limit himself to asking questions that tend to bring out the meaning of the author, without asking the candidate to account for "the order of the particulars," or for "dramatic touches."

In the papers on French and Latin, Grammar and Composition, about 75 per cent. of the marks is given for Prose Composition. I think that at least 50 per cent. of the marks should be allotted to the questions upon Grammar.

There is not enough difference in point of difficulty between the papers for Third and Second Class Candidates. This is especially true of the papers in English Grammar, Prose Literature and Drawing.

I would suggest a frequent change of Examiners in all subjects, as tending to cure many of the evils complained of.

*(To be continued.)*

## Examination Questions.

As Mr. Glashan's Algebra paper has had much attention and is severely criticised by some of our correspondents, we publish it below together with an explanatory note, and Mr. Glashan's Solutions, as given to the public by Professor Young, through the columns of the *Educational Weekly.*

### THE SECOND CLASS ALGEBRA PAPER.

*To the Editor of the* EDUCATIONAL WEEKLY.

SIR,—As the Second Class Algebra Paper at the recent examination of teachers has provoked a good deal of comment, it may interest your readers to see Mr. Glashan's solutions of the questions, with some notes which he has added.

The paper has been called "cranky." Nothing can be more absolutely opposed to the truth than such a statement. The ninth question is an exercise, in which there is nothing peculiar, in the formation of equations; the others, without exception, are applications of the broadest principles of Elementary Algebra.

When the paper was handed in to me as Chairman of the Central Committee, it did not strike me as being too difficult. Nor do I yet think it too difficult for Second Class teachers, prepared as they ought to be. But I admit that I was wrong in supposing that it was suitable for the candidates coming up for examination. It has, in fact, been found to be above the mark of the great majority of them. I need not say how much I regret this error of judgment on my part; and I shall do what I now can to prevent any candidate from being injuriously affected thereby. I am, sir, your obedient servant, GEORGE PAXTON YOUNG.

Toronto, 21st July, 1886.

### MIDSUMMER EXAMINATIONS, 1886.

SECOND CLASS TEACHERS.

### ALGEBRA.

*Examiner.—J. C. Glashan.*

1. Divide $x^{3^n} + 1$ by $x^{3^{n-1}} + 1$.

2. Simplify $1 + \dfrac{z}{x+y-z} + \dfrac{y}{z+x-y} + \dfrac{x}{y+z-x}$.

3. Resolve into linear factors:

(a) $a(b+c)(b^2+c^2-a^2)+b(c+a)(c^2+a^2-b^2)+c(a+b)(a^2+b^2-c^2)$.

(b) $(a^4-b^4)c^2+(b^4-c^4)a^2+(c^4-a^4)b^2$.

4. If $\dfrac{2x-y}{2a+b} = \dfrac{2y-z}{2b+c} = \dfrac{2z-x}{2c+a}$

show that $\dfrac{x+2y+3z}{x+y+z} = \dfrac{41a+38b+47c}{21(a+bc+)}$

5. Prove that if $x^5-qx+r$ have a square factor then will

$$\left(\frac{q}{5}\right)^5 = \left(\frac{r}{4}\right)^4.$$

6. Solve the simultaneous equations

$$\frac{2x+3y-4z}{x+5} = \frac{3x+4y-2z}{5x} = \frac{4x+2y-3z}{4x-1} = \frac{x+y-z}{6}$$

7. Solve $\begin{cases} x^2-xy=11x+4, \\ xy-y^2=11y-8. \end{cases}$

8. Eliminate $x$, $y$ and $z$ from the equations

$$x-z=a(x-y),\ \frac{1}{x}-\frac{1}{z}=b\left(\frac{1}{x}-\frac{1}{y}\right)x^2z=y^3.$$

9. $A$ walking along a road passes $B$, but finding he has lost something turns back and meets $B$ two hours after he passed him. Having found what he lost he overtakes $B$ again three hours after he met him, and arrives at his destination one hour later than he would have done had he *not turned back.* Compare the rates of walking of $A$ and $B$, assuming them to have been uniform throughout the whole time.

### SOLUTIONS.

BY MR. J. C. GLASHAN.

1. $$\left\{\left(x^{3^{n-1}}\right)^3 + 1\right\} \div \left(x^{3^{n-1}} + 1\right)$$

$$= \left(x^{3^{n-1}}\right)^2 - x^{3^{n-1}} + 1$$

$$= x^{3^{n-1}\times 2} - x^{3^{n-1}} + 1.\text{—Ans.}$$

2. The expression vanishes if $x=o$, $\therefore$ $x$ is a factor of the numerator.

The Expn, is symmetrical with respect to $x, y, z$, $\therefore$ $y$ and $z$ are also factors of the numerator.

The numerator is of the third degree, $\therefore$ there are no other literal factors of it. $\therefore$ Expn $= m\,x\,y\,z \mid (y+z-x)\,(z+x-y)\,(x+y-z)$.

To determine $m$, let $x=y=z=1$, $\therefore$ $1+1+1+1=m$. $\therefore$ $m=4$.

$\therefore$ Expn. $=4\,x\,y\,z \mid (y+z-x)\,(z+x-y)\,(x+y-z)$.—ANS.

3. (a) The Expn. vanishes if $x=o$. $\therefore$ $a$ is a factor of it.

The Expn. is symmetrical with respect to $a,b,c$, $\therefore$ $b$ and $c$ are also factors of it.

The Expn. is of the fourth degree, $\therefore$ it must have a fourth linear factor.

This factor must be symmetrical with respect to $a, b, c$, $\therefore$ it must be $a+b+c$. $\therefore$ Expn. $=mabc\,(a+b+c)$.

To determine $m$ let $a=b=c=1$. $\therefore$ $2+2+2=m$. $\therefore$ $2m=2$.

$\therefore$ Expn. $=2abc\,(a+b+c)$.—ANS.

(b) The Expn. vanishes if $a^2=b^2$, $\therefore$ $a^2-b^2$ is a factor of it.

The Expn. is symmetrical with respect to $a^2, b^2, c^2$, $\therefore$ $a^2-b^2$, $b^2-c^2$, $c^2-a^2$ are factors of it.

The Expn. is of the sixth degree, $\therefore$ it has no other literal factors. $\therefore$ Expn. $=m\,(a^2-b^2)\,(b^2-c^2)\,(c^2-a^2)$.

To determine $m$ let $a=o$, $b=1$, $c=2$, $\therefore -4+16=12m$, $\therefore$ $m=1$.

$\therefore$ Expn. $=(a-b)\,(b-c)\,(c-a)\,(a+b)\,(b+c)\,(c+a)$.—ANS.

4. Let each fraction $= m$,

$$\begin{array}{llr} \therefore & 2x-y=m\,(2a+b), & A. \\ & 2y-z=m\,(2b+c), & B. \\ & -x+2z=m\,(a+2c), & C. \\ \therefore\ 4A+2B+C; & 7x=m\,(9a+8b+4c), & D. \\ A+4B+2C; & 7y=m\,(4a+9b+8c), & E. \\ 2A+B+4C; & 7z=m\,(8a+4b+9c), & F. \end{array}$$

$$\therefore\ \frac{D+2E+3F}{D+E+F};\ \frac{x+2y+3z}{x+y+z} = \frac{41a+38b+47c)}{21\,(a+b+c}, \quad \text{Ans.}$$

5. Let $(x-a)^2$ be the factor, then, by division,

$$\begin{array}{c|l} & x^5 \qquad\qquad -qx \quad +r \\ a & \quad +ax^4+a^2x^3+a^3x^2+a^4x \ +a^5-qa \\ \hline & x^4+ax^3+a^2x^2+a^3x+a^4-q \ \big|\ a^5-qa+r. \quad \text{1st Rem.} \\ a & +ax^3+2a^2x^2+3a^3x+4a^4 \\ \hline & x^3+2ax^2+3a^2x+4a^3 \ \big|\ 5a^4-q. \quad \text{2nd Rem.} \end{array}$$

$\therefore$ if $(x-a)^2$ be a factor of $x^5-qx+r$,

$a^5-qa+r=o$, and $5a^4-q=o$,

$\therefore$ $a^4=\frac{1}{5}q$.

$\therefore$ $\frac{1}{5}qa-qa+r=o$,

$\therefore$ $a=\dfrac{5r}{4q}$,

$$\therefore\ \left(\frac{5r}{4q}\right)^4=\tfrac{1}{5}q,\ \therefore\ \left(\frac{r}{4}\right)^4=\left(\frac{q}{5}\right)^5\text{—Ans.}$$