

The limit of $\frac{p}{a^q} - \frac{p}{b^q}$, when $a = b$, is $\frac{p}{q} \frac{p}{a^{q+1}}$.

For let $a = k^q$, $b = l^q$; then $\frac{p}{a^q} = k^p$, $\frac{p}{b^q} = l^p$,

$$\therefore \frac{\frac{p}{a^q} - \frac{p}{b^q}}{a - b} = \frac{k^p - l^p}{k^q - l^q} = \frac{k^p - l^p}{(k - l)(k^{q-1} + k^{q-2}l + \dots + l^{q-1})} = \frac{k^p - l^p}{k - l} \cdot \frac{1}{k^{q-1} + k^{q-2}l + \dots + l^{q-1}} \quad (\text{when } a = b, \text{ or } k = l),$$

$$\frac{pk^{p-1}}{qk^{q-1}} = \frac{p}{q} k^{p-q} = \frac{p}{q} \frac{p}{a^{q+1}}.$$

The limit of $\frac{a^{-n} - b^{-n}}{a - b}$ when $a = b$, is $-na^{-n-1}$.

$$\text{For } \frac{a^{-n} - b^{-n}}{a - b} = \frac{a^{-n}b^{-n}(a^n - b^n)}{a - b} = \frac{a^{-n}b^{-n}(a - b)(a^{n-1} + a^{n-2}b + \dots + b^{n-1})}{a - b} = (a - b) - a^{-n} \cdot na^{n-1} = -na^{-n-1}.$$

The proof of the Binomial Theorem in the case of fractional and negative indices will now be precisely the same as that given above when the index is positive.

Contributions and Correspondence.

INTERMISSIONS IN SCHOOLS.

It is by no means an easy matter for a teacher, without assistants, in an ungraded or partially graded school, to arrange his timetable in such a way as to afford sufficiently frequent changes of position to his pupils. The schools I speak of are to be found chiefly in rural districts, and amongst these there is a considerable diversity of practice with respect to recesses or intermissions. Some teachers never allow any intermission during the forenoon or afternoon, but permit, as in that case they must needs do, each pupil to leave the room whenever he asks leave to do so. Others—and they form a great majority—have one recess in the middle of the forenoon and another in the middle of the afternoon, of about fifteen minutes each. I propose to give the readers of the *SCHOOL JOURNAL* the benefit of my own experience in the matter, and shall be happy if the result of my doing so is to aid both teachers and pupils in securing the maximum of work done with the minimum of irritation and of injury to health.

While teaching, many years ago, in a country school, at a time when assistants and grading were alike unheard of outside of towns, I resolved to make an experiment and watch carefully the result. I was then young enough to have a vivid recollection of the weary hours I had myself spent at school in a thoroughly aimless and listless way, looking forward to the coming recess, when I should be able to get a breath of fresh air and secure a complete change of position as a means of relaxing my fatigued muscles. I could then, and can still, recollect well the zest with which I and my fellow-pupils entered into our sports during the few minutes placed at our disposal, and the new vigour with which we were wont to turn to our work after our play was done. After teaching for some time on the old-fashioned system of intermissions at intervals of an hour and a half, I ascertained by careful observation that the last half hour of each interval was for the most part wasted by the wearied pupils in vain efforts to fix their minds on their work, or thoroughly successful efforts to amuse themselves whenever they thought they were unobserved, while to myself it was a period of continuous and most depressing irritation on account of the increased difficulty of keeping order. Shortly before taking charge of the school I had spent a session in the Provincial Normal School, where the class was dismissed at the end of every hour. I knew from experience how hard it was for even an adult student to keep his attention thoroughly fixed on the lecturer towards the close of the day, with hourly intermissions,

and I came to the conclusion that the difficulty I felt in keeping my school in quiet order was due to the length of the intervals between recesses.

Having resolved on a change, I first consulted the pupils on the subject. I explained to them the reason why both they and I felt so listless and irritable after being at work in vitiated air for a length of time, and proposed, with their consent, to have a shorter intermission at the end of each hour, instead of the fifteen minutes at the end of an hour and a half. Not a few objections were made, for I allowed a free discussion of the matter and ample time for consideration; but eventually it was resolved by the pupils that the change should be made, with the proviso that if it did not suit they should have an opportunity of reconsidering their decision. The change was made accordingly, and neither they nor I had any reason to regret it. So completely satisfactory was it to the school that not a single voice was raised in favour of a return to the old system when the matter was again submitted to them. To me it was an inexpressible relief. Of course the additional confusion inseparable from dismissing and re-assembling the pupils was a drawback, but at the worst it was insignificant in comparison with the freedom from irritation and the great increase in the amount of work accomplished. After long and careful observation under the changed conditions, I was driven to the conclusion that pupils should not be debarred for more than three quarters of an hour at a time from enjoying a few minutes' recreation in the fresh air; in the case of very young children the interval may advantageously be made much shorter even than this. It follows that the school should be, as adult classes in colleges are, dismissed hourly; and even though it may take fifteen minutes to cover the period of recess and the time necessary for getting the school again at work, I am satisfied that after a fair trial no teacher would dream of going back to the old fashion of single recesses or none at all. I should be glad to hear from others on a matter of such vital importance to the health of the pupils, the good temper of the teacher, and the work done by all.

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Examination Questions.

Under this head will be published from month to month the papers set at the examination for entrance into the High Schools of Ontario, the Intermediate High School Examination, the examination of candidates for Public School teachers' certificates, and the Junior and Senior Matriculation examinations of the University of Toronto. The Mathematical papers will in all cases be accompanied by analytical solutions of the more difficult problems and hints on the best methods of solving the others.

PAPERS FOR JULY, 1877.

ENGLISH LITERATURE.

Examiner: J. M. BUCHAN, M.A.

SECOND-CLASS TEACHERS AND INTERMEDIATE.

I.

1. Carlyle says that Scott employed great power in procuring the means to gratify an essentially vulgar ambition. To what does this criticism refer? Do you concur in it? Give reasons for your answer.

2. Name the author of each of the following works:—The Ancient Mariner, Rasselas, Woodstock, Thalaba the Destroyer, Childe Harold's Pilgrimage, The Bard, Hyperion, the Excursion, and Pamela.

3. Tell the story of the ballad of Alice Brand, quoting any parts of it which you may remember. In what part of the Lady of the Lake does it occur?

4. "The Monarch saw the gambols flag,
And bade let loose a gallant stag,
Whose pride, the holiday to crown,
Two favorite greyhounds should pull down,
That venison free and Bordeaux wine