Mr. L. H. Luck has been re-engaged as head master of the Public Schools in Beeton. When Mr. L. went to Beeton two years ago not a pupil had ever passed the entrance examination there. The first year Mr. Luck passed six pupils for entrance and the next two for entrance and four for intermediate, one of the intermediate pupils being only twelve years of age.

Mr. James Paris, Public School teacher in Almonte, is about to retire from the profession.

Mr. W. A. Smith, late head master of the R. C. Separate Schools in Almonte, has been appointed to a similar position in the Renfrew Separate Schools. Before leaving Almonte Mr. Smith was tendered a complimentary supper by his many friends.

Mr. Geo. Lister, for three years teacher in Almonte, has been engaged to teach at McDonald's Corners, *vice* Mr. A. Wilson resigned.

We are pleased to learn that Mr. Wilson Taylor took the Prince of Wales gold medal at the recent Normal School examination held at Toronto. He studied for a first A certificate under Mr. Merchant, and last July took the highest aggregate ever obtained in Ontario by any first-class candidate, taking 2,104 marks out of a total 2,300. We congratulate our young friend on his remarkable success in education, and can safely say that he has a great future before him.—*Ingersoll Sun.*

Some change will be made in the arrangement of the work in the Whitby Collegiate Institute. Mr. Embree, the Principal, will take English Language and Literature, French and German; Mr. T. G. Campbell, mathematics and part of the science; Mr. Fotheringham, classics; Mr. Henderson, history and geography, drawing, commercial subjects, including phonography; Mr. N. W. Campbell, English and science.

The trustees of Greensville Public School, (No. 5, West Flamboro',) have erected during the last summer a magnificent new brick school house, of which the whole section are justly proud. It has been built on the most approved model, at a cost of $3,000. Mr. J. B. Morrow, who so ably managed the school during the last term, has been re-engaged as Principal for 1885, at a salary of $500. Miss Katie Sheehan has been re-engaged as assistant.

Mr. J. B. Turner, formerly of Hamilton, but recently of St. Catharines Collegiate Institute, has been appointed to succeed W. H. Ballard, M.A., as Mathematical Master of the Hamilton Collegiate Institute.

Mathematical Department.

UNIVERSITY OF TORONTO, ANNUAL EXAMINATIONS, 1884.

JUNIOR MATRICULATION.

MATHEMATICS.

Examiner: W. J. LOUDON, B.A.

1. Find the sixth root of 2565726409.
2. (*a*) A square number cannot be of the form $12n+5$.
   (*b*) The product of three consecutive numbers cannot be a perfect square.
3. Divide $3^{3^{14}}-1$ by $3^{3^{13}}-1$.
4. Simplify $a^4\dfrac{(a+b)(a+c)}{(a-b)(a-c)}+\ldots\ldots+\ldots\ldots$, and reduce to lowest terms $\dfrac{8x^7-377x^3+21}{21x^7-377x^4+8}$.
5. Solve the equations:
   $976063x^2-1952450x+976063=0.$
   $16x(x+1)(x+2)(x+3)=9$
   $x\sqrt{1-y^2}-y\sqrt{1-x^2}=xy-\sqrt{1-x^2}\sqrt{1-y^2}=\frac{1}{2}.$
6. Any two sides of a triangle are together greater than the third side.
7. Enunciate and prove Prop. 13, Book II.
8. To find the centre of a given circle.

SOLUTIONS.

1. Extracting the square root, and then the cube root we get 37.

2. The formula is true only when n is integral. When n is a whole number $12n+5$ is an odd number, for it is the sum of $12n$, an even number, and 5, an odd number. Now, every odd square number $\div 12$ leaves remainder either 1 or 9. But $(12n+5)\div 12$ leaves for remainder 5, $\therefore$ $12n+5$ is not a square number.

NOTE.—Every odd number > 12 is one of the forms $12p+11$, $12p+9$, $12p+7$, $12p+5$, $12p+3$, or $12p+1$. Hence every odd square number is one of the forms

$$(12p)^2+2(12p)11+11^2$$
$$(\quad)^2+(\quad)9+9^2$$
$$(\quad)^2+(\quad)7+7^2 \text{ \&c.}$$

Hence every square odd number $\div 12$ is of one of the forms $12x+121$, $12x+81$, $12x+49$, $12x+25$, $12x+9$, or $12x+1$. If we divide these again by 12 we have $12y+1$, $12y+9$ as the final forms, so that the remainders must be either 1 or 9, and never can be 5.

2. (*a*) Let $x-1$, x, $x+1$ be the numbers,
Product$=x(x^2-1)$, which is manifestly not the square.

3.
$$\begin{array}{r|lll|l}
3^{3^{13}} & 3^{3^{14}} & +0 & +0 & -1 \\
 & & 3^{2.3^{13}} & 3^{3^{13}} & \\
+1 & & & +3 & +1 \\
\hline
 & 3^{3^{14}-3^{13}} & 3^{2.3^{13}-3^{13}} & & \\
 & 3 & +3 & +1 & \\
\end{array}$$

$\therefore$ Quotient$\doteq 10\cdot 3^{3^{13}}+1.$

4. (*a*) $a^4.\dfrac{(a+b)(a+b)}{(a-b)(a-c)}=a^4-\dfrac{2a^2(b+c)}{(a-b)(c-a)}$

$\therefore$ by symmetry, the whole expression

$$=a^4+b^4+c^4-2\left(\frac{a^5(b+c)}{(a-b)(c-a)}+\frac{b^5(c+a)}{(b-c)(a-b)}+\text{\&c.}\right)$$

Now sum of the fractions ( )

$$=[a^5(b^2-c^2)+b^5(c^2-a^2)+c^5(a^2-b^2)]\div(a-b)(b-c)(c-a)$$
$$=[a^2b^2(a^2+ab+b^2)-c^2(a^4+a^3b+a^2b^2+ab^3+b^4)+c^3(a+b)]\div(b-c)(c-a)$$
$$=[(b+c)(a^2+ab+b^2)a^2-(b^2+bc+c^2)(a+b)c^2]\div(c-a)$$
$$=-(a^2b^2+b^2c^2+c^2a^2)-(a^2+b^2+c^2)(ab+bc+ca)-abc(a+b+c)$$

Hence the whole expression

$$=a^4+b^4+c^4+2(a^2b^2+\text{\&c.})+2(a^2+\text{\&c.})(ab+\text{\&c.})+2abc(a+b+c$$
$$=(a^2+b^2+c^2)(a+b+c)^2+2abc(a+b+c).$$

NOTE.—For a shorter and more scientific solution see Dr. McLellan's *Handbook*, p. 56, and *Companion*, p. 44. The general form of all such sums is given on p. 47 of the latter, hence we have given an independent solution instead of reproducing these to which our readers can easily refer.

4. (*b*) The H. C. F. of the terms of the fraction $=x^2-3x+1$. The fraction then easily reduces to

$$\frac{8x^5+24x^4+64x^3+168x^2+63x+21}{21x^5+63x^4+168x^3+64x^2+24x+8}.$$

NOTE.—The process of finding the H. C. F. is given for the benefit of those who may find any difficulty in it.

A	$=8x^7-377x^3+21$	
B	$=21x^7-377x^4+8$	
$(21A-8B)\div 377$	$=8x^4-21x^3+1$	$=C$
$(21B-8A)\div 377$	$=x^4-21x+8$	$=D$
$(8D-C)\div 21$	$=x^3-8x+3$	$=E$
$(8C-D)\div 21$	$=3x^3-8x^2+1$	$=F$
$(3E-F)\div 8$	$=x^2-3x+1$	$=G$
$(3F-E)\div 8$	$=x^2-3x+1$	$=H$

Hence this is the H. C. F. For a full exposition of this elegant method see *Teachers' Handbook of Algebra*, pp. 104, 105.

5. (*a*) From the formula $x=\{-b\pm\sqrt{(b^2-4ac)}\}\div 2a$ we get

$$x=\{1952450\pm\sqrt{(1952450^2-4\times 976063^2)}\}\div 2\times 976063$$
$$=\{\ \text{"}\ \pm\sqrt{(1952450+1952126)(\text{"}-\text{"})}\}\div\ \text{"}$$
$$=\{\ \text{"}\ \pm\sqrt{(4^2\times 494^2\times 2^2\times 9^2)}\}\div\ \text{"}\ \text{"}$$
$$=\{976225\pm 4\times 494\times 9\}\div 976063$$
$$\therefore x=\frac{958441}{976063}\text{ or }\frac{994009}{976063}.$$