

$(a+b) = 0$
vanishes

11. Show that $a^3(b-c) + b^3(c-a) + c^3(a-b)$ is exactly divisible by $a+b+c$; and resolve the expression into its factors.

$$(a+b+c)(c-b)(a-b)(b-a)$$

EUCLID.

TIME—TWO HOURS AND A HALF.

Examiner : J. C. GLASHAN.

NOTE.—Candidates in order to pass must make at least 20 marks on this paper, and at least 120 on the group—Arithmetic, Algebra, and Euclid.

(Algebraic symbols must not be used.)

Values.

- 12 1. Define straight line, right angle, parallel straight lines. Supposing you have a flat ruler, how could you ascertain according to Euclid's definitions—
- 4 (a) Whether the edges are straight?
- 4 (b) Whether the ends are cut at right angles to one of the edges?
- 5 (c) What more than Euclid's definitions would you need in order to ascertain whether the edges are parallel?
- 12 2. The interior angles of a triangle are together equal to two right angles.
- 13 The perpendiculars let fall from the extremities of the base of a triangle on the opposite sides will include an angle supplementary to the vertical angle, i. e., the included angle and the vertical angle will be together equal to two right angles.
- 12 3. Equal triangles upon equal bases, in the same straight line and towards the same parts, are between the same parallels.
- 13 The straight lines joining the points of bisection of two sides of a triangle is parallel to the third side.
- 12 4. The complements of the parallelograms which are about the diameter of any parallelogram are equal to one another.
- 13 If through any point in the diagonal of a parallelogram, or in the diagonal produced, lines be drawn parallel to the sides, cutting the sides produced if necessary, the two parallelograms so formed through which the diagonal does not pass are equal in area to one another. (Prove for a point taken in the diagonal produced.)
- 18 5. In every triangle the square on the side subtending any of the acute angles is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall upon it from the opposite angle, and the acute angle.
- 13 The sum of the squares on two sides of a triangle is double the sum of the squares on half the base and on the line joining the vertex to the middle point of the base.

ANSWERS AND SOLUTIONS.

ARITHMETIC.

1. 1; 2. 615-070820. 3. \$120. 4. \$681.36. 5. Inc'd \$40. 6. 20 @ 8, 40 @ 9, 100 @ 10, 80 @ 13, 160 @ 14, is one solution. 7. \$5.00. 8. \$2189.94. 9. 121:125. 10. Together they travel 281 yds. in $6\frac{1}{4}$ ", and 281 yds. is the difference of the distances travelled by them in $47\frac{1}{4}$ ". Hence together they travel 70 mls. per hr., and the dif. of the distances travelled in 1 hr. is 10 mls; $\therefore$ 30 and 40 mls. are rates per hr.

ALGEBRA.

1. -117. $(z-x)a^2 + (x-y)ab + (y-z)b^2$.
2. $\frac{1}{4}a - (\frac{1}{4}b^2 - \frac{1}{4}c^2)^2$; $a + bx + cx^2$.
3. $4(x+a)(y+z)$; $(a+d+b-c)(a+d-b+c)$; $x(5x+8a)(4x+5b)$.
4. $3 - 4x + 7x^2 - 10x^3$.
5. (1). Put into form $4 + \frac{1}{x+1} + 1 + \frac{1}{x+4} = 2 + \frac{1}{x+2} + 3 + \frac{1}{x+3}$; thence $x = -\frac{1}{2}$, other two roots being infinite, as indicated by the vanishing of the coefficient of other powers of x . In fact by putting fractions into form $\frac{4+x}{1+\frac{1}{x}}$, &c., we may see that as x approaches ∞ , the equation is more and more nearly satisfied. (2). $\frac{2}{3}$ or $\frac{1}{3}$. (3). 6, 9, 12. 6. 160: 7. 40, 85. 8. $\sqrt{\frac{1}{2}(1-a)} + \sqrt{\frac{1}{2}(1+a)}$. 9. $5, \frac{1}{4}$; 4, solving the quadratic and introducing cond't'n. that qty. under radical sign shall vanish. 10. Reduce to identities by putting $a = bx$, $c = dx$, and substituting. 11. It vanishes on putting $a = -(b+c)$; $(a-b)(b-c)(a-c)(a+b+c)$.

EUCLID.

1. (a) Take two points and draw a line between them, using the ruler; turn the ruler over and draw a line between them again. The two lines drawn should coincide. (Ax. 10.)
- (b) Draw a straight line ABC ; put the corner of the ruler at B , and the end along AB , and rule a line BD along the edge. Turn the ruler over so that the end lies along BC and rule a line BE along the edge. Then if BD coincides with BE , the angles ABC , CBD are equal, being each equal to the angle of the ruler (Ax. 1), and $\therefore$ are right angles (Def. 10), and $\therefore$ (Ax. 11) the angle of the ruler is a right angle. If BD , BE do not coincide, the angles ABD , CBD are not equal; hence ABD is not a right angle, and $\therefore$ the angle of the ruler is not.
- (c) The edges are, of course, supposed straight. Place one edge along a line AB and draw CD along the other edge. Interchange the positions of the ends of the ruler, the same edge as before coinciding with AB , and draw along the other edge the line EF . Then if the edges be not parallel they approach one another, that is, C is nearer AB than E is, and F than D ; and hence CD , EF (produced if necessary) must intersect; and this will be the test that the edges are not parallel. Similarly, if the edges be parallel, CD , EF are in the same straight line. In the above it will be seen that in the expression "approach one another" is involved the notion that if two lines be not parallel the perpendiculars from one on the other keep getting smaller and smaller, or that when the lines are parallel these perpendiculars are equal, which may be deduced from Prop. 29.
2. The four angles of a quadrilateral are together equal to four right angles. 3 and 4 are immediately deduced from the propositions they accompany. 5. ABC the triangle, D the bisection of BC , AE perpendicular to BC , then $AB^2 = AD^2 + DB^2 + 2BD \cdot DE$, $AC^2 = AD^2 + DC^2 + 2CD \cdot DE$; $\therefore AB^2 + AC^2 = 2AD^2 + 2DB^2$.

Practical Education.

Queries in relation to methods of teaching, discipline, school management, &c., will be answered in this department. J. HUGHES, Editor.

HOW TO TEACH PLAIN SPEAKING.

III.

(Omissions continued.)

H.

One of the most amusing, and at the same time one of the most provoking oddities in enunciation is the omission of h wherever it is marked, and its introduction in similar words where it is not marked.

Examples.

Air	for	Hair.	Old	hold.
Hair	"	Air.	Hold	" Old.
Ear	"	Hear.	Island	for Highland.
Hear	"	Ear.	Highland	" Island.
&c.,			&c.	

Many who do not introduce the h where it is not marked, omit