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THE

SCHOOL MAGAZINE.

DECEMBER, 1880.

HEALTH DEPARTMENT.

Editor: A. Hamilton, M. A., M. D., Port Hope, Ont.

THE SCHOLAR'S EYE.

IV.

OVERSIGHTEDNESS.

Optical Analogue to Oversightedness.
Nature of *do.*
Chief Symptoms of *do.*
Prognosis of *do.*
Percentage of Oversighted Pupils.
Use of Convex Glasses.
Disadvantages and Sufferings.

IN last month's MAGAZINE certain optical facts were impressed upon the mind by an experiment there given. Referring, if necessary, to the experiment as there described, the reader will readily understand what follows immediately.

When rays approximately parallel meet a 3-inch lens they are brought to focus at or just within 3 inches. If the receiving screen be brought to say 2¾ inches, the bright spot is less concentrated. If, by some mechanism, we could so change the form (and so the power) of the lens sufficiently, we could still focus on the screen at the 2¾ inches. If, however, the rays be not quite parallel, but come from a luminous point a foot or two in front of the lens, the focus, even with a 2¾ inch lens, will not be on the screen, but at a point somewhat behind it, as the rays received by the lens are now diverging. We can still have the focus on the screen by either again changing the form of the lens to 2½, 2¼, as needed; or, if changing the form of the lens be out of the question, we can do the same by inserting a weak convex lens before the one already there.

The analogue of all this is going on in the oversighted or hypermetropic eye. The depth of the normal eye from front to rear averages $\frac{19}{20}$ inch outside measurement, or about $\frac{9}{10}$ from cornea to retina or inside measurement. The refracting crystalline lens and its adjuncts are adapted to such a distance. But the oversighted eye is preternaturally short, and so is less than $\frac{9}{10}$ inch the amount which it lacks of being, $\frac{9}{10}$ being a measure of the amount of shortsightedness. Now, the lens of the eye can be so changed in form as to bring parallel rays to a focus at a distance less than $\frac{9}{10}$, say ⅞ inch, by

an effort of the apparatus of accommodation, which is under control of the will, but is exerted almost unconsciously. For rays diverging from a point a foot or two away, as in reading, writing, sewing, and so on, it requires a greater effort of the muscles of accommodation to accomplish this, as the lens must be so strengthened as to both overcome the additional divergence and to bring them to a focus preternaturally near. This, by great effort of the muscles of accommodation, it can do for a short time, but unable to sustain the *strain* soon gives up, and the images become blurred or of indistinct outline.

Let us here infer the chief characteristics of oversightedness to be: (1) fair vision for distance; (2) good sight of near objects, but that only momentary or for a more or less short time, followed by blurring, mistiness, &c.; (3) great aching and weakness referred to the eyes if they be *forced* to go on with the work. In *short*sightedness we have correspondingly (*a*) bad vision for distance; (*b*) good, and continuously good sight for near objects if they are sufficiently near; (*c*) aching eyes, but commonly not so great as in oversightedness, but this depends upon the degree of each. They are not to be compared in this respect unless each be of about equal degree.

In our remarks on nearsightedness it was stated to be progressive, its progress being hastened by the application needed in school life. Is this true of oversightedness? It is not, at any rate, nor to the same extent. True, the defect becomes more noticeable with advancing years quite throughout life; but this advance is not due to use of the eye, but to the fact that as we grow older our power to accommodate the shape of the lens diminishes, and that quite independently of overuse, and progresses even with the utmost care.

It may be asked why eye-balls are preternaturally short or long, and leading thereby to such serious discomfort. Is it an effect of modern civilization? No; it has always been so. "There is nothing new under the sun." Our eye-balls are long or short just as our noses are, depending upon ancestral peculiarities and inherited tendencies, for the evidence of hereditary influence is convincing. We often see several of a family having similar defects and may trace the same back a generation or two. Such defects existed long ago —at least what evidence we have favored that view. "If Gustavus Adolphus had had concave glasses I think he would not only have won the battle of Lutzen, but also saved his own life; but as he did not have them he was unable to distinguish his own colors and became entangled among the Austrians and was killed. His inability to see objects at a distance—and in those days there was no artificial aid to vision —led him to suppose that the enemy were his own men, and the life of a great general was sacrificed."* If these defects are (not more common, but) more noticeable now, it is because the influences of civilization, and notably school life, brings them to light. Science now maps out minor defects and names them; before, they were unknown.

Of 209 pupils in the District Schools of Cincinnati, Drs. Williams and Ayers found 6½ per cent. oversighted. Of 210 scholars in the Intermediate Schools, 6 per cent. were oversighted. The same percentage was found in 211 pupils of the Normal and High Schools. The percentage is often higher than this would indicate. Thus, Drs. Prout and Mathewson found 34 per cent. of the pupils in the Brooklyn, N. Y., Polytechnic Institute, oversighted. Why this marked discrepancy? In the latter case the very smallest grades of the defect have been taken into account. There may be such a small shortening of the eye-ball as to be

*Dr. Roosa in N. Y. *Medical Journal*, 9th Oct., 1880.

insignificant; yet, if counted in, swells the percentage.

Hypermetropia agains differs from Myopia in the pupil not being so much harmed by school life. Indeed, he gets along very well if he be suited by a pair of glasses which exactly focus rays on his retina. What I said last month as to the use and necessity for glasses may be repeated here, but it is unnecessary. The effect of the convex glass is to deliver rays to the eye slightly converging which before were parallel, or else, if diverging before, to deliver them less so. This cannot be any more improper than to deliver to the stomach food properly masticated and prepared for it, and which it can thereby manage the more readily and without inviting a gastric disease.

The oversighted pupil, it follows from what has been said, sees blackboard and map fairly. He fails for close work, especially if prolonged or over fine print. His lessons to be committed at home are badly got. He does not excel or does so under overwhelming disadvantages if his defect be of high grade. He is disgusted with school life. Let the reader discover a typical case of average or high degree who is anxious to excel and who is urged to do so at home as well as in school, and the chronicle of his sufferings will serve to impress the importance of this matter home to him with more emphasis and more intererst than the printed page can convey.

COAL GAS IN THE SCHOOL-ROOM.

At this season the janitor or caretaker of the school has assumed duties not required in Summer. He manages, often mismanages, warming the school building. Where this is done by hot air, or by pipes, conveying hot water or steam, we shall, for the present, have nothing to say. Where it is warmed by a wood fire the same principles apply as when warmed by a coal-consuming stove, but wood is more easily managed than coal, in so far as avoiding filling the school-room with combustion gas is concerned. Practically, the management of the coal furnace, known as the base-burner, is all that need concern us. It is important to have this managed right in a school-room with fifty or more pairs of lungs demanding more oxygen than already exists, and exhaling carbonic acid constantly, with, as a rule, too little ventilation, and too little cubic space per pupil. If the base-burner give out noxious fumes, mainly carbonic acid, the school-room may be a second Black-hole of Calcutta. The stove may be either an engine of disease, yes and death, or an adjunct to ventilation, according to how it is managed. To this the intelligent oversight of the teacher is necessary. Ignorant janitors cannot be depended on, any more than ignorant nurses in the sick-room. Attention to what follows will, it is believed, make the matter easy and simple.

The base-burner consists of a *firepot* with movable grating for a bottom, a *reservoir* covered by a lid, with space between firepot and reservoir to allow of combustion. Pipes convey away the gases, and should do so wholly. The pipes have a movable damper which as needed obstructs the egress of air. The ingress of air is from the grating below the firepot, and from the mica-lighted doors surrounding the glowing coal. Air may enter at the edges of the doors, also where the plates of mica meet the door frames. *These also permit the escape of noxious gases, and that more especially where the egress is obstructed.* Hence the deduction: DO NOT OBSTRUCT THE EGRESS. How are we to control the flame? *By limiting the ingress of air.* Close doors tightly, and do not shake too much ashes down, as they are the best obstructor to ingress. As soon as the dampers are turned, it is changed into a noxious furnace emitting literal poison. The damper, it is true

has often a perforation, which always allows some egress. This aperture is seldom half large enough. Better to obstruct below. The fittings of the stove should be screwed tightly all round. See that no screw has dropped out. See that the doors fit as snugly as possible. See that the mica fits the door frames accurately. Children poke holes through mica. See that fresh mica is supplied forthwith, or, for economical reasons tin may take the place of mica in school. If so, see that the edges of the tin have the same regular curve as the door-frame, for the tin is apt to be bent. See that the mica or tin is fitted tightly to the door. See that the lid on reservoir fits accurately and see that there is no coal dust or small coal intervening between it and the top. There is a direct and an indirect draught. If the flame be moderate the direct draught is the better. Combustion may readily be kept moderate by obstructing ingress sufficiently. The indirect draught is over the edge of the firepot and up the pipe by a more circuitous route. It is claimed that this hot air heats a greater extent of metal surface, and so radiates more heat. This is hypothetical. The truth is that iron is so good a conductor of heat it will get hot anyway in proportion to the heat of the furnace, and this indirect current is unnecessary. As a semi-obstruction it is objectionable. Assuming fifteen pounds to the square inch as the pressure of the atmosphere in all directions, this indirection in the draught, and the obstructing damper in the pipes raises the gas pressure in the furnace to 16 or 18 lbs. to the square inch. What is the result? The furnace and reservoir leak noxious gases. You cannot get your fittings air-tight. That is often a hard problem in mechanics—to get an air-tight joint. Practically, we have not got air-tight stoves yet. Until we have, we must keep the fittings as tight as we can, and keep the gaseous pressure in the furnace down as near as we can to 15 lbs. This is best done by following my previously dogmatic, now rational, statement: Don't obstruct egress. If the pipe be long before delivery into the chimney, it is still more important to have egress free, as it takes quite a pressure to move a long volume of air. This is doubly true if the pipes be largely horizontal or nearly so. It requires considerable *vis a tergo* to create motion in the gases in the pipes It may be objected that motion is created by the heat causing expansion of air and gases which are thereby lightened and so rise. True, yet we do not get a lower pressure than 15 lbs., and we may get a higher before such a volume of air and gas is moved, especially through horizontal pipes. See that the fittings are tight in the pipes. The edges of pipes are often bent to make them enter one another. This permits escape of gas unless they are pushed so far on as to become tight. Small openings in a horizontal pipe are a constant source for gas leakage. Those who know how hard it is to get an air-tight joint will appreciate the necessity of having all fittings accurate. Those who understand the principles involved will see their importance. By this plan there need be no wasted heat. Ventilation in winter is always a struggle between economy of heat and the necessity for free air. Of two evils choose the least. When sailing between Scylla and Charybdis, a little care will prevent calamity on either hand. If health is not worth this care, what is? By this plan the heated air in the furnace may occasionally get below 15 lbs. pressure. Air is then taken from the school-room through the imperfect fittings around the furnace, and so becomes a positive adjunct to ventilation, which with the air received below is quite useful in taking air out of the school-room the place of which will be taken from outdoors.

What is the chief symptom in pois-

oning from coal gas? In slow poisoning, pallor and lowered general health. In a higher degree of poisoning, *headache* is prominent. Free ventilation during the day relieves this promptly if from coal-gas, by removing the cause. If it does not, it is from some other cause beyond the scope of this article to explain.

THE SCHOOL AGE.

We have already quoted an opinion as to the proper school age, wherein seven or eight is given as the age to begin school. At the meeting of the American Social Science Association, held at Saratoga in September, President Gregory, of Illinois, expressed his belief, that if children were kept out of school until nine or ten years old, at fifteen or sixteen they would be in advance of those who began school life earlier. He said he had had experience, and this was his conclusion from several examples within his own knowledge. The question may be resolved into two cases: (1) Where the child is slow to learn, he will be injured in health by the long hours of confinement, in a perhaps crowded room, at tasks for which he gets a dislike, and which get gradually more irksome, so that school is a prison house to be abhorred. (2). Where the child is apt to learn, he is likely to be stimulated to his injury, whereas, were he kept out of school until more able to bear the work, he would, from natural ability, very soon more than make up for his beginning late. In either case, therefore, keep your child at home until his mind and body are much more developed than they can be at five or six.

DEPARTMENT OF ENGLISH.

ANSWERS TO QUESTIONS ON LADY OF THE LAKE.

1. Write a note on the "Lay" or "Metrical Romance."

The chief interest excited in the "Metrical Romance" is that derived from the consideration of startling events and adventures, and not from the development of character. The love interest is also introduced, but is usually subordinated to that of adventure. The element of the supernatural is frequently introduced, but it occupies a very subsidiary position compared with the two former. The personages introduced are the commonest ones of poetry, kings, barons, monks, fair ladies and brave gallants, &c. The lay being the most popular form of poetry, founded on the old ballad, the selection of its subjects is determined by the fact that people naturally take a greater interest in personages above them rather than below them in rank. The measure selected by Scott in the metrical romance of the Lady of the Lake, is the iambic tetrameter, and from the "fatal facility" of its composition, it has betrayed the poet into many imperfections, which he has allowed to remain, perhaps purposely, as he thereby more nearly approaches the rude form and popular spirit of the old minstrel lays.

The language employed should be simple and sensuous, and in addition we find that Scott has made copious use of archaic words and phrases in order to observe that harmony which should exist between the subject and the language in which it is clothed, and also to impart that species of melancholy pleasure which is excited by the contemplation of a distant past,

recalled to remembrance by these old words and antique phrases.

2. Explain the terms realism and idealism as used in literature, and show where Scott exhibits each of these qualities.

Ancient rhetoricians were of the opinion that the great object of poetry is to represent things as they really are—such is realism. Bacon, on the other hand, maintained that poetry should be idealistic—that is, that man is naturally dissatisfied with the things of this world as he finds them, and is only pleased with the contemplation of greater excellence than can be found in Nature. Briefly speaking, Scott may be said to be realistic in his description of scenery, and largely idealistic in his description of character. His care in the depiction of scenery was such, that many places can still be recognized from his description. Many of his principal personages display greater virtues and vices than any to be encountered in the world, and hence are idealistic Closely connected with idealism is Scott's use of coincidence and fortuitous circumstance transcending the bounds of natural possibility.

3. Write a note on the plot of the Lady of the Lake.

The plot of the Lady of the Lake turns chiefly upon an *anagnorisis* or recognition, and is attended with the disadvantage that the curiosity of the reader, one of the most powerful interests attending such a plot, can never be revived after it is once gratified. Such a plot, however, afforded Scott occasion to introduce a large variety of skilfully contrasted characters. The other interests in the poem are those arising from the stirring adventures narrated, that naturally attached to exiled beauty and distressed innocence, and those that are excited by the arts of the skilful poet. We notice that Scott has observed the rule of art, that the interest of plot should be intensified as the story proceeds, and attain its height just before the *denouement*. Of the imperfections of the plot Jeffry remarks, that Malcolm Graeme has too insignificant a part assigned him, and that Scott seems to have rendered Roderick Dhu more interesting than he intended. It is also somewhat improbable that the King should not be recognized by Lady Margaret or Allan Bane, and there is something awkward in the misunderstanding which occasioned Sir Roderick's gathering. The character of Brian is to be regarded as a failure, and spoils the story by its improbability. The quarrel scene between Malcolm Graeme and Roderick must be considered ungraceful and offensive.

4. "Refer to the art shown in introducing the chief characters."

The chief personages of the poem are introduced in a manner which may be said to be very artistic, though not strictly in accordance with the usual methods in the case of the chief hero and heroine.

The poem opens with the animated picture of the stag hunt, which, as has been pointed out, affords not only an opportunity for the introduction of Fitz-James, but occasions the fear of invasion felt by Roderick and his clan. We become interested in the chase, and at its fruitless termination our sympathies are naturally enlisted with the solitary Knight in his luckless plight. Then follows the romantic meeting with Ellen, the heroine of the story—a meeting which was the result of a simple though natural mistake made by her. Ellen makes from the start a very favourable impression on us by her beauty, her innate goodness, and her kindly hospitality. The art of the poet is shown not only in the mode of introducing Fitz-James and Ellen, but also in the fact that he has invested them with such attractions that we follow from the outset with eager interest

their varying fortunes. Their good qualities are not gradually unfolded in the course of the story, but are at once disclosed to us.

By way of contrast with the abrupt and unceremonious introduction of Ellen, we are fully prepared for the appearance of Roderick Dhu upon the scene. In a colloquy between Ellen and Allan Bane, we are told much of his fierce and revengeful nature, and something of his aspirations. He certainly comes at last upon the stage with all the *eclat* befitting the chief figure of the poem. The distant notes of the pibroch, the chorus of the rapidly approaching boatmen, and the warmth of his reception, are all calculated to impress us with a deep sense of the dignity and power of the great Chieftain. In the course of the conversation already referred to, we are informed of the downfall of the Douglases from their former high estate, and also of the mutual affection existing between Ellen and Malcolm Graeme. By one of those lucky coincidences which Scott was so fond of employing, and the frequency of which must be deemed inartistic, Douglas and Malcolm appear in time to relieve Ellen from the unpleasant duty of welcoming her grim kinsman on his landing. We have thus been introduced to the chief characters of the poem, and observe how the skill of the poet is displayed in the various ways in which we have made their acquaintance.

5. "What effect is gained by the introduction of such a personage as Allan Bane?"

The description of the sad old Harper is given with all of Scott's poetic skill. White-haired Allen Bane is the *beau ideal* of a minstrel, devotedly attached to his master's cause. By the contemplation of this character our minds are carried back to the palmy days of romance, to the troubadours and *trouveres* of the Middle Ages. "His dreams, visions, forebodings, fidelity and affection raise us out of our every day thought." His visions and forebodings partake of the nature of *second sight*, the exclusive prerogative of Highland seers. We may briefly say that the introduction of white-haired Allan Bane lends a romantic interest to the narrative.

6. "Point out the poetical peculiarities of the description of the Trosachs as found in the eleventh stanza, Canto I."

First we may notice the plan of the description. The scene is viewed from what is technically known as the traveller's point of view, viz.: only such portion of the scenery is described as would be embraced by the traveller's vision from one standpoint. The two most prominent qualities of matter are form and colour. We find here that Scott conveys the idea of form by reference to well-known objects, as pyramid, pinnacle, turret, dome, cupola, &c., on the principle of explaining the unknown by the known. He conveys the idea of colour by a few words of broad meaning as purple, fire, dark, sheen, green, &c. He never gives minute tints; the nature of his subject and the structure of his verse prevented him from doing so. The fact of the scene being described at a particular point of time serves to add to the reality of the picture. The poetic effect is increased by the similitudes introduced in the main description, and the touches of fancy at the close; the mind is pleased and relieved after the contemplation of the rugged and forbidding rock masses by the lighter graces of the "dew drops sheen," "the brier rose," and the "creeping shrubs of thousand dyes." The last line illustrates one of Scott's characteristics, that of attaching to natural phenomena a melancholy significance:—

"Waved in the West wind's summer sighs."

LADY OF THE LAKE.

(*Intermediate Class.*)

ARCHAISMS.

1. Explain the archaism of poetic diction.

Poetry, being less conversational than prose, is more affected by the language and traditions of the poetry of past ages. The words adapted for metre are limited, and by the constant use of such words in poetry they acquire certain poetic and venerable associations which specially adapt them to the purposes of poetry.

2. Give a list of archaisms from the text.

Sheen, torrent's foaming tide, oft, recked, methinks, vale, agen, glaive, targe, ruth, kern.

DERIVATION AND USE OF CERTAIN WORDS.

3. Derive and trace present use of the following italicised words :—

"An hundred men might hold the *post*."

Post = *positus*, placed; a position where men are posted or placed. In such words as post-office, p.-haste, p. a ledger, &c., the prominent idea is that something placed.

"With hardihood against a *host*."

Host = *hostis*, an enemy; any large number, an army. The same form of word is also used to designate: (1) One who entertains—deriv., *hospes*, a guest; (2) the sacrifice of the Mass in the R. C. Church—deriv., *hostia*, a victim.

Rival = *rivalis*, (rivus, a stream.) (1) A person possessing a brook with another; (2) one on the opposite side; hence (3) an opponent.

"Moves our free course by such fixed cause,
As gives the poor *mechanic* laws."

Mechanic = *mechane*, a contrivance, a machine; hence mechanic, primarily one without intelligence, but one who is under direction of another, probably used thus in the extract by Fitz-James.

(1) "Thy secret keep I *urge* thee not."

(2) "As if an infant's touch could *urge*."

Urge = *urgeo*, I press. In the first extract the word is used in a metaphorical sense, on the principle of the physical and the seen explaining the mental and the unseen, though from its frequent use in the above sense the metaphor is lost sight of. In the second extract the word is used literally.

"Their headlong passage down the *verge*."

Verge = *virga*, (1) a rod; (2) a privileged space marked out by the virga or rod, the emblem of authority; (3) the edge or margin of the space, and (4) any margin or border.

"Though to his heart
The life-blood *thrilled* with sudden start."

Thrilled = *thirlian*, to pierce, cf. thrall. The word is here used metaphorically on the principle already stated.

"See rudely swell,
Crag over crag and *fell* o'er *fell*."

Fell = A. S. *feld*, p. p. of *fellan*, to fell, a hill, (cf. field, ground on which the trees have been felled). See also *fell*, cruel; fell, anger, and fell, the skin.

"Dark lowered the clansman's *sable* scowl."

Sable = (1) a fur-bearing animal; (2) the fur of the animal; (3) a mourning garment, dark; (4) any black color.

FIGURES OF SPEECH.

4. Name the figure in each of the following :—

"And asked Fitz-James, by what strange cause
He sought these wilds, traversed by few,
Without a *pass* from Roderick Dhu."

"Brave Gael, my pass, in danger tried,
Hangs in my belt, &c."

Pun or Paronomasia, *i. e.*, a play on the word pass.

"Watching their leader's beck and will."

Zeugma, *i. e.*, using a verb or participle (watching) with two objects, with only one (beck) of which it can properly be used.

"He manned himself with dauntless air."

Metaphor, which is an implied comparison, the things compared being *he*, in preparing himself to meet danger,

and a ship, which a commander puts in readiness for battle by manning or furnishing with men.

"Come one, come all."

Epizeuxis, a joining of the same words with emphasis.

5. Quote examples of trope, oxymoron, apostrophe, epanorthosis and sarcasm.

Trope: ruffian dagger, lazy hours, cursed steel. The epithets, ruffian, lazy, and cursed, are shifted from their proper subject to an allied one.

Oxymoron: dark lightning, light shade, darkness visible, &c. By this fig. words of opposite signification are joined together.

Apostrophe: "Now, truce, farewell! and, ruth, begone!" This is a sudden turning aside to address another thing.

Epanorthosis:

"Fear nought—nay, that I need not say—
But doubt not aught from mine array."

This is a correction of something said.

Sarcasm, or vituperation:

'Not yet prepared? By heaven! I change
My thought, and hold thy valour light
As that of some vain carpet knight, &c."

METRE.

6. Name the metre of the poem.

Iambic tetrameter.

7. Point out variations and mark the effect of such.

More liberty is taken with the first foot, where a trochee is often substituted for the regular iamb. The general effect of such a change is good by giving variety; but there is also a special effect in each case, one of these being a rapidity of action effected by use of the trochaic foot.

The following are a few examples of variation in metre:

"Muttered their soldier-matins by."

Roderick and Fitz-James, both anxious to arrive at the end of their journey, though from very different motives, hurry their preparations for the start, and their haste is well brought out by the metre of the line above.

"Ever the hollow path twined on."

The trochaic and emphatic *ever* shows the unvarying nature of the pathway over which they travelled.

"Instant through copse and heath arose,
Bonnets and spears and bended bows."

The same effect is here produced as in the first quotation—rapidity of action.

"Homage to name to Roderick Dhu."

In this instance the effect is marked and shows the skill of the poet to good advantage. R., in his indignation, spurns the mere mention of anything tending to peace, and by means of the trochee homage, he scornfully flings the advances of F.-J. back to their author.

Other equally excellent examples may be found, particularly l.l. 203, 331, 417, &c.

NOTES ON DE FIVAS' READER.

71. *Exemplaire*, copy (of printed books, engravings, &c.;) *copie*, transcript (of a writing,) in detached sheets.

72. *Oeufs*; *f* is sounded in the sing. but silent in the plural; so also *boeuf*, *nerf*, but in *boeuf*, *chef*, *nerf*, *oeuf*, *f* is silent always before a consonant and in compounds.

Évêque and bishop are both from L. episcopus; episc, evesque, évêque.

Je pars samedi, I set out on Saturday (a single act;) *il vient le samedi*, he comes on Saturdays (a customary act.)

73. *En sus*, (s sounded) over and above, to boot; *sus* prep. upon; homonym, *susse* from *savoir*;

derivative *dessus* above, *susdit* (sus-di) preceding the noun, and sus-énoncé, following it, aforesaid, above-mentioned.

75. Façon is fem. as also *chanson*, song; *moisson*, harvest; *rançon*, ransom; and nouns in *on* preceded by *is*, *gi*, *si*, *ti*, *xi*, with few exceptions.
Détaler, take in goods (exposed for sale,) to pack up, to scamper off.
Rats en campagne, (the) rats (are) in (the) field immediately.

76. *Arracher à q.u.* to take from s.o.
Dent, *gent*, *jument*, are fem.; other nouns in *ent* are masc.
Prenez garde d'ôter, or *prenez garde que vous n'ôtiez* (subj.,) take care that you don't remove.
J'étais en nage, nouns in *age* are masc. except the six following: *nage*, *cage*, *rage*, *page*, *plage*, *image*.

77. *Plus vite qu'un homme ne saurait;* the verb after a comparative, if positive, is preceded by *ne;* but *ne* is omitted with the second verb if the first is interrogative or negative, or if another conjunction follows *que*. *Il est plus riche qu'il ne l'était; elle n'est pas plus heureuse qu'elle l'était. Il est plus heureux que s'il était riche.*

78. *La ponte a lieu* &c., one every alternate day.
La plus remarquable, *le* in superlatives is invariable with adverbs, and with adjectives when there is no comparison of objects. *On les punit quand ils sont le plus coupables.*
La cigogne est d'un naturel &c.; the stork is of a rather gentle disposition, it is neither distrustful nor wild, and can be easily tamed.

79. *Détruit* (l. 18) the subject is *hirondelle*.
Fois, time (repetition); *temps*, time (duration); homonyms, *foi*, fem., faith; *foie*, masc., liver.
Davantage, *plus*, more; *plus* may precede a noun, adjective or adverb; *davantage* is used absolutely and generally at the end of a sentence; after *encore* or *bien*, plus or davantage are used indifferently at the end of a sentence: *ceci me plaît bien plus* (or *bien davantage*); *Plus* is used and not *davantage* in connection with *peu*, *beaucoup*, or *on ne peut; elle est heureuse, on ne peut l'être plus; davantage* is never used in the sense of *le plus; de toutes les fleurs, la rose est celle qui me plaît le plus* (not *davantage.*)
Printemps; we say *au printemps*, in spring, but *en été*, *en automne*, *en hiver*, in summer, &c.
Qui n'en est pas moins belle; which is none the less beautiful for having been often reproduced.
Hiven, winter, pron., *ivère;* so also *amer*, *cancer*, *fier*, *hier*, *Jupiter*, *Luther*.
Parmi, *entre*; *parmi*, among many taken collectively, je n'ai aucun ami parmi ces gens: *entre*, between two, or among many taken distributively. *Il y a une grande différence entre les hommes; partagez cela entre vous.*
Pays, *contrée*, *campagne*, *patrie*, country; *pays*, country, chiefly with the idea of nationality: *contrée*, extent or region of territory forming a distinct whole: *patrie*, one's native country, fatherland; *campagne*, country in distinction to town.
Ce sont elles; after *ce* the verb is sing. except when followed by the 3rd per. plural, as, *c'est moi*, *c'est vous.*

81. *La forêt*, forest, *le foret*, drill.
Et ne la quitta que; and left it

only (when) pressed by hunger. *Il lui saute à la gorge;* when not ambiguous the French prefer this form to the use of the possessive adjective. De F., 488-9.

Qui n'en veut qu'à, who bears malice only towards this man; *je m'en veux de l'avoir fait;* I can't forgive myself for having done it; *à qui en veut-il*, whom has he to complain of?

Indices, parterres, luxe are masc. *Argent*, silver, then money with reference to quantity and value; *monnaie*, coinage, currency, change.

Qui manquait aux habitants, which was wanting to the inhabitants of M; *Si leur père vient à leur manquer*, if their father should happen to be taken from them; *ne manquer de rien*, to be in need of nothing; *il manque deux volumes à cet ouvrage*; there are two volumes missing of that work.

85. *Grade*; nouns in *ade* are fem. except *grade* and *stade.*

86. Il n'en devait être &c.; should it not be better on that account? I assure you so.

Il vint à passer (l 31,) there happened to pass.

89. *Donnait des ordres.* The partitive is expressed by *de* only, if the noun is preceded by an adjective or if the verb is neg.; but if the sentence is interrog. and neg. the article is sometimes used, with a slight difference in meaning. N'avez-vous pas de la vinde? Have you not meat? *Non, mais j'ai du pain. N'avez-vous pas de viande?* have you no meat.

90. *Tous* (l 15 ;) s is sounded when *tous* is used absolutely after a verb or preposition, s is also sounded in the following words, hard when pronounced alone, and soft when the s is carried to the fol. word beginning with a vowel *as*, ace; *sus*, upon; *jadis*, formerly; *gratis*, gratis; *lis*, lilly; *maïs*, maize; *vis* screw; an s is sounded, but not written, between *quatre* and *yeux* in *entre quatre yeux*, between two persons, (pron. quatre-z-yeux.).

GEOGRAPHY.

QUESTIONS AND ANSWERS.

1. Mention some of the most important natural advantages of North America.

Ans. (*a*). Its greatest width lies in the Temperate Zone. In this it differs from South America and Africa which have their greatest width in the Torrid Zone.

(*b*) It has no high mountains in the interior like Europe and Asia to separate the countries and prevent trade, but it has a great central plain which is fertile, rich in minerals and is connected with the Atlantic on the north, east and south by large navigable rivers. Its great lakes facilitate trade and the evaporation from these mitigates the extremes of climate and increases the amount of rainfall.

(*c*) It has many good harbors on the eastern side which is nearest the great markets of the world.

(*d*) It is much narrower than the combined width of Europe and Asia, and thus has the advantage of the evaporation of both oceans. Owing to this and the presence of the great lakes the rainfall is abundant and uniform.

It has therefore no desert like Gobi or the Sahara.

2. How many republics in North America?

Ans.—Seven.—United States, Mexico, and five independent republics in Central America.

3. Name the six largest cities in the world; Name also the six largest seaports.

Ans. (*a*) London, Paris, Pekin, New York, Tokio, (formerly Yeddo), and Berlin. (*b*) London, New York, Liverpool, Boston, Bombay, and New Orleans.

4. What figure conveys to us the best idea of the shape of the earth?

Ans. A sphere; the equatorial diameter is greater than the polar diameter by about 27 miles but this difference when shown on a globe 25 inches in diameter amounts to about one-twelfth of an inch.

5. What effects have the trade-winds upon the climate and products of South America?

Ans. The north-east trade-winds blow directly against the north-east side, and the south-east trade-winds against the south-east side. These winds are fresh from the sea, and they bear an enormous quantity of moisture. This moisture is deposited over the eastern part of the continent, and is carried back to the sea by the Magdalena, the Orinoco, the Amazon, and the La Plata. When this moisture is condensed the latent heat stored up in it becomes sensible heat. The eastern part therefore has abundance of heat and moisture and hence vegetation is very luxuriant. The Andes prevent the winds from reaching the western side of the continent, hence Peru is a rainless Country.

6. Why has the Amazon river no delta, like the Mississippi or the Nile?

Ans. Because in the valley of the Amazon there is no dry season. It rains there every month in the year, and therefore the river does not overflow as the Nile does. For this reason there is not so much earthy matter carried down to the ocean by the Amazon as by the other rivers, and all that is carried down is swept away by the ocean current that flows past its mouth towards the Gulf of Mexico.

7. North America has many great lakes, South America has more; why does not South America need lakes as reservoirs?

Ans. South America has no monsoons and therefore the trade-winds constantly blow against and over it from the north-east and south-east. The moisture brought by these winds is constant and abundant and therefore lake reservoirs are not needed.

8. Account for the annual overflow of the Nile. What good results are brought about by this overflow?

Ans. The Nile has two main tributaries, the White Nile which has its sources in the great lakes at the equator and the Blue Nile which rises in the mountains of Abyssinia. Moisture is brought to these tributaries by the monsoons from the Indian Ocean. Their supply therefore is not constant; in fact the Blue Nile is almost dry after the rainy season. Lake expansions in a river prevent inundations and act as reservoirs, hence the White Nile coming from the great lakes has a constant flow while the Blue Nile has not. The latter therefore causes the inundations in Egypt. Without these inundations Egypt would be a desert like the Sahara or Arabia These three places are not crossed by winds coming from the sea. It will be seen that the Nile grows smaller as it approaches the sea while the Amazon grows larger.

9. Distinguish between Physical and Political Geography.

Ans. Physical Geography, is the geography of nature (Gr. *phusis*, nature.) Political Geography, is the geography of man (Gr. *polites* a man).

10. In what respects do glaciers resemble rivers?

Ans. (*a*) Rivers carry back to the sea the superfluous rain and snow, that fall below the snow-line all over the earth. Glaciers carry down to the rivers the snow that would otherwise accumulate above the snow-line.

(*b*) Glaciers have a motion as rivers have. Ice has a motion like water, only much slower. It moves more like thick tar or honey. Professor Tyndall placed a row of poles across a glacier in the Alps, and the following figures show the number of yards each pole moved downwards during a year: 5, 20, 48, 55, 62, 64, 67, 69, 79, 68, 64, 54, 47, 39, 21, 11, 1. The central part, like that of a river, moved more rapidly than the sides.

(*c*) Glaciers have tributaries, and carry down earthy matter as rivers do.

11. What do glaciers form?

Ans. In temperate regions they are the sources of rivers such as the Ganges, the Rhine, and the Po. In the polar regions they do not melt, but glide into the sea; large masses of the lower extremity of the glacier break off and float away as icebergs. These icebergs are carried towards the equator and moderate the heat there.

12. Explain the terms Mercator's projection, polar projection and equatorial projection.

Ans. A map drawn on Mercator's projection has the meridians parallel to one another. In a map drawn on a polar projection, one of the poles is the centre of the map and the equator forms the borders. When drawn on an equatorial projection, the equator runs through the middle of the map, and a meridian forms the borders.

ARITHMETIC.—SECOND CLASS.

1. At what times between 4 and 5 o'clock is the minute hand as far from 8 as the hour hand is from 3?

SOLUTION.—If minute hand is as far past 8 as hour hand is past 3, it must be 25 min. in advance. At 4 o'clock it is 20 min. behind, and must gain 20+25=45 min., which it will gain in $1\frac{1}{11}$ min. $\times 45 = 49\frac{1}{11}$ min. But if minute hand is as far behind 8 as hour hand is in advance of 3, it must be between 6 and 7 and as far behind 7 as hour hand is in advance of 4. ∴ while hour hand has gone certain distance, the minute hand, which moves 12 times as fast, must have gone 35 min. (to 7) less that distance; ∴ 35 min. less the distance=12 times the distance and 35 min.=13 times the distance. ∴ 35 min. $\div$ 13 = $2\frac{9}{13}$ spaces passed over by hour hand since 4 o'clock, ∴ $2\frac{9}{11} \times 12 = 32\frac{4}{13}$ minutes passed over by minute hand; ∴ times = $32\frac{4}{13}$ past 4, and $49\frac{1}{11}$ past 4. *Ans.*

2. A's money is 12 per cent. of B's, and 16 per cent. of C's; B has $100 more than C: how much has A?

SOLUTION.—12 per cent. of B's=16 per cent of C's; ∴ 1 per cent. of B's = $\frac{4}{3}$ of C's, or B's = $\frac{4}{3}$ of C's; ∴ $100 = ⅓ C's money, ∴ C's money = $300, ∴ A's money, or 16 per cent. of $300=$48. *Ans.*

3. By mixing 10 lbs. good sugar with 6 lbs. worth only ⅔ as much, the mixture is worth 1 cent a lb. less than the good sugar: find the prices of the ingredients and of the mixture.

SOLUTION.—Cost = 16 cts. less on 16 lbs.; but diff. = ⅓ of cost of 6 lbs. good sugar; 16 cts. = ⅓ of 48 cts.; 48÷6=8 cts., and ⅔ of 8 cts = 5⅓ cts.; ∴ 10 lbs at 8 cts. = 80; lb. @ 5⅓ = 32; ∴ 16 lbs. cost 80 + 32 = 112 cts., ∴ 1 lb. cost $\frac{1}{16}$ of 112 = 7 cts.; ∴ cost of ingredients 8 cts. and 5⅓ cts.; mixt. 7 cts. *Ans.*

4. I can insure my house for $2,500 @ $\frac{8}{10}$ per cent. prem. annually, or permanently by paying down 12 an. premiums; which should

I prefer, and what would I gain: money worth 6 per cent.

SOLUTION.—$2,500 @ $\frac{8}{10}$ per cent. = $20; immediate perpetuity of $20 a year = $20 ÷ .06 = $333⅓, which + 1st payment = $353⅓; 12 payments = $240, ∴ gain $113⅓. *Ans.*

5. A smuggler had brandy which he held @ $198; after selling 10 gals., ⅓ of remainder was seized, by which his receipts were cut down to $162. How many gallons had he and at what price?

SOLUTION.—⅓ of remainder = 198 — 162 = $36, ∴ remainder = $108; ∴ for 10 gals. he received $198 — 108 = 90, or $9 per gal, ∴ 22 gals. *Ans.*

6. A owes B $1,500, due in 1 yr. 10 mos. He pays him $300 cash, and a note at 6 mos. for balance. Find face of note, int. at 6 per cent.

SOLUTION.—Amt. of $300 for gn. time, = $333; ∴ $1,167 = value of note 16 mos. hence. ∴ P. W. of $1,167 = $1,080.56, face of note.

7. The stocks of A, B & C are in trade, 8, 10 and 7 mos. respectively; their gains are $115.50, $204.75 and $183.75. Find their stocks, the difference between B's and C's being $220.

SOLUTION.—A's gain per mo. = $115.50 ÷ 8 = $14.4375; B's = $204.75 ÷ 10 = $20.475; C's $183 ÷ 7 = $26.25, ∴ stock equivalents = 55, 78 and 100, ∴ diff. between B's and C's = 22, ∴ A's cap. = $\frac{5}{22}$ of $220 = $550; B's. $\frac{7}{22}$ of $220 = $780; C's = $\frac{10}{22}$ of $220 = $1000.

8. Stocks of A, B & C are $350, $220 and $250 respectively; gains, $112, $88, $120; find time each stock was in trade; B's time being 2 mos. longer than A's.

SOLUTION.—A's gain = $\frac{112}{350}$ = 32 per cent. B's = $\frac{88}{220}$ = 40 per cent.; C's = $\frac{120}{250}$ = 48 per cent.; C gains 8 per cent. more than B by keeping stock 2 mos. longer in trade, ∴ gain = 4 per cent. per month; ∴ times = 32 ÷ 4, &c., or 8, 10, 12 mos.

9 A grocer knows neither the weight nor first cost of a box of tea, only recollects that if he had sold the whole @ 30 cents a lb. he would have gained $1, but if he had sold it at 22 cents he would have lost $3. Find lbs. and first cost per lb.

SOLUTION.—Difference between $1 gain and $3 loss = $4. ∴ $4 ÷ .08 = 50 No. lbs.; cost = 50 × 30 — $1 = $14; ∴ $14 ÷ 50 = 28 cts.

10. $30,000 bonds at 7 per cent., payable semi-anually, due in 20 years, are bought so as to yield 8 per cent., payable half-yearly. Find price of bonds.

SOLUTION.—3½ per cent of $30,000 = $1050 ½ yearly payment. ∴ $1,050 ÷ .04 = P. W. of payments if paid at end of time. = $26,250, which in 20 years would give gain of $3750; P. W. of 3750 = $781.08; $26,250 + $781,08 = $27,031.08. *Ans.*

MATHEMATICS.

Solutions to First Class Arithmetic Paper.

1.
$$\frac{/48}{/13\ /35} = \frac{/51}{/13\ /38} \times \frac{37.37.38}{49.50.51}$$

$$\frac{3\ /48}{/12\ /36} = \frac{/51}{/13\ /38} \times \frac{3.13.37.38}{49.50.51}$$

$$\frac{3\ /48}{/11\ /37} = \frac{/51}{/13\ /38} \times \frac{3.12.13.38}{49.50.51}$$

$$\frac{/48}{/10\ /38} = \frac{/51}{/13\ /38} \times \frac{11.12.13}{49.50.51}$$

Now sum the fractions in the right hand column, thus:

36.37.38 + 3.13.37.38 = 3.25.37.38
3.12.13.38 + 11.12.13 = 12.13.125
3.25.37.38 + 12.13.125 = 150 (19.37 + 10.13
= 150.833
= 49.50.51

$\therefore$ sum of these fractions = 1

$\therefore$ sum of fractions in left hand column

$$= \frac{/51}{\frac{/13}{/38}}$$

2. 5·5
5·75
5·375
4.6875
3.8437
2.9218
.9804

This result is obtained thus :

Divide 8 by 2, add 7, divide by 2 and so on till 1 is added, then divide by 4.

3. $178\frac{2}{3}$ poles ; 70.62 poles.

4.

1	
1.1	
1.21	1.4641
1.331	2000
4.641)	2928·2 (630·94

5. The glass loses half its weight ; therefore the liquid displaced weighs half as much as the glass, hence the specific gravity is 1.2.

6. Cash value of the goods $\frac{1040}{1.04} = 1000$

Adding $17\frac{1}{2}$ per cent. gives \$1,175 as the cash selling price, and since the credit selling price is \$1200 we require to find the time in which \$1175 will amount to \$1200 at 8 per cent., and since \$94 is the interest on \$1175 for a year, $\therefore$ \$25 is the interest for $\frac{25}{94}$ yr. the time required.

7. Area by this method =

$$(\text{diam.})^2 \times \frac{707}{900}$$

$$= r^2 \times \frac{2828}{900}$$

$$= r^2 \times 3.14222 \ldots$$

True area = $= r^2 \times 3.14159 +$

Dif $= r^2 \times 0.00063$

$\therefore$ area by this method is too great by $\frac{.00063}{3.14222}$ or about $\frac{1}{5000}$ of itself,

8. Let a denote the number of gallons the cistern holds, and b the number supplied every minute. Then

	Taps.	Gals.	Gals.	Min.
	24 empty	$a +$	$5\frac{1}{2}b$ in	$5\frac{1}{2}$ (1
$\therefore$	24 "	$26a +$	$143b$ "	143
Similarly	15 "	$11a +$	$143b$ "	143
$\therefore$	9 "	$15a$	"	143
	$2\frac{3}{5}$ "	a	"	33 (2)
	$15\frac{3}{5}$ "	a	"	$5\frac{1}{2}$
$\therefore$ from (1)	$8\frac{2}{5}$ "		$5\frac{1}{2}b$ "	$5\frac{1}{2}$
	$8\frac{2}{5}$ "		$33b$ "	33
$\therefore$ from (2) and (3)	11 "	$a +$	$33b$ "	33

9. $\log (3^{20} \times 5^{15} \div 2^{11})$
$= \log (3^{20} \times 5^{15} \times 2^{15} \div 2^{26})$
$= \log (3^{20} \times 10^{15} \div 2^{26})$
$= 20 \log 3 - 26 \log 2 + 15$
$= 16.715646$
$\therefore$ there are 17 figures in the integral part.
$\log 3^{-15} = -15 \log 3$
$= -7.1568195$
$= \bar{8}.8431805$
$\therefore$ there are 7 ciphers.

10. (1) Let c be the distance ; then since the whole triangle and the triangle cut off are similar, they will be to one another as the squares of their altitudes.

$$\therefore c^2 : a^2 :: 1 : 2$$

$$\therefore c = \frac{a}{\sqrt{2}}$$

10. (2) Let a, b, c, be the sides, then

$$a+b+c=p \quad (1)$$
$$a^2 + b^2 = c^2 \quad (2)$$
$$ab=pr \quad (3)$$

Square (1) and substitute for a^2+b^2, and ab and we have

$$2c^2+2ac+2bc=p^2-2pr$$
$$\therefore 2c(c+a+b)=p^2-2pr$$
$$\therefore c = \tfrac{1}{2}(p-2r), \text{ \&c.}$$

SOLUTIONS TO FIRST-CLASS ALGEBRA PAPER.

1. Making these substitutions

$ax^2 + bxy + cy^2$ becomes

$(ak^2 + 2bkm + cm^2)u^2 +$

$2(akl + bkn + blm + cmn)uv$

$$+ (al^2 + 2blr + cn^2)\, v^2$$

$$\therefore A = ak^2 + 2bkm + cm^2$$

$$B = akl + bkn + blm + cmn$$

$$C = al^2 + 2bln + cn^2$$

$$\therefore B^2 - AC = (b^2 - ac)(kn - lm)^2$$

$$\therefore B^2 - AC = (b^2 - ac)(kn - lm)z$$

2. $a(b-c)^3 + b(c-a)^3 c + c(a-b)^3 =$
$(a-b)(b-c)(c-a)(a+b+c)$. (1)

$$u = x(By^3 - Cz^3)$$
$$v = y(Cz^3 - Ax^3)$$
$$w = z(Ax^3 - By^3)$$

Substituting these values of u, v, w in
$Au^3 + Bv^3 + Cw^3$ we get
$Ax^3(By^3 - Cz^3)^3 + By^3(Cz^3 - Ax^3)^3$
$+ Cz^3(Ax^3 - By^3)^3$

And from (1) this expression $=$
$(Ax^3 - By^3)(By^3 - Cz^3)(Cz^3 - Ax^3)$
$\times (Ax^3 + By^3 + Cz^3)$

$$= \frac{zw}{x}\cdot\frac{u}{y}\cdot\frac{v}{z}(Ax^3 + By^3 + Cz^3)$$

$$\therefore \frac{Au^3 + Bv^3 + Cw^3}{uvw} = \frac{Ax^3 + By^3 + Cz^3}{xyz}$$

3. Put $a-b=x$, $b-c=y$
and $\therefore a-c=x+y$
and the first expression becomes
$x^2y^2 + (x+y)^2(x^2+y^2)$
$= (x^2 + xy + y^2)^2$
$\therefore$ the square root required is
$x^2 + y^2 + xy$
$= a^2 + b^2 + c^2 - ab - bc - ca$

On making the same substitution, the second expression becomes

4. $x^6 + y^6 + (x+y)^6 - 3x^2y^2(x+y)^2$
$= 8(x^2 + y^2 + xy)^3$
$\therefore$ the cube root required is
$= 2(x^2 + y^2 + xy)$
$= (a-b)^2 + (b-c)^2 + (c-a)^2$

4. $$\frac{a}{x} = \frac{b}{y} = \frac{c}{z}$$

$$= \frac{ax + by + cz}{x^2 + y^2 + z^2}$$

$$= \frac{1}{x^2 + y^2 + z^2} \quad (1)$$

$$\text{Also} = \frac{la + mb + nc}{lx + my + nz} \quad (2)$$

$$\text{Also} = \frac{a^2 + b^2 + c^2}{ax + by + cz}$$

$$= a^2 + b^2 + c^2 \quad (3)$$

Then multiplying the three terms of
$k(x^2+y^2+z^2) + 2(lx + my + nz) + h = 0$
respectively by (1), (2), (3) we get
$k + 2(la + mb + nc) + h(a^2 + b^2 + c^2) = 0$

5. $$\frac{a\sqrt{b} + b\sqrt{a}}{\sqrt{a} + \sqrt{b}} = \frac{\sqrt{ab}(\sqrt{a} + \sqrt{b})}{\sqrt{a} + \sqrt{b}} = \sqrt{ab}$$

$$(\sqrt{4+3i} + \sqrt{4-3i})^2$$
$$= 8 \pm 2\sqrt{16 - 9i^2}$$
$$= 8 \pm 2\sqrt{16 + 9}$$
$$= 8 \pm 10$$

$$\left(\frac{-1 + i\sqrt{3}}{2}\right)^2 + \frac{-1 + i\sqrt{3}}{2} + 1$$
$$= \frac{1 - 2i\sqrt{3} + 3i^2}{4} + \frac{-1 + i\sqrt{3}}{2} + 1$$
$$= \frac{3}{4} + \frac{3}{4}i^2$$
$= 0$, since $i^2 = -1$

6. (ii) $S = a^2 + (a+d)^2 + \&c.$
$= a^2$
$+ a^2 + 2ad + d^2$
$+ a^2 + 4ad + 4d^2$
$+ a^2 + 6ad + 9d^2$
$+ \&c.$
$+ a^2 + 2(n-1)ad + (n-1)^2 d^2$

$$= na^2 + n(n-1)\,ad + \frac{n}{6}(n-1)(2n-1)d^2$$

7. (i) $(a-x)^3 - (x-b)^3 = 0$
Divide by $(a-x) - (x-b)$ (1)
And we have
$(a-x)^2 + (a-x)(x-b) + (x-b)^2 = 0$
$\therefore x^2 - (a+b)x + a^2 - ab + b^2 = 0$

$$\therefore x = \frac{a + b \pm (a-b)\sqrt{-3}}{2}$$

Also from (1) $x = \dfrac{a+b}{2}$

(ii.) $ax + by = 1$

$$\frac{a}{x} + \frac{b}{y} = 1$$

$\therefore ay + bx = xy$

$\therefore a^2by + b^2x^2 = x^2y^2$

$\therefore a^2(1-ax) + b^2x^2 = x^2(1-ax)$

$\therefore ax^3 - (a^2 - b^2 + 1)x^2 + a^2x = 0$

$$\therefore x = \frac{a^2 - b^2 + 1 \pm \sqrt{a^4 + b^4 + 1 - 2(a^2b^2 + a^2 + b^2)}}{2a}$$

(iii.) $$x\left(y + \frac{1}{z}\right) = a$$

$\therefore xyz + x = az$

$$\therefore \frac{a}{xy} - \frac{1}{yz} = 1 \quad (1)$$

Similarly $$\frac{b}{yz} - \frac{1}{zx} = 1 \quad (2)$$

and $$\frac{c}{zx} - \frac{1}{xy} = 1 \quad (3)$$

Multiply (3) by a and add to (1)

$$\therefore \frac{ac}{zx} - \frac{1}{yz} = a + 1$$

Multiply this by b and add (2)

$$\therefore \frac{abc - 1}{zx} = ab + b + 1$$

$$\therefore x = \frac{abc - 1}{bc + c + 1} \quad (4)$$

Similarly $$xy = \frac{abc - 1}{bc + c + 1} \quad (5)$$

and $$yz = \frac{abc - 1}{ca + a + 1} \quad (6)$$

Multiplying (4) and (5) tog'r and dividing by (6) gives

$$x = \frac{(abc - 1)(ca + a + 1)}{(ab + b + 1)(bc + c + 1)}$$

8. The roots of $x^2 - 2x + q = 0$ are $1 + \sqrt{1-q}$ and $1 - \sqrt{1-q}$

and $1 + \sqrt{1-q} = (1 - \sqrt{1-q})^2$

gives $3\sqrt{1-q} = 1 - q$.

$\therefore 3 = \sqrt{1-q}$

$\therefore q = -8$.

(2.) If a, b, c, are the roots of

$$x^3 - px^2 + qx - r$$

then $a + b + c = p$

$ab + bc + ca = q$

$abc = r$

$\therefore 2a^2b^2 + 2b^2c^2 + 2c^2a^2 - a^4 - b^4 - c^4$

$= (a+b+c)(a+b-c)(c+a-b)(b+c-a)$

$= p(p-2c)(p-2b)(p-2a)$

$= p\{p^3 - 2(a+b+c)p^2 + 4(ab + bc + ca)p - 8abc\}$

$= p(p^3 - 2p^3 + 4pq - 8r)$

$= p(-p^3 + 4pq - 8r)$

and $2a^2b + 2bc + 2ca - a^2 - b^2 - c^2$

$= 4(ab + bc + ca) - (a + b + c)^2$

$= 4q - p^2$

$\therefore$ required result is

$$\frac{p(p^3 - 4pq + 8r}{p^2 - 4q} = p^2 + \frac{8pr}{p^2 - 4q}$$

9. Let x = rate of vessel, in miles, per hour.

y = " tide " "

Then with the tide the vessel goes

1 mile in m minutes

or $\frac{60}{m}$ miles in 1 hour.

and against the tide she goes

$\frac{60}{n}$ miles per hour.

$$\therefore x + y = \frac{60}{m}, \quad x - y = \frac{60}{n},$$

$$\therefore x = 30\left(\frac{1}{m} + \frac{1}{n}\right)$$

$$y = 30\left(\frac{1}{m} - \frac{1}{n}\right)$$

10. $x - y = AB = a - b$, &c.,

$\therefore$ the expression becomes

$x^2(y-z) + y^2(z-x) + z^2(x-y) + (x-y)(y-z)(z-x)$

which $= 0$.

FIRST CLASS EUCLID.

July, 1880.

1. Two triangles are equal in every respect.

(i.) If they have two angles of the one equal to two angles of the other, and the side oppo-

site one of these angles in the one triangle equal to the side opposite to the equal angle in the other.

(ii.) If they have two sides of the one equal to two sides of the other, and the angle opposite one of the sides in the one triangle equal to the angle opposite to the equal side in the other triangle, the angles opposite to the other equal sides being each less than a right angle.

2. Enunciation of Euc. bk. 2, prop. 10 given.

3. If through a fixed point within a circle a chord be drawn, the rectangle obtained by its two segments is always the same in whatever direction the chord is drawn.

4. Enunciation of bk. 6, prop. 15 given.

5. " " " 25 "

6. To construct a rectangle that shall be equal to a given square and the difference of whose adjacent sides shall be equal to a given line.

7. To find a point within a triangle from which if straight lines be drawn to the angles they will divide the triangle into three equal parts.

8. Given any triangle to make a similar one of double the area.

9. Enunciation of bk. 6, prop. D. given.

10. If the perpendiculars Am. Bn, Cd, be drawn from the angular points of a triangle ABC upon the sides, show that they will bisect the angles of the triangle mnd.

FIRST CLASS MECHANICS.

July, 1880.

N. B.—Five questions will constitute a full paper.

1. State the conditions of equilibrium of any number of forces acting in one plane at different points of a rigid body.

Three forces, the first acting at the point A, the second at the point B, the third at the point C are represented in magnitude and direction by the lines AB, BC, CA. Determine the resultant.

2. Define uniform velocity and uniformly accelerated velocity. How is variable velocity measured? State the law of the composition of velocities.

Particles P and Q starting simultaneously from O move in straight lines OA, OB which are at right angles to one another, P moving with a uniform velocity of 24 feet per second and Q with a uniform vel. of 7 ft. per second. Determine in magnitude and direction the velocity of Q with respect to P.

3. Define energy and explain the relations between force momentum and energy.

A body weighing 12 lbs. slides with uniform velocity down a plane that rises 5 in 13. How much energy would have to be expended in order to drag the body 13 ft. up the plane by means of a string stretched parallel to the plane?

4. A body moves under the action of a constant force. Prove (i) that its velocity will be uniformly accelerated, (ii) that the spaces described from rest will vary as the squares of the times of describing them.

A constant force causes a mass of 10 oz. to move from rest through 64 feet in 10 seconds. Compare the force with the weight of a mass of 16 oz. ($g = 32$.)

5. State the law of fluid pressure.

A hollow cylinder, closed at both ends is filled with water and held with its axis horizontal, if the whole pressure on the surface, including the plane ends, be three times the weight of the water, compare the height and diameter of the cylinder.

6. State the law of connection of the density pressure and temperation of a perfect gas.

A pipe 15 feet long closed at the upper extremity is placed vertically in a tank of the same height, the tank is then filled with water; if the height of the water barometer be 33 ft, 9 in. determine how high the water will rise in the pipe.

INTERMEDIATE CHEMISTRY.

Answered by G. J. Ratcliffe.

1. Describe and explain the different methods of obtaining Oxygen Gas.

a. How would you determine experimentally its distinguishing properties.

b. What quantity of Oxygen is required for the complete combustion of 100 grs. of Hydrogen, Sulphur and Carbon?

Oxygen may be prepared (1) by heating Mercuric Oxide (HgO) which readily splits up into Mercury and Oxygen—HgO=Hg+O. (2). By heating Manganese Dioxide to redness in an iron retort, Oxygen in large quantities may be very cheaply obtained—3 $MnO_2 = Mn_3O_4 + O_2$. (3). It may be very conveniently prepared by heating Potassium Chlorate ($KClO_3$). If a little Manganese Dioxide be added to the Chlorate the Oxygen is given off at a lower temperature, the Manganese Dioxide undergoing thereby no change, —$KClO_3 = KCl + O_3$.

a. (1). A candle brought into a bell-jar of Oxygen burns very much more brilliantly than in air. (2). Place in a deflagrating spoon some sulphur; light it—it burns with a pale blue flame; introduce it into a jar of Oxygen—it burns brightly, forming (SO_2). (3). Repeat this experiment with Phosphorus, an intensely brilliant light is emitted, while white fumes of P_2O_5 are formed. (4). A steel wire, which has been previously heated, in spiral form, having a filed point coated with sulphur, when ignited and placed in a jar of the gas, burns, giving forth brilliant scintillations and forming Fe_3O_4.

(5). If Oxygen be collected over Mercury, and a solution of Pyrogallic Acid and Potassium Hydroxide be introduced into it, the Pyrogallic solution will be blackened and the Oxygen absorbed. (6). Nitric Oxide led into a jar of Oxygen Gas produces ruddy fumes of N_2O_3 and NO_2.

b. The elements combine in proportion to, or in certain multiples of their atomic weights, therefore in case of Hydrogen two of Hydrogen combine with one of Oxygen to form one molecule of water (H_2O, or as 2 : 16 *i.e.* 1 : 8 *i.e.* 100 : 800; therefore it takes 800 grs. of Oxygen for the complete combustion of 100 grs. of Hydrogen. With Sulphur Oxygen unites in proportion of one of Sulphur to two of Oxygen, forming one molecule of SO_2, or as 32 : 2 × 16 *i. e.* 1 : 1 *i. e.* 100 : 100, therefore it takes 100 grs. of Oxygen for the complete combustion of 100 grs. of Sulphur. In case of Carbon, Oxygen unites with the Carbon to form CO_2 *i. e.* in proportion of one of Carbon to two of Oxygen, therefore as 12 : 2 × 16 or as 1 : $\frac{8}{3}$ or 100 : 266$\frac{2}{3}$. Therefore it takes 266$\frac{2}{3}$ grs. of Oxygen for the complete combustion of 100 grs. of Carbon.

2. Define combustion, destructive distillation, chemical decomposition, analysis, synthesis, electrolysis, catalysis, atomicity or quantivalence.

Ordinary Combustion is the union of certain substances with the Oxygen of the atmosphere, evolving heat and sometimes light.

Destructive Distillation is the subjecting of organic substances (animal or vegetable) to an intense heat in a limited supply of air.

Chemical Decomposition is the separation of a compound into its constituent elements.

Analysis is the chemical decomposition of a substance for the purpose of ascertaining its composition.

Synthesis is just the opposite of analysis, and is the operation of combining the elements in certain proportions to form compounds.

Electrolysis is the decomposition of a sub-

stance in a liquid condition by means of galvanic action.

Catalysis is the action of one substance in contact with another facilitating a change in the condition of the one while the other remains unaffected.

By *Atomicity or Quantivalance* is meant the fixing of the atomic weights of the different elements, and the further arranging of them in groups, according as they have the power of uniting with 1, 2, 3, &c., atoms of Hydrogen or Chlorine.

3. Enumerate the allotropic forms of Carbon.

(*a*). Give their mode of occurrence and physical properties.

(*b*). How does Charcoal act as a disinfectant and deodorizer?

The allotropic forms of Carbon are diamond, graphite or plumbago, and charcoal, (coke, and lampblack.)

(*a*). The *diamond* occurs crystallized in octahedral forms of the cubical system, and is found in alluvial *debris* in India (Golconda). Borneo and Brazil. It is the hardest body known, its hardness being 10; non-conductor of electricity; insoluble in acids; density 3.5—3.6; purest form of Carbon. (2). *Graphite or Plumbago* crystallizes in hexagonal plates of the rhombohedral system; soft, its hardness being only 1.0; conducts electricity; insoluble in acids; density 2.15—2.35; friable, leaving its particles on paper when drawn across it; and is also pure Carbon.

(3.) Charcoal, coke and lampblack do not occur free. Charcoal may be obtained by subjecting wood or bones to destructive distillaion, forming respectively wood charcoal and animal charcoal.

Coke is prepared by subjecting coal to destructive distillation. Lampblack is prepared by burning turpentine or resin in a limited supply of air and condensing the smoke.

(*b*). Charcoal possesses the property of condensing large quantities of Oxygen in its pores. Brought into the chamber of a fever patient it absorbs the fever plants given off and oxidizes them. If decomposing animal matter be brought into a vessel and covered with charcoal, the noxious gases will be absorbed by the Charcoal, and will be oxidized by the condensed Oxygen in the pores of the Charcoal. Upon its power of condensing gases in its pores depend its action as a disinfectant and deodorizer.

4. Give the oxides of Carbon. State how they are prepared, separated, and distinguished.

There are two Oxides of Carbon, Carbon Monoxide (CO) and Carbon Dioxide (CO_2). Carbon Monoxide is prepared by heating Sulphuric Acid (H_2SO_4) with one-third of its weight of Oxalic Acid ($C_2H_2O_4$), the Sulphuric Acid taking away one molecule of water, leaving C_2O_3, which splits up into Carbon Monoxide and Carbon Dioxide :—

$$C_2H_2O_4 + H_2SO_4 = CO + CO_2 + H_2O, H_2SO_4$$

They may be separated by passing them through Potassium Hydroxide (KOH) in solution, the Carbon Dioxide being absorbed by the Potassium Hydroxide, while the Carbon Monoxide may be collected in a bell-jar over water.

Carbon Dioxide is prepared by the action of dilute Hydrochloric Acid on Calcium Carbonate, (marble, chalk, &c.) :—$CaCO_3 + 2HCl = H_2O + CaCl_2 + CO_2$, Carbon Dioxide being evolved, water and Calcium Chlorate remaining in the flask.

For separation see preparation of Carbon Monoxide.

The distinguishing test is that Carbon Monoxide burns with a bluish flame while Carbon Dioxide does not.

If Carbon Dioxide be led into lime water, ($Ca(OH)_2$) a white precipitate will be formed of Calcium Carbonate :—$Ca(OH)_2 + CO_2 = CaCo_3 + H_2O$. No such reaction occurs when Carbon Monoxide is led into a solution of Potassium Hydroxide.

5. Give symbol, atomic weight, occurrence, preparation and properties of Chlorine.

(*a*.) How does it bleach?

(*b*.) When led into a solution of KOH, what reaction occurs?

(*c.*) Does Chlorine support combustion?

Symbol, Cl; atomic weight, 35·5. Chlorine does not occur free in nature, but is found combined with certain metals, as Sodium and Potassium, forming Sodium Chloride or common salt and Potassium Chloride. It is obtained by heating Hydrochloric acid and Manganese Dioxide together in a flask, Chlorine being evolved and Manganese Dichloride and water remaining. The Chlorine is best collected by downward displacement, as it is soluble in water and unites directly with Mercury :—$MnO_2 + 4HCl = Cl_2 + MnCl_2 + 2H_2O$.

Chlorine is a greenish yellow gas, possessing a suffocating smell and acrid taste; does not burn; does not support *ordinary combustion*; but when certain metals, as antimony, arsenic and iron in a finely divided state are dropped into a jar of the gas, light and heat are evolved; condensible to a liquid under a pressure of 4 atmospheres at 15.5°C, and is soluble in half its volume of water.

(*a.*) Dry Chlorine does not bleach, but if the substance required to be bleached be moistened with water, the Chlorine unites at once with the Hydrogen of the water, while the liberated Oxygen oxidizes the colouring matter, thereby destroying it.

(*b.*) The reaction of Chlorine upon Potassium Hydroxide depends upon the temperature of the Hydroxide. (1) When led into a COLD solution of KOH, Potassium Chloride and Hypochlorite are formed :—$2(KOH)+Cl_2 = KCl + KClO + H_2O$, (2) When led into a WARM solution of KOH, Potassium Chlorate and Potassium Chloride are formed :— $6(KOH) + 6Cl = KClO_3 + 5KCl + 3H_2O$.

(*c.*) Chlorine, as a supporter of combustion, differs from *ordinary combustion*, in that it does not unite directly with Carbon as Oxygen does, but when certain metals, as antimony, arsenic and iron, are dropped into a jar of Chlorine, light and heat are evolved; and when a lighted candle is brought into a jar of the gas, it will continue to burn —though with a smoky flame—the Chlorine uniting only with the Hydrogen of the fat, while the Carbon, in the form of dense black smoke, is given off.

6. How is Ammonia prepared? Illustrate its properties experimentally.

Ammonia is prepared by heating the Chloride of Ammonia with quick-lime, Ammonia being evolved. Calcium Chloride and water remaining. The Ammonia, being soluble in water, must be collected over mercury, or by upward displacement :—$2NH_4Cl + CaO = 2NH_3 + CaCl_2 + H_2O$.

(1.) The solubility of Ammonia in water may be very beautifully seen by filling a narrow-necked flask with the gas by upward displacement, corking it, and removing the cork in a vessel containing water. The water will rush in with great violence, absorbing the gas and forming the Ammonia fountain. (2.) If red litmus paper be brought in contact with Ammonia, the colour is changed to blue, thereby showing the alkaline property of Ammonia. (3.) If a platinum spiral, previously heated, attached to a loosely fitting cork, be introduced into a vessel containing concentrated Ammonia, and a *slow* stream of Oxygen be allowed to enter the vessel, the platinum spiral will glow. The Ammonia is oxidized by the reaction to Ammonium Nitrite : $2NH_3 + O_3 = NH_4NO_2 + H_2O$. (4.) If a test tube containing Ammonia be inverted in a dish containing mercury, and a small piece of charcoal be inserted into the test tube, the charcoal will absorb the Ammonia and the mercury will rise and fill the space, 100 volumes of Ammonia being absorbed by 1 volume of charcoal.

7. Given three bottles containing Sulphuric, Nitric, and Hydrochloric Acids respectively; how would you determine which held the Sulphuric, which the Nitric, and which the Hydrochloric?

Barium Chloride, with Sulphuric Acid, forms the insoluble Barium Sulphate, which falls as a white powder.

If a concentrated solution of Iron Sulphate be *carefully* added to Nitric Acid, a black ring will be formed at the place where the two liquids meet. The Nitric Acid, having oxidized the Ferrous Sulphate to Ferric Sul-

phate, has been reduced to (NO) Nitric Oxide, and it is the solution of Nitric Oxide in Ferrous Sulphate which has caused the black ring.

If a few drops of a solution of Silver Nitrate be added to Hydrochloric Acid, a white curdy precipitate of Silver Chloride will be formed, insoluble in Nitric Acid but readily soluble in Ammonia.

8. How many grammes of Nitric Acid do I need to form 100 C. C. of Nitric Oxide, measured at 59° Fah. and 790 m. m. pressure?

$3HNO_3 + 3Cu = 3Cu(NO_3)_2 + 4H_2O + 2NO.$

$\therefore$ 8 (1+14+48) grammes of HNO_3 give 2 (14+16) grammes of NO.

Now, 59° Fah. = 15°C.

$$\therefore \frac{100}{1} \times \frac{790}{760} \times \frac{273}{288} = \frac{179725}{1824} = \text{number}$$

of c. c., 100 c. c. at 59° Fah. and 790 m.m. pressure, becomes at 0° C and 760 m. m. pressure,

and 11.2 litres of NO = 15 grammes of NO

$\therefore$ 1 " " $= \frac{15}{11.2}$ " "

$\therefore$ 1 c. c. " $= \frac{15}{11200}$ " "

$\therefore \frac{179725}{1824}$ c. c. " $= \frac{15}{11200} \times \frac{179725}{1824}$

$= \frac{5\,13\,35}{38\,9\,12}$ grammes of NO.

60 grammes of NO need 504 grammes HNO_3

$\therefore$ 1 " " " $\frac{504}{60}$ " "

$\therefore \frac{5\,13\,35}{38\,9\,12}$ grammes of NO need $\frac{504}{60} \times \frac{5\,13\,35}{38\,9\,12} = \frac{2156\,7}{19456}$ grammes of HNO_3

$= 1.1085 +$ grammes of HNO_3—Ans.

PUBLIC SCHOOL DEPARTMENT.

PERTH COUNTY PROMOTION EXAMINATIONS.

The following are the questions used for promotion examination in the four higher classes in the Public Schools of the County of Perth, March 25th, 1880. Mr. Moran, the Inspector, was one of the first to make an effort to equalize the grading in the schools of his county by means of a simultaneous written examination, and deserves much credit therefor. We have a number of other sets of papers sent us by County Inspectors, (for which thanks), and will use them as fast as space will permit.

Entrance to Sixth Class.

ALGEBRA, EUCLID AND MENSURATION.

1. Define a circle, a scalene triangle, parallel lines.

2. If two straight lines cut one another, the vertical or opposite angles are equal. Prove.

3. Equal triangles upon equal bases in the same straight line and towards the same parts are between the same parallels.

4. Divide $3x^6 + 7x^5 - 12x^4 + 2x^3 - 3x^2 + 13x - 6$ by $x^2 + 3x - 2$.

5. Simplify $\dfrac{(2x^2 - \frac{1}{4})}{2x+1} + \frac{1}{2}$

6. Solve the equations

$$\frac{5}{x-7} = 6 - \frac{7}{x-7}$$

and $2(3x-4) - 3(3-4x) + 9(2-x) = 10$.

7. A person bought a buggy, horse and harness for $300. The horse cost twice as much as the harness, and the buggy twice as much as the horse and harness, find (by an equation) the value of the buggy.

8. Find the area of an equilateral triangle whose side measures 48 yards.

9. A wagon box is 9½ ft. long, 3½ ft. wide and eighteen inches deep, how many bushels will it contain, allowing 5 cubic feet, = 4 bushels?

10. The diameter of the end of a cylindrical saw-log is 20 inches and its length 18 ft. What ought it to weigh allowing a cubic foot of it to weigh 35 lbs.

Value 10 each. Time 2 hours. Full work required.

Entrance to Senior Third Class.

ARITHMETIC.

1. Find the sum of three hundred and two dollars and three cents; forty-six dollars and seven cents; two hundred dollars; one dollar and ninety cents; eighty cents; and fifty-seven dollars.

2. John bought 2lbs. and 8oz. of candy at 2 cents per oz.; 2 gal. and 1qt. of syrup at 16 cents per quart; and 3 bu. and 3 pk. of apples at 8 cents a peck; how much did he pay for all?

3. I paid four thousand and twenty dollars for twelve village lots and sold them at a loss of seventy dollars on each lot. How much did I receive for seven of them?

4. There are 4840 square yards in 1 acre; how many square yards in 7 farms, each containing 129 acres?

5. How many square inches in a black-board 8 ft. long and 3 ft. wide?

6. How many bushels of wheat at $1.00 per bushel are worth as much as 22 cords of wood at $2 per cord?

7. If 18 men can do a piece of work in 90 days, how many days will it take 8 men to do as much?

8. A man receives $64 a month and spends $40 a month; how much will he save in seven years?

9. Divide sixteen million, eighty-four thousand, four hundred and forty, by five thousand and eight.

10. Divide the product of 759 and 806 by 906.

Values—10 each. Time—2 hours. Full work required.

Entrance to Fourth Class.

ARITHMETIC.

1. A farmer owning 100 acres, sold 17 ac. 2 r. 20 sq. per. 12 sq. yds. of his farm. How much had he left?

2. How many cords of wood in a pile 36 ft. long, 6 ft. high and 4 ft. wide?

3. How many gold coins, each weighing 11 dwt. 6 grs. may be coined from 31 lbs. 2 oz. 1 dwt. 6 grs. of standard gold?

4. A man had 42 cords of wood and sold four-sevenths of it at $3 a cord. How much did he get for what he sold?

5. Find the sum of $2\frac{1}{3}+4\frac{3}{8}+3\frac{3}{4}+8\frac{1}{6}$.

6. John had $11\frac{3}{4}$ and he lent James $3\frac{4}{5}$; how much had John left?

7. A farmer had 600 bus. of wheat. He sold 7 loads each containing 56 bu. 2 pk. 2 qt. How much wheat had he left?

8. How many bushels of oats in 2725 lbs?

9. Express in figures, one hundred and nine million, four thousand and eleven, and express in Roman Notation 476.

10. A man bought one horse for $86\frac{2}{3}$ and another for $63\frac{5}{8}$. He sold the span for $187\frac{1}{2}$; how much profit had he?

Values—10 each. Time—2 hours. Full work required.

Entrance to Fifth Class.

ARITHMETIC.

1. How much will it cost to carpet a room 21 ft. 4 in. long and 16 ft. 8 in. wide, with carpet 2 ft. 8 in. wide, at, $1.37\frac{1}{2}$ per yard?

2. What part of a cord of wood is a pile 6 ft. 4 in. long, $3\frac{1}{3}$ ft. high, 20 in. wide?

3. What fraction of 4 chains is $3\frac{1}{3}$ rods?

4. Reduce 14 lbs. 10 oz. Avoir. to Troy weight.

5. What will 1830 lbs. of hay cost at $9 per ton?

6. Find the price of 3 loads of barley

each containing 56 bu. and 20 lbs. at $0.56½ per bu.

7. Find the interest $712.40 for 2½ years at 2¾ per cent.

8. Divide .01295 by .123

9. Divide $\frac{1\frac{3}{4}}{4\frac{1}{2}}$ by $\frac{2\frac{1}{3}}{2\frac{1}{4}}$.

10. A cistern has 3 pipes which will fill it in 10, 20, and 40 minutes. In what time will the three pipes running together fill it?

Values—10 each. Time—2 hours. Full work required.

Entrance to Sixth Class.

ARITHMETIC.

1. Find the sum, difference and product of 3.456 and .425.

2. What would be the proceeds of a note of $150.00 for 90 days, bank discount being 8%?

3. A owes B $300, to be paid as follows; ⅓ in three months, ¼ in 4 months, and the rest in 6 months; what is the equated time.

4. $500.

Stratford, 25th March, 1879.

Seventy days after date, for value received, I promise to pay W. E. Jones, or order, five hundred dollars with interest at the rate of eight per cent. per annum, till paid.

JAMES SMITH.

Endorsements: April 15th, 1879, $95; May 2nd, 1879, $140. What is to pay when the note is due?

5. What must be paid for stocks paying 5 per cent., that the investment may return 8%?

6. What sum must be invested in stocks at 112 paying 9 per cent. to obtain a yearly income of $1260?

7. I sold a horse for ½ of 2⅝ times the cost; what was the gain per cent?

8. A pond of five acres is covered with ice 9 inches thick. Find the weight of the ice in tons, if a cu. ft. of ice weigh 865 oz. Avoir.

9. Find the square root of .00734449.

10. What must be the side of a square which shall contain 10 acres?

Values—10 each. Time—2 hours. Full work required.

Entrance to Senior Third Class.

GEOGRAPHY.

Values.	
14	1. Name all the Canadian rivers flowing into the Georgian Bay and Lake Ontario.
3	2. What provinces lie between Manitoba and New Brunswick.
6	3. In what county is each of the following towns: Cobourg, Simcoe, Brampton, L'Original, Cayuga, Perth?
6	4. What large body of fresh water lies northward from where you are now sitting? What lake to the south?—to the west?
5	5. Bound the Province of New Brunswick and the County of Wellington.
6	6. What townships lie between Wallace and Fullarton?
3	7. What Railways would you travel over in going from Listowel to Barrie?
4	8. Name four small lakes within
—	the Province of Ontario.
50	Time—1 hour.

Entrance to Fourth Class.

GEOGRAPHY.

Values.	
10	1. Name all the great lakes of North America.
8	2. Give the boundaries of British Columbia and South America.
4	3. At what place north of the equator do the Atlantic and Pacific oceans approach each other most nearly?
5	4. Name five large cities in the United States.
8	5. Name eight large rivers in South America.

5	6. Give a reason why there is no large river in South America flowing into the Pacific ocean.
10	7. What and where are Jamaica, California, Yucatan, Coppermine, Sitka, Havanna, Quito, Chiloe, Haarlem, Fundy, Verte, Battleford, Magdalen, Pictou, Minden.

HISTORY.

4	1. Give the date of the founding and the name of the founder of Quebec?
6	2. What generals were slain on the Plains of Abraham? Give the date.
10	3. Who were the U. E. Loyalists?
10	4. Give a short account of the rebellion of 1837.
80	Time—1 hour.

Entrance to Fifth Class.

GEOGRAPHY.

Values	
5	1. Describe the physical features of Australia on the coast, and in the interior.
10	2. Name all the British colonies and dependencies in the Eastern Hemisphere, giving the position and chief towns of each.
5	3. Name all the countries lying between the Russian Empire and British India.
14	4. In sailing along the coast from the mouth of the Seine to Dardanelles what are the most noted cities and the most striking objects you might see? Give the position and a short description of each.
16	5. Draw a small map (3 inches wide by 5 inches long on the border) of England, locating thereon the Capes, Bays, four Rivers, and the Cities of London, Liverpool, Leeds and Bristol.
20	6. What and where are Tay, Galway, Drontheim, Snowdon, Transvaal, Atlas, Melbourne, Valparaiso, Hillsborough, Odessa?
70	

HISTORY.

10	1. Give a short account of the ancient Britons.
10	2. What were the causes and the consequences of the struggle between the Houses of York and Lancaster?
5	3. Give the events which took place on the following dates, 1282, 1588, 1688, 1745, 1776.
15	4. Sketch the life of the Duke of Wellington.
40	Time—1¼ hours.

Entrance to Sixth Class.

GEOGRAPHY.

Values	
10	1. Describe as accurately as you can the position of the equator in regard to the Continents, Oceans, Seas, Gulfs, Islands, &c., over which it passes.
10	2. There is a group of islands situated in about West Longitude 155° and North Latitude 20°, and a large island in East Longitude 140°, and South Latitude 25°; what are their respective names, and in what direction does the group lie from the large island.
10	3. Enumerate five great physical differences between the Old and the New World.
10	4. Describe the Basin of the Nile, and mention any remarkable phenomena observed by travellers therein.
5	5. Name four Islands in the British Channel.
6	6. Describe the Gulf Stream, its causes and effects.
10	7. Draw a map of Africa, South of the Equator, locating thereon the countries, mountains, rivers, lakes, capes and towns.
60	

HISTORY.

10 1. What great man died in prison at St. Helena? Give a sketch of his life.

10 2. Give an account and the date of the Battle of Naseby.

5 3. Give the date, reign and cause assigned for the execution of Mary Queen of Scots.

15 4. Write short notes on Julius Cæsar, the Crusades, Oliver Cromwell, Columbus and Wolfe.

40 Time—1¼ hours.

Entrance to Senior Third Class.

GRAMMAR.

Values

3 1. Define Verb, Pronoun, Conjunction.

17 2. Classify the words in the following sentences :—

"Like most boys, he was delighted to try the power of his new present on anything that came in his way, and among other things, totally ruined a favorite cherry tree belonging to his father."

12 3. Write three appropriate adjectives before each of the following nouns, placing A or AN before each adjective:—

TREE, HOUSE, BIRD, SLATE.

N. B.—The same adjective must not be placed before any two of the nouns.

8 4. Write out in your own words, ten lines of the story about "The Poor Match-Girl."

Entrance to Fourth Class.

GRAMMAR.

Values

8 1. Write the possessive case, singular and plural of each of the following nouns :—BOY, CHILD, KING, WOMAN.

9 2. Analyze the following sentences :—

The grey horses were sold.

There were several persons in the room.

Does the little boy attend school regularly?

14 3. Parse the adjectives, (except a, an and the,) pronouns, and verbs in the following sentence :—

"He gathered a few roots of the sweet flag, of which he was particularly fond, and on his return to the tent, ate a quantity of what he had collected."

9 4. Write ten lines, in your own words, of "Pontiac's attempt to

— capture Fort Detroit."

50 Time— 1½ hours,

Entrance to Fifth Class.

GRAMMAR.

Values

32 1. Analyze :—

With the fleetness of thought now *commenced* a *race that had* ostensibly *for its object* the *recovery* of the lost ball, and *in which he who had driven* it with resistless force *outstripped* them *all.*

32 2. Parse the italicized words in the above sentence.

10 3. Give examples of the different kinds of attributive adjuncts, underlining the adjuncts.

12 4. Correct, giving reasons.

Many have profited from the misfortunes of others.

If there was better management there would be greater security.

After Columbus made his preparations he set out on his voyage of discovery.

Who do you think I saw to-day?

8 5. Give the double plurals with difference of meaning of :—brother, genius, penny, cloth.

6 6. Give the feminine of nephew, Sultan, negro; and the possessive

— plural of who, lady, hero.

100 Time—1½ hours.

Entrance to Sixth Class.

GRAMMAR.

Values.

28 1. Analyze:

To a certain degree the *virtues* of the ancients *ought to inspire* emulation, and are *worthy* of being *precedents* to all posterity; but that soft *charm which* a pure religion and more liberal notions *diffuse* over Christian manners, that animating *prospect* which is now held *out to encourage* laudable endeavors, and those terrors which are denounced against nefarious actions, *could* not *operate* on classical ages, because they were unknown.

32 2. Parse the italicized words.

18 3 Correct the following, if necessary, and quote the rule of syntax violated.

The rapidity of his movements were beyond example.

How beautifully it looks.

His argument was the best of all the others.

The book laid on the floor.

The river has overflown its banks.

Who are you looking for ?

8 4. Form verbs from alien, fertile, just, public, and adjectives from frame, notice, aim, defy.

10 5. Point out and give the meaning of the roots, prefixes and affixes of the following words :—homicide, facility, fugitive, supposition, subjunctive, inanimate, attributive, disturbance, refraction, correspondence.

4 6. Give the plurals of courtesy, genus, beau, madame.

100

COMPOSITION

25 Write—(not less than twenty lines)—an account of "The Past Winter in Canada" enlarging on the agreeable and disagreeable features; the advantages and disadvantages of such a winter.

Time—1½ hours.

Entrance to Senior Third Class.

DICTATION.

Whilst I was thus musing | I cast my eyes | towards the summit | of a rock | that was not far from me | where I discovered one | in the habit of a shepherd | with a little musical instrument | in his hand. As I looked upon him | he applied it | to his lips | and began | to play upon it. | The sound of it | was exceedingly sweet | and wrought | into a variety of tunes | that were inexpressibly melodious | and altogether different | from anything | I had ever heard | they put me in mind | of those heavenly airs | that are played | to the departed souls | of good men | upon their first arrival | in paradise. |

Value 80.—8 marks off for each mistake

In reading the above, stop at the places marked | .

N.B.—Slates are not to be used, but plenty of time can be given to the candidates to write it once carefully on paper.

WRITING.

To be judged from this dictation paper. Value 40. Time ½ hour.

READING.

Third book, page 13. "As he went along".....to "stopping the flow of the water."

Value 50. Expression, 15, Fluency, 35. Two marks off for each error in pronunciation, one mark off for every other error in fluency, such as hesitation, omission, substitution, miscalling, &c., &c. Examiner will please fill in the Reading marks on the list.

Entrance to Fourth Class.

DICTATION.

England | had so long regarded | her naval supremacy | as indisputable, and had been rendered | so confident | by a long series of ocean victories, that, at first, she treated the American war | with undisguised contempt. On

the other hand, the Americans introduced | into their naval operations | the same smartness | which characterized their commercial dealings, and, aware of the importance | of damaging the world's belief | in England's invincibility, they quickly put to sea | several powerful men-of-war.

The president said | he would not allow | that precedent.

As I am stationary | for a time, I require the less stationery.

The butcher took the sheep | away in his sleigh | to slay them.

The above to be written on paper at once—not on slates.

Value 60.—Five marks to be deducted for each error. Time—½ hr.

WRITING.

To be judged from the Dictation paper.—Value 40.

READING.

Third Book, page 287 from "Frederick" to "Word." Value 50.—*i. e.* Fluency 35 and Expression 15. Two marks to be deducted for every mispronounced word, and one for every other error in fluency, such as hesitation, miscalling, &c., &c.

Entrance to Fifth Class.

DICTATION.

1. At first we imagined that it only proceeded from some magazines to which the Russians, as usual, had set fire in their retreat. Eager to know the cause of this conflagration, we sought in vain for some one who could tranquillize our restless curiosity; but the impossibility of satisfying it redoubled our impatience and increased our alarm.

2. Melancholy, campaign, difference, immense, commodities, asylums, victims, insatiable, incendiary, massacred, chisel, humorous, jingle.

3. The baker is in need of a man to knead his dough.

He shot the hart through the heart.

All the poor cobbler had was his awl.

The two deer which he bought were considered too dear.

New editions, with additions are in preparations.

Value 50. 5 marks off for each error. Write at once on paper.

WRITING.

Will be judged from this paper. Value 40.

READING.

Fourth Book. Page 239. "The inhabitants.....buried with them."

Value and marking as in preceding classes.

Entrance to Sixth Class.

DICTATION.

Travellers are inexhaustible in their admiration of the gigantic masses of ruin of the temples, avenues of columns, obelisks colossuses, and catacombs in which the district abounds ..... This stupendous ruin is connected by an avenue of colossal sphinxes, standing at intervals of ten feet from one another..... The portico of the temple is generally regarded as the grandest specimen of Egyptian architecture..... The walls of the apartments and chambers are decorated with statues and figures in relief painted over with brilliant colors.

Illuminate, liquefy, maritime, obloquy, dilapidate, Avoirdupois.

Value 60. 5 marks off for each error. Write at once on paper.

WRITING.

Will be judged from the Dictation paper. Value 40.

READING.

Fifth Book. Page 139. "This important document ..... have been based."

Value and marking as in preceding classes.