B.

11. (*a*) When $x = 2+\sqrt{-5}$ find the value of $x^3 - 2x^2 + x + 18$.

(*b*) Given $1 + \sqrt{1 - \frac{\cdot a}{x}} = \sqrt{1 + \frac{x}{a}}$ to find x.

11. (*a*) Factor $x^3 - 2x^2 + x + 18$, thus $x(x-1)^2 + 18$. Substitute value of x in this result, etc. *Ans.* = 0.

(*b*) Square each side, collect, square result thus, $x^4 + a^4 - a^2x^2 - 2ax^3 + 2a^3x = 0$. Add to left side $-a^2x^2 + a^2x^2$. Then factor, thus $(x^2 - a^2 - ax)^2 = 0$. $\therefore x^2 - a^2 - ax = 0$, etc.

Ans. $x = \frac{a}{2}(1 \pm \sqrt{5})$.

12. (*a*) If the roots of $cx^2 + dx + f = 0$ be α and β, show that the roots of $c^2x^2 + c(d-f)x - df = 0$ are $\alpha + \beta$ and $\alpha\beta$.

(*b*) $x^4 + y^4 = 2x^2y^2 - 15$, $x + y = xy + 1$.

12. (*a*) If roots of $cx^2 + dx + f = 0$, be α β. $\therefore (x-\alpha)(x-\beta) = 0$. $\therefore x^2 - x(\alpha+\beta) + \alpha\beta = 0$. $\therefore$ Since $cx^2 + dx + f = 0$, and $x^2 + \frac{d}{c}x + \frac{f}{c} = 0$, $\frac{d}{c} = -(\alpha+\beta)$ $\frac{f}{c} = \alpha\beta$

Substitute these values in $c^2x^2 + c(d-f)x - df = 0$, or $x^2 + x\frac{d-f}{c} - \frac{df}{c^2} = 0$ thus $x^2 - x(\alpha+\beta+\alpha\beta) + \alpha\beta(\alpha+\beta) = 0$. But the roots of this latter equation are $\alpha+\beta$ and $\alpha\beta$. $\therefore \{x - (\alpha+\beta)\}\{x - \alpha\beta\} = 0$, or $x^2 - x(\alpha+\beta+\alpha\beta) + \alpha\beta(\alpha+\beta) = 0$, etc.

(*b*) Square (2), find difference between result and (1) substitute, etc. $y = 4$ or 1.

13. Find two numbers whose difference is 4, and twice whose product is equal to the cube of the less.

13. Let x = smaller. $\therefore x+4$ = larger, etc. *Ans.* = 8, 4.

14. A number consists of three digits, the square of the second digit equals the product of the other two. The number multiplied by 7 is 124 times the sum of the digits, and if it be increased by 594 the digits will be inverted. Find the number.

14. Let x = digit in hundred's place.
y = " ten's place.
z = " unit's place.
$\therefore y^2 = xz$ .. .. (1)
$7(100x + 10y + z) = 124(x + y + z)$.. .. (2)
$100x + 10y + z + 594 = 100z + 10y + x$.. . (3)
From number 3 we find $x = z - 6$. Substitute this value of x in (2), etc. *Ans.* = 248.

ARITHMETIC AND MENSURATION.

(Solutions appeared in Jan. number, p. 33.)

NOTE.—Candidates for Junior Matriculation must take section A, and any four questions in section B. Candidates for the Junior Leaving Examination must take questions 4 and 5 in section A, any four questions in section B, and any three questions in section C.

A.

1. (*a*) How can you determine, by inspection, when a number is divisible by 5, 9?

(*b*) State and illustrate the proof of multiplication by casting out the nines.

(*c*) Find the value correct to four decimal places, of: $2 + \frac{1}{1\times2} + \frac{1}{1\times2\times3} + \frac{1}{1\times2\times3\times4} + \frac{1}{1\times2\times3\times4\times5} + \frac{1}{1\times2\times3\times4\times5\times6}$.

2. Distinguish between prime and composite numbers. Resolve the composite number 277200 into its prime factors, and by this process find the greatest common measure of 1071, 1092, 2310.

3. The actual cost of making a piano is $256. The manufacturer, importer and local agent each make 25 per cent. profit. For what amount does the agent sell it?

4. One clock strikes 5 strokes in 6 seconds and another strikes 6 strokes in 7 seconds. They strike the 10th stroke of 12 together. If the first clock is correct, what is the error of the second clock when the first clock begins to strike?

5. A speculator is shipping 30 horses, which cost $160 each, to Liverpool. For how much must he insure them at 1¾ per cent. so that in case of loss he may recover the cost of the horses, and the premium paid for insurance?

B.

6. Jones bought a house for $3,000 cash; it is assessed for ⅔ its value, the rate of taxa-