(2) $16x^4 - 81y^4 = 3090960$

$2x + 3y = 54$

(3) $x + yz = y + zx = z + xy = 1$.

3. From

$$\left.\begin{array}{l} x^2 + x_1^2 + x_2^2 = mb^2 \\ y^2 + y_1^2 + y_2^2 = ma^2 \\ xy + x_1y_1 + x_2y_2 = 0 \\ x + x_1 + x_2 = 0 \\ y + y_1 + y_2 = 0 \end{array}\right\} \text{eliminate } x_1, y_1, x_2, y_2.$$

4. If A varies as B when C is invariable, and A varies as C when B is invariable, then A varies as BC when both B and C are variable.

If t be the time of a complete vibration of a pendulum of length l, $t \propto \sqrt{l}$. Hence find the length of a two-second pendulum when the length of the second pendulum is 39.4 inches.

5. Find the limit of an infinite geometrical progression whose common ratio is less than unity.

The first term of an infinite G. P. is 1, and any term is equal to the sum of all the succeeding terms. Find the common ratio.

Sum to $3n$ terms the series

$1 + 4 + 27 + 4 + 25 + 216 + 7 + \text{etc.}$

6. Find the number of permutations of n things taken r together.

Three boxes contain respectively 4, 5, and 6 counters. In how many ways may 4 counters be drawn, not taking more than 2 from one box?

If P_r be number of permutations of n things taken r together, shew that when $m > 2$

$$(P_1 - 1)(P_2 - P_1) \ldots (P_m - P_{m-1}) = P_2 P_3 \ldots P_{m-1} P_{m+1}.$$

7. Prove the binomial theorem for all values of the index.

(1) The remainder after n terms of the expansion of

$$(1-x)^{-2} = \frac{(n+1)x^n - nx^{n+1}}{(1-x)^2}$$

(2) $\sqrt{2} = 1 + \frac{3}{2\lfloor 2} - \frac{3 \cdot 5}{2^2 \lfloor 3} + \frac{3 \cdot 5 \cdot 7}{2^3 \lfloor 4} - \text{etc.}$

EDUCATION DEPARTMENT, ONTARIO.

JULY EXAMINATIONS, 1881.

First Class Teachers—Grade C.

ARITHMETIC.

1. Examine the merits of the following test of the accuracy of a sum in addition:—"Divide the sum of the digits in each horizontal line by 9, retaining only the remainders; divide the sum of these remainders by 9, and if the remainder then obtained be equal to the remainder obtained on dividing the sum of the digits in the answer by 9, the answer is correct."

Will the test apply if "vertical lines" replace "horizontal lines" in the preceding; and if so, why?

The principle is correct both for horizontal and vertical lines.

2. A man sells goods for $1125. Half he sold at an advance of 25 per cent. on the cost, two-fifths at an advance of 12½ per cent., and the remainder at half its cost. What did he originally pay for the goods?

Let unity represent amount of goods, then

$$\frac{1}{2}\left(1 + \frac{25}{100}\right) + \frac{2}{5}\left(1 + \frac{12\frac{1}{2}}{100}\right) + \frac{1}{10}\left(\frac{1}{2}\right) = \$1125, \quad \therefore 1 = \$1000.$$

3. If 4 pumps, each having a length of stroke of 3 ft. and a piston of radius 3 inches, empty a cubical cistern whose side is 6 ft., in 1 hour; what must be the radius of the piston of each of 6 pumps whose stroke is 4 ft., that they may empty a cistern whose sides are half those of the former in ⅝ of an hour, there being a defect in the latter pumps which takes away 10 per cent. of their efficiency?

One pump with stroke of $\left(4 \times 3 \times \frac{\pi}{16}\right)$ cub. ft. discharges 216 cub. ft. in 1 hr. Another pump with stroke of $\left(6 \times 4 \times \pi r^2 \times \frac{9}{10}\right)$ cub. ft. discharges 27 cub. ft. in one hr., or with stroke of $\left(5 \times 6 \times 4 \times \pi r^2 \times \frac{9}{10}\right)$ cub. ft. discharges 216 cub. ft. in 1 hr.

$\therefore 5 \times 6 \times 4 \times \pi r^2 \times \frac{9}{10} = 4 \times 3 \times \frac{\pi}{16}, \quad \therefore r = 1$ in.