. \end{cases}$

IV. Find sum of Geometric Progression in terms of first term, No. of terms and rates,—i. e., Prove $s = \frac{ar^n - a}{r - 1}$

V. There are four numbers, the first three of which form an arithmetic progression, and the last three a geometric progression. The sum of the first and third is 2, and of the second and fourth 37. What are the numbers? (Let $x - y$, x, $x + y$ be first three.)

VI. Expand the following to three terms (indicate fully, do not simplify): $\sqrt[3]{[(x^{-\frac{3}{5}} - 3y^{\frac{5}{4}})^{-5}]}$.

VII. (a) Prove Log. AB = Log. A + Log. B.

(b) In common system, prove that mantissa of a No. is not changed by multiplying or dividing the No. by any multiple of ten. Use: $10^{.4847} = 3.053$.