THE UNIVERSITY OF MANITOBA

AN EXAMINATION OF SOME FACTORS THAT MAY AFFECT STANDING IN GRADE XI CHEMISTRY

BEING A THESIS SUBMITTED TO THE COMMITTEE ON POST-GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION



By

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Summary

Introductory chapter on the place of chemistry in the curriculum, and its effect on the life of the individual.

Object: - To examine some factors as to how they may affect success in Grade XI Chemistry.

Factors examined, - I.Q., numerical ability, reading ability, abstract reasoning ability, amount of assignments done, effect of pre-grade XI chemistry courses, effectiveness of text in learning chemistry; text valuation by Lorge, Flesch and Vogel.

Comparison of chemistry results with ability in other fields to determine the latter's effect on achievement in chemistry.

Some possible changes that might help bring about more effective learning in Grade XI Chemistry.

Abstract

AN EXAMINATION OF SOME FACTORS THAT MAY AFFECT STANDING IN GRADE XI CHEMISTRY

<u>Object:</u> The purpose of this study was to examine some factors that might affect success in Grade XI Chemistry. The contributing factors investigated were I.Q., mathematical ability, reading ability, abstract reasoning ability, the effect of elementary contributory science, and a valuation of the text.

<u>Procedure:</u> Standard tests were used to measure the student's I.Q., as well as his abilities in mathematics, reading, and abstract reasoning. The measurement of the influence of contributory science was made by giving a test in chemistry based on the science covered in Grades VII to X. The homework index was determined from the records of a student's day to day accomplishments in chemistry assignments during the entire year. The valuation of the text was made by the application of standard formulae.

<u>Results:</u> Each of the factors measured was correlated with the student's mark in Chemistry as obtained in June on the Department of Education examination. It was found that there was a very positive correlation between a student's June mark and his performance of assignments throughout the year. The influence of mathematical ability, elementary contributory science, and I.Q. were markedly present, in that order of influence. Reading ability correlation was low, and abstract reasoning ability showed negligible correlation to success in Grade XI Chemistry.

<u>Conclusion:</u> The most outstanding factor of those measured that contribute to a student's success in Grade XI Chemistry is his ability in, and performance of, the daily assignments that constitute such a course.

Claude A. Joyce

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CHAPTER I

INTRODUCTION

Preliminary.-

The purpose of this study is to examine some factors that may affect success in one grade eleven subject, chemistry.

Having taught the subject for sixteen years, with results that were at times bewildering, occasionally confusing, often exasperating, and rarely satisfactory, it was felt that a more scientific approach to the subject would be helpful both in future teaching, and as a guide for others. The writer was also imbued with a desire to follow some of the lines of investigation suggested in one of the works of E.M.Freeman,^I

¹E.M.Freeman, <u>Suggested Program of Invest-</u> <u>igation Having in Mind the Improvement of Instruction</u> <u>in Science at the University of Minnesota</u>. From <u>Problems in College Education</u>, edited by Earl Hudelson, <u>Minneapolis</u>, Minn. University of Minnesota Press, 1928. p.766. wherein he intimates investigations might be conducted to examine the effect of:

The amount of laboratory work on achievement The amount of lecture on achievement The amount of demonstration work on achievement Mentality on achievement Previous scholarship on achievement Sex on achievement Number of tests on achievement Type of lecture on achievement- (a) forcefulness, (b) dramatic appeal, or (c) other qualitative effects. Note-taking on learning retention

The content of this study will be presented under: historical background; the problem, its scope and limitations; the hypotheses to be examined; the setting; the procedure employed; findings and conclusions.

Growth of Science Curriculum.-

The science of chemistry has changed considerably over the centuries, from the wishful thinking of the alchemists to the present concept of the hydrogen bomb and atomic fission. Subsequently, the teaching of the subject has also gone through drastic changes.

Science has not always been "acceptable" in our curricula, having had, in fact, to contest a place for itself against the entrenched classics. Chemistry as a school subject is really of recent origin. But the fact of its importance in industry, in living and in war, have finally brought it to an unassailable position among our leading school subjects.

This position has not always been a happy one as far as the student is concerned, for chemistry as a school subject is overburdened and befogged by theory and hypothesis, by abstractions and speculation, to an enormous degree. Neither mathematics, physics, nor biological science is so completely obscured by terminology and phraseology, by formulae and equations, by abstractions and theorizing. The result is often an appalling confusion to young minds approaching formal chemistry for the first time. The student probably accepts the fact that he cannot get along in modern life without chemistry, but he also seems convinced that he can make use of it quite satisfactorly without having to know too much about it.

Historical Background to Curricular Chemistry .-

The history of the development of chemistry teaching in the schools of Canada emphasizes its place as a "new" subject in our curricula. Evidence exists in support of the conclusion that descriptive chemistry was taught in le Seminaire de Quebec as early as the first half of the 18th century, and in le

College de Montreal some time before 1800. As far back as 1868, chemistry was a subject of examination for candidates who desired to secure a teaching diploma in Quebec.²

In Manitoba, matriculation requirements came under the jurisdiction of the University of Manitoba after its establishment in 1877, and from this date chemistry has been one of the science options under junior matriculation requirements. It did not appear as a second-class teacher's subject (junior matriculation level) until about 1900. However, it was required for the first-class teacher's certificate (Grade XII) from 1876.

The Department of Education, first established in 1890, has stressed the necessity for instruction in practical chemistry. From 1902 to 1919, tests in practical chemistry were obligatory in the Grade XI examinations, and candidates were required to attend one of a half-dozen centres in the province to undergo the test. Attempts to maintain adequate standards on the practical side are now sought by issuing precise instructions to teachers and by requiring inspectors

²C.J.S.Warrington and R.V.V.Nicholls, <u>A History of Chemistry in Canada</u>.Sir Isaac Pitman and Sons (Canada) Limited: Toronto, Canada, 1949.p.412.

to check laboratory notebooks. "The ratio of Grade XI candidates electing chemistry has been maintained always at a high level. In 1906, the ratio was 79 percent, and in 1946, 92 percent." ³ The percentage is even higher now, as a student in Grade XI taking the regular academic course can avoid taking chemistry only by taking two foreign languages, in which case he then has the choice of either physics or chemistry. Chemistry and the Individual.-

Along with its historical background, some consideration should be given to the importance of the place of chemistry as a part of our daily living, and how it affects our way of life.

> The importance of chemistry either as a science or in its practical bearing cannot be overestimated. It is the corner stone of medicine, pharmacy, sanitation, agriculture and other sciences. Chemistry is the ruling factor in practically all of the leading industrial plants of the world, and is being regarded with greater respect by all manufacturers every year Where the chemist was formerly looked upon as a needless luxury, he is now being considered an absolute necessity in competitive big business. When the student once realizes that he cannot avoid chemistry even if he tries; that there is nothing in the material universe that is not a part of chemistry he will begin to comprehend the vastness of

³<u>Ibid</u>, p.486.

the subject and not become discouraged if he fails to understand everything clearly at the beginning $_{\bullet 4}$

Problem.-

More specifically, the purpose of this study is to investigate some probable factors that aid in determining success in chemistry. We have already listed Freeman's suggestions as to what may affect success in science, (page two). To this list we might also add consideration of:

The teacher, - his health, disposition, training, enthusiasm, interest, ability, teaching methods.

The subject,- is chemistry a "more difficult subject" to learn than most other subjects, or does such a differentiation exist between subjects ? An examination of Figure I, page eleven, would seem to indicate that chemistry could be classified, justifiably, as one of the more difficult subjects. This figure shows the subject of maximum failure rate, the subject of minimum failure rate, and the chemistry failure rate in the June Departmental examinations of the province of Manitoba for the years 1939 to 1953 (with the exception of the two years, 1946 and 1948). This shows the chemistry failure rate to be, in most

⁴Frederic B. Emery, Elzy F. Downey, Roscoe E. Davis, Charles E. Boynton, <u>Chemistry in Everyday</u> <u>Life</u>. Lyons and Carnahan, New York, 1928. pp.xiv-xv. years, above the median, and that while it is sometimes the subject of maximum failure rate, it never has been the subject of minimum failure rate. From this it may be assumed that there is some evidence to justify the classification of chemistry as a more difficult subject. "Difficult" in this case denotes a subject that consistently produces a high failure rate.

The suitability of the text,- its readability, the degree to which it fulfills its purpose as a text book for chemistry students, the use and value of questions and problems in the text. In this connection reference may be made again to Figure I. The year 1952 will be noted as having the highest failure rate of any year for chemistry, and this was also the year in which a new text in chemistry was introduced on a province-wide basis. In themselves, the two facts may not be deeply significant, but they would seem to bear out the assumption that the textbook does have some bearing on attainment in chemistry.

The pupil, - his preparedness, his ability with other subjects, his interest in the subject, his care in doing homework assignments, his extra-curricular activities, his health, intelligence, etc. Do some pupils have, or develop, a "chemistry block", either

in whole or in part, just as some pupils have a reading block ?

The school, - relative advantages of urban over rural schools, of large classes over small, of one teacher per class as against one teacher per subject.

Laboratory work, - equipment available, number of experiments performed individually by pupils, number of experiments presented as demonstrations.

The home, - parental interest, economic status, social level of parents, intellect of parents.

Examination, - the type of examination used in testing the pupil's knowledge of the subject; short answer type or essay answer questions; short retention period contrasted with long retention span examinations.

All of these may be variables that affect a student's achievement in chemistry. Most of them are uncontrollable, and many of them would be extremely difficult to measure. It is therefor intended in this study to confine the investigation to those factors that may answer the following questions:

1. Do students have to be of a high level of intelligence to attain success in chemistry ?

2. Does a student's achievement in mathematics, in reading, ability or in abstract reasoning help him to attain high marks in chemistry ? 3. Does a student need a good background level of Junior High and Grade X chemistry in order to attain a high level of achievement in Grade XI chemistry ?

4. Does a student's conscientious regard for the completion of work assignments assure him of satisfactory results in Grade XI chemistry ?

5. To what extent is the present text used in Grade XI chemistry suitable for the course ? <u>Limitations</u>.-

It might be advisable to consider some of the limitations of the study at this point. The scope of the work is of necessity narrow, being confined to one teacher, one teaching method, one school year of work, and only a very small percentage of the total number of pupils in the Province. Only a very limited number of factors bearing upon achievement in chemistry are considered. It is very difficult to examine adequately the worth of the text in the course. The degree of success of a pupil is measured by his standing in Department of Education June final examinations, and this as a criterion of achievement is somewhat questionable, due to such practices as bonusing pupils, variability among markers, and the apparently varying degree of difficulty of examination from one year to another, which would seem to account in part for the

fluctuations in failure rate. In conjunction with this latter statement, Figure II, page twelve may prove of interest. Here are shown the provincial fluctuations in failure rate of Departmental examinations in chemistry, and also how closely the failure rate for the locality studied has followed that of the provincial rate for the past five years. The maximum and minimum failure rate subjects for the same interval are also shown. In the year of the study, 1953, the Flin Flon failure rate was very close to that of the provincial rate, a factor that may tend to give more credence to the findings, if we presume from this that the class studied was typical of the entire province.

Hypothesis.-

Several hypotheses are assumed concerning the relation between success in chemistry and achievement in other fields.

1. I.Q. and achievement in chemistry will show a **pesitive** correlation. To attain success in chemistry a student needs a degree of intelligence that is somewhat above average. By "success" in chemistry is meant in this case the obtaining of a passing mark on the June Department of Education examinations. Average intelligence is taken as an I.Q. rating of from 90

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										5						
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1939-19	MOMINIM															
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0 4 N	0	0/ 00	4	N	0	œ	9	4	2	0	0	9	4	N	0	



to 110, these figures being taken from McCall.⁵

2. Success in mathematics will show a positive correlation with success in chemistry. A weakness in mathematical concepts may account for a student's failure to attain success in chemistry, for much of the High School work in chemistry involves the handling of mathematical figures and formulae. The extent to which this applies may be judged from the fact that in the present Grade XI text, 21.9% of the questions appearing as follow up work at the end of chapters are mathematical in type. In addition, the June Department of Education examinations of the past five years have contained from eleven to fifteen percentage of problem type questions involving the use of mathematics. The kind of arithmetic involved in Grade XI chemistry is some variant of the ratio and proportion type.

3. Ability in reading will show a positive correlation with achievement in chemistry. It may be a linguistic difficulty that precludes a proper understanding of the terminology and language of chemistry. Lack of ability in handling words, both in the understanding of the printed word as well as in expressing thoughts accurately, may account in part for low

⁵William A. McCall, <u>How to Measure in</u> <u>Education</u>. The Macmillan Company, New York, 1922.

attainment in chemistry.

4. A student needs ability in abstract reasoning in order to attain success in chemistry. A consideration of such concepts as the atomic and molecular theories, the theory of ionization, the theory of electrolysis, will serve as examples to show where reasoning of an abstract nature is needed in the learning of chemistry. The cause of failure may be an inability to grasp such hypothetical concepts and theories or to think in such abstract terms. So much of chemistry is theoretical, that this ability well may be a determining factor in learning chemistry.

5. A student's knowledge of chemistry that he has acquired from previous grades will be a contributing factor to his accomplishment in Grade XI chemistry. In the science courses from Grades VII to X, a certain portion of the work consists of chemistry, so the extent of this carry-over to Grade XI may exert some influence on success in Grade XI chemistry.

6. A student's achievement in Grade XI chemistry will be determined by his conscientious fulfillment of homework assignments set by his class teacher during the year. The process of learning in chemistry will not be accomplished by a vigorous cramming at the end of the semester, but by the

persistent and continuous application of mind to the subject throughout the school year.

7. Text book. The present text book as authorized by the Department of Education needs some modification to make it more effective as a medium of learning chemistry in Grade XI.

If any or all of these factors determine standing in chemistry, then achievement in them should show positive correlation with attainment in chemistry. Upon this premise the study was undertaken. Setting of the study.-

The research was **e**arried out in the Flin Flon Collegiate, during the school year from August of 1952 to June of 1953. Eighty-seven students were involved at the beginning of the term, but due to drop outs the final number participating was eighty. Thirty-five boys and forty-five girls made up the final count. Their ages ranged from sixteen to eighteen years, with one of the boys aged twenty-three, he having returned to school after several years' absence. All ages given are as of June 30th, 1953.

Fourteen students involved in the study were repeating the chemistry course of Grade XI, and at the same time were taking some subjects in Grade XII. The remainder were grouped in two classrooms, thirty-eight in an accelerated group, and twentyeight non-accelerated students in the other room. Procedure.-

To measure a student's achievement in the various abilities mentioned, he was subjected to certain testing procedures. The student's attainment in chemistry was taken as being his results obtained in the Grade XI Department of Education examinations in chemistry for June of 1953.

His Intelligence Quotient was determined by use of The Dominion Test, Form A. This test was given early in the term, towards the first part of September, 1952.

In November a test was given in mathematics, the Differential Aptitude Test of Numerical Ability.

A measure of reading ability, the Iowa Silent Reading Test, was given in October.

Also in October of 1952, the Differential Aptitude Test in Abstract Reasoning was given to measure ability in abstract reasoning.

To measure the student's performance in homework assignments, careful records were kept during the entire school year of his work in this field. The results of these records are referred to as the Homework Index.

To determine the student's ability in chemistry upon his entering Grade XI, a pretest was given. This pretest was based upon the work in the science courses outlined in the Programme of Studies for grades VII to X inclusive, and contained questions related to chemistry only. The test was given during the first week in September, 1952.

An analysis was made of the chemistry taught in science courses previous to Grade XI, in order to determine what background of chemistry the student might have obtained on entering Grade XI, and also in order to be able to devise a pretest.

In addition, a full analysis was also made of the present textbook used for Grade XI chemistry in an attempt to determine its value as a text suitable to the course.

When the tests were completed, the correlation coefficient between each of the tests and the Grade XI June chemistry results was found. In this manner it was hoped to arrive at an index that would show to some degree the relationship between the ability measured and the achievement in chemistry.

Samples of all tests are enclosed in the appendix, and the results are enumerated in Table 10, pages 59 to 61.

CHAPTER II

TESTS AND MEASUREMENTS

To obtain some indication of the pupil's general academic abilities, various tests were given to measure different phases of this development. This chapter is devoted to a consideration of these tests. <u>Intelligence quotient</u>.-

The first test given was a measurement of I.Q. The Intelligence Quotient of each pupil was measured by means of The Dominion Tests, Group Test of Learning Capacity: Advanced - Grade 9 to Adult, Form A. These tests were given to all the pupils on the same day, September 2nd, 1952. An example of the test is found in the appendix, and the results are included in Table 9, pages 56 to 58.

The purpose of this test was to obtain a basis whereby I.Q. could be correlated with chemistry marks in order to determine whether success in chemistry was dependent upon an above average intelligence.

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Numerical Ability Test .-

A certain amount of the Grade XI Chemistry course involves the solving of problems and the use of mathematics. In the present Grade XI text 21.9% of the questions appearing as follow-up exercises at the end of chapters are mathematical or problem in type, while three full chapters of the text are devoted to the mathematics of chemistry. In addition, the June Department of Education examinations of the past five years have contained from eleven to fifteen percentage of problem type questions involving the use of arithmetic. It was thus assumed that a high degree of achievement in numerical ability would be necessary to obtain a high mark in chemistry.

The Numerical Ability Test, Form A, one of the Differential Aptitude Tests, was given to both classes on November 6th, 1952. The purpose of this test was to measure understanding of numerical relationships and facility in handling numerical concepts. The raw scores were converted into percentile ratings and are included in Table 9. A copy of the test appears in the appendix. Reading Ability.-

A measurement of the pupil's reading ability was made by a series of tests started on October 20th,

1952. The tests used were the Iowa Silent Reading Tests, New Edition, Advanced Test: Form Am (Revised). The results, expressed as percentiles at the Grade XI level, are given in Table 9.

As the tests were given for the purpose of getting a general measure of ability in reading, and not to determine remedial work needed, the mark listed for the test is an average mark rather than the separate scores for each part of the test. "The median of the nine subtest standard scores is used as a measure of silent reading ability. This median is the fifth subtest standard score when the scores are arranged in rank order." 6

Abstract Reasoning Test -

Many of the theories put forward in chemistry require thinking in abstract terms. While the degree of abstraction may not be as great as that required in some other subjects, it is definitely present in some of the phases of learning chemistry, as in the comprehension of atomic structure and the combination of elements to form compounds, or the appreciation of the kinetic-molecular theory. The premise was taken that mastery in abstract reasoning would be a

⁶George K. Bennett, Harold G. Seashore, Alexander G. Wesman, "Differential Aptitude Tests Manual." The Psychology Corporation, New York, 1952, p.1.

definite asset in the learning of chemistry, and so would correlate positively with achievement in chemistry.

The test in abstract reasoning, one of the Differential Aptitude Tests, Form A, was given on October 30th, 1952. It is, as its name implies, a test of the pupil's ability to visualize abstractly. The results, expressed as percentiles, are shown in Table 9.

Homework Assignment Scoring .-

The relative merits or demerits of homework assignments will not be debated here. In the strictest sense, this was really a measure of assignments completed. As most of the assignments were completed in time allowed during class periods, the assignment became home work only for the tardy and the slow.

Pupils seem to prepare for examinations either by cramming madly a day or two before the examination, or by working consistently throughout the year so as to absorb what they are supposed to know bit by bit as it is offered. It was felt that cramming in chemistry was not a successful practice because of the vast array of technical terms and detailed knowledge involved. It was thought that a better way to tackle the subject was to give conscientious application to the completion of daily or scheduled assignments. If such were the case, a pupil obtaining a high index on the Homework Assignment Scale should likewise obtain a high mark in June chemistry.

To secure a Homework Assignment Score, check lists were made at the beginning of the term containing the students' names in a column on the left hand side, with blank columns on the rest of the page. These sheets were used to keep a record of all the assigned questions and problems each student either failed to do or did wrongly during the school year. In this count a pupil not doing an assignment at all, or being absent from school, was still counted as having the whole assignment wrong. The reason for this was that a valuation was wanted of the actual amount of accurate work a student did during the year. In order to arrive at a valid index, the calculation was made on the basis of the amount of work a student did correctly. This was obtained by subtracting the number of errors from the total number of questions in the assignment. The results were expressed as percentages, and are shown in Table 9, under the title Homework Index. A sample of the record sheets used is shown in the appendix, page 99.

Elementary Contributory Science and Chemistry Pretest.-

Since the student has acquired some knowledge of chemistry in the science courses preliminary to Grade XI, it was deemed well to determine just to what extent these preliminary courses did cover the subject. The purpose in doing this was to determine how much of the Grade XI chemistry is relearning work already covered, and whether or not the retention from previous grades is a determining factor to success in Grade XI Chemistry. It was also necessary to have this knowledge in order to compose a satisfactory pretest. No evaluation of the suitability of pre-Grade XI chemistry was planned.

A full examination was made of the science texts used in grades VII to X. These texts were: for Grade VII, <u>Science Indoors and Out, Book 1</u>, by Hensley, Patterson and Armstrong; for Grade VIII, <u>Science Indoors and Out, Book 2</u>, by the same authors; for Grade IX, <u>Science Indoors and Out, Book 3</u>, same authors; and for Grade X, <u>Everyday Problems in</u> <u>Science</u>, by Beauchamp, Mayfield, and West.

It was found that the amount of chemistry taken varied considerably from one grade to another. The Grade VII text had sixty-one of its three hundred and seventy-seven pages (16.1%) devoted to work on chemistry. The Grade VIII text, fifty of its four nundred and sixty-nine pages (10.6%), the Grade IX text only six of its total of six hundred and fortytwo pages (0.9%), and the Grade X book one hundred and thirty of a total of seven hundred and forty-nine pages required for the course (17.3%), covered work in chemistry. An analysis of the chemistry content for each grade is given in a summarized form in the appendix, pages 84 to 91.

To aid in determing what value this work had in the learning of Grade XI Chemistry, it was necessary to summarize briefly the work of the latter grade also, and at the same time compare to what extent the same topics had been covered in the previous grades. The results of this comparison are shown in the appendix, pages 92 to 93.

been covered on a closely parallel basis, merely the grade in which it was covered is listed. But where there were many marked dissimilarities in treatment, these differences are noted. If the work had not been taken in a previous grade, no reference is made. From this evaluation it appeared that from one quarter to one third of the chemistry taught in Grade XI has already been presented to the pupil in the science of his previous grades.

Following this analysis the Chemistry Pretest was prepared. As the purpose of this test was to find what amount of chemistry had been retained by the pupil on entrance into Grade XI, all questions were based upon the work of a chemical nature covered in previous grades.

The test was written by seventy-nine students during the second week of school, September 5th, 1952. It was of a completion answer type and was so arranged that it could be done in one class period of from thirty-five to forty minutes. All of the students writing had time to complete the test. Students who were repeating the grade in chemistry were not given the test. The score of each pupils as a percentage figure is given in Table 9, and the complete test is reproduced in the appendix.

There were thirty-nine questions in the test, with spaces for the answers to be placed directly on the question paper. Usually one mark was allotted for each correct response. The marks on the paper totalled 98, so that after the papers were marked the mark had to be re-evaluated to a percentage basis. Table 1 lists the percentages of correct responses to each question.

TABLE I

PERCENTAGE OF CORRECT RESPONSES TO CHEMISTRY PRETEST

Question

ş

<u>% correct</u>

1 2345	(2) (3)	0 0 0 0	8 9 6 8	0 0 0 0	0 0 0 0	0 0 0 0		0 0 0 0	8 0 0 0	9 8 0 9	91.1 93.6 62 25.3 100 98.7
6	(4) (1) (2)	0 0	. 0 . 0	0 0 0	0 0	0	. 0 0	0	0 0 0	0 0 0	98.7 89.8 78.4
7	(3) (4) (5) (a) (b)	9 0 9 9	0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0 0	4 0 0 0 0	0 0 0 0 0	0 0 0 0	8 9 0 0 9	26.5 16.4 94.9 92.4
8	(c) (d)	8 8 8 8	0 0 0 0	© © ©	0 0 0	• • •	0 0 0	0 0 0	0 0 0	8 9 9 9	81.0 70.8 83.5 60.1
10	(a) (b) (c)	0 0 0	0	0 0 0	0 0 0	•	0 0 0	0 0 0	0 0 0	0 0 0	59.4 91.1 93.6 93.6
12	(a) (b) (c)	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	97.4 98.7 98.7
13			ÿ			U		Ai) 93. 93. 92.	62645		<u>Oxygen</u> 89.8 88.6 87.3 88.6 28.4
14		9	0	٩	٥	6	0			٥	34.1
15				0	8	0	•	9	۰	0	33.5
10		•	ø	e	a	٥	0	0	0	0	02.9
12		•	0	8	0	9	8	0	0	0	7.0
19		8 8	0	©	0 0	0 0	9 6	0	©	0 0	81.0

Some evaluation of the worth of this test was derived by assessing it for validity and reliability. The length of the test seemed to compare favorably with that suggested by McCall.

ر ے		0	0	0	G	•	0	ø	9	0	/ - 0	
24		٥	•	0	0	٥		0	0	8	91.1	
25			0	9	0		0	0	0		16.4	
26		4	•		a		0	6	0		36.1	
27					-				-		66.6	
28			9		9		0	ø		č	18.9	
20		e	0	0	0	0	0	9	9	Ģ	52 8	
27		0	0	Ø	0	۵	e	0	0	0		
20		0	0	¢	٥	0	0	0	٥	¢		
ŽΤ		e	6	0	0	0	ø	9	•	٥	2/0/	
32		\$	۲	0	0	0	٥	0	e	Θ	40.5	
33	(a)	8	•	ø	0	0	0	ø	0	8	91.1	
	(b)	9	•	e		٥	0	0	0	٥	23.6	
	(c)	0	٥	0	9	9	0	0	9	0	86.1	
	(d)	9	0	0	٥	0	9	0	٥	0	93.6	
34	(a)				e	8	9		0	ø	94.9	
0	(h)		•	-					•		94.9	
२५	$\tilde{(1)}$		•			Š		÷	č	,	86.1	
57	(5)	ø	0	ø	0		ø		e	9	94.9	
	$\left(\frac{2}{2}\right)$	0	0	0	0	0	٥	ø	9	ø	Ŕι ή	
		•	0	0	0	٥	8	ø	0	٥	63 3	
		0	0	0	0	0	9	0	0	0	0	
~ <	$\left(\begin{array}{c} \\ \\ \\ \end{array} \right)$	8	0	ø	۲	0	٥	ø	0	0	7407	
36	(\bot)	ø	0	e	0	۵	٥	0	ø	•	9 °4	
	(2)	0	0	9	0	0	٥	0	0	9	T5°0	
	(3)	ø	0	0	e	0	0	ø	٥	0	7.5	
37		0	0	0	0	0	0	8	0	0	14.7	
38		•	0	0	0	•	0	0	0		83.9	
39		-		6	0				8	0	98.7	
		•				•	•		-	2		

TABLE 1 -- Continued

Question

21

22 23 24

20 argon . neon .

helium

% correct

32.2 85.4

79°7 43

38.6

72.1

The test should be of such a length or so constructed as to eliminate fatigue, particularly if some of the pupils fatigue more easily than others....Fatigue may be eliminated in various ways. First, the test may be made short.7

In another respect the test meets satisfactory standards. "An item missed by everybody or answered correctly by everybody who took the test is of no value in differentiating between good and poor pupils." ⁸ Under this criterion question 5(2) appears to be non-valid in this test.

In testing for validity, the purpose is to determine the difficulty and discriminating value of each item in the test. "When'a test really measures what it purports to measure and consistently measures this same something throughout the entire range of the test it is a valid test in its entirety." ⁹ For testing the validity of each item in the test, a procedure outline by Ross was followed.¹⁰ The twenty-five papers that scored the highest were put in one group, and the twenty-five papers that scored the lowest were put in a contrasting

⁷William A. McCall, <u>Measurement</u>. The Macmillan **Co.**, New York, 1949. p.44. ⁸C.C.Ross, <u>Measurement in Today's Schools</u>, Prentice-Hall Inc., New York, 1949. p.78. ⁹W.A.McCall, <u>Op.Cit</u>. p.49. 10_{C.C.Ross}, <u>Op.Cit</u>. p.79.

group. Next, the number of times each item was answered correctly by the two contrasting groups was determined.

> Those items which show the greatest percentage of successful responses in the best group above that of the poorest group are best; those which show little or no discrimination in favor of the best group are useless; and those which show a percentage of success for the best group below that of the poorest group are worse than useless, since they are actually injurious to the validity of the test.

The results of this measurement are shown in the accompanying Table 2, and in Figure 111, page 31.

TABLE 2

THE PERCENTAGE OF CORRECT RESPONSES FOR THE 25 HIGHEST AND THE 25 LOWEST PAPERS AND THE AMOUNT OF DISCRIMINATION

Question	% corre ct for	% correct for	Excess highest
	top 25	bottom 25	over lowest
123456789011 123	98 98 82 96 100 92 100 94 100 100 100 100 100 97	98 94 68 76 100 82 99 87 98 98 98 98 98 99 98	0 4 14 20 0 10 10 1 7 2 4 2 4 2 1 1

<u>ll_{Ibid}.</u> p.79.
Question	% correct for	% correct for	Excess highest
	highest 25	lowest 25	over lowest
14 16 17 19 22 22 22 22 20 12 33 23 45 67 89 33 33 35 35 35 35 35 35 35 35 35 35 35	96 82 90 96 82 98 91 98 84 86 100 80 90 97 80 90 97 80 96 100 97 100 100 100 100 100	70 62 80 80 96 96 90 90 90 90 90 90 90 90 90 90 90 90 90	26 20 6 16 2 8 6 22 6 3 22 6 4 20 12 18 8 2 2 6 4 20 12 18 8 2 3 1 12 19 4 6

TABLE 2 -- continued

From this it is seen that there are no items which are overly injurious to the validity, i.e., have a discriminating value of less than zero, and only two items that have zero discrimination. However, several items show a low discriminating value, leaving about 60% of the test (items with a discriminating value of six or over) as having marked validity.



A further evaluation of the test was an assessment of its reliability. "By reliability is meant the degree to which the test agrees with itself," ¹² or the degree of consistency with which the test measures whatever it does measure.

The method of testing reliability followed a sequence also described by Ross. After the test was given two scores were recorded for each paper, one for each half, on the division of one point for the even-numbered items and one point for the oddnumbered items. When the two series of scores were obtained, the coefficient of correlation between them was computed. This gave the reliability of the half-test, and worked out to .43. The reliability of the whole test was then calculated by the use of the Spearman-Brown formula. ¹³

$$r_{nn} = \frac{nr_{il}}{1 \neq (n-1)r_{il}}$$

When the reliability of the whole test is being estimated from the half-test, the value of n is 2, so that for this case the ceefficient works out as:

> 12<u>Ibid</u>., p.82. 13<u>Ibid</u>., p.245.

Estimated $r = \frac{2 \times r \text{ of half-test}}{1 \neq r \text{ of half-test}}$

 $= \frac{2 \times .43}{1 \neq .43} = \frac{.86}{1 \cdot .43} = .60$

The significance of this figure may be judged by comparing it with the accompanying extract:

The following are suggested as minimal requirements for the reliability coefficients of a single school grade:

.50 for determining the status of a group in some subject or group of subjects.

.90 for differentiating the achievement of a group in two or more scholastic lines.

.94 for differentiating the status of individuals in the same subject or group of subjects. .98 for differentiating individuals in two or more scholastic lines. 14

For the case under examination, the reliability should be at a level of .90. A figure of .60 would thus seem to indicate that the test has not a high degree of reliability.

From the evaluations to which it was subjected, it may be concluded that the pretest has a favorable construction, a fair degree of validity, but a low rating for reliability.

CHAPTER III

ANALYSIS OF THE TEXT USED IN GRADE XI CHEMISTRY

On the hypothesis that the text book authorized for use in conjunction with the course in chemistry is a contributing factor to achievement in the subject, this chapter is devoted to a consideration of some of the features of the present text. Consideration will be given to the general construction of the book, an evaluation of its question and problem assignments, its readability index as determined by the Lorge and Flesch formulae, and its rating on a spot-check evaluation scale as used by editors of textbook publishing houses.

The Grade XI Text .-

The current text book for Grade XI Chemistry is entitled <u>Modern Chemistry</u>, by Dull, Brooks, and Metcalfe. It first appeared on the course in the fall of 1951 when it replaced the text <u>High School</u> <u>Chemistry</u>, by Nevil Norton Evans. The present text measures 15 x 23 centimetres, weighs 550 grams, has a hard-backed cover, and is printed on white paper

of a medium gloss. These facts indicate qualities of compactness, sturdiness of construction, and weight of sufficient lightness to be handled easily. The material on each page is arranged in two columns, thus making for shorter lines and easier eye span. Besides unit divisions and chapter headings, each chapter is subdivided into sections, and the sections themselves are redivided into topic headings. The book contains 312 pages, of which 225 are required for the Grade XI xtudy.

Departmental Requirements of the Course.-

The Department of Education outlines the requirements for Grade XI Chemistry as follows:

Chemistry II (12% or 96 hours) Text: Modern Chemistry - Dull et al Outline of Laboratory Experiments-Harder (any 10 experiments) **Objectives:** 1. To demonstrate how man adapts his environment to suit his needs 2. To develop the ability to general-ize from raw data and thus to acquire an appreciation of the unity of nature 3. To develop an understanding of the importance of chemistry in modern society Course: The text with the following omissions: Sections Chapter 6 18-21(incl.) 7 10 16 10-13(incl.) 15,16 13 all 17

Chapters	Sections
ī8	6-18(incl.)
19	13-17 (incl.)
20	all
21	all
22	15-28 (incl.)
24	8 (sub-section 2)
25	1-6 (incl.) $18-32$
	(incl.) Problems based
	on these sections are
	to be omitted.

Practical Work

Student participation in at least ten experiments. At least five suitable demonstrations chosen from the approved outline.

All experiments must be described in an approved form in a laboratory note-book kept by each student. The date on which each experiment was performed must be shown and the "demonstration" experiments must be plainly marked as such. These notebooks must be available at all times for examination by the Inspector. 15

Details of Text Construction .-

Some self-evaluation of the text is given by

the authors in the preface:

The authors have endeavored to make the book truly modern both in the chemical theory presented, and also in the chapters dealing with descriptive chemistry. They have eliminated discarded theories and outmoded ideas....

Simple language is used throughout. The authors have especially tried to keep the sentences short and the language simple. The double-column format agrees with the eye span of the reader and thus avoids strain. Equations are printed in clear bold type which stands out on the page.

15 From, <u>Programme of Studies for the Schools</u> of Manitoba, Senior High Schools, 1952-53. Authorized by the Minister of Education, Winnipeg. Printed by C.E.Leech, Queen's Printer for Manitoba -1952. pp. 58-59. All photographs have been selected for their functional teaching value. The line-drawings have been made with care, not only to secure accuracy, but also to make sure they are in accord with good laboratory technique. 16

Illustrations relating to material in the text are numerous, there being 219, of which ninety are photographic reproductions and 129 are illustrations and diagrams. The photographs have a tendency to be too dark, thus diminishing their value as illustrative material. The worst examples are Fig. 15 page 158, Fig. 22 page 251, and Fig. 24 page 269.

Each chapter is headed by a vocabulary giving the meanings of some of the new terms to be found in that chapter. Such vocabulary lists are confined to from four to ten words in each chapter. At the end of each chapter there is a summary of the material covered. This is followed by a list of terms under the title, "Test Yourself on These Terms." Then follows a set of questions, or questions and problems, followed by a section headed, "Some Things for You to do", containing a few simple experiments the student can do on his own at home.

In the pages outlined as constituting the

16_{Charles E. Dull, William O. Brooks, H. Clark Metcalfe, Modern Chemistry. Henry Holt and Company, New York, 1951. p.iv.}

Grade XI course appear 422 questions pertaining to material covered in the text, and i58 problems based upon the mathematics of chemistry. Typical examples are given.

- 7. What are three characteristics of all solutions ? (p.98)
- 8. Why must an automobile engine never be run in a closed garage ?(p.173)
- 1. What are the three most important acids ? Why are they important ? (p.214)
- 7. What volume of hydrogen chloride is liberated by the complete reaction of sulfuric acid with 117 g. of sodium chloride ? (p.215)
- 5. A sample of sodium nitrate is 80% pure. How many grams of nitric acid can be made from 106 g. of the nitrate ? (p.256) 17

Method of Using Problems and Assignments .-

Throughout the year the questions and problems in the text were given as assignments. The general method followed in teaching was to treat each chapter as a unit, spending a class period or more in lecturing on the material and doing illustrative blackboard work. Several experiments outlined in the text but not included in the laboratory course were performed in the classroom as demonstrations.

When a chapter was covered with the pupils

17_{Ibid}. pp. 98, 173, 214, 215, 256.

by the teacher, the students then were required to write out and hand in a summary of the material in the chapter, and also to complete and hand in whatever questions or problems were assigned. A total of 680 questions and problems were assigned during the school year.

By means of the check lists already referred to, (page 22) a record of all the assigned questions and problems each student either failed to do or did wrongly during the year was kept. In this way a record was obtained of the "Homework Index" of the student, as well as a determination of which questions were the most difficult, for it was assumed that any question not solvable by a high percentage of the class could be considered highly difficult in nature. Determination of Value of Assignments in Text.-

At the close of the school term in June, 1953, counts were made from the work sheet records kept during the year. One count was made of the number of times a problem or question was done wrongly or received no answer. In this count, only the students doing the assignment were counted, and not those who were absent or neglected to attempt any part of the work, as a valuation of question difficulty was all that was wanted here. The results of this count were then calculated on a percentage basis as a percentage of error, and the results tabulated in Tables 3 and 4, pages 41 to 45. Separate tables are shown for the questions and for the problems. Only those questions having a percentage of error of 10% or over are shown.

In an attempt to classify the questions according to their difficulty, they were arbitrarily divided into three separate groups. Questions answered wrongly 30 to 50 % of the time were assumed to be of a moderate degree of difficulty. Those wrong 51 to 75 % of the time were given a difficulty rating as high, and those wrong 76 % of the time and more were considered to be extreme in their difficulty rating. This would mean that 24.4 % of the questions appearing in the text, and 57.6 % of the problems, were of a high degree of difficulty. Computation is based on the actual number of questions the student tried during the year. Results are shown in Tables 5 and 6, pages 44 to 47.

TABLE 3

01224 Ody Autor 2: 2000-02404 (04			-		
Page	Question	Percentag e of error	Page	Question	Percentage of error
10	9 13 14	20 27 40	129	26 27 28	20 41 36
44	24 25 26	22 33 20		30 31 32	70 12 36
84	19	11		33 34	33 12 33
98	17 18 24 25 26 28	8 18 12 9 32 14		37 37 38 39 41 41	55 42 36 58 55 53 55 50
113	21	19		42 43	55
129	356790	22 34 33 33 30 67		44 45 46 47 48 49 50	61 58 58 26 48 47
	12 13 14	42 30 73	161	13 23 24	12
	16 17	36	173	22	19
	18 19 20 21 22 23 24 25	20 50 47 55 50 47 55 50 47 55 50 7 37	214	13 15 16 17 18 19 20 21 25	18 16 20 36 45 31 22 80 35

ERROR RATING IN HOMEWORK ASSIGNMENTS: QUESTIONS

Page	Question	Percentag e of err ðr	Page	Question	Percentage of error
226	1 2 4 7 8 9 10	26 20 25 41 52 28 25	226	49 50 51 52 53 54	50 48 41 47 40 41
	11 12 13	40 20 58	255	5 7	19 10
	145678901223457901233456789012345678	222853330777575681222603675737261088	266	578912345678901234 112345678901234 1134569	14 19 49 120 95 58 47 200 57 0 122 43 37 56 1 24 37 56 1 24

TABLE	3	<u>Continued</u>
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Page	Question	Percentage of error
293	4 7 8 16 17 19 23 24 26	20 10 17 15 37 39 39 51 34 32 35 64

TABLE 4

ERROR RATING IN HOMEWORK ASSIGNMENTS: PROBLEMS

Page	Question	Percentage of errør	Page	Question	Percentage
11	134567	24 49 24 27 11	65	4 5 6 7 8 0	22 39 19 11 22
	8 11 12 14	2) 58 87 16 94		10 11 12 13 14	29 58 21 24 35
45	1 2 3 4	42 47 59 50		15 16 17 18	56 69 81 61 34
55	1 2 3	34 43 92		20 21	77 37
65	23	11 22	84	1 2 3	19 25 33

Page	Question	Percentage of error	Page	Question	Percentage of error
135	4567890124567890122245	13 14 12 20 24 28 17 26 27 16 55 50 55 55 55 55 55 55 55 55 55 55 55	148	45678901123456789012345	42 51 386 194 556 397 575 560 600 89
142	5678901123456789011234567890	48 41 54 29 29 29 29 29 29 29 29 29 29 29 29 29	174 215	12345 12345678	57 58 49 64 64 21 37 32 21 37 37 44 55
148	1 2 3	19 24 19	255	1 2 3 4	18 36 24 48

TABLE 4 -- Continued

TĮ	١E	3I	Æ	4	83	6339	С	0	n	t	iı	าน	e	đ
							-							

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	centage Page Question Percentage error of error	Percentage of error	Question	Page
266 1 28 3 62 2 37 5 75 3 30 5 75	58 276 1 58 64 2 17	58 64	56	255
5 94 294 2 26 5 94 3 27 6 24 7 40 8 57	28 3 62 37 5 75 30 5 75 57 294 2 26 94 3 27 6 24 7 40 8 57	28 37 30 57 94	12345	266

TABLE 5

SUMMARY OF ERROR RATING IN HOMEWORK ASSIGNMENT: QUESTIONS

30-50% error;			51-7	51-75% error;			lus e	rror;
	Moder	ate	I	ligh		Ext	treme	
Page	No.	Rate	Page	No.	Rate	Page	No.	Rate
10 44 98 129	14565679236901223	40 32 332 333 330 206 47 55 5 445 5	129 161 226	10 11 18 390 43 56 74 83 10 11 18 18 10 11 18 18 10 11 18 18 10 11 18 18 19 11 18 18 19 19 11 18 18 19 19 11 18 19 19 19 19 19 19 19 19 19 19 19 19 19	6783608535168028 57575556556556555	214	21	80

30-50%error; Moderate			51-7 H	5% e igh	rror;	76% p Ex	lus e treme	error; e
Page	No.	Rate	Page	No_{\bullet}	Rate	Page	No.	Rate
129	5789235672490 2222335672490	37 41 36 36 333 40 40 40 40	266	173237373457579H				
214	17 18 19	30 45 31 35	276 293	23 11 21 26				
226	29 7 11 16	57 4 1 40 48						
266	1901245056802468901 22222333344468901	33 30 47 47 47 47 47 47 47 30 37 47 47 30 60 8 41						

TABLE 5 -- Continued

30-50% error; Moderate			51-75 H	% er ligh	ror;	76% p H	76% plus error; Extreme		
Page	No.	Rate	Page	No.	Rate	Page	No.	Rate	
266 276 293	52 55 55 10 22 24 14 19 10 22 24 14 19 10 22 22 22 22 22 22 22 22 22 22 22 22 22	47 40 41 40 30 45 30 37 47 399 42 37 399 42 35							

TABLE 6

SUMMARY OF ERROR RATING IN HOMEWORK ASSIGNMENTS: PROBLEMS

30- 5 Mc	50% e odera	rror; te	51-7	5% er High	ror;	76% plus error Extreme		
Page	No.	Rate	Page	No.	Rate	Page	No.	Rate
11 45	312 4	49 42 47 50	11 45 65	8 3 11 15	58 59 56	11 55 65	11 14 3 17	87 94 92 81

30-50% error; Moderate			51-75 E	51-75% error; High			76% plus error; Extreme		
Page	No.	Rate	Page	No.	Rate	Page	No.	Rate	
Page 55 65 84 135 142 148 148 174 215 255	No. 125491396902355624478134532356724	Rate 3439547307715508192286039797277468	Page 65 135 142 142 148 174 215 255 266 276	No. 16845781475695026790122212458564135	Ra 6618162634928146377596678445847725767	Page 65 142 148 266	No. 20 17 18 20 18 24 25 5	Rate 77 91 88 79 85 80 89 94	
266 276 294	+2 3 4 7	37 30 49 40	294	Ŕ	7 J 57				

TABLE 6 -- Continued

Readability Index by the Lorge Formula .-

A further analysis of the text was made by computing its readability index according to the Lorge formula. ¹⁸ The procedure suggested is to choose samples throughout the book and analyze them. It is advisable to sample from 5% to 10% of the book in this manner. A sample must start with the begining of a sentence and stop at the end of a sentence. Use the Dale list of 769 easy words to cross out in the sample every word on the Dale list, regardless of its meaning. The count is of the number of different hard words, so that each hard word is counted only once. A copy of the Dale List is contained in the appendix, pages 100 to 104.

The actual procedure followed in this case was to sample fifty-one pages out of the text's 292 pages of reading matter, thus netting a 17.46% sampling. Also it was found more accurate to write out the words on each page of the text not appearing on the Dale List, and then count this number. In this way the danger of counting the same word several times was eliminated.

¹⁸Lorge, "The Lorge Formula for Estimating Grade Placement of Reading Materials," <u>Teachers</u> <u>College Record</u>, Vol. XLV, p.404.

TABLE	7
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RESULTS OF TEXT ANALYSIS BY LORGE FORMULA

Page	Readability Index	Page	Readability Index
246824602802468026802 111222802468026802	6.2807 5.3434 7.4524 6.5873 6.0770 6.7168 6.1657 6.2931 6.5055 6.5241 6.5091 6.0198 6.0035 6.9790 6.8952 6.3434 7.3794 6.3434 7.3794 6.3434 7.0199 7.6439 6.8684 6.5503 5.7594	68 78 88 96 106 115 126 136 146 156 166 176 184 194 204 212 222 228 238 248 232 238 248 258 268 274 284 290 Total Average	6.7937 6.8147 6.4480 5.2324 5.7739 6.2358 5.7570 6.8256 6.2142 6.7991 6.6813 7.0180 5.4826 5.3955 6.3456 6.0586 8.4780 6.4156 7.6131 7.3028 6.5995 6.0000 7.1638 6.2909 6.2049 332.2710 6.5151

The method employed in treating the infor-

mation was:

Basic Data

1. The number of words in the sample. 2. The number of sentences in the sample. 3. The number of prepositional phrases in the sample. 4. The number of hard words in the sample. <u>Computation</u> Item 6, average sentence length: divide 1 by 2 and multiply by .07 Item 8, ratio of prepositional phrases: divide 3 by 1 and multiply by 13.01 Item 9, ratio of hard words: divide 4 by 1 and multiply by 10.73 Constant (C) 1.6126 Readability Index: Add 6, 8, 9, and C

Page 156 of the text <u>Modern Chemistry</u> is taken as typical. Here the sampling begins at line two: "It's specific gravity is about.....", and continues to the very last line of the page: "This process is known as destructive distillation." In sampling any page, explanatory sentences referring to illustrations were also counted. In this case the two sentences under Fig. 15-7 were also included in the count.

This sample netted four hundred and four words on the page, twenty-nine sentences, fiftythree prpositional phrases, and one hundred and seventeen hard words. The computation then yielded:

Number of words divided by number of sentences times .07 l.1682 Number of prepositional phrases divided by number of words times 13.01 l.4245 Number of hard words in the sample divided by number of words times 10.73 2.5938 Constant 1.6126 Yielding a Readability Index of 6.7991 This means that the material on this page has a readability of about Grade VII level. A complete

summary of the text sampling is given in Table 7,

page 49.

Readability Index by Flesch Formula .-

As a check, the Flesch ¹⁹ formula was used to measure the readability of several samples from the text.

TABLE 8

CHEMISTRY TEXT READABILITY INDEX BY FLESCH FORMULA

Text page

0										
0	0	•	6	•	٥	ø	0	¢	0	2.45
	•	0	٢	٥	٥	ø	ø	ø	0	2.40
ø	•	٥	•	¢	0	٥	8	0	0	2.82
ø	0	0	ø	•		0	0	٥	9	3.32
e	0	•	0	6		6	6	6	0	3.39
			٥			-				2.03
						Å	Š	Š		2,14
				,	Ĩ		,			2.35
ě	9		9	ø	ø	ø	ø	9	ø	$2^{\circ} d7$
ø	•	0	9	9	•	ø	0	ø	0	216
ø	ø	٥	٥	٥	ø	۳	ø	۲	•	2040
0	0	0	0	0	ø	٠	0	•	0	2.47
ø	٥	0	0	0	0	0	ø	0	¢	3.34
0	0	ø	0	0	٥	ø	٩	٥	0	2,80
					0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 <td>0 0</td> <td>0 0</td> <td>0 0</td>	0 0	0 0	0 0

Index

19 Rudolph Flesch, <u>The Art of Plain Talk</u>, Harper and brothers, New York, 1949. TABLE 8 -- Continued

Text	pag	;e									Index	
136 146 156 166 176 184 194	0 0 0 0 0 0 0 0	0 0 0 0 0 0	6 6 9 9 6	0 0 0 0 0	0 0 0 0 0 0 0	0 0 0 0 0 0	° ° °	e e e e e e e e e e e e e e e e e e e	0 0 0 0 0	0 0 0 0 0 0	3.01 2.79 3.58 3.33 3.97 3.58 2.74 57.84	
					2,89							

Grade level: VI, almost VII

In applying the Flesch formula, only twenty pages from the text were used, but as the results from these corresponded quite closely to the results obtained by the Lorge formula, it was not deemed necessary to carry the calculations to any greater length. The results are tabulated in Table 8 and give a readability at a Grade VII level. <u>Further Examination of Reading Difficulty.-</u>

According to the preceding formulae, the readability of the text is well within the range of even the poorest Grade XI student. However, it must be borne in mind that what is readable to the student is not of necessity understandable by him. In connection with reading levels of textbooks in chemistry,

Dr. G.M.Mallinson 20 has some pertinent findings.

In his investigations of science textbooks he found that the reading levels of many textbooks were too far advanced for students for whom they were written. In his particular investigation into chemistry textbooks he found that many students were below average in reading ability; hence, for any particular grade level, the reading difficulty of the textbook should be below that of the grade in order to be suitable for these students.

Data collected also indicated that the levels of reading difficulty of the passages within the separate textbooks vary greatly. In any textbook, some passages are not likely to cause difficulty for any of the students for whom they are designed, but other passages are likely to cause difficulty for all students for whom they are designed. It is therefore clear that the average reading difficulty score for a textbook may be somewhat misleading. Some textbooks that have many extremely difficult passages may be balanced by some very easy ones. "It seems reasonable to state from the conclusions already

²⁰G.G.Mallinson, H.E.Sturm, L.M.Mallinson, <u>The Reading Difficulty of Textbooks for High-School</u> <u>Chemistry</u>. "Journal of Chemical Education," Vol. 29, Dec.,1952. pp.629-631.

listed that the differences found make level of reading difficulty a valid criterion for use in the selection of a textbook." ²¹

Even under the exacting scrutiny of Dr. Mallinson's criticism the most difficult page examined in the Grade XI Chemistry text, Page 228 (see Table 7, p.49) shows a reading difficulty of no more than Grade VIII completed. By all criteria, the reading difficulty of the text is well within the ability of Grade XI level.

Spot-check Evaluation of Text.-

As a further check of the suitability of the present text, it was subjected to a spot-check evaluation as devised by Louis Vogel. ²² This scale is intended as a guide for evaluating science textbooks at high school level, and rates a textbook under the headings: Qualifications of author, Organization, Content, Presentation of Material, Accuracy, Readability, Adaptability, Teaching aids, Illustrations, Appearance. The highest possible score for a textbook is 100 points. <u>Modern Chemistry</u> received a score of 88 points on this check test.

²¹Ibid. p.631.

²²Louis F. Vogel, <u>A Spot-Check Evaluation</u> <u>Scale for High School Science Textbooks</u>. "The Science Teacher", Vol. XVIII, No. 2, March 1951.

CHAPTER IV

RESULTS AND FINDINGS

With the completion of all tests and examinations, the results were compiled into one table for further evaluation, Table 9, pages 56 to 58. Each of the six different abilities measured was correlated with the results the pupil obtained from his June Department of Education examination. In this way, assuming other factors constant, it would be indicated to what extent each ability affected the student's achievement in his Grade XI Chemistry.

The method used followed the Pearson productmoment plan for ungrouped pairs of data as illustrated on pages 164 to 166, <u>Statistics for Teachers</u>, Tiegs and Crawford.²³ Details of the method used in finding the correlation between I.Q. and June results are described here, and are summarized in Table 10, pages 59 to 61. The coefficient correlations for the other abilities are summarized on later pages. As our main objective was the determination of the correlation

²³Tiegs and Crawford, <u>Statistics for</u> <u>Teachers</u>, Houghton Mifflin Co.,Cambridge, Massachusetts, 1930.

coefficient, it was not necessary to find the standard deviations of the X and Y variables as such. Also, since a Burroughs adding machine and a Munroe calculator were used, it was not found necessary to reduce the scores by subtracting, as is often done.

TABLE 9

TEST RESULTS OF GRADE XI PUPILS IN FLIN FLON COLLEGIATE

	[Percentages							
Name	I.Q.	Pre- test	Math	Abst. Rsng.	Read- ing	Home- work Index	June final 1953		
Adams, Wesley(R) Allen, Ken(R) Ariko, Elizabeth Ariko, Walter(R) Ash, Arlene Ash, Robert Atkinson, Faye Baily, Shirley Ballard, Yvonne Barker, Zona Bucher, Dennis(R Chigol, Irene Chorley, Bob Clay, Dorothy Cole, Donald Cowie, Carole Cyr, Dennis(R) Davison, Eunice Dowhan, Elsie Duncan, Norma Einarson, Phil Foster, Ron(R) Fraser, Delores Frechette, Denise Fric, Lawrence Fryer, Kathleen Saboury, Denise Gira, Frank Grant, Joan	11520 10030 10030 10030 10030 1000 1000 100	••1.83 •776 •8.657 •6657 •6657 •675 •675 •675 •675 •675	968655888 7 7946388499447699599	50500555055505550550050050005507 76369224868568435605005005507	749486576866735419641134962777	••7•227058 •1•400 •4784 •5735405 ••5•645866 •9•668 •5665 •64555777	653542876898920991507838667663		

TABLE	9	<u>Continued</u>
-------	---	------------------

: .			Percentages								
Name	I.Q.	Pre- test	Math	Abst. Rsng.	Read- ing	Home- work Index	June final 1953				
Greenberg, Kay Gunston, Joan Haga, Orwell Halasz, Steve Hartman, Sheila Hayden, Gerry Hogg, Josephine Huszti, Paul Ibbott, Barry Katcher, Lorna Keddie, Marilyn Lahonen, Leonard Last, Roy Logan, Shirley Lovecky, Joe Lowe, George(R) McDougall, Harley McIntosh, Fred McIsaac, Gerald McMurray, Allan McSheffrey, Brian Mearns, Audrey Mearns, Irene Middagh, Marjorid Milton, Bill Monis, Mona Mote, Larry(R) Murray, Jim(R) Newton, Betty Nielson, Karen Nisbet, Betty Nielson, Karen Nisbet, Betty Norlander, Andy Pankew, Lillian Persson, Vasti(R) Prokop, Nadia Ross, Joan Rossington, Warof Schwandt, Joyce Shockey, Lorne(R) Smith, Alvin	1223465491399956142387531005790579160120866	871 •36300 •858038 •598150 •471 • •50787 •1614 • • •	0755505055055055005000000 *70787888988686799385586 *70787878787893699995560	39619519705568379337587°574638663173863868	9935768578872406896999 *8006888872084424527	67767837 ·322327 ·306615 ·268 · ·85946 ·7744 · · ·	67716698437907004774035956713061439349588 2438				

		Percentages							
Name	I.Q.	Pre- test	Math	Abst. Rsng.	Read- ing	Home- work Index	June final 1953		
Sorli,Sylvia(R) Sorenson,Doug(R) Southern,Mark Southern,Oakley Spencer,Nancy Strand,Delores Strijack,Val Thompson,Betty Turcotte,Ruby Winterton,Mavis (R) signific	106 111 114 100 111 109 116 113 96 103	52 57 68 758 62 49 epeate	50 •5595750 •5595750	86°5095500	586 37773342 79953	**************************************	54 70 37 54 79 79 93 21 73		

TABLE 9 -- Continued

Correlation between I.Q. and June Examinations.-

In the first column of Table 10, page 59, are given the names of the pupils, and from this we get N, the number of cases involved. The second column, (X), gives the I.Q. value for each of these pupils, and the sum of this column (ΣX) is then found. The third column, (Y), denotes the June mark in Chemistry from Department of Education examinations for each of the pupils, while the sum of this column is (ΣY). The fourth column, (XY), gives the products of column (X) and of column (Y), and the sum of this column is (ΣXY). The fifth column gives the squares of the (X) column and the sixth column gives the squares of the (Y) column. The formula for finding (r), the coefficient of correlation, is the same for all the abilities measured.



For the coefficient between the I.Q. and the June marks, "r" works out to:



TABLE 10

COEFFICIENT OF CORRELATION BETWEEN I.Q. AND JUNE MARKS

Pupil	I.Q.	June	Products	Squares	Squares
	(X)	(Y)	(XY)	(_X 2)	(Y ²)
Adams,W. Allen,K. Ariko,E. Ariko,W. Ash,A. Ash,R. Atkinson,F.	115 112 101 109 103 101	63 50 35 54 38 57	7245 5600 3850 5454 4578 3914 5757	13225 12544 12100 10201 11881 10609 10201	3969 2500 1225 2916 1764 1444 3249

²⁴<u>Ibid</u>. pp.164-166.

TABLE 10 -- Continued

Pupil	I.Q. (X)	June (Y)	Products (XY)	Squares (X ²)	Squares (Y ²)
Baily, S. Ballard, Y. Barker, Z. Bucher, D. Chigol, I. Chorley, B. Clay, D. Cole, D. Cowie, C. Cyr, D. Davison, E. Dowhan, E. Duncan, N. Einarson, P. Foster, R. Fraser, D. Frechette, D. Fric, L. Fryer, K. Gaboury, D. Gira, F. Grant, J. Greenberg, K. Gunston, J. Haga, O. Halasz, S. Hartman, S. Hartman, S. Hartman, S. Hayden, G. Hogg, J. Huszti, P. Ibbott, B. Katcher, L. Keddie, M. Lahonen, L. Last, R. Loyan, S. Lovecky, J. Lowe, G. McDougall, H. McIntosh, F.	101 103 108 109 105 100 109 109 109 109 100 100 109 109 100 100	736589209915078386667663892847084379070885557753 789892099150783866676638928470843790788557753	767649644808555012946298610862450249310550642728485746886249344855662427884629789462986135709778946299861677344893105566242728285746984506249344855628536255685867997469845024934485562412	10201 12769 10201 11664 10236 10404 1025 10201 10201 10201 10209 10009 10209 10	5776 1441 3364 37924 3364 37924 3481 620094 34481 620094 39644 43529 677094 42844 40890 715699 4909 32400 52804 409890 409690 29129 529249

. ·

Pupil	I.Q.	June	Products	Squares	Squares
	(X)	(Y)	(XY)	(X ²)	(Y ²)
McSheffrey, B. Mearns, A. Mearns, I. Middagh, M. Milton, B. Monis, M. Mote, L. Murray, J. Newton, B. Nielson, K. Nisbet, B. Norlander, A. Pankew, L. Persson, V. Prokop, N. Ross, J. Rossington, C. Schwandt, J. Shockey, L. Shore, E. Smith, A. Sorli, S. Sorenson, D. Southern, M. Southern, M. Strijack, V. Thompson, B. Turcotte, R. Winterton, M.	117 103 100 100 100 100 100 100 100 100 100	92237965645935888243857375779213 92237965645935888243857375779213	$\begin{array}{c} 10530\\ 2415\\ 2575\\ 3939\\ 8250\\ 10560\\ 7035\\ 5457\\ 6860\\ 9735\\ 5457\\ 6860\\ 9736\\ 5353\\ 9430\\ 10164\\ 3045\\ 4028\\ 10208\\ 4028\\ 5724\\ 7770\\ 4218\\ 7810\\ 5994\\ 8611\\ 9164\\ 10509\\ 2016\\ 7519\end{array}$	13689 1025 10609 10201 12100 12100 1025 11449 1025 11449 9801 10201 1025 11449 9801 10201 11236 12100 14641 11025 11664 1236 12321 1236 12321 12996 12321 12881 13456 12769 9216 10609	8100 529 625 1521 5625 9216 4489 2601 3969 3136 2809 79889 7056 2021 2025 1444 7746 4900 1369 5041 6241 8649 5329
80	8539	4633	499174	914219	302769
(N)	(SX)	(Σ Υ)	(S XY)	(2 X ²)	(XY ²)

TABLE 10 -- Continued

199399

Other Correlation Coefficients .-

The correlation between the Mathematics Test and the Chemistry June finals gives a value of:

$$r = \sqrt{\frac{353073}{450953 - \frac{33235225}{78}} \sqrt{\frac{300775 - \frac{20894041}{78}}{78}}}$$

= .53

The correlation between the Reading Test and the June final Chemistry mark has a value of:

$$\mathbf{r} = \frac{291051 - \frac{(4754)(4571)}{78}}{\sqrt{331116 - \frac{(4754)^2}{78}}\sqrt{300775 - \frac{(4571)^2}{78}}}$$
$$= \cdot .34$$

The correlation between the Abstract Reasoning Test and the Chemistry June final mark works out to:

$$r = \frac{284040 - (4734)(4571)}{78}$$
$$= \sqrt{329704 - (4734)^2} \sqrt{300775 - (4571)^2}{78}$$
$$= .18$$

The correlation between the Homework Index and the Chemistry June final mark is:

$$r = \sqrt{\frac{247230 - (3982)(3640)}{61}}$$
$$= \sqrt{\frac{268510 - \frac{15856324}{61}}{61}} \sqrt{\frac{247088 - \frac{13249600}{61}}{61}}$$
$$= .60$$

The correlation between the Pretest results and the June Chemistry marks works out to:

$$r = \frac{252005 - (4087)(3485)}{58}$$

$$r = \sqrt{293573 - \frac{16703569}{58}} \sqrt{237979 - \frac{12145225}{58}}$$

$$= .51$$

The "t" test of significance.-

The reliability of the correlation coefficient was tested as a further means of determination of its significance. "In experimental and research work the determination of whether an observed difference is of such magnitude that it cannot be attributed to chance factors or sampling variations is often our major interest," 25

The test of significance in this case assumes

25 Allen L. Edwards, <u>Statistical Analysis</u> for Students in Psychology and Education. Rinehard and Co., Inc. New York, 1946. p.172. that the true correlation is zero. If the obtained correlation is large it may then be inferred that the correlation is due to factors other than chance, or that the correlation is significant.

The direct computation of t.-

The hypothesis which we are probably most interested in testing, once we have obtained a given value of r, is the hypothesis that the true r equals zero. If we set up this hypothesis for testing, assuming that our sample value is the result of sampling variation or chance, then the formula for t is

$$t = \left(\frac{r}{\sqrt{1-r^2}}\right)\left(\sqrt{N-2}\right)$$

where r equals the observed sample value of the correlation coefficient, and N is the number of pairs of observations in the sample. 26

Once we have calculated t from the formula, we enter a table of values with degrees of freedom equal to the number of pairs of observations minus two, to determine whether the obtained value is significant at the five or one per cent level.

Using this formula, the values of t obtained for the abilities tested are given below. The portion of the table used in the valuations is shown in Table

26_{1bid}. p.187.
11, page 66.

For I.Q.: chemistry correlation, t is 4.7; Table value of t for this degree of freedom, 1.994 to 2.648.

For Mathematics Test: chemistry correlation, t is 5.48; Table value of t for this degree of freedom is 1.994 to 2.648.

For Reading; chemistry correlation, t is 2.648; Table value of t for this degree of freedom, 1.994 to 2.648.

For Abstract Reasoning: chemistry correlation, t is 1.7607; Table value of t for this degree of freedom, 1.994 to 2.648.

For Homework Index: chemistry correlation, t is 5.72; Table value of t for this degree of freedom, 2.000 to 2.688.

For Pretest: chemistry correlation, t is 4.352; Table value of t for this degree of freedom, 2.005 to 2.678.

Thus all our correlation coefficients show a significant deviation from zero except the one on Abstract Reasoning. In this latter case the coefficient is so low that there is ample evidence to accept the implication of the null hypothesis, that there is zero relationship between abstract reasoning and results in chemistry as obtained under our present examination system, and in this study.

TABLE 11

VALUE OF t @ 5% & 1% LEVELS OF SIGNIFICANCE

Degree of Freedom	5%	1%	
50	2.008	2.678	27
55	2.005	2.668	
60	2.000	2.660	
65	1.998	2.653	
70	1.994	2.648	
80	1.990	2.638	

27<u>Ibid</u>. p.330.

CHAPTER V

INTERPRETATION AND CONCLUSION

Interpretation of the results is not as simple a matter as examining correleation coefficients and arbitrarily stating that such an ability is necessary, while another one is not essential in the learning of chemistry. In valuating any factors that bear on achievement in chemistry, consideration also must be given to their relative significance in relation to those other factors which have not been measured. Consequently, our interpretations will be somewhat invalidated due to the fact that we are assuming all other factors which were not specifically treated in this study as being constants. In addition it is acknowledged that the interpretation of correlation coefficients without adequate consideration of the reliability of amm the measures involved can result only in doubtful conclusions.

Consideration will be given first to the

significance of the correlation coefficients, then some attempt will be made at interpreting these figures.

An empirical classification of correlation coefficients as made by H.O.Rugg, in <u>Statistical</u> <u>Methods Applied to Education</u>, summarizes into:

> Below .15 or .20, "negligible or indifferent" From .15 or .20 to .35 or .40, "present but low" From .35 or .40 to .50 or .60, "markedly present" Above .60 or .70, "high" 28

Summarizing the findings on this basis yields the following information:

Correlation between I.Q. and Chemistry, .47, "markedly present".

Correlation between Mathematical Ability and Chemistry, .53, "markedly present".

Correlation between Reading ability and Chemistry, .34, "present but low".

Correlation between Abstract Reasoning and Chemistry, .18, "negligible or indifferent".

Correlation between Homéwork Index and Chemistry, .60, "high".

Correlation between Pretest and Chemistry, .51, "markedly present".

In conjunction with the above it may be noted

²⁸Tiegs and Crawford, <u>Op.Cit.</u> p.163.

that the only case in which the null hypothesis may not be rejected from a consideration of the test of significance is the Abstract Reasoning result, where the correlation is negligible or indifferent. Interpretation.-

At this stage of the work we are ready to attempt an interpretation of the findings that our study has disclosed . This interpretation for the most part will take the form of an analysis of the significance of the coefficients between Chemistry and I.Q., mathematical ability, reading ability, abstract reasoning, homework index, and the pretest, as well as some evaluation of the present Grade XI chemistry textbook as revealed by the tests employed.

I.Q. and Chemistry -

This correlation works out to .47, a figure that is interpreted as "markedly present". From this we can believe that high intelligence has some effect on achievement in chemistry. The exact extent of this relationship could only be determined by a study more exhaustive than this treatise. However, an examination of individual cases from Table 9, pages 56 to 58, shows that, with some variations, the highest marks in chemistry were obtained by those

pupils with the higher I.Q's. This is not an exact relationship, however, as students' work habits, motivation, initiative, etc., do affect a student's standing also. This has been further emphasized to the author who has found in an examination of students' records over a period of five years that the student with the highest final mark in chemistry was never the one with the highest I.Q. in the class. On the other hand, over the same five year period, involving 194 cases, the students with the lowest marks were those with the lowest I.Q's. The same group of statistics showed that 61.8% of the students with an I.Q. up to 110 received a pass mark in June chemistry, 53.6% passed with an I.Q. up to 105, and only 30.7% passed having I.Q's. up to 100. The lowest I.Q. receiving a pass mark was 96; the highest I.Q. receiving a failure mark was 115.

On the same topic, Paul Brandwein of Forest Hills High School, New York, says: "A careful examination of courses of study and methods of teaching now employed indicates that chemistry teachers think the student body of a given high school is composed of individuals with I.Q's. of 110 or more. Obviously this is not so. Yet the course generally given is

aimed at such students." 29

A high I.Q. does seem to help a student attain a high mark in chemistry, but it is not essential to success in the subject. On the other hand, chemistry does not seem to be a subject which a student with an I.Q. below 100 can cope with successfully. Mathematics and June Chemistry.-

The coefficient here works out to .53, "markedly present". Since much of the work in chemistry involves the use of mathematics, this finding is in keeping with the original premise that students well versed in mathematics would make good chemistry students. This is further verified by the authors of the Numerical Ability test: "For English and social studies as well as for <u>science</u> and mathematics, the Numerical Ability test is among the best predictors. One can but conjecture that facility in computation and reasoning with numbers is in some way indicative of <u>general</u> learning aptitude, since the specific contribution of numerical skill to English or social studies can scarcely be appreciable." ³⁰

²⁹Paul F. Brandwein. "Signposts Twoards the Revision of High School Chemistry", <u>School Science</u> and <u>Mathematics</u>. Vol. LIII, April 1953.p.313 ³⁰Bennett, Seashore, & Wesman, <u>Op.Cit</u>.p.38.

Reading and June finals.-

Here the correlation is .34, "present but low". The evidence would seem to indicate that a high degree of capability in reading is not essential for mastery in chemistry.

Abstract Reasoning and June finals .-

Since it was assumed that chemistry involves high levels of abstraction and theorizing, it was originally presumed that a high degree of ability in abstract reasoning would be necessary as a prerequisite of a good chemistry student. As the coefficient in this case works out to .18, "negligible or indifferent", it would seem that the original premise is unfounded on fact. The assumption that ability in abstract reasoning is necessary in order to visualize and understand the theories and speculations of Grade XI Chemistry is probably untenable.

Homework Index and Chemistry.-

This coefficient works out to .60, "high", and is the highest index of all the tests. It would appear then that the major factor in determining a high standard in Grade XI Chemistry, on the basis of achievement in examinations, is the faithful performance of assignments and tasks set in the subject throughout the school year. Such an attitude in all

probability develops work habits that are consistent with good procedure in learning, and is certainly in direct contrast to that of the proponents of cramming.

Elementary Contributory Science .-

The Pretest was conceived as a way of measuring the amount of elementary contributory science a student brought with him into Grade XI at the begining of his chemistry course. Since the coefficient of relationship between this factor and his June mark in chemistry works out to .51, "markedly present", it is assumed that the student coming to Grade XI with a good background and knowledge of chemistry from his previous grades is going to attain a satisfactory standard at the higher level. This emphasizes the importance of a properly balanced and adequate junior course leading to Grade XI chemistry, for it is in the lower grades that a student will develop proper work habits and attitude towards the subject.

From the analysis of the elementary contributory science as given in the Appendix, pages 84 to 91, it was found that from 25% to 33% of the chemistry course for Grade XI is a repetition of material covered in previous grades. Such an introductory course would seem adequate. This conclusion is further evid-

enced by the fact that its bearing on achievement in chemistry as determined from the correlation coefficient is "markedly present".

The Present Grade XI Chemistry Text .-

An analysis of the Grade XI Chemistry text, <u>Modern Chemistry</u>, by Dull, Brooks, and Metcalve, is given in Chapter III. It is true that "not everything in a textbook need be taught; the textbook is, we must agree, a basic reference - not a strait-jacket".³¹ However, the textbook is the source from which most of the student's learning will come. This is especially true in our present day mass education involving overcrowded classrooms and more inadequately trained teachers. The text is most often the final reference and authority for both the teacher and the pupil, hence it should be so constructed as to give the most for a minimum of effort.

The construction of the present text seems to meet the standards of a good text, and the readability index is well within the range of the student, (see Table 7, p.49). From an examination of the results in Tables 5 and 6 (pp. 44 to 47), in which an evaluation is made of the difficulty of end-of-chapter

31Paul F. Brandwein, Op. Cit. p. 313.

work assignments, there appears to be a major proportion of questions that are beyond the capabilities of the average student to solve. This is a serious criticism when it is recalled that the coefficient between homework and chemistry achievement is .60. Such impossible assignments could well lead to frustration and discouragement. That some of this material is of a high degree of difficulty is stated by the authors: "As a guide in the selection of material, the authors have marked with a star certain whole chapters, paragraphs in other chapters, and certain questions and problems. These starred sections are intended for superior students." ³² Conclusion.-

"Most students in our schools cannot learn a vast assortment of facts unrelated to their present lives, combined with a private shorthand, a private mathematics, high levels of abstraction, often symbolic and highly theoretical in nature, as well as the laboratory skills which accompany learning in chemistry." 33

That this statement is partly true would **deem** evident from the facts disclosed. Chemistry

³²Dull,Brooks,Metcalfe, <u>Op.Cit</u>. p.iii. ³³Paul F. Brandwein, <u>Op.Cit</u>. p.313. should not be classified as a single "subject", so much as a series of abilities coming under one title. That chemistry in Grade XI does present outstanding difficulties for many students is evident from an examination of Figures I and II, pages 11 and 12, in the latter of which the failure rates in this subject for Flin Flon are given covering the past five years.

With such a consistently high provincial failure rate in the subject, it would appear that some form of improvement is long overdue. It was hoped that the study might reveal where the weaknesses were most flagrant, and hence the places where improvement would be most needed.

The study shows that a high level of I.Q. is a help in getting superior grades in chemistry, but is not an essential to being able to grasp enough to pass in the subject at this level. In any case, as the I.Q. factor is beyond the control of the school, there is nothing much remedial we can do in this respect, other than realize that a lower level I.Q. student is going to require more supervision and guidance in this subject. Another alternative would be to lower the requirements of the course down to the level of the students of lesser abilities.

Mathematical ability rates high in relation

to success in chemistry. Here is where close cooperation between teachers of mathematics and teachers of chemistry seems very necessary. From a student's previous record in mathematics, some indication may be derived as to what degree of success he will have in chemistry. While there is some overlapping of the two subjects, the high degree of correlation cannot be explained on this basis alone. It would seem reasonable to assume that whatever abilities are necessary for success in mathematics are the **same** ones required for success in chemistry.

Regardless of the fact that English is the medium of the student's learning, ability in reading does not show a close relationship to ability in Chemistry. Similarly the ability to reason abstractly is not a separate necessity for success in Chemistry, as far as the results of this study were able to show.

The finding of maximum import was the fact that the student who has a high Homework Index rating is the one most likely to succeed in chemistry. It would appear that the best student then is one who, with guidance, can work and learn on his own. At the elementary level we may be able to teach, but at the senior level we appear able only to guide, so this

must influence our teaching at the higher level. Has some of the fault been that we try to apply the same technique at both levels ?

As regards the effect of elementary contributory science, it is found that a high relationship exists between attainment in the lower grades and success in Grade XI Chemistry. It would seem then, that any improvement in the elementary science courses that would emphasize the place of chemistry, would affect the success of the student in his Grade XI course in this subject. What improvements can be made in these grades ? While the amount of chemistry subject matter taught in the lower grades seems adequate, some criticism can be made as regards its distribution. The amount of material devoted to chemistry is 16% of the text for Grade VII, 11% for Grade VIII, 17% for Grade X, but for Grade IX less than 1%. It is in this latter grade that the necessity for a change seems most marked, for here the sequence of the learning is broken, and once the thread of continuity is lost, it is often difficult to pick it up again successfully. True, the junior grades furnish the pupil with a general knowledge of science, but we should also keep in mind the fact that some emphasis should be given to preparing him for the

science he may take in his Grade XI work. In the general course he can take chemistry, biology, or physics. Considering this, it would seem more appropriate to allocate the course in Grades IX and X on the basis of 25% for general science, 25% for physics, 25% for biology, and 25% for chemistry. Such a distribution would increase the chemistry content, which would in all probability be for the better.

While the present text seems suitable in its material content, it is extremely weak in its choice of review questions and problems. This becomes vitally important when we find that the most decisive factor in determining a pupil's standing is his performance of homework assignments. It is therefore tremendously important that these assignments be of such a nature that the student is able to derive knowledge and help by doing them. Hence, they must be of such a nature that he can solve them by his own efforts. Anything that does not aid his progress in this respect, such as the 57% of problems in the text that are rated as too difficult (see Table 6, p.46), should be so modified that the percentage of difficulty is much less. The alternative is for the teacher to select and compile supplementary assignment material. This presupposes that the teacher has the

necessary experience and background for this work, has the time to prepare such assignments, and has the inclination to add this labor to a probably already overloaded timetable. Such a procedure may be necessary, but it certainly decreases the value of the textbook.

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APPENDIX

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Differential Aptitude Test: Abstract Reasoning

Iowa Silent Reading Test

Summary of pre-grade XI chemistry and of Grade XI chemistry text

Grade VII

Chap. 7 Plants Provide Food Energy

To show the effect of iodine upon starch (Exp.1). Testing for sugars. To show the effect of sugar upon Fehling's solution. Fats. Experiment to show the grease spot test for fats.

Chap. 8

Protein. Experiment showing nitric acid test for protein.

"Proteins contain the carbon, hydrogen and oxygen of the carbohydrates and in addition, they contain nitrogen and usually sulphur, and sometimes phosphorous and other elements" (p.76)

Minerals that are important to plants for food,-

Lime (Limestone) Calcium Sodium nitrate(Chile saltpetre) Nitrogen Bone Meal Potassium Potash(Wood ashes) Phosphorous

Common table salt disappears in a glass of water. We say that the salt has dissolved in the water. Any substance that dissolves in this way is said to be soluble.(pp.80-81) "Substances like these (carbon, iron) that cannot be separated into any other simpler substances are called elements. There are only ninety-three different elements in the world. The substance sugar is made up of three elements chemically joined together. Such a substance is called a compound. Carbon dioxide is a compound made up of two elements - hydrogen and oxygen."(p.81) Ash test after burning as test for element materials. Calcium- most important element in bones; necessary for growth of strong bones and good teeth.

Phosphorous- produces good bones and healthy blood.

Iron - forms the red part of the blood. Iodine - In order that the thyroid may do its work properly, it must be supplied with a small amount of the element iodine. Common salt- Common table salt is sodium chloride, a compound of sodium and chlorine. Tears, perspiration also contain salt. Chap. 9

Vitamins C,A,B1,B2,D.

Unit Three. The Air of Our World Picture, page 173: An army blimp filled with helium gas. Why is helium preferable to hydrogen in these dirigibles ?

Chap. 15 The Air We Breathe

Experiment to show that air is dissolved in water. "In the water much air is dissolved" (p.179) Matter: anything that occupies space and has weight. Experiments to show that air is matter. Forms of matter include solids, liquids, gas. "All matter is made up of tiny particles called <u>molecules</u>. These molecules, which are so small that they are quite invisible, are in constant motion, bouncing away from one another." (p.183) Relative structure of molecules in gases, liquids, solids.

Chap. 16 The Properties of Air

In science the characteristics of any material are spoken of as properties. Characteristics or properties, such as colour, odor, taste, weight or density, solubility, compressibility, and changes of state, are called <u>physical properties</u>. Air- gas, colourless, odorless, tasteless, light in weight, somewhat soluble in water. Liquefies at -190°C. Water vapour liquefies at 212°F. Experiments to show that air can be compressed, that it supports burning; experiment with burning phosphorous in inverted jar to show that only twenty-one per cent of the air supports burning.

Chap. 17 The Composition of the Air Air is a mixture of a number of different gases. The part of the air that supports burning or combustion is called <u>oxygen</u>. The part of the air that does not support combustion is called <u>nitrogen</u>. Besides these two gases, air contains about one per cent of other gases: water vapour, carbon dioxide, and a number of rare gases, argon, helium, neon.(p.199).

Experiment to prepare oxygen by heating a mixture of potassium chlorate and manganese dioxide and collecting by water displacement. Experiments to show properties of oxygen,glowing splinter bursts into flame; burning sulphur in oxygen as compared to burning it in air; iron burning in oxygen and in air.

Sulphur unites with oxygen to form a colorless gas with a suffocating odor called sulfur dioxide; similarly iron burns in air to form iron oxide. "The union of any substance with oxygen is called <u>oxidation</u>. Rapid oxidation is commonly called <u>combustion</u> or <u>burning</u>.

Physical properties of oxygen,- gas, colorless, odorless, tasteless, somewhat soluble in water; supports combustion (a <u>chemical</u> change). Over one fifth of the air is oxygen. Oxides are abundant,- as iron oxide, water.

Nitrogen of the air,- four fifths of air is nitrogen; gas, colorless, odorless, tasteless; does not unite readily with other substances; nitrogen necessary for life in the form of nitrates.

Water vapour in the air. Evaporation. "When water is warm its molecules move faster than when it is cold." (p.207). Percentage of gases in air,- oxygen 21%, nitrogen 78%, argon .93%, carbon dioxide .04%, other rare gases .03%, water vapour variable.

Rare gases of the air, - neon, helium, xenon, argon, krypton. Argon employed in the manufacture of electric light bulbs; in television, as fog penetrating lights, and in red neon signs, -Neon. Helium, - used in dirigibles and balloons; much lighter than air; obtained not from the air but from natural gas of oil wells.

Carbon dioxide of the air,- Experiments to find out whether there is much charcoal or carbon in a splinter of wood; to find whether carbon burns to form an oxide (limewater test). "When charcoal burns carbon dioxide is formed;"- gas, colorless. Experiment to show that carbon dioxide is part of our exhaled breath by blowing into limewater. The carbon dioxide cycle. Impurities

in air, as dust, bacteria, mould, spores. Chap. 18 Respiration in plants and animals Chap. 19 Water: evaporation; condensation; water cycle.

Chap. 23. Solids, rocks, minerals.

"The minerals of which rocks are formed are usually in pieces or particles of definite shape; such particles are called <u>crystals</u>." (p.304)

1. Formation of crystals when a liquid solidifies. Experiment to observe the formation of crystals when liquid sulphur solidifies.

2. Formation of crystals as a solution evaporates. Experiment to obtain crystals from a solution of copper sulphate.

3. Formation of crystals as a hot concentrated solution cools. Exp.-formation of crystals by cooling a concentrated solution of alum.

4. Formation of crystals from vapour. Example: hoar frost; limestone crystals forming stalactites and stalagmites.

Crystals formed in nature, - feldspar, quartz, mica, semi-precious stones. 34

Grade VIII

"Each element has a spectrum of its own different from all others. Iron, for example, when glowing, produces a spectrum different from that of any other element; so, too, do calcium, hydrogen, carbon, phosphorous, oxygen and the other elements on the earth....In 1868 strange lines were found in the spectrum of the sun that did not belong to any known element. This showed that in the sun there was an element not known to be on the earth. This unknown element was named helium". (pp.114-115). Chap. 16 Water as a Great Solvent

Sterilizing and disinfecting water. By boiling or by adding suitable chemicals to it.

Ground water contains substances dissolved in it. Exp. of evaporation to show how ground water differs from snow water or rain water Hard water and soft water,-"The real difference between hard water and soft water is that hard water contains dissolved minerals that prevent ordinary soap from forming good, lasting suds, while soft water has not these minerals dissolved in it." (p.210).

Hard water may be softened by addition of washing soda and borax. One kind of hardness in water may be removed by boiling. Soft water from frozen hard water. Water is

³⁴C.A.Hensley, D.A.Patterson, O.A.Armstrong, Science Indoors and Out, Book 1. W.J.Gage & Co, Toronto.

a great solvent in nature. Insoluble substances: china, porcelain, metal, glass; sand, rocks, wood, bricks, stone, dissolve very slightly; paints, varnish, grease, oils are almost insoluble. "The fact that it is very difficult to find materials that will permanently resist water serves to show more clearly how great is the solvent power of water." (p.217)

Chap. 18 The Three States of Matter Water as a solid, a liquid, and a gas. How scientists explain the change from solid to liquid to gas; the molecular theory. Change of state: solid to liquid and liquid to gas. The change from gas to liquid,condensation. Evaporation and condensation,distillation. Sublimation: "The evaporation of a solid substance directly to a gas and the condensation of this gas directly to a solid again is called sublimation."(p.235). Sublimation important in formation of <u>dry</u>

ice, carbon dioxide.

Chap. 19. Measuring Temperature by Water Changes. What temperature is;- the degree of

warmth of one object as compared to another. Practical exercise in making and graduating a Centigrade and a Fahrenheit thermometer. Details of freezing and boiling points; -40 comes at the same point on both the F. and the C. scales.

Chap. 20 The Changes in Water as it is cooled. Water contracts when it **is** cooled. Water is heavier at 4°C., 39°F., than at any other temperature. Water expands as it freezes. Ice is lighter than water. Atmospheric pressure and the barometer.

35

Grade IX

Chap. 26

Conservation of our individual efficiency. Alcohol and tobacco. Alcohol as an anaes-

³⁵C.A.Hensley, D.A.Patterson, O.A.Armstrong, <u>Science Indoors and Out</u>, Book 2. W.J.Gage & Co., Toronto. thetic, not a stimulant. Three anaesthetics,ether, alcohol, chloroform.

Contents of cigarette smoke.(p.469) Nicotine Glycol Carbon monoxide Ammonia Pyridine Formaldehyde Tobacco tars Formic acid Acrolein Furfural Saltpeter

Chap. 30 Digestion and Health

Fehling's solution as a test for sugar. Saliva converts starch to sugar. Mortar and pestle, Fig. 390. Absorption,- the process of taking food into

living cells by soaking through the living cell wall.

Fig. 397.- Apparatus to show the diffusion of a liquid through an animal membrane (osmosis).

. 36

Grade X

Unit 1 How Scientists Work The world is a rich storehouse of materials. "Chemistry is the science or knowledge of how the materials of the world are made." (p.11). "There are four important things that the scientist does with materials: (1) He discovers new materials. (2) He studies materials to find out what they are made of. (3) He finds out how to take materials apart so that he can get two or three or more materials from one kind of material. (4) He experiments with putting materials together to make new and different materials."

From black lumps of coal come the materials for many perfumes....Chemists can put limestone, water, salt and lampblack together to make plastics and synthetic rubber.

"The way scientists think and work,-(1) The scientist gets clearly in mind

³⁶C.A.Hensley, D.A.Patterson, O.A.Armstrong, <u>Science Indoors and Out, Book 3</u>.W.J.Gage & Co., Toponto. the problem he wants to solve. He sees clearly just what it is he is trying to do, or explain, or prove, or disprove.

(2) He thinks of all the possible ways of explaining the facts he has found, or of solving his problem.

(3) He chooses the explanation, or solution that looks as if it might be the correct one.

(4) He plans and tries an experiment to see if his explanation, or solution, is the correct one.

(5) If the experiment seems to show that the explanation is a good one, he tests the explanation by other experiments to be sure that the solution is correct." (p.22)

Scientists must verify or prove their results.

Scientific instruments, - telescope, microscope, spectroscope, thermometer, stethescope, X-ray, cyclotron.

Solids, liquids, gases. All materials are alike in that they have weight and occupy space.

Three important characteristics of solutions: (1) The liquid is clear; that is, the particles of the dissolved solid cannot be seen even with a compound microscope. (2) The particles are so small that they pass through filter paper. (3) The particles stay all through the liquid; they do not settle to the bottom or rise to the top even when the liquid is allowed to stand for several days. These three statements describe a solution.

Mixtures and how they differ from solutions. Solvents other than water. The molecular theory,- All kinds of matter are made up of particles called molecules; there are spaces between the molecules; the molecules are always moving. Use of the molecular theory to explain solutions.

Difference between elements and compounds. Experiment on the heating of HgO to show that it decomposes into Hg and a supporter of combustion, oxygen. A symbol is a sign standing for the element. A formula is an abbreviation of a compound.

Table 2, page 52, headed "Some Common Elements", lists twenty-eight elements with their symbols, and some of their characteristics and uses. Table 3, page 53, "Some

90

that

Common Compounds, their formula and uses" lists sixteen compounds.

The metric system as compared to the English system of measurements....lcu.ft. water weighs 62.4 lbs.

Unit 3. How Materials Change

How heating and cooling change materials. "Most solids expand when heated and contract when cooled." (p.65). Change of state: solid, liquid, gas. Melting and boiling points of some common metals, and of water: Fahrenheit and Centigrade (Table 5, p.68). Effect of heating and cooling on liquids and on gases. How the molecular theory explains change of state. How chemical change affects the characteristics of a substance, viz., wood is heated, sulfur and kron are heated together (chemical combin/ ation, iron sulfide is formed); sulfuric acid on sugar.

Chemical changes caused by light, as in a photographic filml explanation of chemical changes by the molecular theory.

2H₂ ≠ 0₂ --- 2H₂0 2Hg ≠ 0₂ --- 2Hg0 2Na ≠ Cl₂ --- 2NaCl 4Fe ≠ 30₂ ---2Fe₂0₃

Unit 4. Use and Control of Fire

Burning an example of oxidation; similar to iron rusting; transormation of chemical energy into heat energy; Lavoisier and his experiment to prove oxygen supported combustion of merwury; dangers of gasoline, benzene, Naphtha; alcohol near a fire; fire extinguishers, as carbon tetrachloride, carbon dioxide in foam extinguishers.

37 To determine what value this work had in the learning of Grade XI chemistry, it was necessary to

³⁷Wilbur L. Beauchamp, John C. Mayfield, Joe Young West, <u>Everyday Problems in Science</u>. W.J. Gage & Co., Ltd. Toronto, 1948. summarize briefly the work of the latter grade, and at the same time point out the places where the subject matter had been taught previous to Grade XI. Where the material has been covered on a closely parallel basis, merely the grade in which it was covered is listed, but where there are any marked dissimilarities in treatment, these differences are mentioned. If the context has not been taken in a previous grade, no reference is made.

Summary of Grade XI chemistry:

Energy and matter (Grade VIII), states of matter (Grade X), physical and chemical properties, (Grade VII), metric system (Grade X). Elements, mixtures, compounds (Grades VII & X). Molecular hypothesis, osmosis (Grade VII), atomic hypothesis, law of definite proportions.

Oxygen: preparation, properties, and uses (Grades VII & X); equations and formulae (Grade

X); combustion and oxidation (Grades VII & X). Hydrogen: preparation, properties, uses.

Barometric pressure and the atmosphere (Grade VIII).

Gas laws: standard temperature and pressure; Boyles' law, Charles' law.

Water and solutions: hydrates, composition by volume and weight, analysis, synthesis; purification by filtration, chlorination, distillation. (In Grade VIII water as a solvent; hard and soft waters; and methods of purification are covered).

Solutions and crystallization: solute, solvent, saturated, supersaturated; emulsion; solubility graph; standards of purity; efflorescence, deliquescence. (Solutions are well covered in Grade X, while crystallization is given in some detail in Grade VII).

Atomic theory and atomic structure; atomic weights and atomic number.

Types of chemical bonding: electrovalent, covalent, coordinate-covalent.

Chemical equations and what they mean (a very meagre introduction to chemical equations is made in Grade X).

Chemical formulae; molecular weight (introductory formulae in Grade X).

Avogadro's law.

Solving chemical problems by use of formulae and equations.

Carbon - allotropic forms, properties, uses. Oxides of carbon,-

Carbon dioxide,- preparation, properties, uses. (Grade VII studies carbon diozide and its properties).

Carbon monoxide, - preparation, properties, uses.

Fire extinguishers (Grade X)

Ionization theory.

Acids, bases, salts; preparation and examples. Types of chemical reaction, - combination, decomposition, replacement, double replacement, hydrolysis, oxidation, reduction.

Compounds of nitrogen:

Ammonia: preparation, properties, uses, compounds.

Nitric acid: preparation, properties, uses. (Slight study of atmospheric nitrogen Grade VII)

Sulfur and its compounds:-

Allotropes,- preparation, properties, uses. Hydrogen sulphide,- preparation, properties,

uses.

Sulfur dioxide,- Preparation, properties, uses. (Very elementary consideration of SO₂ in Grade VII).

Sulfuric acid, - preparation, properties, uses.

Sulfurous acid.

Chlorine, - preparation, properties, uses. Hydrochloric acid, - preparation, properties, uses.

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³⁸Charles E. Dull, William O. Brooks, H. Clark Metcal**f**e, <u>Modern Chemistry</u>. Henry Holt and Company, New York, 1951.

Chemistry Pretest, Grd. XI. Answer all questions on this sheet in the spaces provided.

 If a food, on being tested with iodine turns dark blue of black, then we know that the food contains...
 A food giving a brick-red precipitate when boiled with Fehling's solution indicates the presence of

4. All food substances contain the element...... 5. In writing up a laboratory experiment, the usual procedure is to outline the process under the headings:-

6. In what part of the body are the following minerals found,-

(2) Phosphorus.....(5) Sodium chloride

7. The two elements in water are.....and.....and.....and
and in carbon dioxide are....and....and....and
8. Give a definition for matter:

9. Name two gases that are lighter than air.....
10. Is air soluble in water ?

11. What are three forms, or states, of matter ? 12. The weights of 62 lbs., 14 ozs., and 440 lbs., represent the weights of one cubic foot of air, water, and iron, but not in that order. Match the numbers with the appropriate substance to give the correct weight. air....iron.....water.....iron...... 13. Give the properties of air, and of oxygen under the following headings: Air Oxygen State Color..... Odor..... Tastegeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee Solubility..... 14. When phosphorus is burned in a jar of air it is found that only% of the air supports co, bustion. 15. The chemical test for the presence of Carbon Dioxide is: 16. Air is a mixture of gases. Four of these gases are:-17. Oxygen may be prepared by heating..... 18. The presence of oxygen is indicated by,-19. When water is heated some of its molecules move faster and fly off into space; this is called: 20. Give a use for each of the following gases:-

21. When a hot, concentrated solutions cools, some of it solidifies or forms.....

22. Fermentation of sugary foods produces the chemical compound known as.....

23. A common anaesthetic is.....
24. Tobacco contains a poisonous chemical called....
25. During digestion food passes from the alimentary tract into the blood stream by a seepage process

called.....

28. Soda beverages "pop" when the cap is removed. What does this indicate regarding the effect of pressure on the solubility of a gas in a liquid ?

29. What are two main assumptions of the molecular theory ?

30. Give the names of ten elements whose symbols are given below:-

Al.H.N.Ca.I.O.C.Fe.K.Cl.Pb.Si.Cu.Hg.Na.3l. Name five of the compounds whose formulae are
given below,-Si.

C ₂ H ₅ OHN	2N0300000000000000000000000000000000000
CuS04	HCL 3 • • • • • • • • • • • • • • • • • •
CC14 Ci	20
NaClC	12 ^H 22 ⁰ 11
NaOH H	g0
32. The system of weights the	at is based on the kilo-
gram is called the	•••system.
33. Of water, its boiling po	int on the Fahrenheit
is, on the Centigra	ade and
its freezing point Fahrenhei	t isand Centi-
grade is	
34. Gases (and most solids).	••••••••••••••
heated and W	hen cooled.
35. By inserting the word "cl indicate which kind of change of the following,-	hemical" or "physical" e is represented by each
1. Butter melts when heated.	
2. A photographic film is exp	posed to light
3. A fire-cracker explodes wi	hen lighted
4. A piece of iron is magnet	ized
5. A silver spoon tarnishes contact with egg.	on • • • • • • • • • • • • • • • • • • •
36. Complete the following cl	hemical equations,-
(1) 2H ₂ ≠ 0 ₂	
(2) 2Hg ≠ 0 ₂	
(3) 2Na / Cl ₂	

37. Examples of three different forms of carbon are,-

38. Three methods that are commonly used in the purification of water are:-

39. Water that forms a curd or precipitate whenssoap is added is known as.....

Name......

Grade.....Age....

Sample score sheet showing how record was kept of assignments done. Figures indicate questions done wrongly.

	P.44	P. 45	P.54	P.55	Pp. 65 & 66
Barker,Z.	<u>16,25</u> ·	1,2,3,4		1,2,3	11,14,16,17, 18, 19 ,20
Bailey,S.		3		3 .	14,15,16,17, 18,20,21
<u>Clay,D.</u>	9,14,25,26	1,2,3		2,3	7, 8, 9, 10, 12, 15, 16, 17, 18, 20, 21
<u>Cole,D.</u>	8	3			5, 6, 14, 15, 16, 17, 19, 20, 21
Cowie,E.		1,2,3, 4			17,18,20
Fraser,D.	25	1,2,3,4		3	11,14,15,16, 17,18,20
Fric,L.	21,23,24, 25,26	2,3		¥	2,8,14,16,17, 18,20
Gira,F.	1	4.	13,14	2,3	4,6,7,14,15, 16,17,20
<u>Greenberg,K</u>		1,2,3,4	26	1,3	6,10,11,12,13, 15,16,17,18,20
Hag a, 0.	8			3	3,4,5,8,9,10, 11 13,16,17,18,19
Halasz,S.	25	4	24	3	11,14,15,16,17, 18,19,20
Hartman,S.		1,2,3	24	3	4,6,9,10,12,16, 17,18,20
Hayden,G.		1,2,3,4		1,2,3	3,5,6,7,8,9,10, 15,16,17,18,20
Huszti,P.	25		and a second second second second second		4, 5, 11, 17, 18
Ibbott,B.	-	2,3,4		1.2.3	3,18,20,15, 16,17
Keddie,M.		2		3	10,11,15,16, 17,18,20
Lahonen,L.		1,2,3,4		1.2.3	None of assign- ment done
Last, R.		1.2.3.4		1.2.3	None of assign- ment done
Logan,S.	n mananan an farin iyo daha dan marakar sarakari da dabaranan	1.2.3		3	3,4,8,9,11,13, 20,21
Lovecky, J.	8,9	1.2.3		1,3	1,2,7,11,14,15, 16,17,18,20,21
McIntosh.F.	26	4		7.2.2	3,4,5,6,14,15, 16,17-21
McIsaac,G.	8,10, 14,16	1.3		1.2.3	1,11,15,16, 18,20

Dale Check list of 769 easy words,-

A	В		C	
A a about above across act afraid after afternoon again again against ago air all almost alone along already also always am American an and animal another answer any anything apple are arm around as ask	B baby back bad bag ball band bank basket be bear bear bear bear bear bear bear b	both bow box boy branch brave bread break bridge bright bring broken brother brought brown build building built burn busy but butter by	C cake call came can cap captain car care careful carry case catch cause cent cause cent chair chance chair chance chief child children choose Christmas church circle city class clean clock clothes cloud	corner cost could count country churse cover cow cried cross crowd crown cry cup cut
at away	blind blood blow blue board		coal coat cold color come	
	boat body bone book born		coming company cook cool corn	
D	E	Ŀ	G	H
--	--	--	--	---
dance dark day dead dear deep did die different dinner do doctor does dog done don't door double down draw dream dress drink drive drop dry dust	each ear early earth east easy eat edge egg eight either else end England English enough even every every everything except eye	face fair fall amily far farm farm farm farm farm farm farm	game garden gate gave get gift give glad glass go God gold gold gold gold gold gold grain grass gray great green grow guess	had hair half hall hand hang happy hard has hat have he hear heard heart heard heart heart heart here herself hid high hill his hold hole home horse house how hunt hurry hurt

1	L.	M	N	0
I ice if in Indian instead into iron is it its	lady laid lake land large last late laugh lay lead learn leave left leg lesson	made mail make man mary march mark market market matter may me mean mean measure meat meet	name near neck need neighbor neither nest never new New York next nice night nine	oak ocean of off office often old on once one only open or other
J just jump	let letter lie lift light like line lion lips listen	meet men middle might mile milk mill mind mine minute miss	noise none noon nor north nose not note nothing now	out outside over own
K keep kill kind king kiss knee knew know	little live load long look lost lot loud love low	money month moon more morning most mother mouth mouth move Mr. Mrs. much music must my myself	number	

S

silk

sing

sir

sit

six

size

skin

sleep

slow

small

smoke

snow

soft

sold

some

song

soon

sound

space

speak

spread

spring

square

stand

start

station

star

stay

spot

soldier

so

sky

silver

sister

R

ran

red

roll

roof

room

rose

row

run

page paint pair paper part party pass path pay pen people pick picture piece place plain plant play please point poor post pound present press pretty pull put

Ρ

Q

quarter

queen

quick

quiet

quite

race said rain sail salt rather same reach sand read sat ready save real saw reason say school remember sea rest season rich seat ride second right see ring seed river seem road seen rock self sell send sent serve round set seven several south shake shall shape she sheep shine ship show shop short should shoulder

> show shut sick side sign

stop stick still stone stood stop store storm story straight street strike strong such sugar suit summer sun suppose sure something surprise sometime sweet

T

W

U

table tail take talk tall taste teach teacher tear tell ten than thank	took top touch town trade train tree true true try turn twelve twenty	uncle until up upon us use	wait walk wall war war war was wash wash waste water water wave	with without woman wonder wood word work world world would write wrong
that	CWO	vallev	way	
the		verv	wear	
their		visit	weather	Y
them			week	
then			well	yard
there			went	year
these			were	yellow
they thigh			west whet	yes
thin		·	what whoet	yesterday
thing			wheel	yet
think			when	you
this			where	young
those			whether	your
though			which	
thought			while	
thousand			white	
three			who	
through			whole	
throw			whom	
tie			whose	
till			why	
time			wide	
tire(d)			wild	
TO To Jam			WILL	
rocay			Win	
rogerner			W LNC window	
tomorrow			wing	
tongue			winton	
too			wish	,

M.A.	
C.A.	
M.A.	
C.A. X 100	

THE DOMINION TESTS

GROUP TEST OF LEARNING CAPACITY Advanced-grade 9 to Adult

FORM A

DO NOT OPEN THIS PAPER OR TURN IT OVER UNTIL YOU ARE TOLD TO DO SO.

Fill in the blanks below, giving your name, age, etc., and when you have done so, read the rest of this cover page. Only a short time will be given for this so you will need to work rapidly.

Name	LAST NAME	• • • • • • • • • • • • • • • • • • • •	FIRST	NAME	. Age	Years
Birthday.	MONTH	DAY	Grade. YEAR	Today'	s Date	· · · · · · · · · · · · · · · · · ·
School				Town or City	у	· · · · · · · · · · · · · · · · · · ·

Four sample questions are given below to show you what the test is like. In questions such as 1 and 2 you must in each case select the best answer from the five choices presented and write the number of your choice in the brackets following the question. Questions in which no choices are given, such as 3 and 4 below, make quite clear what you are expected to do. The sample questions have all been answered for you. The questions in the test must be answered in the same manner.

In doing this test you must work as rapidly as possible. Skip any questions which appear to be too difficult and return to them later if you have any time left. Spend your time now in studying the samples below.

1.	Which word does not belong in this list?
	1 green 2 purple 3 red 4 sweet 5 yellow \dots (4)
2.	Bird is to air as fish is to
	1 water 2 swim 3 bait 4 net 5 catch
3.	What number comes next in the following series?
	2, 4, 6, 8, 10, 12,(14)
4.	are Canada small cold in winters?
	If one word were omitted from the above the others could be rearranged to
	form a sentence. Print the \mathbf{first} letter of the word to be omitted(S)

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right, Санада 1939	DEPARTMENT OF EDUCATIONAL RESEARCH ONTARIO COLLEGE OF EDUCATION 371 BLOOR ST. WEST TORONTO 5	ŝ
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Score.....

No. 128A-25M-551

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1.	Which word does not belong in this list? 1 piano 2 harp 3 violin 4 guitar 5 cornet	
2.	What number comes next in the following series?192, 96, 48, 24,	
3.	She is to hers as I is to 1 my 2 me 3 our 4 mine 5 we)
4.	Which word does not belong in this list? 1 grouse 2 lark 3 partridge 4 pheasant 5 quail)
5.	Examination is to fail as game is to 1 fun 2 work 3 lose 4 baseball 5 play()
6.	If Mary had 7 cents more, she would have 3 times as much money as Lucy. Lucy has 5 cents. How much has Mary?)
7.	Which word does not belong in this list? 1 build 2 damage 3 strengthen 4 repair 5 improve)
8.	Canoe is to paddle as airplane is to 1 wings 2 air 3 aviator 4 propeller 5 steer 5 steer)
9.	 Which proverb means the same as the proverb, "Company in misery makes it light"? 1. Birds of a feather flock together. 2. He who is in the mud likes to pull another into it. 3. Misery acquaints men with strange bed-fellows. 4. Two in distress makes sorrow less. 5. A friend in need is a friend indeed)
10.	Picture is to frame as lake is to 1 shore 2 water 3 river 4 island 5 fish)
11.	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Find the fourth letter before the letter which comes midway between G and K in the alphabet. Print it)
12.	Equestrian is to pedestrian as ride is to 1 horse 2 gallop 3 walk 4 sit 5 saddle)
13.	Destitute persons are 1 shrewd 2 needy 3 famous 4 despised 5 wealthy)
14.	Breeze is to gale as brook is to 1 spring 2 torrent 3 wind 4 pond 5 water)
15.	When a city is sacked it is 1 pillaged 2 burned 3 evacuated 4 beleaguered 5 fortified)
	Co on to pade	2

	2	
16.	\bigcirc is to \bigtriangledown as \bigcirc is to	
	$(1) = (2) ((3) () (4) (5) = \dots (6)$.)
17.	What number comes next in the following series? 1, 3, 8, 10, 15, 17,)
18.	is to is to	
	(1) (2) (3) (4) (5) (5) ()
9.	Print the letter of the word 'INDESCRIBABLE' that is as far from the beginning of the word as it is from the beginning of the alphabet()
20.	What number comes next in the following series?1, 3, 7, 15, 31,)
21.	July is to May as September is to 1 August 2 November 3 July 4 October 5 May()
22.	What number comes next in the following series?2, 3, 5, 8, 12,)
3.	Which word does not belong in this list? 1 happiness 2 bliss 3 joy 4 rapture 5 fun)
4.	What number comes next in the following series?50, 40, 31, 23, 16, 10,)
5.	is to as \square is to	
	$(1) \qquad (2) \qquad (3) \qquad (4) \qquad (5) \qquad (5) \qquad (1) \qquad (1) \qquad (2) \qquad (3) \qquad (3) \qquad (4) \qquad (2) \qquad (5) \qquad (2) \qquad (3) \qquad (3) \qquad (3) \qquad (4) \qquad (2) \qquad (3) $)
6.	windy often season and rainy autumn are days If one word were omitted from the above, the others could be rearranged to form a sentence. Print the first letter of the word to be omitted()
7.	If 5 and 4 make 9, write 9, unless 4 and 4 make 7, in which case write 8)
8.	What number comes next in the following series?6, 10, 8, 13, 10, 16, 12,)
9.	\bigvee is to \bigvee as \bigwedge is to	
	(1) $\not $ (2) $\not $ (3) $\not $ (4) $\not $ (5) $\not $)
	Go on to page	3

A

30. home soldiers defending If one word were form a sentence. Pri

A

31. A B C D E F G H I J What letter com the word UNIVERS.

32. What number comes net 7, 5, 10, 8,

33. Land is to isthmus as 1 ocean 2 strait

34. A **candid** person is one 1 innocent 2 shrew

35. What number comes net 17, 12, 14, 9,

36. We **raze** a house by 1 tearing it down its value.....

37. What number comes nex 75, 74, 72, 68

38. Square is to cube as ci 1 circumference 2

39. To contaminate is to 1 pollute 2 germin

40. What number comes nex 54, 52, 49, 45

41. \implies is to || as \checkmark is (1) \checkmark (2) \implies

42. What number comes nex 8, 3, 8, 9, 8

43. If a boy can run 25 feet while the car travels

44. The opposite of **conven** 1 recall 2 reject

45. What number comes nex 5, 10, 12, 24,

	•
g hardest their bravery when fight re omitted from the above, the others could be rearranged to int the first letter of the word to be omitted()
K L M N O P Q R S T U V W X Y Z nes just as far after L in the alphabet as V comes before T in ALITY? Print it)
ext in the following series? 16, 14, 28,()
water is to 3 island 4 bay 5 peninsula()
who is wd 3 polite 4 friendly 5 frank()
ext in the following series? 11, 6,()
2 heating it 3 plundering it 4 building it 5 increasing)
ext in the following series? 3, 60, 44,)
ircle is to compasses 3 area 4 radius 5 sphere()
nate 3 approximate 4 slander 5 strengthen()
xt in the following series? 5, 40, 34,()
s to	
= (3) $//$ (4) $=$ (5) $//$ ()
xt in the following series? 8, 27, 8,()
t while a car travels 60 feet, how many feet can the boy run 100 yards?)
e is 3 disperse 4 acquit 5 resign()
xt in the following series? 26, 52,()
Go on to pag	e 4

—3—

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	46.	5, 26, 12, 27, 15, 9, 7, 10, 23, 1, 22, 14, 31, 17, 3. In the line above, how many odd numbers are greater than 7 and smaller than 23?()
	47.	If ten horses eat ten sacks of oats in ten days, how many days will it take one horse to eat one sack of oats?()
	48.	What number comes next in the following series? 68, 34, 44, 22, 32, 16, 26, 13,	.)
	49.	Dick stands at the head of the class and Jack at the foot. Bill stands somewhere between Dick and Jack, Tom between Dick and Bill, and Harry between Dick and Tom. The middle boy is 1 Dick 2 Jack 3 Bill 4 Tom 5 Harry)
	50.	Except for one letter the letters of the word 'TRIFLED' follow one another in the word in the opposite order to that in which they occur in the alphabet. Print this letter. ()
	51.	A gullible person is easily 1 satisfied 2 offended 3 deceived 4 taught 5 frightened)
ang ting begin series in the series of the series of the series from	52.	Lend is to borrow as rich is to 1 wealthy 2 poor 3 money 4 poverty 5 beg)
- "admitis - ann ann d' - Maanaa ag	53.	Which word does not belong in this list? 1 me 2 us 3 him 4 she 5 them	.)
a a stadi da su	54.	A char-à-banc is a 1 riot 2 vehicle 3 confection 4 decoration 5 flower)
	55.	I gave Tom half my money, and a dollar and a half besides. I have 4 dollars left. How many dollars had I in the beginning?()
	56.	A contrite person is 1 reluctant 2 repentant 3 serious 4 dependable 5 insidious()
	57.	most to salaries a men living work earn must If one word were omitted from above, the others could be rearranged to form a sentence. Print the first letter of the word to be omitted)
	58.	Impromptu means the same as1 expedient2 speech3 prompted4 tardy5 extempore)
	59.	A clock which loses two minutes a day shows the correct time at 9 a.m. How many seconds slow will it be by 5 p.m. of the same day?()
	60.	Pecuniary matters refer to 1 money 2 ability 3 law 4 humour 5 manner()
and the second se	61.	form creeks build to logs dams across beavers ponds If one word were omitted from the above, the others could be rearranged to form a sentence. Print the first letter of the word to be omitted()

A

Go on to page 5

A

62.	Grotesque means the same as 1 fantastic 2 solemn 3 huge 4 horrible 5 wicked(
63.	A man stands some distance from a high cliff, and on shouting hears the echo after 5 seconds. If sound travels 1100 feet a second, how many feet is the man from the cliff?
64.	Taciturn persons are1 inquisitive2 villainous3 eminent4 haughty5 reticent
65.	It was 2.45 by Tom's watch when he left home to go to the post office. While at the office he corrected his watch by setting it forward from 3.13 to 3.21. It was 3.39 by his watch when he arrived home. How many minutes was he away?(
66.	is to is to
	(1) (2) (3) (4) (5) (5) (5) (6)
67.	Which of the following is a piscatorial activity? 1 farming 2 fishing 3 reading 4 hunting 5 sleeping
68.	If in the army there is one officer for 15 privates, how many officers are there in a corps consisting of 1200 officers and privates?
69.	Respite means the same as 1 hatred 2 protection 3 delay 4 release 5 injury(
70.	If Jack and Don together weigh 260 pounds and Don is 20 pounds heavier than Jack, how many pounds does Don weigh?
71.	The sum of my marks in Algebra and French was 124. I was poorer than George in Algebra by 3 marks, although I got 4 more marks in Algebra than in French. What was George's mark in Algebra?
72.	To requite is to 1 acquit 2 desert 3 silence 4 reward 5 admire(
73.	What number is 3 less than what 4 is 3 less than one-third of?(
74.	I am half as old again as my brother, who is 10 years younger than I am. What is my age in years?(
75.	A bag of marbles is divided among a group of boys in such a manner that Bill gets exactly three times as many as each of the others. If his share is one-fourth of all the marbles, how many boys are in the group?(
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NUMERICAL ABILITY

FORM A

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET, print your name, address, and other requested information in the proper spaces.

In the space after Form, print an A.

Then wait for further instructions.

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Mark your answers on the separate **Answer Sheet**

DIRECTIONS

This test consists of forty numerical problems. Next to each problem there are five answers. You are to pick out the correct answer and fill in the space under its letter on the separate Answer Sheet.

30

20

EXAMPLE X

EXAMPLE Y

Subtract

SAMPLE OF ANSWER SHEET

С D ٤

ii

ii

Add	13	Α	14
	12	в	25
		С	16
		D	59
		Ε	none of these

In Example X, 25 is the correct answer, so the space under the letter for 25—B—has been filled in.

In Example Y, the correct answer has not been given, so the space under the letter for "none of these"—E—has been blackened.

A B C D

Ē

15

26

16

8

none of these

Each answer must be reduced to its simplest terms. For example, if two choices are $1\frac{1}{2}$ and $1\frac{2}{4}$, only the $1\frac{1}{2}$ is correct.

DO ALL YOUR FIGURING IN THE SPACE PROVIDED ON THE ANSWER SHEET.

1. Add 393 4658 3790 67	ANSWER A 7908 B 8608 C 8898 D 8908 E none of these	6. Multiply .025 .025	Answer A .001375 B .00625 C .625 D 1.375 E none of these	11. Divide 64.7)304.09	ANSWER A .47 B 4.07 C 4.7 D 47 E none of these
2. Subtract 5473 2987	A 2485 B 2486 C 2496 D 3486 E none of these	7. Multiply .016 .016	A 256 B 25.6 C .00256 D .000256 E none of these	12. Divide .04)4.036	A 1.009 B 10.9 C 10.09 D 100.9 E none of these
3. Multiply 484 25	A 10900 B 11100 C 11900 D 11700 E none of these	8. Divide 46)69	A 1 13/46 B 1 23/46 C 1.5 D 15 E none of these	$\frac{1}{4} \div \frac{1}{8} =$	A $\frac{1}{32}$ B $\frac{1}{8}$ C $\frac{1}{2}$ D 2 E none of these
4. Multiply 2.04 .75	A 1.5300 B 153.0 C 1530 D 15300 E none of these	9. Divide .75)2.25	A .0003 B .03 C .3 D 3 E none of these	14. $\frac{2}{7} \times \frac{3}{7} =$	A 6/49 B 3/7 C 2/3 D 6/7 E none of these
5. Multiply 4.50 22	A .99 B 98.40 C 99.00 D 9900 E none of these	10. Divide 3.6).72	A .02 B .2 C 2 D 20 E none of these	$\frac{3 \times 10}{5 \times 9} =$	A 27/50 B 1 1/2 C 30/45 D 2/3 E none of these

BOTTLES

в С D E

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XII

16. Add	Ai	NSWER	25.	A	NSWER	33. Cube root	Answer
$ \begin{array}{r} 4 & \frac{3}{4} \\ 9 & \frac{1}{2} \\ 13 & \frac{7}{8} \end{array} $	A B C D E	26 11/14 27 1/8 28 1/2 28 11/14 none of these	15 = 75% of ?	A B C D E	.20 10.25 20 22.5 none of these	$\sqrt[3]{rac{1}{8} imesrac{125}{64}}$	A 5/8 B 375/512 C 2 1/2 D 15 5/8 E none of these
17. Add 2 ft. 3 in. 28 ft. 11 ¹ / ₂ in. 17 ft. 5 in. 4 ¹ / ₂ in.	A B C D E	49 ft. 48 ft. 2 in. 47 ft. 24 in. 48 ft. none of these	26. 25 = ? % of 125	A B C D E	1/5 5 20 31.25 none of these	34. List price = \$75.00 Discounts = $33\frac{1}{3}\%$; 2% Net price=\$?	A 25 B 48.50 C 49.50 D 50 E none of these
18. Add 3 lbs. 3 oz. 6 lbs. 7 oz. 7 lbs. 5 oz. 11 lbs. 1 oz.	A B C D E	28 lbs. 16 oz. 28 lbs. 27 lbs. 16 oz. 18 lbs. none of these	27. 2.5 = ? % of 2	A B C D E	5 8 80 125 none of these	35. What one num both question m $\frac{2}{?} = \frac{?}{50}$	aber can replace arks? A 1 B 10 C 25 D 100 E none of these
 19. Square root √169 20. Square root 	A B C D E A	13 43 84 ¹ / ₂ 169 none of these .03	$\frac{28}{8} = \frac{3}{24}$	A B C D E	1/8 1 3 4 none of these	36. What one num both question m $\frac{1}{?} = \frac{?}{36}$	arks? A 6 B 12 C 35 D 36 E none of these
$\sqrt{.09}$ 21. Square root $\sqrt{\frac{4}{2} \times \frac{25}{77}}$	BCDE ABC	.3 3 9 none of these ²⁵ / ₈₁ ²⁵ / ₃₆ 5/ ₉	29. $\frac{5}{9} = \frac{55}{?}$	A B C D E	^{55/99} 11 45 99 none of these	37. What one numboth question m $\frac{4}{?} = \frac{?}{100}$	arks? A 1 B 20 C 25 D 200 E none of these
v 9 36 22. ? = $33\frac{1}{3}$ % of 963	DE ABCDE	2 7/9 none of these 32.19 231 321 32100 none of these	30. $\frac{11}{4} = \frac{77}{?}$	A B C D E	^{77/₂₈ 28 44 308 none of these}	38. What one num both question m $\frac{8}{?} = \frac{?}{12 \frac{1}{2}}$	arks? A 1 ¹ / ₂ B 4 C 64 D 100 E none of these
23. ? = $12\frac{1}{2}\%$ of 816	A B C D E	.12 12 102 104 none of these	31. Cube root $\sqrt[3]{32 \times 2}$	A B C D E	4 8 21 ¹ / ₃ 192 none of these	39. What one numboth question m $\frac{6.25}{?} = \frac{?}{16}$	arks? A 4 B 10 C 16 D 50 E none of these
24. ? = $\frac{4}{9}$ of 648	A B C D E	14.58 72 218 1458 none of these	32. Cube root $\sqrt[3]{.000729}$	A B C D E	.000243 .009 .027 .09 none of these	$\begin{array}{l} 40.\\ \frac{9\!+\!1\!\times\!6\!-\!3}{4\!+\!2\!\times\!7\!-\!6} = \end{array}$	A 57/50 B 1 7/12 C 1 D 57/36 E none of these



ABSTRACT REASONING

FORM A

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET, print your name, address, and other requested information in the proper spaces.

In the space after Form, print an A.

Then wait for further instructions.

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ABSTRACT REASONING

Mark your answers on the separate **Answer Sheet**

DIRECTIONS

In this test you will see rows of designs or figures like those on this page. Each row is a problem. You are to mark your answers on a separate Answer Sheet as shown in the samples below.

Each row consists of four figures called Problem Figures and five called Answer Figures. The four Problem Figures make a series. You are to find out which one of the Answer Figures would be the next, or the fifth one in the series.

EXAMPLE X

PROBLEM FIGURES





ANSWER FIGURES

Note that the lines in the Problem Figures are falling down. In the first square the line stands straight up, and as you go from square to square the line falls more and more to the right. In the fifth square the line would be lying flat. So the answer is D, which is indicated on your Answer Sheet Ē by filling in the little space below D, like this li ä

EXAMPLE Y



Study the position of the black dot. Note that it keeps moving around the square clockwise: upper left corner, upper right corner, lower right corner, lower left corner. In what position will it be seen next? It will come back to the upper left corner. Therefore, B is the answer, and you would mark your Answer Sheet like this i ii ii

Remember-You are to select the one figure from among the Answer Figures which belongs next in the series.

DO NOT TURN OVER THE BOOKLET UNTIL YOU ARE TOLD TO DO SO.











PROBLEM FIGURES

ANSWER FIGURES

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Supervision Median NEW EDITION Median By H. A. GREENE Median Director, Bureau of Educational Research and Service, University of Iowa Median A. N. JORGENSEN Grade President, University of Connecticut Grade and V. H. KELLEY Diversity Appointment Office, University of Arizona, Tucson, Arizona					
	NCED TEST: FORM AM (Revised)				
eDate Date Boy Girl ol					
TT STAND	Score, TEST Median				
IEST SCORE	Scale 1R 1C 2 3 4 5 6 7A 7B Score				
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Comprehension: A + B					
Directed Reading					
Poetry Comprehension					
Word Meaning					
ientence Meaning	$- \begin{vmatrix} 170 \\ 160 \\ 100 \\ 100 \\ 100 \\ 100 \\ 100 \\ 100 \\ 100 \\ $				
aragraph Comprehension					
A. Use of Index					
B. Selection of Key Words	$\begin{bmatrix} 130 + + + + + + + + + + + + + + + + + + +$				
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TEST 1. RATE-COMPREHENSION - PART A

DIRECTIONS. This is a test to see how well and how rapidly you can read silently. Read the story below very car so that you can answer questions about it.

At the end of one minute you will hear the word "Stop." Put a circle around the word you are then reading wait for further instructions.

GLASS

¹ Glass is made by melting sand with lime, potash, soda, or oxide of lead at a great heat. ² Silica, which is the basis of sand, enters into all varieties of glass. ³ It has more to do with determining the quality than any of the other ingredients. ⁴ The purity of the ingredients and the proportion in which they are mixed also have much to do with the quality of the glass.

⁵ Sand may be said to form the basis of the glass. ⁶ Consequently the clearness of the glass depends largely upon the quality of this ingredient. ⁷ The proportion of silica varies in different kinds of glass. ⁸ In lead glass it is from 42 to 60 per cent; plate contains about 79 per cent, and window glass about 70 per cent. ⁹ The amount of silica usually determines the degree of hardness, though other substances have some effect upon this quality. ¹⁰ Lead tends to make glass soft. ¹¹ Sometimes lime is used to make it hard.

¹² Nearly all the silica used in the glass factories within the last fifty years is in the form of sand. ¹³ Prior to that the best qualities of glass were produced by crushing and washing flint and quartz rock. ¹⁴ This process was so expen-

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sive that it made the glass too costly for general. ¹⁵ Bohemian and a few other varieties of European gla still made from silica obtained in this way. ¹⁶ The ex of Bohemian glass in this country restricts it to the h of wealthy people.

¹⁷ In the manufacture of glass of high grade, the qu and purity of sand are of the greatest importance. ¹ most searching examination and careful tests are ma determine the nature and extent of any impurities u the sand may contain. ¹⁹ These impurities are comm oxide of iron (iron rust), alumina in the form of clay, gravel, and decaying animal or vegetable matter. ²⁰ of these impurities except iron can be removed by bu and washing. ²¹ Oxide of iron can be removed only b use of chemicals. ²² Iron is the most troublesome because it discolors the glass and destroys its transpar ²³ For the best qualities of glass it must be entirely free iron. ²⁴ A proportion greater than one half of one per renders the sand worthless for even the poorest qual glass.

Wait for further directions. Do not answer any of the questions until you are told to do so.

• •	urity in sand which most seriously affects the clearness of glass is — I vegetable matter 2 clay 3 oxide of iron
6	I foreigners 2 wealthy people is everyone.
8	use in making glass must not contain more iron than — I one half of one per cent 2 one per cent 3 five per cent
7	ocess in the manufacture of glass formerly made it too expensive for general use? I purifying the silica 2 obtaining silica from quartz 3 melting silica
ه ۵	f source of the silics used in making glass in the United States is — A flint 2 sand 3 quartz rock
g	ron oxide removed from the sand used for making glass? I burning 2 washing 3 using chemicals
	factor in the manufacture of glass which most affects the quality of the product is — I the silica used 2 the melting process 3 the amount of lead used
6	nd of glass contains the greatest proportion of silica? I window glass 2 lead glass 3 plate glass
⁸	ocess is always used in the manufacture of glass? I melting silica 2 crushing quartz 3 compressing sand
<u> </u>	:termines the transparency of the glass? I amount of lead 2 quality of sand 3 proportion of sand
	hat is said to be the basis of sand? I soda 2 silica 3 lead
of this correct orrectly.	his work. question and the answers given below it. Select the correct answer. Notice the number the answer spaces at the right fill the space under this number. The sample is answered c

TEST 1. RATE-COMPREHENSION - PART B

ECTIONS. Read this story very carefully so that you can answer questions about it. When you hear the word op," put a circle around the word you are then reading and wait for further instructions.

ATTEMPTS TO INCREASE CITIZEN CONTROL

The government of the United States is merely the icy by which the people protect their own rights and rties. ² Our government may be said to be the organized of all the people. ³ The people govern in this country. e men and the means by which they govern, all comd, are the government.

Public officers are not masters, but servants. ⁶ The ident, Senators, Congressmen, and judges in the nation, governors, senators, and members of the legislatures he states, are only agents or servants of the people to y out the people's will. ⁷ The power of government not rest in Washington, the capital of the nation, nor he capitals of the different states. ⁸ Governmental er exists all over these United States. .⁹ In fact, the er of government exists right in the homes and hearts he people.

The President has no power except that conferred upon by the Constitution and the laws which the people adopted. ¹¹ Neither have the Senators, the Congress-, nor the judges any power except that given by the le, and the people at any time can take away any part e power given. ¹² By people, of course, is meant all the le. ¹³ Not that all the people must agree to any law to it enacted. ¹⁴ The majority of the people make the , as a rule. ¹⁵ This fact will be taken up and considered completely later, in connection with the initiaand referendum. ¹⁶ Government is power to exercise ority. ¹⁷ Authority is in the people, and the authority e people is expressed as they want it in laws which they e.

The problem of particular interest here is that of atpting to prevent abuses of public office, and of still her increasing citizen control. ¹⁹ Early in the history ir government the system of appointing men to office use they had rendered some special party service lted in a great many abuses. ²⁰ These abuses are gradually being corrected through a better system of appointment, known as Civil Service Reform. ²¹ Under civil service people who wish to be considered for a particular position must give evidence of their ability to fill the position satisfactorily by passing an examination designed to test their qualifications for the service demanded. ²² This method of appointment has a tendency to procure more competent public officials.

²³ One of the devices to secure more direct self-government or citizen control is known as the initiative. ²⁴ This plan permits any person or group of persons to draft a proposal for a law. ²⁵ If the signatures of a certain percentage of the voters are secured, this proposal is then submitted to all the voters for their approval or disapproval, which they express by voting "Yes" or "No." ²⁶ If approved by a majority vote, the proposed measure becomes a law.

²⁷ The referendum, as the word suggests, means a referring of something to the people. ²⁸ Before most of the state constitutions were adopted, they were referred to the people. ²⁹ In a similar manner, amendments to state constitutions are referred to the people for adoption or rejection. ³⁰ The referendum, therefore, is not an entirely new idea. ³¹ As applied in some states, the referendum provides a plan whereby a measure passed by the legislature must be submitted at the next election to the vote of the people, provided a certain percentage of the voters petition that this be done.

³² The recall provides a way to remove a man from office if the voters decide he has failed to give satisfactory service.
³³ Under this plan, whenever a certain number of voters are dissatisfied with the conduct of an elective officer, they can get up a petition against him. ³⁴ This will compel a new election; and, if the officer then fails to be elected, he loses his office.

Wait for further directions. Do not turn this page until you are told to do so.

$\begin{array}{c} \begin{array}{c} \begin{array}{c} R_{ATE:} \ A + B \\ \hline Standard \ Score \end{array} \hline \begin{array}{c} 0 \\ \hline 79 \end{array} \\ \hline 81 \end{array} \\ \hline 84 \end{array} \\ \hline 86 \end{array} \\ \hline 88 \end{array} \\ \hline 91 \end{array} \\ \hline 81 \end{array} \\ \hline 84 \end{array} \\ \hline 86 \end{array} \\ \hline 88 \end{array} \\ \hline 91 \end{array} \\ \hline 93 \end{array} \\ \hline 95 \end{array} \\ \hline 98 \end{array} \\ \hline 100 \end{array} \\ \hline 101 \end{array} \\ \hline 110 \end{array} \\ \hline 111 \end{array} \\ \hline 1110 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111$ \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 11111 \end{array} \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 1111 \\ \hline 1111 \end{array} \\ \hline 1111 \end{array} \\ \hline 1111 \\ \hline 11111 \\ \hline 1111 \\ \hline 11111 \\ \hline 111111111 \end{array} \\ \\ \hline 11111 \\ \hline 111111 \\ \hline 1111 \\ \hline 1111 \\ \hline 1111

PART B. SELECTION OF KEY WORDS

CTIONS. This is a test of your ability to choose key words for use in looking up information in an index. Study ample. Read each question and note that four numbered words or phrases are given below it. Three of these s or phrases would, if looked up in an index, be likely to lead to an answer to the question. One of the numbered would not help in locating the information. Locate this one word or phrase, the one that would not help, and note mber. Then fill in the answer space at the right of the exercise which has the same number as the word or phrase h you chose. The sample is answered correctly. LE. What is the value of our annual corn crop? 4 sweet corn 1 crops 2 wheat 3 corn 1 2 Vhat is the value of our annual supply of dairy products? 2 cream 3 wool 1 butter 1 .2 Vhen was the first transcontinental railroad completed in the United States? 1 United States 2 travel 3 railroads 1 2 Vas Lafayette the leader of the "Committee of Public Safety" during the "Reign of Terror"? 1 2 Vas Hindenburg the commander of the Allied Armies during the World War? 2 Allied Armies 1 Hindenburg 1 9 What was the loss to the citrus fruit industry caused by insects in 1937-1938? 1 production 2 oranges 1 2 Vas Longfellow the author of "The Courtship of Miles Standish"? 1 American literature 2 poem 3 Longfellow 1 2 s the metallic element called "radium" obtained solely from pitchblende, a uranium mineral? 1 2 Iow does the United States rank with other countries in the production of rubber? 1 United States 2 rubber 3 tire industry 2 1 What was the character of the literature of New England throughout the Colonial Period? 1 literature 2 Colonial writers 2 1) id the Cabinet system of England begin with Queen Victoria? 3 English Cabinet 1 Cabinet 2 Reign of Queen Victoria 16-2 Iow does the United States rank with the more important European countries in the production of wool? 1 woolens 2 imports 3 sheep 2 Nas the "Golden Age" of Rome during the period of Hadrian? 4 "Golden Age".....12 2 Roman culture 3 Hadrian 1 period 2 1 Was the Boy Scouts of America the first national organization for boys? 1 national organizations 2 Boy Scouts 3 leaders 1 2 Was General Wolfe in command of the French at the battle of Quebec? 3 French and Indian War 4 battle of Quebec.....14 1 General Wolfe 2 battle 2 1 is the North Pole surrounded by land or water? 2 North Pole 3 arctic regions 1 water 2 1 What one factor contributes most to the present death rate in the United States? 2 accidents 1 death rate 2 1 Was Aristotle known principally as a philosopher of early Roman culture? 3 philosophy 4 Roman philosophy......17 1 Aristotle 2 literature 1 2 What effect did the mosquitoes have on the development of the Panama Canal? 1 Panama Canal 2 mosquitoes 2 1 Was Garfield the fifth President of the United States? 1 government 2 Garfield 3 American politics 1 2 Has the Socialist party generally followed the policy of closed shops and government ownership? 1 government ownership 2 Socialistic policies 3 closed shops

Stop here. Wait for further instructions.

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TEST 1. RATE-COMPREHENSION - PART B (Cont'd)

DIRECTIONS. Without looking again at the article, answer these questions. Study these statements carefully. Decide whether, in terms of the article, a statement is true, false, or not discussed. If, according to the article, the tatement is true, fill in the answer space under T (for true); if false, fill in the space under F (for false). If a statement is not discussed in the article (even though true or false in itself), fill in the space under N (for not discussed). The sample is answered correctly.

	To the United Castor the real summer of all the state of
	In the United States the real source of all governmental authority is in the people themselves
	The agency for the exercise of the authority delegated by the people is called politics.
	In a democratic nation a public officer is actually the servant of the people who elect him
	In order for a law to be enacted it must be approved by the Supreme Court
	The control of government in the American system is in Congress
	Citizens, by their votes, may delegate authority to officers but have no power to
•	Judges have no authority except that specifically granted each judge by the President
	Men are frequently appointed to government office because of some special party service they have rendered.
	A voter is entitled to vote as he pleases
	Ambassadors are appointed from Civil Service lists
	According to this article the Civil Service system has corrected abuses connected with political appointments
	4⇒
	All laws passed by Congress are automatically referred to the people
	The Dred Scott Decision was a famous court ruling
	Under the Constitution of the United States the only persons who can draft a proposal for a law are Congressmen
	Government control is centered in the hands of the state and national officers
	Civil Service examinations are open only to voters from the party in control at the time
	A proposed measure when referred to the voters becomes a law if approved by a majority
	An officer who is recalled loses his office even though the voters
	The Federal income tax provides money for the support of the national government.
	Under Civil Service rules an appointment to public office is determined by the man's qualifications.
	The initiative is a privilege which may be used only by a government officer.
	The way to remove an unsatisfactory official from office is by means of a petition signed by a number of voters.
	The appointment of men to government office as rewards for political service is called the Spoils System.
	The power of government in a democracy is delegated unreservedly to one man.
	Many state constitutions were referred to the people before they were adopted.
	Do not turn this page until you are told to do so.

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TEST 7. LOCATION OF INFORMATION

PART A.

Iowa Silent Reading : New Ed. : Adv. : Am

USE OF T	HE INDEX					5	
in Column 2 question and er the proper	Samples.						
er among the ad fill in the ed the same.	 A. On what page will you find information about coal in Indiana? 1 85 2 88 3 145 4 146 5 159A 	1	2 	3	4 	5 	
to answer	B. Can you find information about the schools of Denmark? 1 Yes 2 No. B	1	2		••		
r "Indiana" eference, 145. he question;	1. Next to what page can you find a map of Alaska? 1 129 2 147 3 197 4 210 5 2131		2	3 	4	5 	
he answer in ed. ay.	 Does the index tell where to find information about the industrial uses of corn? 1 Yes 2 No	1	2 				
	3. On what page can a definition of citizenship be found? 1 18 2 20 3 22 4 24 5 26 3		2	8 ·	4 	5 	
pmmerce, 214, ests, 210–212; facing 197. ponsibility of,	4. Under what topic can you find additional references to gas? 1 cattle 2 coal 3 fuel 4 petroleum 5 power4	1	2	8]]	4	5 	
ids of, 9–18;		••	••		**	**	
a, 31–43; and cation, 65–66; organization	5. What is the number of the figure which shows some- thing about the export of corn from the United States? 1 182 2 185 3 187 4 189 5 1905	1 	2 	8 []	4 	5 	
States exports es of, 189.	 6. Under what entry does the index refer you to additional information about railroads? 1 American 2 freight cars 3 tracks 4 transportation 5 United States 	1 !!	2 !!	3 	4	5 	
2–183; states			- 11		11		
11 (Fig. 262), esources, 181–	 about tobacco as a cause of nervousness? 1 312 2 363 3 385 4 386 5 4007 	1 	2 	3 	4 	Б []	
3–155; coch- 50; dyewoods 5, 155; recent r natural, 153,	8. What is the number of the chart showing recent changes in the value of dye products? 1 11 2 12 3 15 4 20 5 22 8	1 	2	8 	4 	5 	
58. See also	9. Does the index tell you on what page you can find something about flour? 1 Yes 2 No		:: 2 	**	**	::	
<i>dso</i> Power. ; wheat, 85. l defects, 310; L. 313; from	 10. On what page would you learn about the insects which injure wheat? 1 43 2 48 3 50 4 51 5 56 	1 	2 	8 	4 	б ·	
-222; east of illes in United 39. See also	 In On how many pages is a continuous discussion given about the Grand Canal of Venice? 1 1 2 2 3 3 4 4 5 5	1	2	8	4	5]]	
juries of, 365; n, 363–386. c Ocean, 396;	 12. Information about the admission of Texas to the Union is given on what page? 1 310 2 312 3 315 4 317 5 31812 	1 	2	3]]	4]]	5 	
anufacturing,	13. On how many different pages are brief references given to the commerce of Denmark?	1	2	3	4	5	
world's bread	1 2 3 3 4 4 5 5		2 	3]]	4 	5 	
1	 15. Under what other word would you look for further information about dairy products? 1 cattle 2 corn 3 cows 4 Denmark 5 Texas	1	2	3 []	4 :::	.5 []	
$\frac{10}{175} \frac{11}{181} \frac{12}{187} \frac{13}{193} \frac{14}{202}$	Do not turn this page until you are told to do so.				**		

CTIONS. The answers to the questions ound in the index below. First read the find the desired answer by looking unde in the index. Then locate your answe ole answers given with the question ar er space in the margin which is number idy the samples carefully before you th uestions.

ok at Sample A. In the index under vill find the word "coal" and the page re s third among the answers given with t e third answer space has been filled in. ok at Sample B. See if you can find the

idex. The correct answer space is mark swer the remaining exercises the same w

INDEX

a: agricultural possibilities, 213, 214; co ; exports, 214 (Fig. 147); fisheries and fore farms, 210; imports, 214; map (Fig. 129), nship: defined, 24; boys and girls, 26; res 84-85; duties of, 29-30, 49-59. See also A unities: definition, see Community; kir in of, 11-12; growth of, 12-20; large and peration of, 19–20, 42, 49, 113; and health protection of life and property, 45; and edu beauty, 72-85; money for expenses, 87-98 39-111; dependent upon each other, 139. in America, 187; Argentina, 282; United ; 190), 282-284; plant, 187; industrial use s: city, 108–110; county, 125; state, 120–1 -268. 2

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na: coal, 145; corn, 44; hogs, 88; oil, 159 ousness: 385; and school life, 308; physical ventable, 311; causes of, 312; habit, 31 acco, 363.

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t: fertilizers for, 48; insects injurious to, 51; paration of seed bed, 55; when to sow, 57; in, 52; wheat diseases, 59.

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TEST 2. DIRECTED READING

ECTIONS. A story is given below, with each sentence numbered. These numbers are to help you answer quess about the story. Read each question and find the sentence in the story which answers it. Notice the number his sentence. Find this number among the answer spaces at the right of the question and fill in the space under it. ook at the sample below. Space No. 1 is filled because the question in the sample is answered in sentence No. 1 he article. Answer the other questions in a similar manne

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ou will have three minutes for this work. You may reread

RUBBER

Rubber is a substance composed of carbon and hydroobtained from a milky liquid known as latex. ² Latex es from the roots, stems, branches, leaves, and fruit wide variety of trees. ³ For the most part these trees 7 in the tropics. ⁴ The milky juice is not the true sap. a secretion which does not seem to be essential to the of the plant. ⁵ If this liquid is allowed to stand for a nours, the particles of rubber rise to the surface. ⁶ The thy mass thus obtained can easily be rolled into a sheet ther convenient form. ⁷ When allowed to dry, it loses loughy character and becomes the firm, elastic solid vn as raw or crude rubber.

in whatever form the crude rubber comes to the fac-, the first thing that must be done is to clean it thorly and test it, as rubber varies greatly in composition. Intil it is used it is stored in a cool, dark place, usually rground. ¹⁰ When a load is brought to the manufacg plant, the first step is to steam it into a soft, plastic

1. ¹¹ It is then thoroughly washed by being passed 1gh heavy rollers while water is sprinkled on from e. ¹² Finally it comes out looking like a thin piece of sponge. ¹³ Vacuum driers take this spongy sheet extract every particle of moisture.

Next it is put into mills which rub and crush it until es its elasticity and becomes soft and plastic like putty. this form it is ready for the mixing room, where suland other ingredients are added to it. ¹⁶ Each rubber uct has a special requirement which must be taken into unt in the preparation. ¹⁷ For some articles the subce must be hard, for others soft; some must stand sion, others heat. ¹⁸ Some will come in contact with others must stand continuous pounding, and still rs a steady pressure. ¹⁹ Each ingredient is weighed painstaking care. ²⁰ Then the mixture is rolled een hot rollers, from which it emerges a sheet of pre-1 rubber about a quarter of an inch in thickness.

The rubber is then ready for the products factory. ter the articles have been fashioned, they are vul-²³ That is, the rubber is cured by the use of heat. æd. e hardness of the article is determined by the amount at and the length of time it is applied.

ner .d	parts of the story if you need to do so.	
Sai	IPLE. In which sentence does the article tell what rubber is made from?	
1.	From what part of the plant is the liquid obtained from which rubber is made?	
2.	Does the removal of the liquid kill the plant?2	
3.	In what parts of the earth do rubber-producing plants grow?	2 3
4.	What happens if the juice of the rubber tree is allowed to stand undisturbed for a time?	4 5
5.	What is the first step in the treatment of the raw rubber at the factory?	6 7
6.	What causes the doughy mass taken from the top of the latex to become firm and elastic?	6 7
7.	Where is crude rubber kept before it is taken to the manufacturing plant?7	8 9
8.	How are rollers used in washing the plastic rubber?s	
9.	Why is steam applied to the crude rubber?9	
0.	What appearance does the rubber have after being washed?10	10 11
	5 🖚	
1.	What is done to change the crude rubber into a putty- like mass?11	
2.	How is the water removed from the sheet rubber?12	
3.	Where is sulphur added to the raw rubber?13	
4.	Are different processes required for rubber which is to be used for special purposes?14	14 15
4. 5.	Are different processes required for rubber which is to be used for special purposes?	14 15 15 16
4. 5. 6.	Are different processes required for rubber which is to be used for special purposes?	14 15 15 16 18 19
4. 5. 6. 7.	Are different processes required for rubber which is to be used for special purposes?	14 15 15 16 18 19 18 19 18 19 18 19 18 19 18 19 18 19 18 19 18 19
4. 5. 6. 7. 8.	Are different processes required for rubber which is to be used for special purposes?	14 15 15 16 15 16 18 19 19 20 20 21
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4. 5. 6. 7. 8. 9.	Are different processes required for rubber which is to be used for special purposes?	14 15 15 16 18 19 18 19 20 21 20 21 11 11 12 20 20 21 11 11

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TEST 3. POETRY COMPREHENSION

TIONS. This is a test of your ability to read and interpret poetry. Read the poem below very carefully attempting to answer any of the questions about it.

ice that in this selection certain passages are marked by numbered brackets. Read each question and find the eted passage which contains the best answer to the question. Answer the question by filling in the answer space end of the question which has the same number as the bracketed passage which contains the correct answer. 1 may reread parts of the poem if necessary. 2 sample is answered correctly.

, entrifier to many encode controlling.

E. To whom is the poet addressing his discourse?.....

Wisdom

sons of men, with just regard attend, pserve the preacher, and believe the friend, hose serious Muse inspires him to explain, nat all we act, and all we think is vain, at in this pilgrimage of seventy years, ver rocks of perils, and through vales of tears, estined to march, our doubtful steps we tend, red with toil, yet fearful to its end. nat from our birth, we take our fatal shares follies, passions, labors, tumults, cares; id at approach of death we shall only know e truths, which from these pensive numbers flow. hat we pursue false joy, and suffer real woe. it O! ere yet original man was made, e the foundations of this earth were laid, was opponent to our search, ordained, at joy, still sought, should never be attained; is sad experience cites me to reveal, ld what I dictate is from what I feel, orn as I was, great David's favorite son, ear to my people, on the Hebrew throne; blime my court with Ophir's treasures blessed, y name extended to the farthest east, y body clothed with every outward grace, rength in my limbs, and beauty in my face, y shining thought with fruitful notions crowned, lick my invention, and my judgment sound. ise, (I communed with myself) arise; ink, to be happy; to be great, be wise; intent of spirit must from science flow. r 'tis a godlike attribute to know.

1. Are we all asked to believe the explanation given here? 3. What does the speaker say about all that we do and 6. Do people ever await the end of life with fear?.....6 9. What will we come to realize as we near the end?...9 10. At what time in history was it decreed that happiness should never be realized?.....10 6₽ 11. What does the poet say is the object of what we call 12. Over what race was Solomon a ruler?12 13. Is Solomon's father mentioned in this poem?.....13 14. Did Solomon know how well his people liked him?.14 15. Was Solomon widely known in the Orient?.....15 16. What indication is there that Solomon was 17. Did Solomon have a strong and healthy body? 18. What did Solomon say to himself when reviewing all that was given to him?.....18 19. Where does he say spiritual contentment 20. What did Solomon say about knowledge?.....20 Do not turn this page until you are told to do so.

From "Knowledge," by John Pryor

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Iowa Silent Reading : New Ed. : Adv. : Am

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TEST 6. PARAGRAPH COMPREHENSION (Cont'd)

Corn is the great feed crop of the nation. Unlike , it can only with difficulty be transported long dis-, because it is heavy and bulky and spoils quickly packed. Moreover, it is not in great demand for a food, because it does not make such light bread as does. Therefore, only a very small percentage of nited States corn crop is sent to other countries, and fths of it is used where it is grown, for the feeding of sheep, and hogs. Nearly one half of all the crop to hogs alone in the Corn Belt.

The western part of the United States was not settled ich later than the eastern. The discovery of gold y drew many settlers to California; and, as the for precious metals was carried farther, the entire ioon became explored and settled.

Professor Louis Agassiz was a great scientist who natural history at Harvard University. His skill sifying birds, fish, or insects was remarkable. If he iven a single bone of a bird, he could tell instantly id of bird to which it belonged. He could do the vith other animals.

The red in the cross stands for sacrifice, for giving the warm crimson blood gives life to the body. The as the same length on all four of its arms, to signify gives life equally to all, high or low, east or west. ds alone always, no words or markings on it, to show the Red Cross workers have only one thought — to They ask no questions, they care not whether the

ed be ours or those of another race. Their duty is ; and to give quickly.

C. Corn is used in the United States chiefly for —

human food
making bread
food for animals......C

6

A. Choose the best title for the paragraph.

The Search for Gold
Gold and the Development of the West
Gold in California.....A

B. Approximately how much of the annual corn crop does

the United States export? 1 practically the entire

3 a small percentage.....B

A. Choose the best title for the paragraph.

Crops to Hogs

crop

1 Using the American Corn Crop

2 a large percentage

- B. The West was developed 1 at about the same time as the East 2 much earlier 3 long after B

-13♣

3 Harvard.....B

 A. Choose the best title for the paragraph.

 1 A Great Scientist
 2 Harvard University

 3 Classification of Animals

 iill

 he

 B. At what educational institution did Agassiz do his great work as a scientist?

 1 Columbia

2 Johns Hopkins

C. Louis Agassiz attained wide renown as a result of his remarkable skill in — 1 classifying animals 2 teaching natural history 3 writing......C

8

- C. The four arms of the Red Cross symbol are equal, to indicate — 1 world-wide service 2 equality of all who need help 3 universal charity.....C

Go right on to the next page.

7.

55

5 5 5 5

5 5

5 5 5 5

TEST 4. WORD MEANING

ECTIONS. Each of the exercises in Parts A, B, C, and D of this test consists of a statement which is correctly comed by one of the five numbered words or phrases. Find the number of this correct answer. Then, in the answer e at the right of the exercise, fill in the space which has the same number as the word or phrase you selected. he sample is answered correctly.

PART A. SOCIAL SCIENCE	-
make a <i>treaty</i> means to —	
1 make war 2 trespass 3 make an agreement 4 become violent 5 restrict	1
mistice means — 1 continued 2 suspension of arms 3 chivalry 4 a campaign 5 a battle array	2
constitution means a — 1 tax 2 conspiracy 3 judicial act 4 fundamental body of law 5 national debt	3
amendment means — 1 a change in a constitution 2 a property tax 3 an agreement 4 a national convention 5 an income tax	4
egiance means — 1 felony 2 anarchism 3 impeachment 4 adjournment 5 lovalty to one's country	•••
migrate means to — 1 emigrate 2 threaten 3 come into a country 4 losses a country 5 country 5 country 5	
pital means — 1 paper money 2 accumulated wealth 3 gold and silver	6
+ spending money o property	7
4 the right of the people to introduce a new course of action 5 an injunction	8
construction means the same as — 1 reconciliation 2 destruction 3 reorganization 4 discovery 5 obstruction	9
7	•
embargo is a — 1 legal act 2 prohibition on commerce 3 diplomat 4 treaty 5 judicial statement	.10
boycott is to — 1 secure goods illegally 2 combine against a person or organization 3 protect a trademark 4 allow credit 5 sell imported goods	.11
envoy is — 1 an envious individual 2 a soldier 3 a general 4 a period of time 5 a messenger	. 12
frage means — women's voting 2 representation 3 the right to vote 4 intrigue 5 suffering	.13
impeach means to -	
ligerent means —	.14
1 friendly 2 dangerous 3 warlike 4 peaceful 5 fearful	.15
<i>utraband</i> means — 1 a forbidden article 2 a careful criticism 3 a contradiction 4 war supplies 5 a veteran	. 16
mesty means —	0
1 a conviction 2 an embargo 3 an armistice 4 a civil law 5 a general pardon erendum means — 1 submitting to a vote of the people 2 an amendment	. 17
3 the passage of an act by Congress 4 voting in party convention 5 recommendation	. 18
numpy means to — 1 invalidate 2 secede 3 pass laws 4 create public sentiment 5 oppose legislation.	. 19
rit refers to — 1 legal evidence 2 a stock certificate 3 a credential 4 a mandate 5 a special tax.	.20
	•

TEST 6. PARAGRAPH COMPREHENSION

TIONS. Read each paragraph carefully, and then study the questions A, B, and C at the right. Select the t answer. Notice the number of this answer. In the margin at the right, fill in the answer space under this er.

In some parts of the world metal pins have been in r ages. In certain Egyptian tombs pins of bronze opper have been found. Pins like our hatpins, and like the safety pins of today, were used by people in ancient times. The first pins made in our country othing but bits of wire. The wire was rolled up at id to form a head, while the other end was sharpened.	1 A. Choose the best title for the paragraph. 1 Bronze and Copper Pins 2 Early Metal Pins 3 The Use of Hatpins. A B. Over how long a period have pins been made and used? 1 since modern times 2 since very ancient times 3 since the founding of this country. B. C. The pins found in Egyptian tombs were made of — 1 bronze and copper 2 copper wire 3 iron wire. C Copper Vire C	1 2 3 1 2 3 1 2 3 1 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
The great production of corn in the corn belt has this grain the largest and most valuable of all can crops. Each year the United States produces 3,000,000,000 bushels of corn — a crop three times ge as the wheat crop and three fourths of the total rop of the world.	 A. Choose the best title for the paragraph. The American Corn Crop 2 The Corn Belt The Wheat Crop. A B. How does the size of the annual corn crop of the United States compare with the wheat crop of the world? three fourths as large 2 twice as large three times as large. three times as large. B. Hourited States produces more corn than -12 C. The United States produces more corn than -12 all of the European countries 3 the rest of the world combined. 	
The Eskimos have two kinds of houses, one for use amer and the other for use in winter. The winter is made of blocks of snow or ice and is like a sugar turned upside down. Outside the door there is a unnel, also made of snow or ice, and through this, crawl on their hands and knees when they go in or The windows are of ice, or thin skin, for there is no n the country.	3 A. Choose the best title for the paragraph. 1 The Houses of Eskimos 2 Summer Houses of Eskimos 3 The Winter Houses of Eskimos A B. Why do some Eskimo families have two kinds of houses? 1 because they do not like to use tunnels 2 because of the seasonal changes 3 because they like snow houses	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
One way to protect ourselves against poison ivy is to l poison-ivy plants that grow in yards or in other where people are likely to touch them. Someone not easily poisoned should put on leather gloves and is plants up by the roots. The plants may also be by cutting them off at the roots and pouring some- on the roots which will kill them. Lubricating oil s is used in automobiles will kill poison-ivy plants.	 4 A. Choose the best title for the paragraph. 1 Poison-Ivy Plants 2 Protective Measures against Poison Ivy 3 Killing Poison Plants	1 2 3 1 2 3

whend means to	TEST 4 (Cont'd). PART B. SCIENCE Iowa Silent Reading: New Ed.: Adv.: Au	3 4
idation means — 4 combin	ad 2 become smaller 3 become larger 4 derive 5 rebound 1 1 combining with oxygen 2 drying 3 osmosis 1 2 ning with hydrogen 5 neutralizing	3
wity means — 1 serious	sness 2 gratitude 3 attraction of bodies 4 capillarity 5 energy	3 4
action means —	ion 2 emulsion 3 equation 4 inertia 5 chemical change	3 3
locity is the same as	$ \frac{1}{2} $	3 (11 1
adulierate means to 5 make i	$-$ 1 concede 2 caution 3 instruct 4 reduce $-$ 1 $\frac{1}{2}$ impure by mixing with other substances	3
uble means —	2 neutral 3 rigid 4 liquefiable 5 solid 7	3 (11 1
nsity means — 1 4 ratio of	1 1 2 1 1 2	3
filter means to — 1 strain	2 radiate 3 mix 4 dissolve 5 resist	3 4
diffuse means to — 1 digest	2 comprehend 3 assimilate 4 digress 5 spread out10	3 4
bigment is a — 1 colorin	ag matter 2 plaster 3 white substance 4 liquid 5 smooth surface	3
inslucent means — 1 transm	narine 2 partially transparent 3 transpose 4 transfer 5 luminous12	3
here means to — 1 recogn	tize 2 listen 3 stick fast 4 adjust 5 mix together	3
ume means — 1 height	2 depth 3 capacity for holding 4 space occupied 5 model	3
1 qualita	ative 2 dormant 3 quantitative 4 peculiar 5 visible	
innent moons to	PART C. MATHEMATICS 8	2
1 invest	2 inventory 3 simplify 4 factor 5 turn upside down	
1 cut acr	ross 2 reduce 3 cancel 4 subtract 5 insert	3
1 size	2 angles 3 solids 4 decimals 5 division	
<i>finita</i> means	2 inaccurate 3 estimated 4 averaged 5 combined	2
1 careful	1 2 precisely limited 3 infinite 4 divided 5 decimal	0
1 quotien	nt 2 transformation of quantities 3 reduction 4 review 5 repetition	
4 a line	from angle to angle 5 a line which bisects a figure	3
gin means — 1 beginn	ning 2 drill 3 difficulty 4 tables 5 decimals	a
rnces pertain to — 1 decima	als 2 multiplication 3 angles 4 equality 5 values	3
nque means — 1 slantin	ng 2 straight 3 opposite 4 parallel 5 symbolical10	3
nzoniai means — 1 straigh	nt 2 perpendicular 3 hypothesis 4 a line connecting two points 5 level11	3
<i>ujeculum</i> means the single 1 angle	2 sphere 3 conjunction 4 extension 5 projectile	3
1 breadt	th 2 width 3 area 4 base 5 length	3
1 many :	angles 2 many numbers 3 one term 4 many terms 5 one number	ð
1 cancel	1 2 correspond 3 approach 4 combine 5 estimate	3

1

re judicial decisions ever reversed?
Does insufficient evidence ever result in a conviction?
)o alleged facts often need to be verified?
)oes similarity between objects necessitate their being identical?
Are ceremonious activities characteristic of informal gatherings?
)o most people approach an unusual ordeal with apprehension?
loes the League of Nations approve open hostilities among its members?
re consistent statements usually untrue?
hould a valid answer be based on exact data?
s the circulation of slanderous rumors ethical?
a marked discrepancy usually obvious?
hould an antagonist in a contest show aggressive behavior?
a certain amount of prejudice necessarily debasing?
114
•
re arguments ever free from enmity?

 RIGHT MINUS WRONG
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 Standard Score
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 RIGHT MINUS WRONG
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 Standard Score
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Iowa Silent Reading : New Ed. : Adv. : Am

autobiography is a 1 characterization 2 caricature 3 contradiction 4 memoir of one's life 5 classic	
alistic means —	
1 conventional 2 true to life 3 romantic 4 idealistic 5 dramatic	
1 a lyric 2 a similarity 3 a poem 4 an analogy 5 a dialogue	
brefix means — 1 that which is put after 2 that which is put before 3 a figure of speech 4 a title of a book 5 an appendix4	
egend is — 1 a song 2 a motto 3 a tradition 4 a title 5 an editorial	
ective refers to — 1 verbs 2 nouns 3 adverbs 4 adjectives 5 case	
ynopsis is — 1 an outline 2 a climax 3 a general review 4 an alliteration 5 a controversy7	
brologue is similar to a — 1 suffix 2 prefix 3 table of contents 4 bibliography 5 preface	
onymous means — 1 critical 2 fictitious 3 eloquent 4 of unknown authorship 5 singular	
nanuscript is a — 1 magazine 2 manual 3 document 4 folio 5 pamphlet	
<i>rical</i> means — 1 suitable to be sung 2 dramatic 3 narrative 4 descriptive 5 poetical	
ackets are — 1 italics 2 initials 3 diagrams 4 outlines 5 gunctuation marks	
allegory is a — 1 figurative story 2 couplet 3 comedy 4 ballad 5 diary	
gree is a quality of — 1 conjunctions 2 adjectives 3 objects 4 infinitives 5 pronouns	
<u>•</u> 9 ●	
hos means — 1 humor 2 song 3 drama 4 quality of sorrow 5 melancholy	
<i>itemporary</i> means — 1 in contact 2 living at the same time 3 complete 4 emphasis 5 continual	
ire is similar to — 1 humor 2 wit 3 vice 4 buffoonery 5 irony	
loquial refers to — 1 everyday talk 2 folklore 3 idioms 4 pastorals 5 dialects	
ibliography is a — 1 history 2 personal record 3 list of books 4 description 5 writer	
epigram is a — 1 pithy saying 2 maxim 3 jest 4 jingle 5 prosody	
	• -

Number right, Part D.....

 $\frac{\text{No. Right: A + B + C + D}}{\text{Standard Score}} = \frac{1}{95} \frac{2}{98} \frac{3}{101} \frac{2}{103} \frac{3}{106} \frac{4}{108} \frac{5}{101} \frac{6}{108} \frac{7}{111} \frac{8}{110} \frac{9}{120} \frac{10}{121} \frac{12}{124} \frac{12}{127} \frac{12}{129} \frac{13}{132} \frac{14}{137} \frac{15}{139} \frac{16}{142} \frac{19}{142} \frac{20}{144} \frac{21}{146} \frac{22}{148} \frac{22}{152} \frac{23}{154} \frac{24}{156} \frac{25}{158} \frac{26}{158} \frac{27}{160} \frac{7}{160} \frac{8}{100} \frac{11}{113} \frac{116}{119} \frac{119}{121} \frac{12}{124} \frac{127}{129} \frac{132}{132} \frac{134}{137} \frac{139}{139} \frac{142}{142} \frac{14}{146} \frac{19}{148} \frac{20}{148} \frac{21}{148} \frac{22}{150} \frac{22}{152} \frac{23}{154} \frac{24}{156} \frac{25}{158} \frac{26}{158} \frac{27}{160} \frac{15}{168} \frac{15}{169} \frac{15}{171} \frac{13}{173} \frac{34}{174} \frac{35}{176} \frac{36}{178} \frac{37}{180} \frac{38}{181} \frac{39}{183} \frac{40}{181} \frac{41}{183} \frac{42}{188} \frac{43}{190} \frac{45}{192} \frac{46}{195} \frac{47}{195} \frac{48}{195} \frac{49}{195} \frac{50}{197} \frac{51}{198} \frac{52}{200} \frac{51}{202} \frac{52}{203} \frac{54}{207} \frac{54}{207} \frac{54}{207} \frac{54}{207} \frac{54}{205} \frac{57}{208} \frac{59}{215} \frac{60}{217} \frac{61}{218} \frac{62}{213} \frac{63}{224} \frac{63}{224} \frac{64}{225} \frac{66}{27} \frac{67}{29} \frac{68}{231} \frac{69}{235} \frac{70}{235} \frac{59}{235} \frac{56}{235} \frac{57}{208} \frac{58}{215} \frac{59}{217} \frac{58}{213} \frac{59}{215} \frac{60}{217} \frac{61}{218} \frac{62}{213} \frac{63}{224} \frac{64}{225} \frac{65}{227} \frac{67}{229} \frac{68}{231} \frac{69}{235} \frac{70}{235} \frac{59}{235} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255} \frac{59}{255}$
Å

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YES NO

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YES NO 1 YES NO YES NO YES NO YES NO

YES NO III III YES NO III III

YES NO YES NO

YES NO

YES NO

VES NO

YES NO

TEST 5. SENTENCE MEANING

TIONS. You are to read each sentence and answer it by filling in the answer space under the right answer. Study mples. Do not guess.
LES. A. Are all people dishonest?
B. Are authors often quoted?
o people sometimes coöperate for self-preservation?1
o all students have the same determination to achieve?
re dishonest officials ever in charge of political campaigns?
[ay external appearances be deceiving to the uninitiated?
o the bacteria causing tuberculosis grow rapidly in fresh air?
an undesirable reputation often based upon a record of misbehavior?
re agility and endurance considered good qualifications for an athlete?
re exact measurements usually secured with inaccurate instruments?
foolhardiness a sure indication of one's courage?
oes public opinion ever disregard the decrees of justice?10
re careless observations the only causes of mistakes in arriving at conclusions?
10 🐢
o many people fail to live up to their possibilities?
'ill our knowledge of scientific facts be decreased by experimentation?
o individuals always adjust themselves to their environment?14
/ill the pleasure of the host be increased by the presence of an obnoxious guest?
an one predict future events with absolute surety?16
oes a knowledge of the rules of traffic tend to decrease accidents?
'oes a controversy always result in a satisfactory solution of a problem?
oes the absence of authority often result in frivolity?19
lay there be contention among the members of a parliament?20
re valuable natural resources an asset to a nation?
re all anti-trust laws enforced with facility?
the cause of liberty weakened by freedom of the press?
re editorials always based upon quotations from authorities?24
3 all good writing the result of frequent consultation of an outline?
Go right on to the next page.