

Annual report of the Superintendent of Public Instruction of the State of Michigan, with accompanying documents, for the year 1898.  
Lansing: The Superintendent, 1898.

STATE EXAMINATIONS.

1. QUESTIONS PREPARED BY STATE BOARD OF EDUCATION FOR EXAMINATIONS HELD AT LANSING AND PETOSKEY, AUGUST, 1898.

ALGEBRA.

1. Factor and give rule:  $x^2 - 6x^2 + 6x - 1$ .
2. Find the L. C. M. of  $x^2 - 6x^2 + 11x - 6$ ,  $x^2 - 6x^2 + 26x - 24$ , and  $x^2 - 6x^2 + 18x - 12$ .
3. Solve: When the greater of two numbers is divided by the less, the quotient is 4 and the remainder 8; and when the sum of the two numbers is increased by 38 and the result divided by the greater of the two numbers, the quotient is 2 and the remainder 2.
4. Simplify  $(3a^2b)^3$ ; also  $(-8m^2n)^3$ . Give rule for simplifying.
5. Put  $-36x^2$  under a radical whose index is 4. Give rule for same.
6. Reduce  $a^2 + e$  and  $(a - e)^2$  to a common index. Give rule for same.
7. How do you solve complete quadratic equations?
8. A farmer puts his sheep in four pens. In the first he places four less than one-third; in the second, two more than one-fourth; in the third, three more than one-fifth; and in the fourth, twenty-five. How many sheep had he?
9. An army corps of 12,860 men was formed with two squares, one of which had ten men more on a side than the other. How many men were there in each square?
10. Mention two of the best text-books in algebra. State reasons for choice.

ARITHMETIC.

1. (a) If 300 laborers can make an embankment in 48 days, how many more days would be required if the number of men is diminished by 60?  
(b) An express train runs 40 miles in 64 minutes; at the same rate how many miles will it run in 24 minutes?
2. (a) Explain as to a class the difference between the simple and local value of figures.  
(b) Write in figures fourteen million, one thousand and five hundredths; three trillion, two hundred one, and one thousand seventy billions; also write in words, 7,504,306,046,524.
3. I own a horse and a farm; one-fourth the value of the farm is four times the value of the horse, and both taken together are worth \$1,700. Find the value of each. Write out a complete analysis.

DEPARTMENT OF PUBLIC INSTRUCTION.

4. (a) Draw a government township, with all the subdivisions made by the government survey.  
(b) Define base line and meridian, and locate relatively town 14 N, range 10 W.
5. A man paid  $\frac{1}{2}$  of his money for a farm, and  $\frac{1}{4}$  more than  $\frac{1}{2}$  of the remainder for repairs, after which he had \$2,631 left. How much had he at first?
6. State original problems illustrative of the different cases in longitude and time. Work one of them, and explain as to a class.
7. Make out in form a bill of not less than four items purchased by a hardware merchant of a wholesale house. Compute and receipt the bill as clerk.
8. How many feet board measure in a board 24 ft. long, 23 inches wide at one end and 17 inches at the other, and  $1\frac{1}{2}$  inches thick?
9. Would you teach the business rules of arithmetic by formula? Give reason?
10. A horse-dealer sold a horse for \$80, and lost 25% of the cost of the horse. He sold another horse at an advance of 20% on the cost, and gained as much as he lost on the first one. What was the selling price of the second horse?

BOTANY.

- DIRECTIONS.—(1) He sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
1. Give some of the distinguishing characteristics of the following groups of plants and arrange the groups in their natural order: liverworts, algae, mosses, fungi, gymnosperms, dicotyledons, monocotyledons ferns.
  2. Give the chief characteristics of three families of flowering plants, and name three plants in each family, using illustrations familiar to this region.
  3. Name the principal parts, or members, of one of the higher plants, and tell in few words the function of each part.
  4. Name six modifications of plant organs, illustrating in each case from horticultural, or garden plants, and telling for what use to the plant the modification is made.
  5. Describe the location, structure, and function of the wood and bark in higher plants, and tell what uses are made of these parts in manufacture.
  6. Describe the manufacture of sugar and starch by plants.
  7. Describe and contrast the processes of carbon-assimilation and of respiration in plants.
  8. What factors go to make a fertile soil, and what substances do plants take from the soil?
  9. What means known to you do plants possess for non-sexual propagation? What means do horticulturists use for the same purpose?
  10. Describe the process of sexual reproduction in flowering plants.
- Note.—State what training and experience you have had in the science of botany.

CHEMISTRY.

- DIRECTIONS.—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
1. Define and give example:
    - (a) Heat of combustion.
    - (b) Indirect oxidizing agent.
    - (c) Basic salt.
    - (d) Hydrocarbon.
    - (e) Osmotic pressure.

2. Discuss chlorine in respect to preparation, and physical and chemical properties.
3. What experiments are necessary to teach the pupil the essentials concerning the composition of water?
4. (a) Describe a method for determining, accurately, the composition of air by volume. (b) Write out the formula commonly applied in reducing the volume of a gas to standard conditions.
5. (a) Describe fully the Marsh test for the detection of arsenic. (b) How can arsenic be distinguished from antimony?
6. (a) Name and briefly describe the three allotropic modifications of carbon. (b) Make a diagram of the ordinary gas flame. (c) How may a non-luminous flame be made luminous? How may a luminous flame be made non-luminous?
7. (a) Outline the chemical work necessary to determine the atomic weight of oxygen. (b) Describe briefly the specific heat method of determining atomic weights.
8. (a) Briefly describe a test for sulphuric acid and carbonic acid, writing the equation for reaction. (b) How is a chloride detected in the presence of a bromide?
9. (a) Give brief description of a method for the separation and identification of lead, silver, and mercurousum. (b) For the separation and identification of iron.
10. What chemical preparation should the student possess before being admitted to qualitative analysis?  
NOTE.—State fully what work you have done in chemistry.

## CIVIL GOVERNMENT.

1. Mention the different ways in which judges of State supreme courts are selected. Which, in your opinion, is the better way, and why?
2. Discuss direct and indirect taxation, giving an example of each.
3. Describe the Australian system of voting. What do you consider the two strongest points in its favor?
4. (a) Define prohibition and high license. (b) Give two arguments advanced by advocates of each.
5. Give two synonyms for wealth, enumerating four different forms of wealth.
6. Define paper money, specie payment, gold and silver certificates.
7. Briefly explain the law of supply and demand.
8. Define capital and credit, co-operation and profit.
9. Write fully regarding some of the results growing out of combinations of capital. (20 credits.)

## ENGLISH LITERATURE.

1. Give a brief account of English Literature previous to the Norman Conquest.
2. Chaucer is called "The Father of English Poetry." On what grounds is he so called? Give a synopsis of his works and a brief account of one of them.
3. Name some of the causes of the great revival of literature in the Elizabethan Period. What are the chief literary characteristics of the period? Name some of the authors and their chief works in support of what you say of the characteristics of the period.
4. Of what great movement in literature were Spenser, Wordsworth, and Coleridge leaders? Give some account of the movement.
5. Give a brief account of the life and works of Whittier. What features of Whittier's work tend to make it simply the literature of one age. What features of his work will tend to make it always live?

## DEPARTMENT OF PUBLIC INSTRUCTION.

6. Name the greatest writers of American prose who have written during the past twenty-five years. Give reasons for your selection.
7. Thackeray is considered by the English people their greatest novelist. What are the reasons for this estimate of Thackeray?
8. Give a short account of the evolution of the novel.
9. What is the general trend of the literature of today, (1) in England, (2) in America?
10. Give your opinion of literature as a school study.

## GENERAL HISTORY.

1. What do you understand by a period of history? How do you divide general history into periods? Give reasons for your division.
2. Compare Gladstone and Bismarck in regard to (a) character, (b) service to their own countries, (c) service to the world.
3. What led to the formation of the present French Republic? What are the most important points of likeness and of unlikeness between that government and our own?
4. What has been the general tendency in European government during this century? Reason for your answer.
5. What have been the principal services in history of the Christian church?
6. Compare as to powers of government an ancient Greek city, as Athens in the height of its power, and a modern city, as New York.
7. Give country, century and special service of five of the following: Savonarola, Raphael, Sir Christopher Wren, Farnese, Von Moltke, Victor Hugo, Cecil Rhodes, Talleyrand.
8. Give author, period treated, and historical value of any five of the following: Tale of Two Cities, Romola, The Last of the Barons, Ivanhoe, The Egyptian Princess, Quo Vadis.
9. State the location and historical interest connected with any five of the following: St. Peter's, Parthenon, Louvre, Kenilworth, San Souci, Alhambra.
10. Trace briefly the rise and fall of Spain as a "Power."

## COMPOSITION—RHETORIC.

- DIRECTIONS.**—(1) Be sure you understand the question. (2) Take time enough and pause enough to make sure you fully understand and read. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
1. Give in narrative form a short account of your preparation in rhetoric and composition, as follows: (1) State the school (or schools) you attended; (2) the time spent upon these studies; (3) the number of compositions written; (4) the text-books used; (5) any exercises or methods of instruction that seem to you to have been particularly profitable or unprofitable.
  2. Prepare an outline for an essay of about 1,000 words on one of the following topics, indicate the divisions and sub-divisions with such definiteness that the course of the thought from point to point can easily be traced.
    - (a) Resources of the State of Michigan.
    - (b) Origin of the War with Spain.
    - (c) Influence of a Circulating Library.
- N. B.—Do not write an essay.

3. Having examined the following essay written by a pupil in the 9th grade, state (1) what you regard as the prevailing fault; (2) what advice you would give the writer to assist him in overcoming his defects of composition:
- While I was spending my summer vacation in the country we had quite a bad runover. While out driving one afternoon, myself and a friend, we had a very spirited span of horses, and we were going by a bicycle when the horses took fright and started to run away. Of course I was so frightened, never being in a runaway before, that I really didn't know what to do. So I jumped out over the wheel, spraining my ankle. The driver soon got the horses under control and came back to where I was and took me home, which place I did not leave for three weeks, and you may be sure when I did I didn't go out riding, and after it I was so timid I would not go again.
- N. B.—Write what you would actually say to the pupil, if you were talking with him about his essay.
4. State three important rhetorical principles with which pupils in the 8th grade should, in your opinion, be familiar.
5. Analyze the following paragraph, indicating (a) the leading thought, (b) the office of each sentence in the development of this thought: (Sentences are numbered (1) I would save the Union. (2) I would save it in the shortest way under the Constitution. (3) The sooner the national authority can be restored, the nearer the Union will be "The Union as it was." (4) If there be those who would not save the Union unless they could at the same time destroy slavery, I do not agree with them. (5) My paramount object in this struggle is to save the Union and is not either to save or destroy slavery. (6) If I could save the Union without freeing any slave, I would do it; and if I could do it by freeing some and leaving others alone, I would also do that. (7) What I do about slavery and the colored race, I do because it helps to save this Union; and what I forbear, I forbear because I do not believe it would help to save the Union. (8) I shall do less, whenever I shall believe what I am doing hurts the cause; and I shall do more, whenever I shall believe doing more will help the cause. (9) I shall try to correct errors when shown to be errors; and I shall adopt new views so fast as they shall appear to be true; even, (10) I have here stated my purpose according to my view of official duty; and I intend no modification of my oft-expressed personal wish that all men, everywhere, could be free.
6. Make a list of all the words which can be used to supply the omission in the following sentence, indicating the word which in your opinion is most fitting for this purpose, and giving reasons for your choice:
- After the concert the people often waited outside to accompany him to his hotel. Paganini seemed delighted with this kind of homage and would go out at such seasons and mix freely with them; but he was often quite \_\_\_\_\_ and bent upon absolute seclusion.

## GEOGRAPHY.

1. What should be the central thought of all geography teaching, and what special points are to be noted in the study of any country?
2. How does the spherical form of the earth affect the direction of the winds and ocean currents? Give illustration.
3. (a) What general laws govern the relief forms of every continent?  
(b) Cite some fact to show that the earth's interior is still cooling and contracting.
4. What can you say of the manufacture and use of the following: olive oil, gun-cotton, indigo, linseed oil, quinine?
5. Account for the following:  
(a) Aridity of Rocky Mountain District.  
(b) Frequency of north-westerly winds.  
(c) Periodic rains of the Pacific Slope.

6. (a) Why is the Suez canal regarded as the most important maritime trade route in the world?  
(b) By the construction of what canal can the two branches of our navy be practically united?
7. What peninsula did Japan mean to occupy at close of the China-Japan war, and how was she prevented from so doing?
8. The Congo Free State: Its location and approximate area; when organized, for what purpose, and how governed?
9. Tell of the location, climate, chief exports, and population of the Philippines? Why so named?
10. (a) What places in the United States have recently been made rallying points for our troops, and why were they selected?  
(b) Make an outline sketch showing the relative location of Tampa, Key West, Havana, Santiago de Cuba, and San Juan.

## GEOLOGY.

1. Discuss in full the destructive and constructive effects of water; as streams, ocean currents, waves and tides.
2. Explain from a diagram the principle of the Artesian well. In nature what conditions are necessary for their formation?
3. Under what conditions do reef-building coral animals flourish? How may we account for the formation of the typical coral island?
4. Discuss the formation and geological effects of glaciers.
5. How may we account geologically for the absence of any great mountain ranges in the Mississippi Valley?
6. How have our Great Lakes been formed and what can you give of their history?
7. Of the great rock divisions of the geological series, which are represented in Michigan? Why these? Why no others?
8. These Michigan strata furnish what economic products? From what parts of the state are these several products obtained?
9. Give the structure, composition and methods of formation of sandstone and granite.
10. What does geology teach in regard to the origin, progress and development of animal and vegetable life?

## GEOMETRY.

1. Demonstrate: The perpendicular is the shortest line that can be drawn from a point to a straight line.
2. State correctly five propositions concerning arcs and chords.
3. State two propositions concerning tangents and demonstrate one of them.
4. State a proposition concerning circles and polygons.
5. Define equal, equivalent, congruent, perigon. Give authority for your definition.
6. State two propositions under similarity and demonstrate one of them.
7. Demonstrate: In the same circle or equal circles, two angles at the center have the same ratio as their intercepted arcs. (Let the arcs be incommensurable.)
8. State two propositions under comparison of polygons.
9. State two propositions concerning the mensuration of the prism.
10. Demonstrate: The volume of a triangular pyramid is equal to one-third the product of its base and altitude.

## GRAMMAR.

1. Give the principal parts of went, lie (to recline), sit, send, bring.
2. Mention three devices you have used successfully for interesting small children in language work.
3. Analyze or diagram:
  - (a) *To fly from need not be to hate mankind.*
  - (b) *What man, seeing this, does not blush?*
4. Parse italicized words in question three.
5. Give the word or phrase that fits the following description:
  - (a) Personal pronoun, third singular, masculine, objective.
  - (b) Verb *go*, potential, present perfect, plural.
  - (c) Verb *use*, indicative, present perfect, progressive, singular.
  - (d) Verb *read*, indicative, present perfect, passive, singular.
  - (e) Verb *write*, imperative, present perfect, singular.
6. Write the following four times, giving only a different position each time, and state exactly what each sentence means: Only he mourned for his brother.
  - (a) Write a sentence in which the verbal is used as a noun.
  - (b) Write a sentence in which the verbal is used as a participle.
7. When should the study of technical grammar begin? Why?
  - (a) He who did the mischief you should punish, not I.
  - (b) My friend's father's house.
  - (c) Who did you write to.
  - (d) If you see my son or my daughter, send them home.
  - (e) He bought a hog's head of sugar.
  - (f) The fleet was set off Hatteras.
8. Criticise the following and give reasons:
  - (a) He who did the mischief you should punish, not I.
  - (b) My friend's father's house.
  - (c) Who did you write to.
  - (d) If you see my son or my daughter, send them home.
  - (e) He bought a hog's head of sugar.
  - (f) The fleet was set off Hatteras.
9. Write the possessive plural of the following words: man, child, captain, man-servant, and sheep.

## ORTHOGRAPHY.

1. Discuss three practical advantages to be gained by the study of orthography.
2. Indicate pronunciation of the following: apricot, bath, thought, bouquet, comma, parabola, benzine, clique, regime, encore, rudely.
3. Give three of the most valuable rules for spelling.
4. Give reasons for the spelling of the following: acre, trackling, boeing.
5. Give the meaning of the following prefixes, illustrating by example: mal, ovi, trans, ultra, uni.
6. Make an outline of the sounds and diacritical marks of *a* and *e*.
7. Using the ending *cidr* or *logy*, show how you teach word-building.

## PHYSICS.

1. What name would you give to the attraction which causes your hands to be wet by a liquid? Is it molar or molecular force? Explain.
2. What is Boyle's law? Are there any exceptions to this law? If so, what?
3. What is that which is sometimes called the "force of suction"? Explain.
4. (a) Can you suck air out of a bottle? (b) Can you suck water out of a bottle? Explain.
5. (a) In swimming you put water in motion: what causes your body to advance? (b) What propels the bird in flying?
6. A stone falls from the top of a railway carriage which is moving at the rate of one-half a mile a minute. Find what horizontal distance and what vertical distance the stone will have passed through in one-tenth of a second, disregarding the resistance of the air.

## DEPARTMENT OF PUBLIC INSTRUCTION.

10. (a) How do bodies acquire energy? (b) From what source did coal obtain its molecular potential energy? (c) How does animal energy originate?
8. Define ohm, volt, ampere, coulomb and watt.
9. (a) Does a dead coil emit ether waves? (b) Does it emit light-waves? Explain.
10. (a) How do you account for the color of flowers? (b) How do you account for the colors seen on a soap bubble?

## PHYSIOLOGY.

1. Mention the appliances you use in conducting a class in physiology and give reasons for their use.
2. (a) What is the function of the muscles? (b) Locate the principle muscles of the body.
3. Outline a lesson on the lower extremities, carefully indicating heads and sub-heads.
4. Make a drawing of the stomach, showing its connection with the liver and intestines.
5. Explain visual sensation.
6. (a) Why cannot coffee, tea, and water be used as substitutes for saliva in process of digestion? (b) What is the influence of acids upon digestion?
7. Describe the structure of the heart.
8. Give some of the preventives suggested by the State Board of Health for scarlet fever and diphtheria.
9. (a) Describe in full the action of alcohol upon the stomach. (b) Why is the risk of a surgical operation upon the habitual drinker greater than in case of a temperate person? Make a drawing to show the action of a muscle in raising the forearm.
10. Explain sensory and motor action. Make a drawing to show the action of a muscle in raising the forearm.

## SCHOOL LAW.

- Directions.—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it answered. (3) Write plainly and legibly. (4) Correspond with the number of the question or its several subdivisions. (5) Write plainly and legibly.
1. (a) With whom should a contract to teach in the common schools be made? (b) Is it necessary to have this contract in writing?
  2. Under the laws of Michigan, who may teach in the common schools? Explain fully.
  3. Who may grant teachers' certificates in this State?
  4. May non-resident pupils attend the common schools without paying tuition?
  5. (a) May a teacher in this State inflict corporal punishment? (b) What control has the teacher over his pupils on their way to and from school?
  6. Who decides what textbooks shall be used in a particular common school in this State?
  7. Give general duties of the county commissioner of schools.
  8. Can parents be compelled to send their children to school in this State? Explain fully.
  9. (a) What is the source of the money with which the teacher is paid? (b) Who fixes the amount of the school fund in the State as well as in a particular district?
  10. What have you read upon the subject of "School Law"?

## THEORY AND ART OF TEACHING.

1. Name four great educational writers of the past whose teachings you best know, and describe the theory of each. (25 credits.)
2. What is the difference between the science and the art of teaching? In your own experience which came first? (6 credits.)
3. What steps are included in the preparation of a lesson by a teacher? (8 credits.)
4. "Spare the rod and spoil the child." Give your own reasons for and against the soundness of this as a principle of teaching. (5 credits.)
5. What do you understand to be the purpose of a "Course of Study"? Why not allow each teacher to follow any chance order of lessons? (8 credits.)
6. (a) Distinguish between remembering and recollecting; (b) between judging and reasoning; (c) between feeling and thinking. (10 credits.)
7. In what sense is the following statement true: "I know, but I can't tell"? In what sense untrue? (10 credits.)
8. What defects in teaching arise from a lack of scholarship on the part of the teacher? (10 credits.)
9. What defects arise from a lack of professional knowledge? (10 credits.)
10. What are the qualities of a teacher who is "strong in government"? (8 credits.)

## UNITED STATES HISTORY.

1. (a) What is a colony? (b) What were the objects of European countries in establishing colonies in America during the seventeenth century?
2. (a) When was there formed a permanent union among the English colonies in America? (b) Why did it occur at that time?
3. Defend the attitude of the loyalists or Tories in 1775 and 1776.
4. Mention the most important service to the United States of each of the following: Alexander Hamilton, Robert Morris, Benjamin Franklin, Samuel Adams, John Marshall.
5. Make clear the meaning of the following terms: Implied Powers, State Sovereignty, Reconstruction, Joint Resolution.
6. Compare Congress in 1776, in 1782 and in 1792 in regard to the composition of the body and its powers.
7. (a) What was the service rendered the country by the Federal party? (b) Why was it defeated in 1800?
8. Give a brief account of our relations with Spain up to 1898.
9. (a) What are the two most important questions before the American government at the present time? (b) What settlement of each do you favor? Why?
10. (a) What are the methods being used to defray the expenses of the present war? (b) Compare these with the methods employed during the Revolutionary and the Civil War.

## ZOOLOGY.

1. Name some classifications of animals with regard (1) to teeth, (2) to food, (3) to toes, (4) to feet, (5) to bearing young.
2. (a) What is meant by "the survival of the fittest." (b) Show how some animals have changed their forms to adapt themselves to change in environments.
3. (a) How does the cricket chirp?  
(b) How does the snicker chirp?  
(c) How does the partridge drum?  
(d) How does the firefly shine?  
(e) How does the bee sting?

## DEPARTMENT OF PUBLIC INSTRUCTION.

4. Trace the development of the nervous system from the lower to the higher orders of animals.
5. Name an insect and tell in what way it is injurious to (1) the apple, (2) the plum, (3) the maple tree, (4) wheat, (5) sheep, (6) hens.
6. Describe and compare the respiratory organs of the fish and the bird.
7. State what is meant by the following terms and name an animal to which each will apply: (1) hibernation, (2) aestivation, (3) amphibious, (4) oviparous, (5) insectivorous, (6) metamorphosis.
8. Describe the circulatory system of insects.
9. Name three characteristics of ruminants; of rodents; of marsupials.
10. Show how the feet of birds indicate their habits.

II. QUESTIONS PREPARED BY THE STATE BOARD OF EDUCATION FOR EXAMINATION HELD AT LANSING, DECEMBER, 1898.

## ALGEBRA.

1. (a) If a man walks  $s$  miles in  $r$  hours, at what rate does he walk? (b) If a man can do a piece of work in  $m$  days, how much of the work can he do in  $r$  days?  
(c) If a thermometer at 1 o'clock p. m. indicates  $s$  degrees below zero and at 7 p. m.  $o$  degrees below zero, express the difference in temperature of the two hours. (d) How many times is  $m$  a factor of  $(2m)(3m^2)$ ?
2. (a) Given  $5x^2 + 21x = 62$ . Solve.  
(b) What name is given to this equation from the fact that it contains both  $x^2$  and  $x$ ?
- (a) Reduce to simplest form the complex fraction  $\frac{1 + \frac{a}{1-a}}{\frac{1+a}{1-a}}$   
(b)  $\frac{x^2+3}{x-3} \times \frac{1}{x+3} - \frac{x-3}{x+3} = ?$
4. Prove, giving the fundamental principles of fractions, that the expression  $\frac{m}{a-b} + \frac{n}{b-a}$  is equal to the expression  $\frac{m}{a-b} - \frac{n}{a-b}$
5. Three towns are at the three angles of a triangle. From the first to the second through the third is 88 miles; from the first to the third through the second is 97 miles; from the second to the third through the first is 89 miles. Find the direct distance between the towns.
6. (a) Simplify the expression  $\sqrt[4]{\frac{1}{\frac{a^2+1}{b^2m}}}$ . (b) Divide  $3\sqrt[4]{7}$  by  $2\sqrt[4]{8}$  and express the result in its simplest form.
- (c) Simplify the expression  $\left[ \frac{1}{\frac{a^2+1}{b^2m}} \right]^{p-1}$
7. Two persons, A and B, can do a piece of work in 16 days. They work together 4 days, after which B finishes the work in 36 days more. In what time can each do it separately?
8. (a) State an axiom which gives authority for changing the signs of all the terms of an equation.

(b) Define elimination. (c) Define and give illustration of like, or similar terms.

$$9. \text{ Solve without clearing of fractions: } \left\{ \begin{array}{l} \frac{10}{x} - \frac{y}{7} = 8 \\ \frac{x}{8} + \frac{15}{7} = -1 \end{array} \right.$$

10. Two cubical vessels have together a capacity of 1072 cubic inches, and the sum of their heights is 16 inches. What is the capacity of each?

NOTE.—What is your preparation in this subject? Where obtained?

## ARITHMETIC.

State Examination.

December, 27-30, 1898.

- (a) Find, by factoring, the g. c. d. of 9801, 33,759, and 121,968. (b) What is the Euclidean method of finding the g. c. d.?
- Give five fundamental properties of fractions.
- At what time between 1 and 2 o'clock are the hands of a clock at right angles to each other? Give analysis.
- Write a 90-day note, signed by Peter Brown and payable to your order, bearing the legal rate of interest; indorse it so that it shall be payable to the order of Robert Jones.
- Which is the better investment, and how much; one of \$4,200, yielding \$168 semi-annually, or one of \$7,500, producing \$712½ annually?
- A body will fall 16.1-12 feet in the first second of its fall, 48½ feet in the second, and so on. How far will it fall in one minute?
- (a) Explain the difference between a ratio and a proportion. (b) How would you teach the idea of number?
- Trade discounts of 20%, 10%, and 8 1-3% are equivalent to what single discount?
- A semi-annual dividend of 2½ on Illinois Central railroad stock bought at 92½ is equivalent to what per cent of annual interest on the investment?
- Find the cost of a lot 50 feet front, 85 feet rear, and 62½ feet deep, at \$3.50 per square foot.

NOTE.—What preparation have you had in this subject? Where obtained?

## AMERICAN HISTORY.

- What points were in dispute between England and the United States at the time of "Jay's Treaty"? Outline the terms of "Jay's Treaty".
- What were the causes of our commercial difficulties at the close of Jefferson's administration; how did we try to remedy them and with what result?
- Compare the attitude of the Democratic-Republican party on national questions in John Adams' administration with its position in the last of Madison's. Name the questions at issue in each case.
- Trace in outline the history of the United States Bank from its inception to the expiration of its charter in 1836.
- Contrast colonial Massachusetts and Virginia in regard to purpose of settlement, character of settlers, form of local government and religion.
- In what states was the Emancipation Proclamation to take effect, and why was it called a war measure?
- Compare President Johnson's ideas of re-construction with the congressional plan.
- For what do the following men stand in American history: Parkman, Bancroft, Lowell, Samuel Adams, Hawthorne, Stephen A. Douglas, Chas. Sumner, Calhoun, and John Marshall?

- Mention two instances of arbitration between England and the United States, and the settlement-in-each case.
- What is meant by the term "States rights"? Mention three instances in which the question has been prominently before congress. How and when finally settled?

## BOTANY.

Directions.—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.

- (a) Where have you studied botany, for how long a time and with what texts? (b) What is the purpose of such study in our schools?
- Discuss the important characteristics of protoplasm.
- State what conditions are necessary for germination, and explain clearly why these conditions are necessary.
- Describe in detail the origin and development of the root, and discuss its function.
- Describe, with the assistance of drawings, the structure of a typical exogenous stem.
- Discuss fully the work of the leaf.
- Enumerate five reasons for considering a flower a modified leaf-bud.
- Describe the various devices by which nature prevents self-pollination.
- Give the botanical name of the edible part of the following plants: Potato, celery, strawberry, pea, cabbage, turnip, string bean, apple, tomato, rhubarb.
- Name five plant families, with a type under each, and discuss the family characteristics exhibited by each type.

## CHEMISTRY.

Directions.—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.

- State your educational experience in chemistry: (a) school; (b) teacher; (c) amount of time—weeks or months; (d) laboratory work done; (e) text-books used.
- (a) What are the main constituents of the atmosphere by weight and by volume? (b) Name two others regularly present. (c) What apparatus would you need and what experiments would you use to show the presence and the amount of each of these four constituents? (d) Sketch the apparatus. As above for the two main constituents of water, but give more than one way of showing the composition.
- (a) What is the molecular formula for water? (b) Upon what facts is the reasoning based by which you reach this formula? (c) Give steps in the reasoning.
- What is the molecular weight of water? Fully describe method of finding it.
- (a) What takes place when sulphuric acid is brought into contact with common salt? (b) When the gaseous product of (a) is passed into water up to saturation? (c) When the result of (b) reacts with manganese dioxide? Are these reactions peculiar or typical? Illustrate.
- (a) State in full the process for making Le Blanc Soda. (b) Ammonia soda (Solvay process).
- Classify the elements and name one good example of each class. What is the basis of the classification?
- Treat the topic ordinary combustion in full: (a) ordinary combustibles (fuels); (b) physical and chemical products; (c) kindling temperatures; (d) heat of combustion.

10. (a) What salts may be formed from sulphuric acid and a monovalent metal?  
(b) From normal phosphoric acid and a monovalent metal? Illustrate.
- N. B.—If desirable, applicant may substitute the following for No. 7:  
(a) Neutralize reagent ammonia with nitric acid. (b) Extract iron from a solution of the acetate in a gas generating apparatus. How test neutralization in (a)? What will be the form in (c).

## CIVIL GOVERNMENT.

1. Mention some of the corporate powers of a town.
2. Explain the difference between a *general* and *special* city charter, and tell what necessity calls for the latter.
3. Why is the writ of *habeas corpus* called the "chief bulwark of liberty?"
4. Give general idea of the duties of the following state appointees: Adjutant, oil inspector, labor commissioner, railroad commissioner, adjutant general.
5. (a) How were the members classified in the first U. S. senate? (b) How are vacancies filled in the senate?
6. How may an alien become a citizen of the United States? Full answer.
7. What are the "government securities?"
8. What is done with vessels captured on the high seas in time of war, and what is your opinion as to the wisdom of this method?
9. For what purposes may the national troops be called out?
10. Name the bill that will probably receive most attention in our state legislature this winter, and explain its purpose.

## ENGLISH LITERATURE.

1. Relate briefly the incidents of the play Macbeth.
2. (a) What is Macbeth's mental and moral condition at the opening of the play?  
(b) Discuss the motives within and the influences without, which led him to murder Duncan.
3. What motives had Lady Macbeth for her share in the murder of Duncan?
4. (a) State approximately the time of Scott's literary work. (b) Discuss briefly the two kinds of literature he produced.
5. Would you encourage the use of fairy tales in the lower grades? If so, tell why and mention several you would recommend for study.
6. Name ten American poems and five American novels suitable for outside reading for a class in American history, giving reason for use of each.
7. (a) What is a novel? (b) Give the motif and rank of some modern novel.
8. (a) What preliminary work would you assign to a class about to make a study of Lowell's Vision of Sir Launfal? (b) Give the story, plan, and purpose of the poem.
9. (a) What is an oration? Name the parts of an oration. (b) Give a list of ten of the best American orations, naming author of each.
10. Outline briefly a plan for study of Bryant's Thanatopsis.

## GENERAL HISTORY.

1. (a) What men composed the first triumvirate in Roman history? (b) what was its purpose? (c) what was accomplished?
2. (a) For what purpose was the Delian Confederacy organized? (b) how operated? (c) what nation was benefited? (d) what was the result?
3. What is meant by the "Commonwealth" in English history? what brought it into being, who was its leader, what permanent results did it accomplish?

## DEPARTMENT OF PUBLIC INSTRUCTION.

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4. Give a brief sketch of the lives of any three of the following men—Augustus Caesar; Gustavus Adolphus; Innocent III; Charles V of Spain.
5. (a) What is meant by "Home Rule for Ireland"? (b) What great men have advocated it? (c) what is the present status of the question?
6. (a) What did the Crusades accomplish directly? (b) What nations took part and what effects did the Crusades have on the world in general?
7. (a) Name five tribes that took part in the Teutonic migrations. (b) Where did each settle?
8. Outline the important events in the reign of Justinian.
9. What is meant by the Doomeday Book, Magna Charta, Edict of Nantes Reformation?
10. What were the causes and results of the Hundred Years' War?

## GEOGRAPHY.

1. Show the connection between geology and geography.
2. Name at least three authorities whom you would recommend for geographical reference.
3. State the effect on coast lines of the elevation and depression of land.
4. Briefly describe the growth of railroads in the United States, naming the most important ones, and compare their number with those of Europe.
5. With what diplomacy is the visit of the German Emperor to the Holy Land associated?
6. Account for artesian wells, hot springs, and geysers.
7. Compare in full the plants of the hot belt with those of the cool belt.
8. Name some of the aids to commerce and make a rough sketch indicating five ocean routes, at least two of which are not via Atlantic.
9. Name the leading governments of the world and the ruler of each.
10. Locate Fashoda and tell in what connection it has recently been brought before the public.

## GEOLOGY.

1. Compare igneous and sedimentary rock, (a) as to structure; (b) as to relative position.
2. Define fossil, fault, dip, anticrop, and erosion.
3. Under what conditions are glaciers formed?
4. What is the theory as to the causes of volcanoes, earthquakes, and geysers?
5. (a) What are deltas and how formed? (b) Of what use are fossils to the geologist?
6. (a) What is the difference between shale and slate? (b) How does limestone differ from chalk and marble?
7. Name three periods of Paleozoic times and the characteristic rock of each period.
8. How does hornblende differ from quartz and feldspar?
9. (a) How can you distinguish granite from felspar? (b) What is mica schist?
10. Do you believe geology should be taught below the high school? Give reason for your answer.

## GEOMETRY.

- Demonstrate: The line joining the vertex of the right angle of a right triangle to the center of the hypotenuse is equal to half the hypotenuse.
- Construct a mean proportional to two given lines. Give proof.
- (a) Find, to three decimal places, the area of a triangle having equal sides, each five inches in length.  
(b) If the radius of a circle is six inches, find the area of a sector of  $10^\circ$ . In the quadrilateral A, B, C, D let E, F, G and H be the middle points of the sides. Prove: E, F, G, H is a parallelogram.
- Show the difference between an angle of an equilateral triangle and an exterior angle of an octagon.
- The base of a hexagonal monument is 9 feet on a side. How much ground does it cover?
- When will the perimeter of a regular polygon and the periphery of an equivalent circle coincide?
- Prove that if the hand of a clock is perpendicular to its moving axis, it describes a plane in its revolution.
- (a) State four methods of determining a plane.  
(b) Define apothem, collinear, concurrent, congruent, coplanar.
- Demonstrate: Parallel transverse sections of a pyramidal space are similar polygons whose areas are proportional to the squares of the distances from the vertex to the cutting planes.
- Note.—State your presentation in this subject. Where obtained:

## GRAMMAR.

- What is a facilitive predicate? Give two examples.
- Parse the words italicized in the following: *I had rather die than do it.*
- Define cognate object. Give two examples.
- What are the different uses of participles and participial phrases?  
(a) *Is like* used as a conjunction? (b) Use *like* as an adjective, as an adverb, as a noun, and as a verb.
- Use *so* as an adverb, also as an adjective. (b) Use *the* as an adverb.
- (a) What should be the object in composition writing? (b) What very important details should be carefully supervised in composition writing?
- Take "orange" for description, and outline your method of procedure with a class in the lower grammar grade.
- Analyze, without the diagram: Revenge is a kind of wild justice, which the more man's nature runs to, the more ought law to weed it out. For, as for the first wrong, it doth but offend the law; but the revenge of that wrong putteth the law out of office.
- Parse italicized words in question nine.  
Note.—Where were you prepared in this subject? When?

## ORTHOGRAPHY.

- (a) Name and illustrate three of the five uses of silent letters.  
(b) What letters represent the sounds of *q* and *x*?
- Illustrate the use of the dieresis, cedilla, tilde, breve, and suspended macron.
- Give meaning of the following prefixes: *dis*, *cor*, *hex*, *mis*, *pleni*, *juxta*, *re*, *preter*, *rect*, *peri*. Illustrate with words.
- Why is the English called a composite language? Give full explanation.

## DEPARTMENT OF PUBLIC INSTRUCTION.

- Indicate correct pronunciation of the following: clap-board, bombazine, souvenir, sough, ewe, oaths, cognac, plaque, goal, Fall Mall.

## PHYSIOLOGY.

- Locate the masseter and temporal muscles, giving their function.
- Explain the lymphatic system: (a) structure of lymph vessels; (b) movement of lymph; (c) lymphatic glands; (d) ductless glands; (e) thoracic duct.
- Explain digestion: (a) saliva; (b) gastric juice; (c) bile. What effect has the excessive use of intoxicants upon digestion?
- Explain nutrition: (a) tissue building and energy-yielding foods; (b) the source of energy expended in muscular work.
- Describe the knee joint.
- What is the lumbar enlargement of the spinal cord, and to what is it due?
- Describe a heart-beat and its results along the blood vessels.
- Describe the peculiar adaptation of the structure of the lungs for their function.
- Of what advantage are the valves in the veins?
- Contrast combustion in an engine with oxidation in the body.

## PENMANSHIP.

As a specimen of your penmanship, write not less than 100 words, expressing your opinion of the vertical system.

## PHYSICS.

- What is the principal difference between the structure of the lamp producing the arc light and that producing the incandescent light?
- Give the ratio of pressure upon the bottom of a cubical tank full of water, compared with that on one of its sides.
- Describe a method of forming ice artificially.  
At Laredo, Tex., July 17, 1898, a Centigrade thermometer registered  $47^\circ$  in the shade. What would have been the reading on a Fahrenheit scale?
- (a) Distinguish between a real and a virtual image.  
(b) What is the appearance of an object seen through a concave lens? A convex lens?
- (a) What is energy? (b) Water held in a mill dam is an example of what kind of energy? Water turning a water wheel?
- During the winter the ground was frozen, but the sidewalks were free from snow and were dry; after the south wind had been blowing several days, while the ground was still frozen, the stone walks became very wet, while the plank walks remained dry. Account for this difference.
- Name six mechanical powers and give a practical application of any three of them.
- (a) What are the essential features of a barometer? (b) What measures pressure at the sea level? (c) Give drawing of barometer.
- Describe the process of finding the specific gravity of an insoluble substance as follows: (a) one heavier than water; (b) one lighter than water.



## SCHOOL LAW.

- DIRECTIONS**—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
- What, if any, new legislation affecting schools was enacted during the last session of the State legislature? Explain fully.
  - How is a new school district organized in Michigan?
  - Under the laws of Michigan, who may teach in the common schools?
  - (a) Explain fully the right of a teacher to inflict corporal punishment. (b) May the teacher punish a pupil for misconduct committed off the school grounds, on the way to and from school?
  - Name the chief duties of the county commissioner of schools?
  - Can parents be compelled to send their children to school in this State? If so, for what period in each year?
  - How many months of school must a district maintain each year to entitle it to a portion of the primary school fund?
  - Who may grant teachers' certificates in Michigan?

## RHETORIC.

- DIRECTIONS**—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
- Name two recent text-books on rhetoric, and compare them as to quality of text and educational value. (b) May the subject be effectively taught without a text-book? How?
  - (a) I (avow, acknowledge, confess) my guilt. Which word is preferable? Why?  
(b) Criticise the following: I seldom found him indolent; he was not of an idle disposition.
  - Point out fault of style in the following sentence and improve it:  
"Since the great navigator on two several and successive occasions makes mention of himself as having been born in Genoa, we may rest assured that we have conclusive evidence of the fact that he was a native of that important maritime city."
  - What qualities of style are essential to effective sentence and paragraph structure?
  - Write a brief outline of an argument for or against our acquiring the Philippines.
  - Write a single paragraph upon some subdivision of the above outline.
  - Name figures in the following:  
(a) Laughter and tears are meant to be the wheels of the same machinery of sensibility. One is wind power, the other water power. That is all the difference.  
(b) Put on thy strength, O Zion; put on thy beautiful garments, O Jerusalem, the holy city.  
(c) The prodigal robs his heir, the miser robs himself.  
(d) When you have nothing to say, say it.  
(e) Man shall live by the sweat of his brow.
  - Punctuate the following:  
(a) The present life is not wholly prosaic precise and tame and finite to the gifted eye it abounds in the poetic.  
(b) Punctuate and use necessary capitals in the following:  
A cobbler at leyden who used to attend the public disputations was asked if he understood latin no replied the fellow but I know which is wrong in the argument how why by seeing which gets angry first.

- Name and scan the following verses:  
(1) Low voluptuous music winding trembled.  
(2) Look aloft and be firm, and be fearless of heart.  
(3) Come, ye disconsolate, where'er ye languish.  
(4) No more, sweet Taviot, blaze the glaring battle-fires upon thy silver tides; steel-clad warriors ride along thy wild and willowed shores no longer. (Change the last into four iambic tetrameter verses, rhyming alternately.)

## THEORY AND ART OF TEACHING.

- DIRECTIONS**—(1) Be sure you understand the question. (2) Take time enough and pains enough to answer it in the way you wish it to be understood and graded. (3) Number your answers to correspond with the number of the question or its several subdivisions. (4) Write plainly and legibly.
- Designate the studies you have pursued in this subject, as follows:  
(a) Name three books read.  
(b) Recent works studied.  
(c) Educational papers regularly read.  
(d) Work taken in school. (15%.)
  - (a) Distinguish between the theory and the art of teaching. (b) Name and characterize briefly one book devoted to each. (15%.)
  - Describe and compare any two of the following ways of teaching reading:  
(a) word method; (b) sentence method; (c) alphabet; (d) Follard system. (4%.)
  - What are your reasons for thinking that music and drawing should be made a part of every elementary school course? If you think they should not be, give reasons. (5%.)
  - What is meant by nature study, and what results are aimed at in intermediate and grammar grades? (6%.)
  - In the teaching of United States history what work should be done before a text-book is taken up? (6%.)
  - Name two laws of mind, and indicate their significance to the teacher. (12%.)
  - Name two principles of teaching, and illustrate their meaning by reference to some actual school exercises. (12%.)
  - What powers of mind are chiefly appealed to in eighth grade or above in teaching spelling? In teaching history? (12%.)
  - What are the educational ill effects of a too loose school discipline? (12%.)

## ZOOLOGY.

- Give an outline for the classification of animals.
- Mention four peculiarities that distinguish man from other animals.
- State what animals are most like man in general structure, and give the order to which each belongs.
- Compare the structure of a cat with that of a dog.
- Name the carnivora common in the United States.
- Describe the ant and its natural enemy.
- (a) What are the periods of life of an insect? (b) During which does it consume the most food?
- Describe the appearance and habits of the potato beetle in two of its metamorphic stages.
- To what order do the following belong? (1) locusts, (2) dragonflies, (3) beetles, (4) butterflies.
- Give an account of the bee communities.