THE UNIVERSITY OE MANITOBA

AN EXAMTNATION OF SONE FACTORS<br>THAT MAY AFFECT STANDING<br>IN GFADE XI CHEMISTRY

## BEING A THESIS SUBMITTED TO THE CONLITTEE ON POST-GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MESTER OF EDUCATION



## 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.G.g numerical ability, reading ability, abstract reasoning ability, amount or assignm ments done, effect or pre-grade XI chemistry courses, effectiveness of text in learning chemistry; text valuation by Lorge, Flesch and Vogel.

Comperison of chemistry results with ability in other fields to determine the Iatter'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<br>THAT MAY AFFEGT STANDING<br>IN GRADE XI CHEMISTRY

Object: 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., mathema= tical ability, reading ability, abstract reasoning ability, the effect of elementary contributory science, and a valuation of the text.

Procedure: 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.

Results: 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.

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

Claude A. Joyce

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## CNAPTBR I

TMETODUCPION

## Prelimineryo-

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

Having taught the subject for sixteen years, with results that wexe at times bewilaering, oceasionally confusing, ofton exasperating, and rarely satisfactoryg 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 mriter was also imbued with a desire to follow some of the lines of investige ation suggested in one of the works of E. Moreemang ${ }^{\text {I }}$

1. F. Freemang Suggested Progran of Invest $^{\text {F }}$ Igation Having in Hind the Improveluent of Instruction In science at the lniversity of innesota. From problems in College Eaucation, edited by Berl Mudelson, Minneapolis, Minn. Wiversity of Minnesota Press. 1928. ${ }^{2} .766^{\circ}$
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) forcerulness, (b) dramatic appeal, or (c) other qual itative effects.
Notertaking 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 con clusions. Growth of Science Curriculum.

The science of chemistry has changed consid erably over the centuries, from the wishrul thinking of the alchemists to the present concept of the hydrogen bomb and atomic fission. Subsequentiy, 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 Chemistryo $=$

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。?

In Manitoba, matriculation requirements cane 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

[^0]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 pexcentage 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 man ufacturers every year.....OThere the chemist was formerly looked upon as a needless luxury, he is now being considered an absom lute 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
$3_{\text {Ibid, }}$ p. 486 .
the subject and not become discouraged if he fails to understand everything clearly at the beginning. 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, $\infty$ is chemistry a "more difficult subject" to learn than most other subjects, or does such a differentiation exist between subjects ? An examination of Figure $I_{\text {g }}$ 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 ifanitoba 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
${ }^{4}$ Frederic B. Emery, Elzy F。Downey, Roscoe E. Davis, Charles E. Boynton, Chemistry in Everyday Life. Lyons and Carnahan, New York, 1928. ppoxivmxv.
years, above the median, and that while it is somew times 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 textg its readabilityg 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 provincemide 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 pupilgo his preparedness, his ability with other subjects, his interest in the subject, his care in doing homework assignments, his extramcurriculer 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 schoolg- 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. Host 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 Figh 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 satism factory results in Grade XI chemistry?
5. To what extent is the present text used in Grade XI chemistry suitable for the course?

## Imitations.-

It might be advisable to consider some of the Iimitations of the study at this point. The scope of the work is of necessity narrow, being confined to one teacher, one teaching method, one schocl 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 stending 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 failuxe 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 exame inations 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 railure 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.
I. I.Q. and achievement in chemistry will show a positive correlation. To attain success in chemistry a student needs a degree of intelligence that is somem what 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 $I_{0}$ Q. rating of from 90




FIGURE II
COMPARISOIN OF FAILURE RATES, 1949-1953
FROVINCIAL FAILURE RATES FOR SUBJECTS OF MAXIIMM
AND MINTMUM FAILURE RATES, FOR CHEMISTRY, AND THE
CHEMISTRY FAILURE RATE FOR FLIN FLON STUDENTS (p.10)

| Failure |
| :--- |
| rate $\%$ |

46 (
to 110, these figures being taken from MoCall. 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, $21.9 \%$ or 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 lin guistic 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

5 William A. McCall, How to Measure in Education. 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 consid. eration 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 contribo uting factor to his accomplishment in Grade XI chem istry. In the science courses from Grades VII to $\mathrm{X}_{9}$ a cextain portion of the work consists of chemistryg so the extent of this carryoover 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

## 15

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 Iearning 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 aarried 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 3 th, 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 解entyeight 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 Homevork 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 $X I$, 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.

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 or these tests. Intelligence quotient. -

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 Ao 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 intellig. ence.

Numerical Ability Test. ${ }^{\infty}$
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 dem voted 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 handing 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 Abilityo

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 Iisted 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

[^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 Scoringo

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

Pupils seem to prepere for examinations eithex by craming madly a day or two berore the examination, or by working consistentiy throughout the year so as to absorb what they are supposed to know bit by bit as it is offered. It was felt that craming in cheme istry was not a successful prectice because of the Vast array of technical tems and detailed knomledge 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 lert 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 amøunt 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 $X I$, 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 reten tion 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, Science Indoors and Out, Book I, by Hensley, Patterson and Armstrong; for Grade VIII, Science Indoors and out, Book 2, by the same authors; for Grade IX, Science Indoors and Out, Book 3, same authors; and for Grade $X$, Everyday Problems in Science, 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 fortym two 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 (17.30), 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 necessm ary 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 Teble 9 , and the complete test is reproduced in the appendix.

There were thirtyonine 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 I Iists the percentages of correct responses to each question.

## TABLE I

PERCENTAGE OF CORRECT RESPONSES TO CHEMISTEY PRETEST


TABLE I -- Continued


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.

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 valioity, 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 follow ed. 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

[^2]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. 11

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

## TABLE 2

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

| Question | $\%$ <br> correct for <br> top 25 | $\%$ correct ior <br> bottom 25 | Excess highest <br> over lowest |
| :---: | :---: | :---: | :---: |
| 1 | 98 | 98 | 0 |
| 2 | 98 | 94 | 4 |
| 3 | 82 | 68 | 14 |
| 4 | 96 | 76 | 20 |
| 5 | 100 | 100 | 0 |
| 6 | 92 | 82 | 10 |
| 7 | 100 | 99 | 1 |
| 8 | 94 | 87 | 7 |
| 9 | 100 | 98 | 2 |
| 10 | 100 | 96 | 4 |
| 11 | 100 | 98 | 2 |
| 12 | 100 | 99 | 1 |
| 13 | 97 | 96 | 1 |

11 Ibid. $p .79$.

TABLE $2-\infty$ continued

| Question | \%orrect for <br> highest 25 | $\%$ <br> correct for <br> lowest 25 | Excess highest <br> over lowest |
| :---: | :---: | :---: | :---: |
| 14 | 96 | 70 | 26 |
| 15 | 82 | 62 | 20 |
| 16 | 90 | 84 | 6 |
| 17 | 96 | 80 | 16 |
| 18 | 82 | 80 | 2 |
| 19 | 98 | 90 | 8 |
| 20 | 91 | 85 | 6 |
| 21 | 98 | 96 | 2 |
| 22 | 84 | 62 | 22 |
| 23 | 86 | 80 | 6 |
| 24 | 100 | 97 | 3 |
| 25 | 80 | 58 | 22 |
| 26 | 90 | 84 | 6 |
| 27 | 97 | 93 | 4 |
| 28 | 80 | 60 | 20 |
| 29 | 96 | 84 | 12 |
| 30 | 100 | 99 | 1 |
| 31 | 97 | 89 | 8 |
| 32 | 100 | 92 | 8 |
| 33 | 100 | 98 | 2 |
| 34 | 100 | 99 | 3 |
| 35 | 91 | 98 | 1 |
| 36 | 81 | 62 | 12 |
| 37 | 100 | 96 | 4 |
| 38 | 100 |  |  |
| 39 |  |  |  |

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 zeros 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.
$31$


A further evaluation of the test was an assesment or its reliability. "By reliability is meant the degree to which the test agrees with itselfg" 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

$$
r_{\mathrm{nn}}=\frac{n r_{i I}}{I \notin(\mathrm{n}-1)_{i l}^{r_{i l}}}
$$

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 Ibid., p. 82.
13 Ibid., p. 245.

Estimated $r=\frac{2 x r}{} \frac{1}{f r}$ half-test

$$
=\frac{2 x .43}{1 \neq .43}=\frac{.86}{1.43}=.60
$$

The significance or 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 ois 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 reliabo ility 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 subjecta ed, it may be concluded that the pretest has a favorable construction, a fair degree of validity, but a low rating for reliability.
${ }^{14}$ Ibid., p.86.

## CHAPTER III

## ANALYSIS OF THE TEXT USED IN GRADE XI CHEMISTRY

On the hypothesis that the text book authorm ized 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. Consid eration 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 Modern Chemistry, by Dull, Brooks, and Metcalfe. It first appeared on the course in the fall of 1951 when it replaced the text High School Chemistry, by Nevil Norton Evans. The present text measures $15 \times 23$ 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 Experimentsm Harder (any 10 experiments)
Objectives:

1. To demonstrate how man adapts his environment to suit his needs
2. To develop the ability to generalize from raw data and thus to acquire on 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: Chapter Sections $6 \quad 5$

Chapters Sections
18
19
20
21
22
24
211
211
$6=18$ (incl.)
13-17 (incl.)
15-28 (incl.)
8 (sub-section 2)
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 demon=
strations 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 examin
ation by the Inspector. I5

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, Programme of Studies for the Schools of Lanitoba, Senior High Schools, 1952-53. Authoriz= ed 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 linemdrawings 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 experm iments the student can do on his own at home.

In the pages outlined as constituting the

16Charles E. Dull, William O. Brooks, $\mathrm{H}_{0}$ 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 $i 58$ 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)
I. What are the three most important acids ? Why are they important ? ( $\mathrm{p}, 214$ )
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 lecture ing 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 materiel 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 "Fomework 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 recopds 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 workg 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 clessify the questions according to their difficulty, they were arbitrarily divided into three separate groups. Questions answerm ed 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
ERROR RATING IN HOMEWORK ASSIGNENTS: QUESTIONS

| Page | Question | Percentage of error | Page | Question | Percentage of error |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 10 | 9 | 20 | 129 | 26 | 20 |
|  | 13 | 27 |  | 27 | 41 |
|  | 14 | 40 |  | 28 | 36 |
|  |  |  |  | 29 | 36 |
| 44 | 24 | 22 |  | 30 | 70 |
|  | 25 | 33 |  | 31 | 12 |
|  | 26 | 20 |  | 32 | 36 |
|  |  |  |  | 33 | 33 |
| 84 | 19 | 11 |  | 34 | 12 |
|  |  |  |  | 35 | 33 |
| 98 | 17 |  |  | 36 | 42 |
|  | 18 | 18 |  | 37 | 30 |
|  | 24 | 12 |  | 38 | 26 |
|  | 25 | 9 |  | 39 | 58 |
|  | 26 | 32 |  | 40 | 55 |
|  | 28 | 14 |  | 41 | 53 |
|  |  |  |  | 42 | 40 |
| 113 | 21 | 19 |  | 43 | 55 |
|  |  |  |  | 44 | 40 |
| 129 |  | 22 |  | 45 | 61 |
|  | 5 | 34 |  | 46 | 58 |
|  | 6 | 33 |  | 47 | 58 |
|  | 7 | 33 |  | 48 | 26 |
|  | 9 | 30 |  | 49 | 48 |
|  | 10 | 67 |  | 50 | 47 |
|  | 11 | 58 |  |  |  |
|  | 12 | 42 | 161 | 13 | 12 |
|  | 13 | 30 |  | 23 |  |
|  | 14 | 73 |  | 24 |  |
|  | 15 | 22 |  |  |  |
|  | 16 | 36 | 173 | 22 | 19 |
|  | 17 | 20 |  |  |  |
|  | 18 | 56 | 214 | 13 | 18 |
|  | 19 | 40 |  | 15 | 16 |
|  | 20 | 47 |  | 16 | 20 |
|  | 21 | 45 |  | 17 | 36 |
|  | 22 | 45 |  | 18 | 45 |
|  | 23 | 45 |  | 19 | 31 |
|  | 24 | 28 |  | 20 | 22 |
|  | 25 | 37 |  | 21 | 80 |
|  |  |  |  | 25 | 35 |

TABLE 3 --Continued
$\left.\begin{array}{c|c|c|c|c|c}\hline \text { Page } & \text { Question } & \begin{array}{c}\text { Percentage } \\ \text { of error }\end{array} & \text { Page } & & \text { Question }\end{array} \begin{array}{c}\text { Percentage } \\ \text { of error }\end{array}\right]$

## 43

TABLE 3 - Continued

| Page | Question | Percentage <br> of error |
| :---: | :---: | :---: |
| 293 | 4 | 20 |
|  | 7 | 10 |
|  | 8 | 17 |
|  | 14 | 15 |
|  | 16 | 37 |
|  | 17 | 39 |
|  | 19 | 39 |
|  | 21 | 51 |
|  | 23 | 34 |
|  | 24 | 32 |
|  | 25 | 35 |
|  | 26 | 64 |

TABIT 4
ERROR RATING IN HOMWORK ASSIGNMENTS: PROBLIMS

| Page | Question | Percentage of errer | Fage | question | Percentage of error |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 11 | 1 | 24 | 65 | 4 | 22 |
|  | 3 | 49 |  | 5 | 39 |
|  | 4 | 24 |  | 6 | 19 |
|  | 5 | 27 |  | 7 | 11 |
|  | 6 | 11 |  | 8 | 22 |
|  | 7 | 25 |  | 9 | 27 |
|  | 8 | 58 |  | 10 | 29 |
|  | 11 | 87 |  | 11 | 58 |
|  | 12 | 16 |  | 12 | 21 |
|  | 14 | 94 |  | 13 | 24 |
|  |  |  |  | 14 | 35 |
| 45 | 1 | 42 |  | 15 | 56 |
|  | 2 | 47 59 |  | 16 | 69 81 |
|  | 4 | 50 50 |  | 18 | 61 |
|  |  |  |  | 19 | 34 |
| 55 | 1 |  |  | 20 | 77 |
|  | 2 | 43 |  | 21 | 37 |
|  | 3 | 92 | 84 | 1 | 19 |
| 65 | 2 | 11 |  | 2 | 25 |
|  | 3 | 22 |  | 3 | 33 |

44

TABIE 4 - Continued
$\left.\begin{array}{c|c|c||c|c|c}\hline \hline \text { Page Question } & \begin{array}{c}\text { Percentage } \\ \text { of error }\end{array} & \text { Page } & \text { Question } & \text { Percentage } \\ \text { or error }\end{array}\right]$
$44-B$

TABLE $4-\infty$ Continued

TABIE 5
SUMMARY OF ERROR RATING IM HOMEWORK ASSIGNUENT:
QUESTIONS QUESTIONS

| 30-50\% error; Moderate |  |  | $\begin{gathered} 5 \mathrm{I}-75 \% \text { error; } \\ \text { High } \end{gathered}$ |  |  | $76 \%$ plus error; Extreme |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Page | No. | Rate | Page | No. | Rate | Page | NO. | Rate |
| 10 | 14 | 40 | 129 | 10 | 67 | 214 | 21 | 80 |
| 44 | 25 | 33 |  | 11 | 58 |  |  |  |
| 98 | 26 | 32 |  | 14 | 73 |  |  |  |
| 129 | 5 | 34 |  | 18 | 56 |  |  |  |
|  | 6 | 33 |  | 30 | 70 |  |  |  |
|  | 7 | 33 |  | 39 | 58 |  |  |  |
|  | 9 | 30 |  | 40 | 55 |  |  |  |
|  | 12 | 42 |  | 41 | 53 |  |  |  |
|  | 13 | 30 |  | 43 | 55 |  |  |  |
|  | 16 | 36 |  | 45 | 61 |  |  |  |
|  | 19 | 40 |  | 46 | 56 |  |  |  |
|  | 20 | 47 |  | 47 | 58 |  |  |  |
|  | 21 | 45 | 161 |  | 60 |  |  |  |
|  | 22 | 45 | 226 | 8 | 52 |  |  |  |
|  | 23 | 45 |  | 13 | 58 |  |  |  |

$$
45
$$

TABLIT $5-$ - Continued

| $\begin{gathered} 30-50 \% \text { error; } \\ \text { Moderate } \end{gathered}$ |  |  | $\begin{gathered} \text { 51-75\% error; } \\ \text { High } \end{gathered}$ |  |  | $\begin{aligned} & 76 \% \text { plus error; } \\ & \text { Extreme } \end{aligned}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Page | No. | Rate | Page | No. | Rate | Fage | No. | Rate |
| 129 | 25 | 37 |  | 17 |  |  |  |  |
|  | 27 | 41 |  | 23 |  |  |  |  |
|  | 28 | 36 |  | 32 |  |  |  |  |
|  | 29 | 36 |  | 33 |  |  |  |  |
|  | 32 | 36 |  | 37 |  |  |  |  |
|  | 33 | 33 |  | 43 |  |  |  |  |
|  | 35 | 43 |  | 45 |  |  |  |  |
|  | 37 | 30 | 266 | 15 |  |  |  |  |
|  | 42 | 40 |  | 17 |  |  |  |  |
|  | 44 | 40 |  | 19 |  |  |  |  |
|  | 49 | 48 |  | 21 |  |  |  |  |
| 214 | 50 | 36 |  | 23 |  |  |  |  |
|  | 18 | 31 | $\begin{aligned} & 276 \\ & 293 \end{aligned}$ | $\frac{11}{21}$ |  |  |  |  |
|  | 19 | 35 |  |  |  |  |  |  |
|  | 25 | 35 |  |  |  |  |  |  |
| 226 | 7 | 41 |  |  |  |  |  |  |
|  | 17 | 40 |  |  |  |  |  |  |
|  | 16 | 48 |  |  |  |  |  |  |
| 266 | 19 | 33 |  |  |  |  |  |  |
|  | 20 | 30 |  |  |  |  |  |  |
|  | 21 | 47 |  |  |  |  |  |  |
|  | 22 | 47 |  |  |  |  |  |  |
|  | 24 | 47 |  |  |  |  |  |  |
|  | 25 <br> 30 | 45 31 |  |  |  |  |  |  |
|  | 35 | 50 |  |  |  |  |  |  |
|  | 36 38 | 33 47 |  |  |  |  |  |  |
|  | 40 | 47 |  |  |  |  |  |  |
|  | 42 | 47 |  |  |  |  |  |  |
|  | 44 46 | 36 30 |  |  |  |  |  |  |
|  | 48 | 36 |  |  |  |  |  |  |
|  | 49 | 50 48 |  |  |  |  |  |  |
|  | 50 | 48 |  |  |  |  |  |  |
|  | 51 | 4 |  |  |  |  |  |  |

## TABLE 5 - Continued

| 30-50\% error: Moderate |  |  | $\begin{gathered} 51-75 \% \text { error; } \\ \text { High } \end{gathered}$ |  |  | $\begin{gathered} 76 \% \text { plus error; } \\ \text { Extreme } \end{gathered}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Page | No. | Rate | Page | INO. | Rate | Page | No. | Rate |
|  |  |  |  |  |  |  |  |  |
|  | 53 54 | 41 |  |  |  |  |  |  |
| 266 | 8 | 40 |  |  |  |  |  |  |
|  | 16. | 38 |  |  |  |  |  |  |
|  | 20 | 40 |  |  |  |  |  |  |
|  | 22 24 | 45 |  |  |  |  |  |  |
| 276 | 13 | 30 |  |  |  |  |  |  |
|  | 14 | 37 |  |  |  |  |  |  |
| 293 | 19 | 41 |  |  |  |  |  |  |
| 29 | 17 | 39 |  |  |  |  |  |  |
|  | 19 | 39 |  |  |  |  |  |  |
|  | 23 | 34 |  |  |  |  |  |  |
|  | $\begin{aligned} & 24 \\ & 25 \end{aligned}$ | $\begin{aligned} & 32 \\ & 35 \end{aligned}$ |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

TABLE 6
SUMMARY OF EPROR RATING IN HOMEWORK ASSIGNGUTSS: PROBLEMS

| 30-50\% error; <br> Moderate | 51-75\% error; <br> High |  |  | $76 \%$ plus errox |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Extreme |  |  |  |  |  |  |

TABIE 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 begin ing 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 differ ent 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 fiftymone 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.
${ }^{18}$ Lorge, "The Lorge Formula for Estimating Grade Placement of Reading Materials," Teachers College Record, Vol. XLV, p.404.

TABLE 7
EESULTS OF TEXT ANALYSIS BY LORGE FORMULA

| Page | Readability <br> Index | Page | Readability <br> Index |
| ---: | :---: | :---: | :---: |
| 2 | 6.2807 | 68 | 6.7937 |
| 4 | 5.3434 | 78 | 6.8147 |
| 6 | 7.4524 | 88 | 6.4480 |
| 8 | 6.5873 | 96 | 5.2324 |
| 12 | 6.0770 | 106 | 5.7739 |
| 14 | 6.7168 | 115 | 6.2358 |
| 16 | 6.1657 | 126 | 5.7570 |
| 20 | 6.2931 | 136 | 6.8256 |
| 22 | 6.5055 | 146 | 6.2142 |
| 28 | 6.6515 | 156 | 6.7991 |
| 30 | 6.5241 | 166 | 6.6813 |
| 32 | 6.5091 | 176 | 7.1088 |
| 34 | 6.0198 | 184 | 7.0180 |
| 36 | 6.0035 | 194 | 5.4826 |
| 38 | 6.9790 | 204 | 5.3955 |
| 40 | 6.8952 | 212 | 6.3456 |
| 42 | 6.3434 | 222 | 6.0586 |
| 46 | 7.3794 | 228 | 8.4780 |
| 48 | 6.3434 | 232 | 6.4156 |
| 50 | 6.3054 | 238 | 7.6131 |
| 52 | 7.0199 | 248 | 7.3028 |
| 56 | 7.6439 | 258 | 6.5995 |
| 58 | 6.8684 | 268 | 6.0000 |
| 60 | 6.5503 | 274 | 7.1638 |
| 62 | 5.7594 |  | 294 |
|  |  |  | 6.2909 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

The method employed in treating the inform 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.

## Computation

Item 6, average sentence length divide 1 by 2 and multiply by . 07
Item 8, ratio of prepositional phrases: diviide 3 by $I$ and multiply by 13.01
Item 9, ratio oi hard words: divide 4 by I and multiply by 10.73
Constant (C) 1.6126
Readability Index: Add 6, 8, 9, and C
Page 156 or the text Wodern Chemistry is
taken as typical. Fere 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
Number of prepositional phrases
divided by number of words times 13.01 1.4245

Number of hard words in the sample $\begin{array}{ll}\text { divided by number of words times } 10.73 & 2.5938 \\ \text { Constant } & \\ \text { Yielding a Readability Index of } & \underline{6.7991}\end{array}$
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

${ }^{19}$ Rudolph Flesch, The Art of Plain Talk, Harper and brothers, New York, 1949.

TABLE \& - Continued
Text page Index


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。 Further Examination of Reading Difficultyo-

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,

Dre G. Mo Mallinson 20 has some pertinent findingso 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 partioular 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 greatiy. 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 textw books that have many extremely difficult passages may be balanced by some very easy ones. "It seems reasonable to state from the conclusions already
 The Reading Dirficulty of Textbooks for High-School Chemistry. "Journal of Chemical Education," Vol. 29, Dec..1952. pp.629-631.

Iisted that the differences found make level of readm ing 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 Texto-

As a further check of the suitability of the present text, it was subjected to a spot-checix evalvation 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, Organizationg Content, Presentation of Material, Accuracy, Readability, Adaptability, Teaching aios, Illustrationsg Appearance. The highest possible score for a textbook is 100 points. Modern Chemistry received a score of 88 points on this check test.

21 Ibid. p.63I.
${ }^{22}$ Louis $F$. Vogele A Spot-Check Evaluation Scale for High School Science Textbooks. "The Science Teacher"g Vol. XVIII, No. 2, March 195I.

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 productm moment plan for ungrouped pairs of data as illustrated on pages 164 to 166 , Statistics for Teachers, Tiegs and Crawford. 23 Details of the method used in finding the correlation between $I_{0} Q_{0}$ and June results are described here, and are summarized in Table lo, pages 59 to 61. The coefficient correlations for the other abilities are summarized on Iater pages. As our main objective was the determination of the correlation
$23_{\text {Tiegs }}$ and Crawford, Statistics for Teachers, Houghton Mirflin Coos Cambridge, Massachusetts, 1930.
coefficient, it was not necessary to find the standard deviations of the $X$ and $Y$ variables as such. Alsc, 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 <br> TEST RESULTS OF GRADE XI PUPILS IN FLIN FLON COLLEGIATE

| Name | I. ${ }_{\text {a }}$ | Percentages |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Pretest | Math | Abst. <br> Rsng. | $\begin{aligned} & \text { Reade } \\ & \text { ing } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { Homem } \\ & \text { word } \\ & \text { Index } \end{aligned}$ | June final 1953 |
| Adams, Wesley (R) | 115 | - 0 | 90 | 75 | 77 | - | 63 |
| Alleng Ken( B ) | 112 | $\stackrel{\circ}{\circ}$ | 65 | 60 | 41 | $\bigcirc$ | 50 |
| Ariko, Elizabeth | 110 | 71 | 85 | 35 | 94 | 57 | 35 |
| Ariko, Walter(R) | 101 | $\bigcirc$ | 65 | 60 | 46 |  | 54 |
| Ash, Arlene | 109 | 68 | 50 | 90 | 84 | 62 | 42 |
| Ash, Robert | 103 | 63 | 55 | 25 | 65 | 42 | 38 |
| Atkinson, Faye | 101 | $\bullet$ | 80 | 25 | 54 | 53 | 57 |
| Baily, Shirley | 101 | 71 | 85 | 45 | 72 | 80 | 76 |
| Ballard, Yvonne | 113 | 77 | 80 | 80 | 65 | 65 | 38 |
| BarkergZona | 101 | 66 | 75 | 65 | 87 | 68 | 69 |
| Bucher, Dennis(R) | 108 |  | 70 | 85 | 68 | $0 \cdot$ | 58 |
| Chigol, Irene | 106 | 85 | 97 | 55 | 65 | 91 | 89 |
| Chorley, Bob | 104 | $\bigcirc$ | 40 | 60 | 72 |  | 52 |
| Clay, Dorothy | 99 | 66 | 65 | 85 | 38 | 64 | 60 |
| Cole, Donald | 102 | 75 | 30 | 45 | 58 | 60 | 59 |
| Cowie, Carole | 105 | 57 | 85 | 35 | 46 | 80 | 59 |
| Cyrs Dennis ( P ) | 105 | $\bigcirc$ | 80 | 50 | 17 |  | 41 |
| Davison, Eunice | 1 IO | 64 | 45 | 60 | 92 | 54 | 25 |
| Dowhan, Elsie | 101 | 69 | 90 | 35 | 63 | 67 | 70 |
| Duncan, Norma | 103 | 57 | 90 | 80 | 49 | 68 | 67 |
| Einarson, Phil | 99 | 65 | 40 | 20 | 17 | 54 | 28 |
| Fosters Ron(R) | 103 |  | 40 | 40 | 13 | - | 63 |
| Fraser, Delores | 113 | 63 | 70 | 75 | 35 | 65 | 38 |
| Frechette, Denise | 96 | 47 | 65 | 85 | 41 | 47 | 26 |
| Fric, Lawrence | 117 | 85 | 95 | 70 | 91 | 53 | 66 |
| Fryer, Kathleen | 107 | 64 | 90 | 15 | 63 | 55 | 27 |
| Gaboury, Denise | 93 | $\bigcirc$ | 55 | 65 | 22 | 54 | 26 |
| Giragrank | 117 | 82 | 95 | 70 | 70 | 70 | 76 |
| Grantg Joan | 307 | 70 | 90 | 97 | 77 | 75 | 53 |

TABLE 9 -continued

| Name | I. 8. | Percentages |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \text { Pred } \\ \text { test } \end{gathered}$ | Math | Abst。 Rsng | Reade | $\left\lvert\, \begin{aligned} & \text { Honem } \\ & \text { work } \end{aligned}\right.$ Index | $\left\lvert\, \begin{aligned} & \text { June } \\ & \text { final } \\ & 1953 \end{aligned}\right.$ |
| Greenberg, Kay | 110 | 87 | 80 | 30 | 91 | 68 | 68 |
| Gunston, Joan | 122 | 81 | 97 | 97 | 94 | 76 | 79 |
| Haga, Oxvell | 103 |  | 85 | 65 | 38 | 75 | 72 |
| Halasz, Steve | 94 | 73 | 35 | 15 | 58 | 66 | 18 |
| Hartman, Sheila | 106 | 76 | 85 | 97 | 70 | 77 | 64 |
| Hayden, Gerry | 115 | 83 | 80 | 50 | 63 | 68 | 67 |
| Hogg, Josephine | 304 | 70 | 85 | 15 | 82 | 73 | 90 |
| HusztigPaus | 119 | 90 | 90 | 99 | 58 | 87 | 88 |
| Ibbott, Barxy | 101 |  | 85 | 70 | 79 |  | 34 |
| Katcher, Loma | 103 | 68 | 85 | 30 | 86 | 73 | 63 |
| Keddie, Maxilyn | 109 | 75 | 60 | 55 | 84 | 72 | 57 |
| Lahonen, Leonard | 109 | 68 | 85 | 65 | 77 | 52 | 29 |
| Lasty Roy | 109 | 80 | 65 | 85 | 32 | 43 | 70 |
| Logan, Shirley | 105 | 83 | 70 | 35 | 84 | 82 | 87 |
| Lovecky, Joe | 1106 | 78 | 90 | 75 | 70 | 67 | 80 |
| McDougali, Harles | 111 | $\stackrel{\circ}{5}$ | 3 | 95 | 68 | $\stackrel{\circ}{0}$ | 50 |
| IncIntosh, Fred | 172 | 69 | 80 | 35 | 49 | 50 | 54 |
| MeIsaac, Gerald | 103 | 58 | 50 | 75 | 46 | 46 | 57 |
| Mcilurray, Allan | 108 | 71 | 50 | 50 | 49 | 56 | 34 |
| Mcherfrey, Brian | 117 | 85 | 80 | 85 | 89 | 71 | 90 |
| Mearns, Audrey | 105 | 60 | 60 | 70 | 49 | 45 | 23 |
| Mearns, Trene | 103 |  |  |  |  |  | 25 |
| Middagh, inarjoris | 101 | 64 | 75 | 50 | 38 | 72 | 39 |
| Milton, Bill | 910 | 77 | 60 | 75 | 60 | 46 | 75 |
| Monis, Mona | 110 | 81 | 75 | 40 | 60 | 68 | 96 |
| Mote, Larry (R) | 105 | -。 | 80 | 65 | 46 | - | 67 |
| Murray, $\operatorname{Jim}(R)$ | 107 |  | 70 | 35 | 58 |  | 51 |
| Newton, Betty | 109 | 75 | 85 | 85 | 18 | 68 | 63 |
| Mieison, Karen | $\underline{00}$ | 60 77 | 70 85 | 65 | 58 77 | 55 | 40 |
| Norlander, Andy | $\underline{0}$ | 78 | 95 | 35 | 77 9 | 69 | 56 |
| Pankew, Lillian | 99 | 57 | 35 | 15 | 60 | 56 | 34 |
| Persson, Vasti(R) | 101 |  | 65 | 75 | 18 |  | 53 |
| Prokop, Nadia | 106 | 81 | 90 | 35 | 94 | 87 | 89 |
| Ross, Joan | 110 | 66 | 90 | 85 | 54 | 7 ? | 83 |
| Rossington, tarol | P21 | 81 | 95 | 65 | 72 | 64 | 84 |
| Schwandt, Joyce | 105 | 64 | 55 | 35 | 24 | 64. | 29 |
| Shockey, Lorne(R) | 108 | $\because$ | 55 | 80 | 75 | - | 45 |
| Shore, Eleanor (R) | 206 | $\because$ | 60 | 60 85 | 52 97 | $\because$ | 38 |
| Smith,Alvin | 116 | $\bigcirc$ | 80 | 85 | 97 | $\because$ | 88 |

TABLE 9 - Continued

| Name | I. Q 0 | Percentages |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Prem | Math | Abst. <br> Rsng. | Read- <br> ing | Home work Index | $\begin{aligned} & \text { June } \\ & \text { final } \\ & 1953 \end{aligned}$ |
| Sonıi, Sylvia(R) | 106 | $\because$ | 85 | 80 | 58 | -0 | 54 |
| Sorenson, Doug (R) | 117 | $\bigcirc 0$ | 90 | 65 | 86 | - | 70 |
| Southerng Mark | 114 |  |  |  |  |  | 37 |
| Southern, Oakley | 110 | 52 | 85 | 65 | 35 | 79 | 71 |
| Spencer, Nancy | 111 | 57 | 85 | 80 | 75 | 55 | 54 |
| Strand, Delores | 109 | 68 | 99 | 99 | 77 | 78 | 79 |
| Strijack, Val | 116 | 75 | 75 | 85 | 93 | 67 | 79 |
| Thompson, Betty | 113 | 68 | 97 | 95 | 93 | 81 | 93 |
| Turcatte, Ruby | 96 | 62 | 65 | 60 | 54 | 61 | 21 |
| Winterton, Mavis | 103 | 49 | 80 | 40 | 32 | 67 | 73 |

Correlation between $I_{\text {a }}$ 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 $N_{\text {, }}$ the number of cases involved. The second columng ( $X$ ), gives the I. Q. value for each of these pupils, and the sum of this column ( $\Sigma \mathrm{X}$ ) is then found. The third colum, (Y), denotes the June mark in Chemistry from Department of Education examinations for each of the pupils, while the sum of this column is (EY). The fourth column, (XY), gives the products of column ( $X$ ) and of colunn ( $Y$ ), and the sum of this column is ( XXY ). The fifth colum 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 coefificient between the $I$. Q and the June marks, "x" works out to:

$$
\begin{aligned}
r & =\frac{499174-\frac{(8539)(4633)}{80}}{\sqrt{914219-{\frac{(8539)^{2}}{80}}^{302769-\frac{(4633)^{2}}{80}}}} \\
& =.47
\end{aligned}
$$

TABLE 10

COEFFICIENT OF CORRELATION BETWEEN I。Q。AND JUNE MARKS

| Pupil | $\left.I_{\bullet} Q_{0}\right)_{0}$ | June (Y) | Products (XY) | Squares $\left(x^{2}\right)$ | Squares $\left(Y^{2}\right)$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Adams, ${ }^{\text {d }}$ | 115 | 63 | 7245 | 13225 | 3969 |
| Alleng K. | 112 | 50 | 5600 | 12544 | 2500 |
| Ariko, E\% | $\underline{110}$ | 35 | 3850 | 12100 | $\underline{225}$ |
| Ariko, Wo | 101 | 54 | 5454 | 10201 | 2916 |
| Ash, A. | 109 | 42 | 4578 | 11881 | 1764 |
| $A s h, R_{0}$ | 103 | 38 | 3914 | 10609 | 1444 |
| Atkinson, F . | 101 | 57 | 5757 | 10201 | 3249 |

TABLE 10 －Continued

| Pupil | I．Q 。 <br> （X） | $\begin{aligned} & \text { June } \\ & (Y) \end{aligned}$ | Products （XY） | Squares $\left(x^{2}\right)$ | Squares $\left(Y^{2}\right)$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Baily，So | 101 | 76 | 7676 | 10201 | 5776 |
| Ballarde $\mathrm{Y}_{0}$ | 113 | 38 | 4294 | 12769 | 1444 |
| Barkerg Z。 | 101 | 69 | 6969 | 10201 | 4761 |
| Bucher，D． | 108 | 58 | 6264 | 11664 | 3364 |
| Chigolg I． | 106 | 89 | 9434 | 11236 | 7921 |
| Chorley，Bo | 104 | 52 | 5408 | 10816 | 2704 |
| Clay， $\mathrm{D}_{0}$ | 99 | 60 | 5940 | 9801 | 3600 |
| Cole， $\mathrm{D}_{0}$ | 102 | 59 | 6018 | 10404 | 3481 |
| Cowie， $\mathrm{C}_{\text {e }}$ | 105 | 59 | 6195 | 11025 | 3481 |
| Cyr，${ }^{\text {d }}$ | 105 | 41 | 4305 | 11025 | 1681 |
| Davison，E． | 101 | 25 | 2525 | 10201 | －625 |
| Dowhan，E． | 101 | 70 | 7070 | 10201 | 4900 |
| Duncang No | 103 | 67 | 6901 | 10609 | 4489 |
| Einarson，$P_{0}$ | 99 | 28 | 2772 | －9801 | － 784 |
| Foster， $\mathrm{R}_{0}$ | 103 | 63 | 6489 | 10609 | 3969 |
| Fraser， $\mathrm{D}_{0}$ | 113 | 38 | 4294 | 12769 | 1444 |
| Frechette， $\mathrm{D}_{\text {。 }}$ | 96 | 26 | 2496 | － 9216 | － 676 |
| Fric，$L_{0}$ | 117 | 66 | 7722 | 13689 | 4356 |
| Fryer，K． | 107 | 27 | 2889 | 11449 | 729 |
| Gaboury，D． | 93 | 26 | 2418 | 8649 | 676 |
| Gira， $\mathrm{F}^{\text {－}}$ | 117 | 76 | 8436 | 12321 | 5776 |
| Grant，Jo | 107 | 53 | 5671 | 11449 | 2809 |
| Greenberg， $\mathrm{K}_{\text {，}}$ | 110 | 68 | 7480 | 12100 | 4624 |
| Gunston，Jo | 122 | 79 | 9638 | 14884 | 6241 |
| Hagas $\mathrm{O}^{\circ}$ | 103 | 72 | 7416 | 10609 | 5184 |
| Halasz，So | 94 | 18 | 1692 | －8836 | 324 |
| Hartman，$S_{0}$ | 106 | 64 | 6784 | 11236 | 4096 |
| Haydeng $\mathrm{G}_{0}$ | 115 | 67 | 7705 | 13225 | 4489 |
| Hogg， $\mathrm{J}_{0}$ | 104 | 90 | 9360 | 10816 | 8100 |
| Husztig ${ }^{\text {P }}$ | 119 | 88 | 10472 | 14161 | 7744 |
| Ibbott， $\mathrm{B}_{0}$ | 101 | 34 | 3434 | 10201 | 1156 |
| Katcher， I＊ | 103 | 63 | 6489 | 10609 | 3969 |
| Keddie， $\mathrm{M}_{0}$ | 109 | 57 | 6213 | 11881 | 3249 |
| Lahoneng $L_{0}$ | 109 | 29 | 3161 | 11881 | 841 |
| Last， $\mathrm{R}_{0}$ | 109 | 70 | 7630 | 11881 | 4900 |
| Logang So | 105 | 87 | 9135 | 11025 | 7569 |
| Loveckys Jo | 106 | 80 | 8480 | 11236 | 6400 |
| Lowe， $\mathrm{G}_{0}$ | 117 | 50 | 5550 | 12321 | 2500 |
| McDougall， H 。 | 104 | 54 | 5616 | 10816 | 2916 |
| MeIntosh， F 。 | 122 | 77 | 8624 | 12544 | 5929 |
| McIsaac， $\mathrm{G}^{\text {a }}$ | 103 | 57 | 5871 | 10609 | 3249 |
| Mchurray，A。 | 108 | 34 | 3672 | 11664 | 1156 |

TABIE 10 －Continued

| Pupil | $\begin{aligned} & I_{0} Q_{0} \end{aligned}$ | June （Y） | Products （XY） | Squares $\left(X^{2}\right)$ | Squares $\left(Y^{2}\right)$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| McSheffrey， $\mathrm{B}_{6}$ | 117 | 90 | 105.30 | 13689 | 8100 |
| Mearns，A。 | 105 | 23 | 2415 | 11025 | 529 |
| Mearns，I． | 103 | 25 | 2575 | 10609 | 625 |
| Middagh，M． | 101 | 39 | 3939 | 10209 | 1521 |
| Miltong B | 110 | 75 | 8250 | 12100 | 5625 |
| Monis，M． | 110 | 96 | 10560 | 12100 | 9216 |
| Mote， $\mathrm{L}_{\text {。 }}$ | 105 | 67 | 7035 | 11025 | 4489 |
| Murray，J． | 107 | 51 | 5457 | 11449 | 2601 |
| Newton， $\mathrm{B}^{\text {o }}$ | 109 | 63 | 6867 | 11881 | 3969 |
| Nielson，$K_{\text {d }}$ | 100 | 40 | 4000 | 10000 | 1600 |
| Nisbet，${ }^{\text {B }}$ | 105 | 56 | 5880 | 11025 | 3136 |
| Norlander，A． | 107 | 91 | 9737 | 11449 | 8281 |
| Pankew， $\mathrm{L}_{\text {o }}$ | 99 | 34 | 3366 | 9801 | 1156 |
| Persson， $\mathrm{V}_{\text {O }}$ | 107 | 53 | 5353 | 10201 | 2809 |
| Prokops， | 106 | 89 | 9434 | 11236 | 7921 |
| Ross，${ }^{\text {d }}$ | 110 | 83 | 9130 | 12100 | 6889 |
| Rossingtong $\mathrm{C}_{6}$ | 121 | 84 | 10164 | 14.641 | 7056 |
| Schwandtg Jo | 105 | 29 | 3045 | 11025 | 841 |
| Shockey，L． | 108 | 45 | 4860 | 11664 | 2025 |
| Shore，E． | 106 | 38 | 4028 | 11236 | 1444 |
| Smith，A。 | 116 | 88 | 10208 | 13456 | 7744 |
| SorligSo | 106 | 54 | 5724 | $\pm 1236$ | 2916 |
| Sorenson，D． | 111 | 70 | 7770 | 12321 | 4900 |
| Southern，Mo． | 114 | 37 | 4218 | 12996 | 1369 |
| Southern， 0. | 110 | 71 | 7810 | 12100 | 5041 |
| Spencer， 1 | 171 | 54 | 5994 | 12321 | 2916 |
| Strand，D． | 109 | 79 | 8611 | 11887 | 6241 |
| Strijackovo | 116 | 79 | 9164 | 33456 | 6243 |
| Thomps on，B． | 113 | 93 | 10509 | 12769 | 8649 |
| Turcotte，Re | 96 | 21 | 2016 | 9216 | 441 |
| WintertongM． | 103 | 73 | 7519 | 10609 | 5329 |
| $\begin{aligned} & 80 \\ & (\mathrm{I}) \end{aligned}$ | $\begin{aligned} & 8539 \\ & (\Sigma \mathrm{\Sigma}) \end{aligned}$ | $\begin{aligned} & 4633 \\ & (\Sigma \mathrm{E}) \end{aligned}$ | $\begin{array}{r} 499174 \\ (\Sigma X Y) \end{array}$ | $\begin{array}{r} 914219 \\ \left(5 x^{2}\right) \end{array}$ | $\begin{array}{r} 302769 \\ \left(\Sigma Y^{2}\right) \end{array}$ |

Other Correlation Coefficients. -
The correlation between the ilathematics
Test and the Chemistry June finals gives a value of:

$$
\begin{aligned}
r & =\frac{353073-\frac{(5765)(4571)}{78}}{\sqrt{450953-\frac{33235225}{78} \sqrt{300775-\frac{20894041}{78}}}} \\
= & .53
\end{aligned}
$$

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

$$
\begin{aligned}
r & =\frac{291051-\frac{(4754)(4571)}{78}}{\sqrt{331116-\frac{(4754)^{2}}{78}} \sqrt{300775-\frac{\left(45711^{2}\right.}{78}}} \\
& =.34
\end{aligned}
$$

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

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

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

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

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

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

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

$$
=.51
$$

The "t" test of significance.
The reliability of the correlation coeffice lent was tested as a further means of determination of its significance. "In experimental and research work the determination of whether an observed differ m ence is of such magnitude that it cannot be attribute to chance factors or sampling variations is often our major interest." 25

The test of significance in this case assumes

25Allen Lo Edwards, Statistical Analysis for Students in Psychology and Education Rinehard and CoogInc. New York g 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 $t_{\text {. }}$ -

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

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

where $r$ equals the observed sample value of the correlation coefficient, and $\mathbb{N}$ 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 peirs 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
${ }^{26}$ Ibid. 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 coerf. icient 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.

PABLE 11
VALUE OF $t @ 5 \% \& 2 \%$ LETELS OF SIGNTPICANCE

| Degree of Freedom | $5 \%$ | $1 \%$ |
| :---: | :---: | :---: |
| 50 | 2.008 | 2.678 |
| 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 Ibid. p. 330.

## CHAPTER V

INTERPRETATION AND CONCIUSION

Interpretation of the results is not as simple a matter as examining correleation coeffo icients 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 specificm ally treated in this study as being constants. In addition it is acknowledged that the interpretation of correlation coefificients without adequate considm eration 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 coefricients as made by H．O．Rugg，in Statistical Methods Applied to Education，summarizes into：

Below ． 15 or 020 ，＂negligible or indifferent＂ From ． 15 or .20 to .35 or 040 ，＂present but low＂ From． 35 or 40 to ． 50 or .60 ，＂markedly present＂ Above ． 60 or $\cdot 70$ ，＂high＂

Summarizing the findings on this basis yields the following infornation：

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

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

Correlation between Reading ability and Chem－ istry，． 34, ＂present but low＂．

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

Correlation between Homework Index and Chem－ istry，．60，＂high＂．

Correlation between Pretest and Chemistry，
－51，＂markedly present＂．
In conjunction with the above it may be noted $28_{\text {riegs }}$ and Crawford，Op．Cit．p．I63．
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 employo ed.

## Io 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. $\mathrm{Q}^{\prime}$ 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' recorls 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 classo 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, $53.5 \%$ passed with an I. Q. up to I05, and only $30.7 \%$ passed heving I.g's. up to 100. The Iowm est I.Q. receiving a pass mark was 96 ; the highest I.Q. receiving a failure mark was 1150

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 $I_{0}$ Qs. of 110 or more Obviously this is not so. Yet the course generally given is
aimed at such students." 29
A high I.g. 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 science 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 general learning aptitude, since the specific contribution of numerical skill to English or social studies can scarcely be appreciable." 30
${ }^{29}$ Paul $F$. Brandwein. "Signposts Twoards the Revision of High School Chemistry", School Science and Mathematics. Vol. LIII, April 1953.p. 313

30Bennett, Seashore, \& Wesman, Op,Cit.p. 38.

## Reading and June finals.-

Here the correlation is . 34, "present but Iow". 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 reasoring 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 caefficient 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 centainly in direct contrast to that of the proponents of craming.

## 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 begin ing of his chemistry course. Since the coefficient of relationship between this factor and his June mark in chemistry works out to . 51, "markedy 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 emphasiza es 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 coerficient is "markedly present". The Present Grade XI Chemistry Text. An analysis of the Grade XI Chemistry text, Modern Chemistry, 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 Fowever, 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 clessrooms 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 readm ability 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 ( $p$ p. 44 to 47), in which an evaiuation is made of the difficulty of end-of-chapter 31paul $F$. Brandwein, Op,Cit. p.313.

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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 mith a stax 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 Iives, combined with a private shorthand, a private mathematics, high levels of abstraction, often sym bolic and highly theoretical in nature, as well as the laboratory skills which accompany learning in chemistry." 33

That this statement is partly true would
seem evident from the fects disclosed. Chemistry

32 DuII, Brooks, Metcalfes Op.Cit. p.iii. 33 Paul F' Brandwein, Op.Cit. 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 cheristry, 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 or the school, there is nothing much remedial we can do in this respect, other than realize that a lower level I。 $\mathrm{Q}_{0}$ student is going to require more supervision and guidance in this subject. Another alternative would be to Iower 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 mey be derived as to what degree of success he will have in chemistry. Wile 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 meximum 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 chemm istry is $16 \%$ of the text for Grade VII, $11 \%$ for Grade VIII, $17 \%$ for Grade X , but for Grade IX Iess 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 junjor 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 oi 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 tremendousIy 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 difficula ty is much Iess. The alternative is for the teacher to select and compile supplementary assignment material. This presupposes that the teacher has the

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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 alm ready overloaded timetable. Such a procedure may be necessary, but it certainly decreases the value of the textbook.

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## APPBNDIX

PageSummary of Pre-grade XI chemistry. . . 84Summary of Grade XI chemistry. . . . 92
Chemistry pretest, Grade XI. . . . . 94
Sample homework record score sheet . . 99
Dale check list of 769 easy words. . . 100
Group Test of Learning Capacity
Differential Aptitude Test: NumericalAbility
Differential Aptitude Test: AbstractReasoning
Iowa Silent Reading Test

Summary of premgrade XI chemistry and of Grade XI chemistry text

Grade VII
Chap. 7 Plants Provide Food Energy To show the effect of iodine upon starch (Expel). 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 additiong they contain nitrogen and usually sulphur, and sometimes phosphorous and other elements" ( p .76 )
Ifinerals that are important to plants for food, Lime (Limestone) Calcium Sodium nitrate(Chile saltpetre) Nitrogen Bone ireal Potash(Wood ashes) Potassium Phosphorm ous
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) "Substences 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 aiter burning as test for element materials. Calcium most importent 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 bloode Iodine - In order that the thyroid may do its work properiy, it must be supplied with a small amount of the element iodine.

Common salte Common table salt is sodium chloride, a compound of sodium and chlorine. Tears, perspiration also contain salt.
Chap. 9
Vitamins $C, A, B_{1}, B_{2}, D$ 。
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 Bxperiment 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, gaso "All matter is made up of tiny particles called molecules. 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. Charm acteristics or properties, such as colourg odor, taste, weight or density, solubility, compressibility, and changes of state, are called physical properties. Air- gas, colourless, odorless, tasteless, light in weight, somewhat soluble in water. Liqueries at $-190^{\circ} \mathrm{C}$. Water vapour Iiquefies at $212^{\circ} \mathrm{F}$. Experiments to show that air can be compressed, that it supports burning; experiment with burning phosphorous in inverted jar to show that only twentywone 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 oxygen. The part of the air that does not support combustion is called nitrogen. Besides these two gases, air contains about one per cent of other gases: water vapour, carbon dioxide, and a number of rare gasesg- 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 oxygengglowing spinter bursts into ilame; 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 colorm less gas with a suffocating odor called sulfur dioxide; similerly iron burns in air to form iron oxide. "The union or any substance with oxygen is called oxidation. Rapid oxidation is commonly called combustion or burning.

Physical properties of oxygeng- gas, colorm less, odorless, tasteless, somewhat soluble in water; supports combustion (a chemrcal change). Over one fifth of the air is oxygen. Oxides are abundant, - as iron oxide, water.

Nitrogen of the airg- 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 aix, 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 bulbsg in television, as fog penetrating Iights, 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 airg- 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 (Iimewater test). "When charcoal burns carbon dioxide is formed;" ${ }^{\prime \prime}$ gas, colorless. Expeximent to show that carbon dioxide is part of our exhaled breath by blowing into Imewater. The carbon dioxide cycle. Impurities in air, as dust, bacteria, mould, spores.
Chap. 18 Respiration in plents 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 $\overline{\operatorname{cin}}$ definite shape; such particles are called crystals." (p.304)
I. 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 con centrated 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
"Bach 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, cerbon, 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". (ppo114-115). Chap. 16 Water as a Great Solvent

Sterilizing and disinfecting water. By boiling or by ading 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 waterg "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 boilinge Soft water from frozen hard water. Water is
${ }^{34}$ C. A.Hensley, D.A.Patterson, O.A.Armstrong, Science Indoors and Out, Book I. W. J.Gage \& Co, Toronto.
a great solvent in nature. Insoluble sube stances: 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 permanentIy 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 liquidgm condensation. Evaporation and condensationg= 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." $(\mathrm{p} .235)$. Sublimation important in formation of dry ice, cerbon 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 $4^{\circ} \mathrm{C}$., $39^{\circ} \mathrm{F}$., than at any other temperature. Water expands as it freezes. Ice is Iighter than water. Atmospheric pressure and the barometer.

Grade IX
Chap. 26
Conservation of our individual efficiency. Alcohol and tobacco. Alcohol as an anees

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C.A.Hensley, D.A.Patiterson, O.A.Armstrong, Science Indoors and Out, 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 Tobacco tars Acrolein

Formaldehyde
Formic acid
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).

## 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 thet 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 mate
erials for many perfumes......Chemists can put Iimestone, water, salt and lampblack together to make plastics and synthetic rubber.
"The way scientists think and work,
(I) The scientist gets clearly in mind

36
C.A. HensIey, D.A.Patterson, D.A.Armstrong, Science Indoors and Out, Book 3. W. J. Gage \& Co., Tomonto.
the problem he wants to solve. He sees clearly just what it is he is trying to do, or ex plain, 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 that looks as if it might be the correct one.
(4) He plans and tries an experiment to see in 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." ( $\mathrm{p}, 22$ )

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 solm utions: (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 nolecular 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 Hg 0 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 mlements", lists twenty-eight elements with their symbols, and some of their characteristics and uses. Table 3, page 53. "Some

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

The metric system as compared to the English system of measurements....olcu.ft. water weighs 62.4 Ibs.
Unit 3. How Materials Change
How heating and cooling change materials.
MIMost solids expand when heated and contract when cooled." (p.65). Change of state: solid, liquid, gas. Melting and boiling points of some comon metals, and of water: Fahrenheit and Centigrade (Table 5, p.68). Effect of heato ing and cooling on liquids and on gases. How the molecular theory explains change of state. How chemical chenge affects the characteristics of a substance, viz., wood is heated, sulfur and $\boldsymbol{3 r o n}$ are heated together (chenical combint ation, iron sulfide is formed); sulfuric acid on sugar.

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

$$
\begin{aligned}
& 2 \mathrm{H}_{2} \nleftarrow \mathrm{O}_{2}=-2 \mathrm{H}_{2} \mathrm{O} \\
& 2 \mathrm{Hg} \nleftarrow \mathrm{O}_{2}--2 \mathrm{HgO} \\
& 2 \mathrm{Na} \nleftarrow \mathrm{Cl}_{2}-\infty 2 \mathrm{NaCl} \\
& 4 \mathrm{He} \nleftarrow 3 \mathrm{O}_{2}--2 \mathrm{Fe}_{2} \mathrm{O}_{3}
\end{aligned}
$$

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 mere \&uxy; dangers of gasoline, benzene, Naphthay alcohol near a ifire; fire extinguishers, as carbon tetrachloride, carbon dioxide in foam extinguishers.

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

37Wilbur L. Beauchamp, John Ce Mayrield, Joe Young West, Everyday Problems in Science. W. Jo Gage \& Coo, 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; solm ubility graph; standards of purity; efflorese cence, deliquescence. (Solutions are well coverm ed 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 carbong-
Carbon dioxide,- preparation, properties, uses. (Grade VII studies carbon diozide and iss 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.
Fydrogen sulphide, preparation, properties,
uses.
Sulfur dioxide, - Preparation, properties,
uses. (Very elementary consideration of $\mathrm{SO}_{2}$ in Grade VII).

Sulfuric acid, preparation, properties,
uses.
Sulfurous acid.
Chlorine, - preparation, properties, uses. Hydrochloric acidg- preparation, properties,
uses.
$38_{\text {Charles E. Dull, William O. Brooks, H. }}$ Clark Metcalfe, Modern Chemistry. Benry Holt and Company, New Yorik, 1951.

Chemistry Pretest, Grd. XI. Answer all questions on this sheet in the spaces provided.
I. The difference between fresh water and salt water is that................contains more dissolved mineral matter.
2. If a food, on being tested with iodine turns darix blue of black, then we know that the food contains... 3. 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 head-ings:-

6. In what part of the body are the following minerals found,
(I) CaIcium
(4) Iodine.
(2) Phosphorus............(5) Sodium chloride
(3) Iron
7. The two elements in water are...........and.......
and in carbon dioxide are..............and.
8. Give a derinition 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 Ibs., $1 \frac{1}{4}$ ozs., and 440 Ibs.g represent the weights of one cubic foot of air, water, and iron, but not in that order. ifiatch the numbers with the appropriate substance to give the correct weight.
air............water...................................................
13. Give the properties of air, and of oxygen under the following headings: Air

Oxygen


Color.........................
Odor.
Tasteg........................
Solubility
14. When phosphorus is burned in a jar or air it is found that only...........\% of the air supports co, bustion.

I5. 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 or it solidifies or forms
22. Fermentation of sugery foods produces the chem
ical 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.
26. Chemistry is the science of............................
27. Three characteristics (properties) of solutions are:-
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 nemes of ten elements whose symbols are given below:-

Al................ $H_{0} \ldots . . . . . . . . . . . . N_{0} . . . . . . . . . .$.

C.o............... Fe................. $K_{\text {................. }}$

Clo............... Pb................. Si................
Cu................. Hg.................. Na................
31. Name five of the compounds whose formulae are given below,

37. Examples of three different forms of carbon are, -
38. Three methods that are commonly used in the purifu ication of water are:-
39. Water that forms a curd or precipitate whenssoap is added is known as.......................................

Name

Grade.................Date.........................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． 6586 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Barker， Z ： | 16，25 | $1,2,3,4$ |  | $1,2,3$ | $\begin{aligned} & 11,14,16,17, \\ & 18,16,20 \end{aligned}$ |
| Bailey，S． |  | 3 |  | 3 | $14,15,16,17,$ |
| Clay，D． | 2，14，25，26 | 1，2，3 |  | 2.3 | $\begin{aligned} & 7,8,9,10,12,15, \\ & 16,17,18,20,21 \end{aligned}$ |
| Cole，D． | 8 | 3 |  |  | $\begin{aligned} & 5,6,14,15,16 \\ & 17,19,20,21 \end{aligned}$ |
| Cowie，E． |  | 1，2，3，4 |  |  | 17，18，20 |
| Fraser，D． | $\frac{25}{27}$ | 1，2，3，4 |  | 3 | $\begin{aligned} & 11,14,15,169 \\ & 17,18,20 \end{aligned}$ |
| Fric， $\mathrm{I}_{0}$ | $\begin{aligned} & 21,23,24, \\ & 25,26 \end{aligned}$ | 2,3 |  | $\square$ | $\begin{aligned} & 2,8,14,16,17, \\ & 18,20 \end{aligned}$ |
| Giras $\mathrm{F}^{\text {d }}$ |  | 4 | 13，14 | 2，3 | $\begin{aligned} & 4,6,7,14,159 \\ & 16,17,20 \\ & \hline \end{aligned}$ |
| Greenberger |  | $1,2,3,4$ | 26 | 1.3 | $\begin{aligned} & 6,10,11,12,13, \\ & 15,16,17,18,20 \end{aligned}$ |
| Hage， 0. | 8 |  |  | 3 | $3,4,5,8,9,10,11$ $13,16,17,18,19$ |
| HelaszgS． | 25 | 4 | 24 | 3 | $11,14,15,16,17,$ |
| Hartman，S． |  | 1，2，3 | 24 | 3 | $\begin{aligned} & 4,6,9,10,12,16, \\ & 17,18,20 \end{aligned}$ |
| Hayden，G。 |  | 1，2，3，4． |  | 1，2，3 | $\begin{aligned} & 3,5,6,7,8,9,109 \\ & 15,16,17,18,20 \end{aligned}$ |
| Euszti，Po | 25 |  |  |  | $4,5,11,17,18$ |
| Ibbott，B． |  | 2，3，4 |  | 1，2，3 | $\begin{aligned} & 3,18,20,159 \\ & 16,17 \end{aligned}$ |
| Kedcie，Mo |  | 2 |  | 3 | $\begin{aligned} & 10,11,15,16, \\ & 17,18,20 \end{aligned}$ |
| 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， $\mathrm{S}^{\text {．}}$ |  | 1，2，3 |  | 3 | $\begin{aligned} & 3,4,8,9,11,13, \\ & 20,21 \end{aligned}$ |
| Lovecky，J． | 8，9 | 1，2，3 |  | 1,3 | $1,2,7,11,14,159$ |
| McIntosh，F． | 26 | 4 |  | 1，2，3 | $\begin{aligned} & 3,4,5,6,14,159 \\ & 16,17-21 \\ & \hline \end{aligned}$ |
| McIsaac， $\mathrm{G}_{\text {O }}$ | $\begin{aligned} & 8,102 \\ & 14,16 \end{aligned}$ | 1，3 |  | 1，2，3 | $\begin{aligned} & 1,11,15,16, \\ & 18,20 \\ & \hline \end{aligned}$ |

Dale Check list of 769 easy wordsg-
A B C

| a | baby | both | cake | corner |
| :---: | :---: | :---: | :---: | :---: |
| about | back | bottom | call | cost |
| above | bad | bow | came | could |
| across | bag | box | can | count |
| act | ball | boy | cap | country |
| afraid | band | branch | captain | c五urse |
| after | benk | brave | car | cover |
| afternoon | basket | bread | care | cow |
| again | be | break | careful | cried |
| against | bear | breakfast | carry | cross |
| ago | beat | bridge | case | crowd |
| air | beautiful | bright | catch | crown |
| all | because | bring | cause | cry |
| almost | bed | broken | cent | cup |
| alone | bee | brother | centre | cut |
| along | been | brought | chair |  |
| already | before | brown | chance |  |
| also | began | build | change |  |
| always | begin | building | chief |  |
| am | behind | built | child |  |
| American | believe | burn | children |  |
| an | being | busy | choose |  |
| and | bell | but | Christmas |  |
| animal | belong | butter | church |  |
| another | beside | by | circle |  |
| answer | best |  | city |  |
| any | better |  | class |  |
| anything | between |  | clean |  |
| apple | big |  | clear |  |
| are | bill |  | clock |  |
| arm | bird |  | close |  |
| around | bit |  | cloth |  |
| as | black |  | clothes |  |
| ask | bless |  | cloud |  |
| at | blind |  | coal |  |
| away | blood |  | coat |  |
|  | blow |  | cold |  |
|  | blue |  | color |  |
|  | board |  | come |  |
|  | boat |  | coming |  |
|  | body |  | company |  |
|  | bone |  | cook |  |
|  | book |  | cool |  |
|  | born |  | com |  |

101

| D | E | F | G | H |
| :---: | :---: | :---: | :---: | :---: |
| dance | each | face | game | had |
| dark | ear | fair | garden | hair |
| day | early | $f \mathrm{fll}$ | gate | half |
| dead | earth | amily | gave | hall |
| dear | east | fancy | get | hand |
| deep | easy | far | gist | hang |
| did | eat | farm | girl | happy |
| die | edge | farmer | give | hard |
| different | egg | fast | glad | has |
| dinner | eight | fat | glas | hat |
| do | either | father | go | have |
| doctor | else | feed | GOd | he |
| does | end | feel | going | head |
| dog | England | feet | gold | hear |
| done | English | fell | golden | heard |
| don't | enough | fellow | gone | heart |
| door | even | felt | good | heavy |
| double | evening | fence | got | help |
| down | ever | few | grain | her |
| araw | every | field | grass | here |
| dream | everything | fight | gray | herself |
| dress | except | 1ill | great | hid |
| drink | eye | find | green | high |
| drive |  | ine | grew | hill |
| drop |  | finger | ground | him |
| dry |  | finish | grow | himself |
| dust |  | fire | guess | his |
|  |  | first |  | hold |
|  |  | fish |  | hole |
|  |  | fit |  | home |
|  |  | five |  | hope |
|  |  | fix |  | horse |
|  |  | floor |  | hot |
|  |  | flower |  | house |
|  |  | fly |  | how |
|  |  | follow |  | hundred |
|  |  | food |  | hunt |
|  |  | foot |  | hurry |
|  |  | for |  | hurt |
|  |  | forget |  |  |
|  |  | fourth |  |  |
|  |  | found |  |  |
|  |  | four |  |  |
|  |  | fresh |  |  |
|  |  | friend |  |  |
|  |  | from |  |  |
|  |  | front |  |  |
|  |  | fruit |  |  |
|  |  | full |  |  |


| I | L | III | N | 0 |
| :---: | :---: | :---: | :---: | :---: |
| I | Iady | made | name | 02k |
| ice | laid | mail | near | ocean |
| if | Iake | make | neck |  |
| in | land | man | need | off |
| Indian | large | many | neighbor | office |
| instead | last | march | neither | often |
| into | late | mark | nest | old |
| iron | laugh | market | never | on |
| is | lay | matter | new | once |
| it | lead | may | New York | one |
| its | Iearn | me | next | only |
|  | leave | mean | mice | open |
|  | left | measure | night | or |
|  | 1 eg | meat | nine | other |
|  | lesson | meet | no | out |
|  | let | men | noise | outside |
| $J$ | letter | middle | none | over |
|  | lie | might | noon | own |
| just | Iift | mile | nor |  |
| junp | Iight | milk | north |  |
|  | like | mill | nose |  |
|  | line | mind | not |  |
|  | Iion | mine | note |  |
|  | lips | minute | nothing |  |
|  | listen | miss | now |  |
| K | little | money | number |  |
|  | live | month |  |  |
| keep | load | moon |  |  |
| kept | long | more |  |  |
| kill | look | morning |  |  |
| kind | lost | most |  |  |
| king | lot | mother |  |  |
| kiss | loud | mountain |  |  |
| knee | love | mouth |  |  |
| knew | low | move |  |  |
| know |  | Mr. |  |  |
|  |  | Wrs. |  |  |
|  |  | much |  |  |
|  |  | music |  |  |
|  | , | must |  |  |
|  |  | my |  |  |
|  |  | myself |  |  |

## 103

| P | Q | R | S |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| page | quarter | race | said | silk | stop <br> stick |
| paint | queen | rain | sajl | silver |  |
| pair | quick | ran | salt | sing | still |
| paper | quiet | rather | same | sir | stone |
| part | quite | reach | sand | sister | stood |
| party |  | read | sat | sit | stop |
| pass |  | ready | save | six | store |
| path |  | real | saw | size | storm |
| pay |  | revson | say | skin |  |
| pen |  | red | school | sky | straight |
| people |  | remember | sea. | sleep | straight <br> street |
| pick |  | rest | season | sIow | strike |
| picture |  | rich | seat | small | strong |
| plece |  | ride | second | smoke | such |
| plain |  | ring | seed | snow | sugar |
| plant |  | river | seem | soft | suit <br> summer |
| play |  | road | seen | sold | sun |
| please |  | rock | self | soldier |  |
| point |  | roll | sell | some |  |
| poor |  | roof | send | something |  |
| post |  | room | sent | sometime | sweet |
| pourid |  | rose | serve | song |  |
| present |  | round | set | soon |  |
| press |  | row | seven | sound |  |
| pretty |  | run | several | south |  |
| pull |  |  | shake | space |  |
| put |  |  | shall | speak |  |
|  |  |  | shape | spot |  |
|  |  |  | she | spread |  |
|  |  |  | sheep | spring |  |
|  |  |  | shine | square |  |
|  |  |  | ship | stand |  |
|  |  |  | show | star |  |
|  |  |  | shop | start |  |
|  |  |  | short | station |  |
|  |  |  | should | stay |  |
|  |  |  | shoulder |  |  |
|  |  |  | show |  |  |
|  |  |  | shut |  |  |
|  |  |  | sick |  |  |
|  |  |  | side |  |  |
|  |  |  | sign |  |  |


| T |  | U | W |  |
| :---: | :---: | :---: | :---: | :---: |
| table | took | uncle | wait | with |
| tail | top | under | walk | without |
| take | touch | until | wall | woman |
| talk | town | up | want | wonder |
| tall | trade | upon | war | wood |
| taste | train | us | warn | word |
| teach | tree | use | was | work |
| teacher | true |  | wash | world |
| tear | try |  | waste | would |
| tell | turn |  | watch | Write |
| ten | twelve |  | water | wrong |
| than | twenty | V | wave | Wrong |
| thank | two |  | way |  |
| that |  | valley | we |  |
| the |  | very | wear |  |
| their |  | visit | weather | Y |
| them |  |  | week |  |
| then |  |  | well | yard |
| there |  |  | went | year |
| these |  |  | were | yellow |
| they |  |  | west | yes |
| thick |  |  | what | yesterday |
| thin |  |  | wheat | yet |
| thing |  |  | wheel | you |
| think |  |  | When | young |
| this |  |  | where | your |
| those |  |  | whether |  |
| though |  |  | which |  |
| thought |  |  | while |  |
| thousand |  |  | white |  |
| three |  |  | who |  |
| through |  |  | whold |  |
| throw |  |  | whom |  |
| tie |  |  | whose |  |
| till |  |  | why |  |
| time |  |  | wide |  |
| tire(d) |  |  | wild |  |
| to |  |  | Will |  |
| today |  |  | win |  |
| together |  |  | wind |  |
| told |  |  | window |  |
| tomorrow |  |  | wing |  |
| tongue |  |  | winter |  |
| too |  |  | wish |  |


| M.A. |  |
| :--- | :--- |
| C.A. |  |
| $\frac{\text { M.A. }}{\text { C.A. }} \times 100$ |  |

## 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.................. | firstiome |
| :---: | :---: |
| Birthday......... | $\underset{\text { YEAR }}{\ldots} .$ |
| School. | . Town or City |

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 $\qquad$
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?
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 first letter of the word to be omitted....................(S )

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


A

$$
-1-
$$

1. Which word does not belong in this list?

1 piano 2 harp 3 violin 4 guitar 5 cornet $\qquad$
2. What number comes next in the following series?

192, $96, \quad 48, \quad 24, \ldots . .$. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ()
3. She is to hers as $\mathbf{I}$ is to

1 my 2 me 3 our 4 mine 5 we. $\qquad$
4. Which word does not belong in this list?

1 grouse 2 lark 3 partridge 4 pheasant 5 quail $\qquad$
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? $\qquad$
7. Which word does not belong in this list?

1 build 2 damage 3 strengthen 4 repair 5 improve $\qquad$
8. Canoe is to paddle as airplane is to

1 wings 2 air 3 aviator 4 propeller 5 steer $\qquad$
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 $\qquad$
6. Picture is to frame as lake is to

1 shore 2 water 3 river 4 island 5 fish....................................... ()
11. ABCDEFGHIJKLMNOPQRSTUVWXYZ

Find the fourth letter before the letter which comes midway between $G$ and $K$ in the alphabet. Print it $\qquad$
12. Equestrian is to pedestrian as ride is to

1 horse 2 gallop 3 walk 4 sit 5 saddle $\qquad$
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............. ( )
16.

(1) $\sqrt{7}$
(2) $\square$
(3)
(3) $\nabla$
(4) $\square$
(5) $\qquad$
$\qquad$ .)
17. What number comes next in the following series?

$$
1, \quad 3, \quad 8,10, \quad 15,17, \ldots
$$

18.     - is to $<$ as $\square$ is to
(1)
${ }^{(2)} \leftharpoonup$
(3) $\angle$
(4) $\zeta$
(5) $\Sigma$ $\qquad$ )
19. 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?

$$
\begin{aligned}
& \text { hat number comes next in the following series? } \\
& 1, \quad 3, \quad 7, \quad 15, \quad 31, \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . .
\end{aligned}
$$

21. July is to May as September is to

August $\quad 2$ November 3 July 4 October 5 May................................
22. What number comes next in the following series?

$$
2, \quad 3, \quad 5, \quad 8,12, .
$$

23. Which word does not belong in this list?

1 happiness 2 bliss 3 joy 4 rapture 5 fun.
24. What number comes next in the following series? $50, \quad 40, \quad 31, \quad 23, \quad 16, \quad 10,$.

5. $L$ is to $\rceil$ as $Q$ is to
(1) $\square$
${ }^{(2)} \square$
(3)
(4) $\bigcap$(5)
$\square$
$\qquad$ $\ldots$ ( )
26. 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................. (
27. If 5 and 4 make 9 , write 9 , unless 4 and 4 make 7 , in which case write 8 $\qquad$ ..( )
28. What number comes next in the following series? $6, \quad 10, \quad 8, \quad 13,10,16,12, \ldots$
29. $N$ is to $V$ as $A$ is to
(1) $/ \sim$
(2) $\forall$
(3) $\neg$
(4) $A$
(5) 7

A
30. home soldiers defending hardest their bravery when fight

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.
31. ABCDEFGHIJKLMNOPQRSTUVWXYZ

What letter comes just as far after $L$ in the alphabet as $V$ comes before $T$ in the word UNIVERSALITY? Print it.
32. What number comes next in the following series? $7, \quad 5, \quad 10, \quad 8,16,14, \quad 28$
33. Land is to isthmus as water is to 1 ocean 2 strait 3 island 4 bay 5 peninsula
34. A candid person is one who is 1 innocent 2 shrewd 3 polite 4 friendly 5 frank
35. What number comes next in the following series? $17, \quad 12, \quad 14, \quad 9, \quad 11$,
36. We raze a house by

1 tearing it down 2 heating it 3 plundering it 4 building it 5 increasing its value.
37. What number comes next in the following series?
$75,74, \quad 72,68,60,44,$.
38. Square is to cube as circle is to

1 circumference $\quad 2$ compasses 3 area 4 radius $\quad 5$ sphere
39. To contaminate is to

1 pollute $\quad 2$ germinate $\quad 3$ approximate 4 slander $\quad 5$ strengthen
40. What number comes next in the following series? $54, \quad 52, \quad 49, \quad 45, \quad 40, \quad 34$
41. = is to \| as $\backslash$ is to
(1)
$(2)=$
(3) //
(4) $=$
(5) //
42. What number comes next in the following series? $8, \quad 3,8,9,8,27,8$,
43. If a boy can run 25 feet while a car travels 60 feet, how many feet can the boy run while the car travels 100 yards?.
44. The opposite of convene is
opposite of convene is
1 recall $\quad 2$ reject $\quad 3$ disperse $\quad 4$ acquit $\quad 5$ resign
45. What number comes next in the following series? $5, \quad 10, \quad 12, \quad 24, \quad 26, \quad 52, \ldots$

A
46. $5,26,12,27,15,9,7,10,23,1,22,14,31,17,3$.

In the line above, how meny 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?

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 deccived 4 taught 5 frightened............... ()
52. Lend is to borrow as rich is to

53. Which word does not belong in this list?

1 me 2 us 3 him 4 she 5 them $\qquad$
54. A char-a-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? $\qquad$
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 $\qquad$
58. Impromptu means the same as

1 expedient 2 speech 3 prompted 4 tardy 5 extempore $\ldots \ldots \ldots \ldots \ldots$............ )
59. A clock which loses two minutes a day shows the correct time at $9 \mathrm{a} . \mathrm{m}$. 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.............................. ()
61. form creeks build to $\operatorname{logs}$ 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

## $-5-$

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 are

1 inquisitive 2 villainous 3 eminent 4 haughty 5 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. ${ }^{T}$ is to $I$ as $\dot{\text { is to }}$
(1)

(2)
$\Gamma$
(3) 7
(4) $\Gamma$
(5) $\quad$
67. Which of the following is a piscatorial activity?
1 farming
2 fishing 3 reading
4 hunting 5 sleeping. $\qquad$
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? $\qquad$
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? $\qquad$
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?

## END OF TEST



# 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.

DO NOT MAKE ANY MARKS IN THIS BOOKLET.


## Mark your answers

 on the separate
## 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.

```
Example X
    Add 13 13 Al A 14 
```

In Example X, 25 is the correct answer, so the space under the letter for $25-\mathrm{B}$-has been filled in.

Example Y
$\begin{array}{lllll}\text { Subtract } & 30 & & \text { A } & 15 \\ & 20 & B & 26 \\ & - & C & 16 \\ & & \text { D } & 8 \\ & & \text { E } & \text { none of these }\end{array}$
In Example Y, the correct answer has not been given, so the space under the letter for "none of these"- E -has been blackened.

Sample of Answer Sheet


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 | ANSWER |
| :---: | :--- |
| $\mathbf{3 9 3}$ | A 7908 |
| 4658 | B 8608 |
| $\mathbf{3 7 9 0}$ | C 8898 |
| $\mathbf{6 7}$ | E 8908 |

2. Subtract

|  | A | 2485 |
| :--- | :--- | :--- |
| 5473 | B | 2486 |
| 2987 | C | 2496 |
| - | D | 3486 |
|  | Enone of these |  |

## 3. Multiply

|  | A | 10900 |
| :--- | :--- | :--- |
| 484 | B | 11100 |
| 25 | C | 11900 |
|  | D | 11700 |
|  | E none of these |  |

## 4. Multiply

| , | A 1.5300 |
| :---: | :---: |
| 2.04 | B 153.0 |
| . 75 | C 1530 |
|  | D 15300 |
|  | E none of these |

## 5. Multiply

| , | A . 99 |
| :---: | :---: |
| 4.50 | B 98.40 |
| 22 | C 99.00 |
|  | D 9900 |
|  | E none of these |

6. Multiply
. 025
.025
7. Multiply

|  | A 256 |
| :--- | :--- |
| .016 | B 25.6 |
| .016 |  |
|  | C .00256 |
|  | E .00256 |
|  |  |

8. Divide
$4 6 \longdiv { 6 9 }$

| A | 1 | $13 / 46$ |
| :--- | :--- | :--- |
| B | $123 / 46$ |  |
| C | 1.5 |  |
| D | 15 |  |
| E none of these |  |  |

9. Divide

| .75) 2.25 | A . 0003 |
| :---: | :---: |
|  | B . 03 |
|  | $\begin{aligned} & \mathrm{C} .3 \\ & \mathrm{D} \\ & \hline \end{aligned}$ |
|  | E none of these |

10. Divide

|  | A . 02 |
| :---: | :---: |
|  | B . 2 |
| 3.6).72 | $\mathrm{C}^{\text {- }}{ }^{2}$ |
|  | D 20 <br> E none of thes |

$\begin{array}{ll}\text { A } & .001375 \\ \text { B } & .00625 \\ \text { C } & .625 \\ \text { D } & 1.375 \\ \text { E } & \text { none of these }\end{array}$
11. Divide
$6 4 . 7 \longdiv { 3 0 4 . 0 9 }$
ANSWER
12. Divide
$. 0 4 \longdiv { 4 . 0 3 6 }$

| A | 1.009 |
| :--- | :--- |
| B | 10.9 |
| C | 10.09 |
| D | 100.9 |
| E | none of these |

13. 

$\frac{1}{4} \div \frac{1}{8}=$

| A | $1 / 32$ |
| :--- | :--- |
| B | $1 / 8$ |
| C | $1 / 2$ |
| D | 2 |
| E none of these |  |

14. 

$$
\frac{2}{7} \times \frac{3}{7}=
$$

15. 

$$
\frac{3 \times 10}{5 \times 9}=
$$

| 16. Add | ANSWER |
| ---: | :--- |
| 433 | A $2611 / 14$ |
| $91 / 2$ | B $271 / 8$ |
| $137 / 8$ | C $281 / 2$ |

## 17. Add

| ft. 3 in. | A 49 ft . |
| :---: | :---: |
| $28 \mathrm{ft} .111 / 2 \mathrm{in}$. | B $48 \mathrm{ft}$.2 in . |
| 17 ft . 5 in. | D 48 ft . 24 in . |
| $41 / 2 \mathrm{in}$. | E none of th |

18. Add

19. Square root

| 19. | A 13 |
| :---: | :---: |
| $\sqrt{169}$ | B 43 |
|  | C $841 / 2$ |
|  | D 169 |
|  | E none of these |
| 20. Square root |  |
|  |  |
| $\sqrt{ } \mathbf{0 9}$ | B . 3 |
|  | C <br> D |
|  | E none of thes |

21. Square root

1
12.
i3.

| $?=12_{\overline{2}}^{1} \%$ of 816 | A . 12 |
| :---: | :---: |
|  | B 12 |
|  | C 102 |
|  | D 104 |
|  | E none of thes |

24. 

$$
?=\frac{4}{9} \text { of } 648
$$

A
B
C
C
D
D
E
E none of these
2.
? $=33 \frac{1}{3} \%$ of 963
$\begin{array}{ll}\text { A } & 32.19 \\ \text { B } & 231 \\ \text { C } & 321 \\ \text { D } & \mathbf{3 2 1 0 0} \\ \text { E } & \text { none of }\end{array}$
E none of these
25.

ANSWER
$15=75 \%$ of ?

| A | .20 |
| :--- | :--- |
| B | 10.25 |
| C | 20 |
| D | 22.5 |
| E none of these |  |

26. 

$25=? \%$ of 125

| A | $1 / 5$ |
| :--- | :--- |
| B | 5 |
| C | 20 |
| D | 31.25 |
| E none of these |  |

27. 

$$
\begin{array}{lll}
2.5=? \% \text { of } 2 & \text { A } & 5 \\
& \text { B } & 8 \\
& C & 80 \\
& \text { D } & 125 \\
& \mathrm{E} & \text { none of these }
\end{array}
$$

28. 

$$
\frac{?}{8}=\frac{3}{24}
$$

| A | $1 / 8$ |
| :--- | :--- |
| B | 1 |
| C | 3 |
| D | 4 |
| E | none of these |

29. 

$$
\frac{5}{9}=\frac{55}{?}
$$

31. Cube root
$\sqrt[3]{32 \times 2}$

| A | $77 / 28$ |
| :--- | :--- |
| B | 28 |
| C | 44 |
| D | 308 |
| E | none of these |

30. 

$\frac{11}{4}=\frac{77}{?}$

| A | $55 / 99$ |
| :--- | :--- |
| B | 11 |
| C | 45 |
| D | 99 |
| E | none of these |

$\begin{array}{ll}\text { A } & 28 \\ \text { B } & 28 \\ \text { C } & 44 \\ \text { D } & \text { none of these }\end{array}$
38. What one number can replace both question marks?

$$
\begin{aligned}
& \frac{8}{?}=\frac{?}{121 / 2} \\
& \begin{array}{ll}
\text { A } & 11 / 2 \\
\text { B } & 4 \\
\text { C } & 64 \\
D & 100 \\
\text { E } & \text { none }
\end{array}
\end{aligned}
$$

37. What one number can replace both question marks?

$$
\begin{aligned}
& \text { A } 1 \\
& \frac{4}{?}=\frac{?}{100} \\
& \begin{array}{ll}
\text { B } & 20 \\
\text { C } & 25 \\
\text { D } & 200
\end{array} \\
& \text { E none of these }
\end{aligned}
$$



## 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.

Do not make any marks in this booklet

## ABSTRACT REASONING DIRECTIONS

## Mark your answers

 on the separate Answer SheetIn 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 $\mathbf{D}$, which is indicated on your Answer Sheet by filling in the little space below $D$, like this


## Example Y

PROBLEM FIGURES


ANSWER FIGURES


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

| A | B | C | D | E |
| :--- | :--- | :--- | :--- | :--- |
| $\vdots$ | I | $\vdots$ | $\vdots$ | $\vdots$ |

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

$\underset{A}{\sim}$


13.

15.

16.


PROBLEM FIGURES




| $\square \quad \square$ | $\square$ | $\square$ | $\square \square \square \square$ |  | $\triangle$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\square$ | $\square$ | $\square$ |  |  |  |
| $\square$ | $\square$ |  |  |  |  |
|  | $\square$ | $\square \square \square \square$ | $\triangle$ | $\square$ | $\square$ |


41.




43 | $O$ | $O$ | $C$ | $C$ | $\sim$ | 0 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0 | 0 | $C$ | $C$ | $\sim \sim$ | $\sigma$ | 0 |




By H．A．Greene<br>Director，Bureau of Educational Research and Service，University of Iowa<br>A．N．Jorgensen<br>President，University of Connecticut<br>and V．H．Kelley<br>University Appointment Office，University of Arizona，Tucson，Arizona

| Median <br> Score |  |
| :--- | :--- |
| Grade <br> Percen－ <br> tile |  |
| Grade <br> Equiv． |  |
| Age <br> Equiv． |  |

## ADVANCED TEST：FORM Aм （Revised）



PROFILE CHART

| Test | Stand Score |
| :---: | :---: |
| Rate：A＋B |  |
| Comprehension： $\mathrm{A}+\mathrm{B}$ |  |
| Directed Reading |  |
| Poetry Comprehension |  |
| Word Meaning |  |
| Sentence Meaning |  |
| Paragraph Comprehension |  |
| Location of Information <br> A．Use of Index |  |
| B．Selection of Key Words |  |


| Score Scale | TEST |  |  |  |  |  |  |  |  | Median Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1R | 1. | 2 | 3 | 4 | 5 | 6 | 7 A | 7 B |  |
|  |  |  |  |  |  |  | 圭 圭 京 |  |  |  |

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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 readin 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-
sive that it made the glass too costly for genera ${ }^{15}$ 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 $l$ of wealthy people.
${ }^{17}$ In the manufacture of glass of high grade, the qi 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 the sand may contain. ${ }^{19}$ These impurities are comn 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.

<2




- yiom siyt lof saf



## 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 ties. ${ }^{2}$ 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 iident, 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 ie people.
The President has no power except that conferred upon by the Constitution and the laws which the people $\geqslant$ 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 $\geqslant$ 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 atting to prevent abuses of public office, and of still ier 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 Ited in a great many abuses. ${ }^{20}$ These abuses are gradu-
ally 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.

## TEST 7. LOCATION OF INFORMATION Tora Silen Readige: Nem Ed. Adv: Ax

## 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 imber. Then fill in the answer space at the right of the exercise which has the same number as the word or phrase 1 you chose. The sample is answered correctly.
LE. What is the value of our annual corn crop?
1 crops. 2 wheat 3 corn 4 sweet corn

What is the value of our annual supply of dairy products?
1 butter 2 cream 3 wool 4 cheese
Vhen was the first transcontinental railroad completed in the United States?
1 United States 2 travel 3 railroads 4 transcontinental railroads. . . . . . . . . . . . . . . . . . . . 2
Vas Lafayette the leader of the "Committee of Public Safety" during the "Reign of Terror"?
1 Lafayette 2 Public Safety 3 "Reign of Terror" 4 leader.
Vas Hindenburg the commander of the Allied Armies during the World War?
1 Hindenburg. 2 Allied Armies. 3 enemies. 4 World War $\qquad$
What was the loss to the citrus fruit industry caused by insects in 1937-1938?
1 production 2 oranges 3 citrus fruit 4 insects
Nas Longfellow the author of "The Courtship of Miles Standish"?
1 American literature 2 poem 3 Longfellow
4 Miles Standish. .6 .
s the metallic element called "radium" obtained solely from pitchblende, a uranium mineral?
1 radium 2 pitchblende 3 uranium 4 elements.
fow does the United States rank with other countries in the production of rubber?
1 United States 2 rubber 3 tire industry 4 rubber plants.
What was the character of the literature of New England throughout the Colonial Period?
1 literature 2 Colonial writers 3 imagination 4 New England authors. $\qquad$
Pid the Cabinet system of England begin with Queen Victoria?
1 Cabinet 2 Reign of Queen Victoria. 3 English Cabinet 4 constitution ............... . 10
fow does the United States rank with the more important European countries in the production of wool?
1 woolens 2 imports 3 sheep 4 wool.
Nas the "Golden Age" of Rome during the period of Hadrian?
1 period. 2 Roman culture 3 Hadrian 4 "Golden Age". 12
Nas the Boy Scouts of America the first national organization for boys?
1 national organizations 2 Boy Scouts 3 leaders 4 scouting.
Nas General Wolfe in command of the French at the battle of Quebec?
1 General Wolfe 2 battle. 3 French and Indian War 4 battle of Quebec. . . . . . . . . . . . . . 14
Is the North Pole surrounded by land or water?
1 water
2 North Pole
3 arctic regions
4 polar regions.

What one factor contributes most to the present death rate in the United States?

$$
1 \text { death rate } 2 \text { accidents } 3 \text { disease } 4 \text { contributions. }
$$

16. 

Was Aristotle known principally as a philosopher of early Roman culture?
1 Aristotle 2 literature 3 philosophy 4 Roman philosophy. . . . . . . . . . . . . . . . . . . . . . . . . . 17
What effect did the mosquitoes have on the development of the Panama Canal?
1 Panama Canal 2 mosquitoes 3 illness 4 climate.
Was Garfield the fifth President of the United States?
1 government
2 Garfield
3 American politics
4 Presidents

Has the Socialist party generally followed the policy of closed shops and government ownership?
1 government ownership 2 Socialistic policies 3 closed shops 4 party.

Stop here. Wait for further instructions.

Jrections. Without looking again at the article, answer these questions. Study these statements carefully. Jecide 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 stateaent 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.
Sample. In order for a law to be enacted it must be approved by all the voters.

1. In the United States the real source of all governmental authority is in the people themselves.
2. The agency for the exercise of the authority delegated by the people is called politics.

4
3. In a democratic nation a public officer is actually the servant of the people who elect him.
4. In order for a law to be enacted it must be approved by the Supreme Court.
b. The control of government in the American system is in Congress.
6. Citizens, by their votes, may delegate authority to officers but have no power to withdraw it.
7. Judges have no authority except that specifically granted each judge by the President.
8. Men are frequently appointed to government office because of some special party service they have rendered.
9. A voter is entitled to vote as he pleases.
0. Ambassadors are appointed from Civil Service lists.

1. According to this article the Civil Service system has corrected abuses connected with political appointments.

11
2. All laws passed by Congress are automatically referred to the people.

12
3. The Dred Scott Decision was a famous court ruling.
4. Under the Constitution of the United States the only persons who can draft a proposal for a law are Congressmen.
5. Government control is centered in the hands of the state and national officers.
6. Civil Service examinations are open only to voters from the party in control at the time.
7. A proposed measure when referred to the voters becomes a law if approved by a majority.
8. An officer who is recalled loses his office even though the voters reëlect him.
9. The Federal income tax provides money for the support of the national government.
0. Under Civil Service rules an appointment to public office is determined by the man's qualifications.

1. The initiative is a privilege which may be used only by a government officer.
2. The way to remove an unsatisfactory official from office is by means of a petition signed by a number of voters.
3. The appointment of men to government office as rewards for political service is called
the Spoils System.
4. The power of government in a democracy is delegated unreservedly
to one man.
5. Many state constitutions were referred to the people before they were adopted.

## PART A. USE OF THE INDEX

crions. The answers to the questions in Column 2 jund in the index below. First read the question and find the desired answer by looking under the proper in the index. Then locate your answer among the sle answers given with the question and fill in the or space in the margin which is numbered the same. idy the samples carefully before you try to answer uestions.
ok at Sample A. In the index under "Indiana" vill find the word "coal" and the page reference, 145. $s$ third among the answers given with the question; e third answer space has been filled in.
jk at Sample B. See if you can find the answer in idex. The correct answer space is marked. swer the remaining exercises the same way.

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$\because$ 482-488; advantages for, $483-484$; Arctic Ocean, 396; imos with white people, 388 ; Hawaiian sugar, 465 .
e: 55, 340-344; Grand Canal, 34I-343; manufacturing,
t: fertilizers for, 48; insects injurious to, 57 ; kinds of, 43 ; paration of seed bed, 55 ; when to sow, 57 ; world's bread in, 52 ; wheat diseases, 59 .

Samples.
A. On what page will you find information about coal in Indiana?
185
288
3145
4146
5159.
... $A$
$B$. Can you find information about the schools of Denmark? 1 Yes 2 No.

1. Next to what page can you find a map of Alaska? $1129 \quad 2147 \quad 3197 \quad 4210 \quad 5213$.
2. Does the index tell where to find information about the industrial uses of corn?
1 Yes 2 No.
3. On what page can a definition of citizenship be found?
118
220
322
424
526
4. Under what topic can you find additional references to gas?
1 cattle
2 coal
3 fuel
4 petroleum
5 power $\qquad$
$\qquad$
$\qquad$ .4
5. What is the number of the figure which shows something about the export of corn from the United States? $1182 \quad 2185 \quad 3187 \quad 4189 \quad 5$ 190...5
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. . . . . .
7. On what page will be found information
$15 \Rightarrow$ about tobacco as a cause of nervousness?
1312
2363
33854386
$5400 . .7$
8. What is the number of the chart showing recent changes in the value of dye products?
111212 3 15 4 20 5 22
9. Does the index tell you on what page you can find something about flour? 1 Yes 2 No.
10. On what page would you learn about the insects which injure wheat?
$143-248$
350
451
556
.10
11. On how many pages is a continuous discussion given about the Grand Canal of Venice?
11
22
33
44
55
$\qquad$
12. Information about the admission of Texas to the Union is given on what page?
1310
2312
3315
4317
$5318 . .12$
13. On how many different pages are brief references given to the commerce of Denmark?

$$
1122 \text { 3 } 3 \text { 44 5 5............ } 13
$$

14. On what page is a discussion of the county court given? $1125 \quad 2127 \quad 3260 \quad 4272 \quad 5278.14$
15. Under what other word would you look for further information about dairy products?
1 cattle 2 corn 3 cows
5 Texas
4 Denmark
...........

## TEST 2. DIRECTED READING

ectrons. 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 manner. ou will have three minutes for this work. You may reread parts of the story if you need to do so.

## 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 fin 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 zours, the particles of rubber rise to the surface. ${ }^{6}$ The thy mass thus obtained can easily be rolled into a sheet her convenient form. ${ }^{7}$ When allowed to dry, it loses loughy character and becomes the firm, elastic solid in 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. Jntil it is used it is stored in a cool, dark place, usually rground. ${ }^{10}$ When a load is brought to the manufacig plant, the first step is to steam it into a soft, plastic 1. ${ }^{11}$ It is then thoroughly washed by being passed Igh 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 subse 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 is 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 pre1 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 vuled. ${ }^{23}$ That is, the rubber is cured by the use of heat. e hardness of the article is determined by the amount at and the length of time it is applied.

Sample. 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?
3. In what parts of the earth do rubber-producing plants grow?
4. What happens if the juice of the rubber tree is allowed to stand undisturbed for a time?
5. What is the first step in the treatment of the raw rubber at the factory?
6. What causes the doughy mass taken from the top of the latex to become firm and elastic?
7. Where is crude rubber kept before it is taken to the manufacturing plant?
8. How are rollers used in washing the plastic rubber ?8
9. Why is steam applied to the crude rubber? .9
10. What appearance does the rubber have after being washed?
.10
11. What is done to change the crude rubber into a puttylike mass?
12. How is the water removed from the sheet rubber? . . . 12
13. Where is sulphur added to the raw rubber?
14. Are different processes required for rubber which is to be used for special purposes?
15. Are the materials which are added to the crude rubber measured very accurately?
16. Are some rubber articles made to withstand the action of acids?
.16
17. In what shape is the rubber in its last stage in the rubber mill?

17
18. What is the name of the process by which rubber articles are made tough and hard? 18
19. What determines the hardness of rubber articles?. . 19
20. What physical treatment is the basis of the curing process applied after the rubber has been molded into the shapes of various articles?.
.20

## TEST

The art of clay-working was first evolved through the ufacture of pottery. The development of satisfactory es and color effécts came through trial and error and rdingly involved great expenditure of labor. As the industry grew, these processes were held in secrecy improvements were slow in coming. With the adement of science in other industries, however, it was ral that its attention should also be directed toward -working.

## 9

A. Choose the best title for the paragraph.
1 Growth of Industries 2 Manufacture of Vases
3 Art of Clay-Working.
B. Why did clay-working as an art develop slowly? Because of - 1 secrecy concerning the processes 2 introduction of scientific methods
3 labor trouble.
. . . . . . . . . . . . . . . . . . . . . . . . . . . .
C. Early improvements in pottery body and color effects came about largely as a result of - $\quad 1$ research

2 an accidental discovery 3 trial and error....c

10
A. Choose the best title for the paragraph.

1 Uses of the Coconut Palm 2 Native Canoes
3 Palm-Leaf Baskets.
. A
B. The natives use the leaves of the coconut palm to make - 1 cups 2 canoes 3 baskets..... B
C. The trunks of the palm trees are used to make -

1 fish nets 2 native canoes 3 fans. .......c

## 11

A. Choose the best title for the paragraph.

1 Planting Cotton 2 Picking Cotton
3 Producing Cotton.
B. During what month is cotton planting usually begun in the South? 1 September 2 February
3 May.
. B
C. Growing corn in the corn belt is much like growing cotton in the South because - 1 the seed is planted in hills in plowed fields 2 planting of both is done at the same period 3 both are cultivated by hand $c$

## 12

A. Choose the best title for the paragraph.

1 Discovery of Coal 2 Discoveries about Coal
3 By-products of Coal.
A
B. What is the most recent of the important discoveries concerning the uses of coal? 1 recovery of byproducts from coal gas 2 recovery of coal gas 3 its heat-producing qualities.
C. In order to produce coke, coal must be heated -

1 under air pressure 2 away from air
3 under water.
Do not turn this page until you are told to do so.

## TEST 3. POETRY COMPREHENSION

mons. 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.
: sample is answered correctly.
E. To whom is the poet addressing his discourse? .

## Wisdom

$\geqslant$ sons of men, with just. regard attend, aserve the preacher, and believe the friend, hose serious Muse inspires him to explain, sat all we act, and all we think is vain, sat 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.
1at from our birth, we take our fatal shares
follies, passions, labors, tumults, cares;
id at approach of death we shall only know 1e truths, which from these pensive numbers flow,
1at we pursue false joy, and suffer real woe.
it Ol ere yet original man was made,
e the foundations of this earth were laid,
was opponent to our search, ordained,
lat joy, still sought, should never be attained;
is sad experience cites me to reveal,
id what I dictate is from what I feel,
im as I was, great David's favorite son, zar 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, ick 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.
Ir 'tis a godlike attribute to know.
From "Knowledge," by John Pryor

1. Are we all asked to believe the explanation given here?1
2. What feeling inspired the poet to write?
3. What does the speaker say about all that we do and think?
4. Is the path of life very difficult to travel?
5. How does the poet refer to the length of life?........ 5
6. Do people ever await the end of life with fear?. . . . o
7. When do we begin our work and worry? .7
8. What do we take with us through life? . . . . . . . . . . . . 8
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?
11. What does the poet say is the object of what we call life?
12. 
13. Over what race was Solomon a ruler?
.12
14. Is Solomon's father mentioned in this poem? . . . . . 13
15. Did Solomon know how well his people liked him? . 14
16. Was Solomon widely known in the Orient? . . . . . . . . 15
17. What indication is there that Solomon was wealthy?
.16
18. Did Solomon have a strong and healthy body?
19. What did Solomon say to himself when reviewing all that was given to him?
.18
20. Where does he say spiritual contentment comes from?
.19
21. What did Solomon say about knowledge? .20

## TEST 6. PARAGRAPH COMPREHENSION (Cont'd)

Sorn 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 iited 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.

5
A. Choose the best title for the paragraph. 1 Using the American Corn Crop 2 Feeding Crops to Hogs 3 Transporting Corn........... A
B. Approximately how much of the annual corn crop does the United States export? 1 practically the entire crop 2 a large percentage 3 a small percentage. $\qquad$ . B
C. Corn is used in the United States chiefly for 1 human food 2 making bread 3 food for animals. $\qquad$
$\qquad$

## 6

A. Choose the best title for the paragraph. 1 The Search for Gold $\quad 2$ Gold and the Devel-
opment of the West
B. The West was developed - 1 at about the same time as the East 2 much earlier 3 long after B
C. The discovery of gold in California was an important factor in - 1 the settlement of the East 2 the building of the steamboat 3 the development of the West.

## 7

A. Choose the best title for the paragraph.

1 A Great Scientist 2 Harvard University
3 Classification of Animals . . . . .................. A
B. At what educational institution did Agassiz do his great work as a scientist? 1 Columbia
2 Johns Hopkins 3 Harvard. . ${ }^{8}$
C. Louis Agassiz attained wide renown as a result of his remarkable skill in - $\quad 1$ classifying animals 2 teaching natural history 3 writing............

8
A. Choose the best title for the paragraph 1 Red Cross Workers 2 Description of the
Red Cross
3 Meaning of the Red Cross......A
B. What one word expresses the characteristic for which the Red Cross is known? 1 sacrifice 2 service 3 safety. . ............................. .
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

## TEST 4. WORD MEANING

PCIIONS. Each of the exercises in Parts A, B, C, and D of this test consists of a statement which is correctly comdd 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. ie sample is answered correctly.
pte. To toil is to -
1 read 2 play 3 work 4 fall 5 believe

## PART A. SOCIAL SCIENCE

Co make a treaty means to -
1 make war 2 trespass 3 make an agreement 4 become violent 5 restrict. . . . . . . . 1 4 rmistice means - 1 continued 2 suspension of arms 3 chivalry

4 a campaign 5 a battle array.
1 constitution means a $\overline{2}$
1 tax 2 conspiracy 3 judicial act. 4 fundamental body of law 5 national debt. . . . . . 3
In amendment means - 1 a change in a constitution. 2 a property tax. 3 an agreement
4 a national convention 5 an income tax $\qquad$
1 llegiance means -
1 felony. 2 anarchism 3 impeachment. 4 adjournment. 5 loyalty to one's country . . . 5 mmigrate means to -

1 emigrate 2 threaten 3 come into a country 4 leave a country 5 punish severely. 6 Tapital means - 1 paper money, 2 accumulated wealth 3 gold and silver

4 spending money 5 property $\because \cdot 7$
nitiative means - 1 iniquity 2 prohibition 3 administration of an inheritance tax
4 the right of the people to introduce a new course of action 5 an injunction.
Reconstruction means the same as $=$
1 reconciliation 2 destruction 3 reorganization 4 discovery 5 obstruction.

In embargo is a -
1 legal act. 2 prohibition on commerce 3 diplomat 4 treaty 5 judicial statement . . 10 So 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. $\qquad$
In envoy is - 1 an envious individual. 2 a soldier. 3 a general
4 a period of time 5 a messenger.
iuffrage means -
1 women's voting
2 representation
3 the right to vote 4 intrigue 5 suffering. $\qquad$
So impeach means to -
1 elect 2 indict 3 protect 4 yield 5 renounce. $\qquad$
3elligerent means -
1 friendly 2 dangerous 3 warlike. 4 peaceful 5 fearful. . . . . . . . . . . . . . . . . . . . . . . 15
Tontraband means - 1 a forbidden article. 2 a careful criticism 3 a contradiction
4 war supplies
5 a veteran.
1 mnesty means -
1 a conviction 2 an embargo 3 an armistice 4 a civil law. 5 a general pardon. . . . 17 Zeferendum means - 1 submitting to a vote of the people. 2 an amendment

3 the passage of an act by Congress 4 voting in party convention 5 recommendation . . . . 18 To nullify means to

1 invalidate 2 secede. 3 pass laws 4 create public sentiment 5 oppose legislation. 19 1 writ refers to -
1 legal evidence
2 a stock certificate
3 a credential
4 a mandate
5 a special tax.

## TEST 6. PARAGRAPH COMPREHENSION

'rions. 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 כpper 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 1othing but bits of wire. The wire was rolled up at id to form a head, while the other end was sharpened.

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 je as the wheat crop and three fourths of the total rop of the world.

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.

Jne way to protect ourselves against poison ivy is to I 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 ie plants up by the roots. The plants may also be by cutting them off at the roots and pouring someon the roots which will kill them. Lubricating oil s is used in automobiles will kill poison-ivy plants.

## 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

## 2

A. Choose the best title for the paragraph.

1 The American Corn Crop 2 The Corn Belt
3 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? 1 three fourths as large 2 twice as large 3 three times as large. . ${ }^{3}$
C. The United States produces more corn than -
1 all of the European countries

1 all of the European countries
2 all other American countries 3 the rest of the
world combined $\qquad$

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.


## 4

A. Choose the best title for the paragraph. 1 Poison-Ivy Plants 2 Protective Measures against Poison Ivy 3 Killing Poison Plants

C. To prevent ivy poisoning, one should -

1 pour oil on the hands 2 destroy all near-by poison-ivy plants 3 wash hands frequently...C


B. How may poison-ivy plants be killed? 1 by pulling them up 2 by cutting them off at roots 3 by pouring oil over them.............. $B$



1 extension 2 emulsion 3 equation 4 inertia 5 chemical change................... . 4 slocity is the same as -

1 motion 2 rate of movement 3 power of combining 4 friction 5 process. . . . . . . . 5 3 adulterate means to $\quad 1$ concede 2 caution 3 instruct 4 reduce

5 make impure by mixing with other substances . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6 Ihuble means -
1 stable
2 neutral
3 rigid 4 liquefiable
5 solid. 5 rebound. $\qquad$ 4 combining with hydrogen 5 neutralizing ............... $\qquad$
$\qquad$
$\qquad$

1 seriousness 2 gratitude 3 attraction of bodies 4 capillarity 5 energy.
$\qquad$ action means -
(


$\qquad$ 3 filter means to -

1 strain 2 radiate 3 mix 4 dissolve 5 resist.9

3 diffuse means to -
1 digest 2 comprehend 3 assimilate 4 digress 5 spread out.
pigment is a $=$
1 coloring matter 2 plaster 3 white substance 4 liquid 5 smooth surface... . . . . . 11 ranslucent means -

1 transmarine 2 partially transparent 3 transpose 4 transfer 5 luminous........ 12
There means to -
1 recognize
2 listen
3 stick fast
4 adjust 5 mix together.
olume means -
1 height 2 depth 3 capacity for holding 4 space occupied 5 model. . 14 atent means -
1 qualitative
2 dormant
3 quantitative
4 peculiar
5 visible

## PART C. MATHEMATICS

o invert means to -
1 invest 2 inventory 3 simplify 4 factor 5 turn upside down.
intersect means to -
1 cut across 2 reduce 3 cancel 4 subtract 5 insert. . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2 legree pertains to -

1 size 2 angles 3 solids 4 decimals 5 division
proximate means -
1 exact. 2 inaccurate 3 estimated. 4 averaged. 5 combined lefnite means -

1 careful 2 precisely limited. 3 infinite 4 divided. 5 decimal........................ 5 peration means - $\underset{1}{1 \text { quotient }} 2$ transformation of quantities 3 reduction 4 review 5 repetition......... 6

1 quotient 2 transformation of quantities 3 reduction 4 review 5 repetition diagonal is - 1 a diameter 2 a description 3 an extreme

4 a line from angle to angle. 5 a line which bisects a figure
rigin means -
1 beginning 2 drill 3 difficulty 4 tables 5 decimals. . . . . . . . . . . . . . . . . . . . . . . . . . . 8
entices pertain to -
1 decimals 2 multiplication 3 angles 4 equality 5 values.......................... . 9
blique means -
1 slanting 2 straight 3 opposite 4 parallel 5 symbolical. . . . . . . . . . . . . . . . . . . . . . . 10
!orizontal means -
1 straight 2 perpendicular. 3 hypothesis 4 a line connecting two points. 5 level. . . 11 rojection means the same as -

1 angle 2 sphere 3 conjunction 4 extension 5 projectile. . . ................... 12
inear pertains to-
1 breadth 2 width 3 area: 4 base 5 length.

## 'olynomial means -

1 many angles 2 many numbers 3 one term 4 many terms 5 one number....... . 14
To converge is to -
1 cancel 2 correspond 3 approach 4 combine. 5 estimate.
Go right on to the next page.
Number right, Part B.
Number right, Part C.

## TEST 5. SENTENCE MEANING (Cont'd)

$\qquad$Does insufficient evidence ever result in a conviction?27
Oo alleged facts often need to be verified? ..... 28
oos similarity between objects necessitate their being identical? ..... 29
re ceremonious activities characteristic of informal gatherings? ..... 3
lo most people approach an unusual ordeal with apprehension? ..... 31
oes the League of Nations approve open hostilities among its members? ..... 32
re consistent statements usually untrue? ..... 33
hould a valid answer be based on exact data? ..... 34
s the circulation of slanderous rumors ethical? ..... 35
3 marked discrepancy usually obvious? ..... 36
bould an antagonist in a contest show aggressive behavior? .....  37
; a certain amount of prejudice necessarily debasing? ..... 38
re arguments ever free from enmity? ..... 39
; an intemperate person usually characterized by excessive activities? ..... 40
fair play a good policy to follow in all international relationships? ..... 41
re persons innocent of criminal intent never indicted and convicted? ..... 42
oes irksome employment sometimes prove to be profitable to the worker? ..... 43
o insolvent business enterprises sometimes go into bankruptcy? ..... 44
; a loquacious individual necessarily a bore? ..... 45
re presumptuous persons often bold and arrogant? ..... 46
; a conscientious worker often subjected to the embarrassment of his employer's criticism? ..... 47
oo obstinate individuals usually respond readily to admonition? ..... 48
; rich and expensive food essential to the happiness of a gourmand? ..... 49
isatisfaction in work well done generally considered an adequate substitute for an economic reward? .....  50
t turn this page until you are told to do so. No. Right. No. Wrong Right minus Wrong


## TEST 4 (Cont'd). PART D. ENGLISH

n autobiography is a -
1 characterization
2 caricature
3 contradiction
4 memoir of one's life
5 classic Sealistic means -

1 conventional 2 true to life 3 romantic 4 idealistic 5 dramatic simile is -

1 a lyric 2 a similarity 3 a poem 4 an analogy 5 a dialogue $\qquad$ prefix 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 appendix
legend is -
1 a song 2 a motto 3 a tradition 4 a title. 5 an editorial.
bjective refers to -
1 verbs 2 nouns 3 adverbs 4 adjectives 5 case.
synopsis is
1 an outline. 2 a climax 3 a general review 4 an alliteration 5 a controversy. . . . . 7 prologue is similar to $\mathrm{a}-$

1 suffix 2 prefix 3 table of contents 4 bibliography 5 preface. . . . . . . . . . . . . . . . 8 nonymous means -

1 critical 2 fictitious 3 eloquent 4 of unknown authorship 5 singular. $\qquad$ manuscript is a

1 magazine 2 manual 3 document 4 folio 5 pamphlet. . . . . . . . . . . . . . . . . . . . . . 10 yrical means -

1 suitable to be sung 2 dramatic 3 narrative 4 descriptive 5 poetical........... 11 rackets are -

1 italics 2 initials 3 diagrams 4 outlines 5 punctuation marks. . . . . . . . ....... 12
n allegory is a
1 figurative story 2 couplet 3 comedy 4 ballad . 5 diary. . . . . . . . . . . . . . . . . . . . . 13 legree is a quality of -

1 conjunction
2 adjectives
3 objects
4 infinitives 5 pronouns. .14
athos means -
1 humor
2 song
3 drama
.4 quality of sorrow
5 melancholy ontemporary means -

1 in contact. 2 living at the same time 3 complete 4 emphasis 5 continual....... 16 .15 atire is similar to-

1 humor 2 wit 3 vice 4 buffoonery 5 irony $\qquad$
olloquial refers to -
1 everyday talk 2 folkiore 3 idioms 4 pastorals 5 dialects. . . . . . . . . . . . . . . . . . . . . 18
bibliography is a -
1 history
2 personal record
3 list of books 4 description 5 writer. $\qquad$ n epigram is a $=$
1 pithy saying 2 maxim 3 jest 4 jingle 5 prosody. . . . . . . . . . . . . . . . . . . . . . . . . 20

Do not turn this page until you are told to do so.

## TEST 5．SENTENCE MEANING

：rrons．You are to read each sentence and answer it by filling in the answer space under the right answer．Study mples．Bo not guess．
exs．A．Are all people dishonest？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．A
B．Are authors often quoted？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． B
：o people sometimes coöperate for self－preservation？
o all students have the same determination to achieve？
re dishonest officials ever in charge of political campaigns？
3.

Lay external appearances be deceiving to the uninitiated？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 4
o the bacteria causing tuberculosis grow rapidly in fresh air？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 5 an undesirable reputation often based upon a record of misbehavior？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 6
re agility and endurance considered good qualifications for an athlete？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 7
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$\qquad$
re careless observations the only causes of mistakes in arriving at conclusions？
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0 many people fail to live up to their possibilities？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 12
＇ill our knowledge of scientific facts be decreased by experimentation？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 13
o individuals always adjust themselves to their environment？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 14
Ill the pleasure of the host be increased by the presence of an obnoxious guest？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 15
an one predict future events with absolute surety？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 16
oes a knowledge of the rules of traffic tend to decrease accidents？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 17
oes a controversy always result in a satisfactory solution of a problem？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 18
oes the absence of authority often result in frivolity？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 19
Tay there be contention among the members of a parliament？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 20
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re all anti－trust laws enforced with facility？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 22
；the cause of liberty weakened by freedom of the press？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 23 re editorials always based upon quotations from authorities？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 24 ；all good writing the result of frequent consultation of an outline？．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 25


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