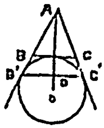
Let $a=0$, $b=1$, $c=2$,

Then $5\cdot 3+(-3)\cdot 5+(-3)\cdot 3=N(-3\cdot 3)$,

$\therefore N=1$,

and $\therefore$ (1) = (2).

VIII. Let $ABC$ be a triangle; and let a circle, whose centre is $O$, touch its side $BC$ and the sides $AB$, $AC$ produced at $B'$ and $C'$. Required to find chord $B'C'$.




Join $AO$; then $AO$ can be shewn to bisect $B'C'$ at right angles. Also, $AB'$ is equal to the semiperimeter of the triangle $ABC$. Let $s$ denote this semiperimeter.

Then $B'D=AB'\sin\frac{A}{2}$, because $AO$ bisects angle $A$,

$$\therefore B'D=s\sin\frac{A}{2},$$

wherefore $B'C'=2s\sin\frac{A}{2}$.

E. HAGARTY, Toronto.

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## PROBLEMS.

BY DAVID FORSYTH, B.A., MATHEMATICAL MASTER, BERLIN HIGH SCHOOL.

28. In $AB$, one side of a $\triangle ABC$, any point $D$ is taken. $BC$ is produced to $E$ so that rectangle $BE$, $EC$ = rectangle $AB$, $BD$. Shew that $\angle ACD=\angle AED$.

29. In the fig. of Prop. 47, Bk. I., join $GH$, $KE$, $FD$ and $AE$. Shew that 4 times $\triangle ADE$ = whole fig. = ½ sum of squares on sides of $\triangle ADE$. (Bks. I. and II.)

30. One circle touches another internally at point $A$. Describe an isosceles $\triangle$ about the smaller circle such that the vertex and one side shall lie on common tangent, and another angular point on circumference of larger circle.

31. I buy stock at a certain rate discount, and sell at same rate premium, brokerage being ¼ % in each case. Find selling price of stock in order that 28⅔ % may be gained on money invested.

32. Three men, $A$, $B$, $C$, labour at a piece of work by turns of one day each. It is found that the time occupied will be 14, 13¼ or 13 days, according as $A$, $B$ or $C$ does the first day's work. How long would each take to do same amount of work?

33. $A$, $B$, $C$ start at a given place to travel round an island 120 miles in circumference. $A$'s rate is 5½ miles a day; $B$'s, 17¼; $C$'s, 29¼; in what time will they all be together again?

34. Solve $=n\ x^4-14x^3+71x^2-154x+120=0$; having given that roots are in arithmetical progression.

35. If $c=\sqrt[2y]{1+x}$, then $x=1+2y+2y^2+\frac{4}{3}y^3+\frac{2}{3}y^4+\frac{4}{15}y^5+\dots$

36. If $1=x(x-a)=y(y-b)$, and $4=a^2+b^2+c^2-abc$, find value of $c$ in terms of $x$ and $y$.

37. If the H. C. D. of $a^4+2a^2b+2ac+d$, and $a^3+ab+c$, be a quadratic factor but not a complete square, then the expression, $a^4+2a^2b+2ac+d$, must be a complete square.

38. If $a+b+c=a^2+b^2+c^2=a^3+b^3+c^3=n$, then $abc=\frac{1}{6}(n^3-3n^2+2n)$.

39. Shew that $\dfrac{\frac{1}{1^n}+\frac{1}{3^n}+\frac{1}{5^n}+\text{\&c., } ad\ inf.}{\frac{1}{2^n}+\frac{1}{4^n}+\frac{1}{6^n}+\text{\&c., } ad\ inf.}=$

$$n+\frac{n(n-1)}{|\underline{2}}+\frac{n(n-1)(n-2)}{|\underline{3}}+\dots+\frac{n(n-1)}{|\underline{2}}+1$$

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## UNIVERSITY OF TORONTO EXAMINATIONS, 1879.

### *Honor Problems.*

*Examiners*—Charles Carpmael, M.A.; A. K. Blackadar, B.A.

1. The sides $AB$, $AC$ of the triangle $ABC$ are produced to $D$ and $E$, $DE$ is parallel to $BC$ and the triangle $DEB$ is double the triangle $ACB$; prove that $AB$ is equal to $BD$.

2. A common tangent to two intersecting circles subtends supplementary angles at the points of intersection.

3. If two circles cut each other at right angles, the line passing through their centres is divided harmonically by the circles.

4. Prove, $x_1+x_2(1-x_1)+x_3(1-x_1)(1-x_1)+x_4(1-x_1)(1-x_2)(1-x_3)+\dots\dots n$ terms.

$\equiv 1-(1-x_1)(1-x_2)(1-x_3)\dots n$ factors.