

2. In drawing a vase, goblet, or other similar object, would you draw the right or left side first? Give reasons for your answer.
3. In introducing a class to object drawing, what are the most important things to be attended to?
4. In drawing an object, should its real or apparent form be given? (b) Why?
5. State the two methods of giving a blackboard drawing lesson. (b) Which would you adopt? State reasons for doing so.
6. Give rules for drawing the perpendicular and horizontal lines in a row of houses, seen from a distance by a person looking down the street on which they are situated.
7. Draw the wheel of a wheelbarrow, or any similar wheel; 1st, with the eye opposite the centre of the end of the hub; 2nd, viewing the wheel obliquely. Let there be eight spokes in the wheel. Give construction lines in each case.

MUSIC.

Examiner: JAMES HUGHES.

FIRST AND SECOND-CLASS TEACHERS.

1. Define Interval, Unison, Ledger lines, Octave, Cleff, Measure, Bar, Voice Register.
2. Explain the difference between the Chromatic and Diatonic Scales.
3. Give the order of tones and half tones in a Major Diatonic Scale, and construct the scales of *re*, *la*, and *mi* ♭, giving their signatures.
4. Why may two intervals of the same name be of different lengths?
5. Fill a measure of $\frac{3}{4}$ time in as many ways as possible.
6. Make the crotchet and quaver rests, and show how they may be prolonged.
7. Name the four classes of voices, and explain the difference in their registers.
8. What notes constitute the common chord?
9. Explain the difference between Melody and Harmony.

ALGEBRA.

Examiner: J. A. McLELLAN, LL.D.

I.

1. Prove $x^m \div x^n = x^{m-n}$.
 - (1.) Simplify $(a+b+c)^3 - 3(a+b+c)^2c + 3(a+b+c)c^2 - c^3$.
 - (2.) Divide $1 - 3xy - y^2 - x^2$ by $1 - x - y$.
2. Prove the rule for finding the L. C. M. of two quantities. Find the L. C. M. of—
 - (1.) $x^3 + 6x^2 + 11x + 6$, $x^3 + 6x^2 - 25x + 150$.
 - (2.) $a^3 + b^3 + c^3 - 3abc$, $(a+b)^3 + 2(a+b)c + c^3$.
3. Prove $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$.
Simplify $\left(\frac{1-x^2}{1-x^3} + \frac{1-x}{1-x+x^2} \right) \div \left(\frac{1+x}{1+x+x^2} - \frac{1-x^2}{1+x^3} \right)$
4. Reduce to their lowest terms $\frac{a^{2m} + a^{2m-2}}{a^{2m} + a^{2m-2}}$ and $\frac{a(a+2b) + b(b+2c) + c(c+2a)}{(a^2 - b^2 - c^2 - 2bc)}$.
5. (1.) If $a^3 - pa^2 + qa - r = 0$, then $x^3 - px^2 + qx - r$ is exactly divisible by $x - a$.
(2.) Prove that $(a+b+c)(bc+ca+ab) - (b+c)(c+a)(a+b)$ is divisible by abc . Is there any other divisor?
6. If $x = \left(\frac{a+b}{a-b} \right)^{\frac{2mn}{n-m}}$, then $\frac{a^2 - b^2}{a^2 + b^2} (\sqrt[n]{x} + \sqrt[n]{x}) = \left(\frac{a+b}{a-b} \right)^{\frac{m+n}{n-m}}$
7. Solve the equations—
 - (1.) $\frac{8-2x}{1-2x} - \frac{5-2x}{7-2x} = 1 - \frac{4x^2-2}{7-16x+4x^2}$
 - (2.) $8x - 2y = 5z - 6y = 7z - 4z = 1$.
 - * (3.) $\frac{x+8}{x+4} - \frac{x+1}{x+2} = \frac{4x+9}{2x+7} - \frac{12x+17}{6x+16}$.

* Candidates for 2nd-class certificates may omit this equation.

8. A person going at the rate of p miles an hour, and desiring to reach home by a certain time, finds, when he has still r miles to go, that, if he were continuing to travel at the same rate, he would be q hours too late. How much must he increase his speed to reach home in time?

9. Of the three digits comprising a number, the second is double of the third; the sum of the first and third is 9, and the sum of the three digits is 17. Find the number.

10. A owes B \$ a , due m months hence, and also \$ b due n months hence. Find the equation which determines the time at which both sums could be paid at once, reckoning interest at 5 per cent. per annum.

ALGEBRA.

II.

1. Simplify

$$\left\{ \left(\frac{x+y}{x-y} \right)^2 + 1 \right\} \left\{ \left(\frac{x+z}{x-z} \right)^2 + 1 \right\} \left\{ \left(\frac{y+z}{y-z} \right)^2 + 1 \right\} \times \frac{x^2(y-z) + y^2(z-x) + z^2(x-y)}{x^3y^2 + x^2y^4 + x^4z^2 + x^2z^4 + y^4z^2 + y^2z^4 + 2x^2y^2z^2}$$

2. Solve (1.)

$$\frac{ax+m+1}{ax+m-1} + \frac{ax+n}{ax+n-2} = \frac{ax+m}{ax+m-2} + \frac{ax+n+1}{ax+n-1}$$

$$(2.) \sqrt[3]{1+\sqrt{x}} + \sqrt[3]{1-\sqrt{x}} = 2.$$

3. A, B, and C start from the same place; B, after a quarter of an hour, doubles his rate, and C, after walking 10 minutes, diminishes his rate one-sixth; at the end of half an hour, A is a quarter of a mile before B, and half a mile before C, and it is observed that the total distance walked by the three, had they each continued to walk uniformly from the first, is $6\frac{1}{4}$ miles. Find the original rate of each.

4. (1.) Investigate the relations that must exist between the constants in order that $Ax^2 + By^2 + Cz^2 + ayz + bxz + cxy$ shall be a perfect square.

- (2.) Find the conditions that the values of x and y derived from the equations $ax + by = \frac{a^3}{x} + \frac{b^3}{y} = c^2$ may be rational.

5. If $x^2 + px + q$ and $x^2 + mx + n$ have a common factor, then $(n-q)^2 + n(m-p)^2 = m(m-p)(n-q)$.

6. Prove $(a^m)^n = a^{mn}$, whether m and n be positive or negative, integral or fractional.

$$\text{Show that } (x^{2m} + x^{2n})^{\frac{1}{mn}} = \frac{1}{x^m} + \frac{1}{x^n} \times (x^{m-n} + x^{n-m})^{\frac{1}{mn}}$$

$$7. (1.) \text{ If } \frac{a}{b} = \frac{c}{d}, \text{ then } \sqrt{\frac{a^2 + b^2}{c^2 + d^2}} = \left(\frac{a-b}{c-d} \right)^{\frac{1}{2}}$$

$$(2.) \text{ If } \frac{a^2 d^n - b^2 c^n}{\frac{1}{2}n(a^n - b^n - c^n + d^n)} = \frac{a^2 c^n - b^2 d^n}{\frac{1}{2}n(a^n - b^n - d^n + c^n)}, \text{ then}$$

$$\text{each of these fractions} = \frac{1}{n}(a^n + b^n + c^n + d^n).$$

8. If x be very small, show that—

$$\frac{(1+2x)^{\frac{1}{2}} + (1+8x)^{\frac{1}{2}}}{2+5x-(1+4x)^{\frac{1}{2}}} = 2-4x, \text{ very nearly.}$$

9. Prove that

$$1 - n^2 + \frac{n^2(n^2-1^2)}{1^2 \cdot 2^2} + \frac{n^2(n^2-1^2)(n^2-2^2)}{1^2 \cdot 2^2 \cdot 3^2} - \dots = 0.$$

10. If a debt \$ a at compound interest be discharged in n years by annual payments of $\frac{a}{m}$, show that $(1+r)^n(1-mr) = 1$,

where r is the interest on \$1 for a year.

11. Solve—(1.) $3x^2 - 2xy = 55$.

$$x^2 - 5xy + 8y^2 = 7.$$

$$(2.) \frac{5}{x^2 - 7x + 10} + \frac{5}{x^2 - 18x + 40} = x^2 - 10x + 19.$$

$$(8.) a^2 b^2 x^{\frac{1}{2}} - 4a^{\frac{3}{2}} b^{\frac{3}{2}} x^{\frac{3}{2}} = (a-b)^2 x^{\frac{1}{2}}.$$