

ABSTRACT OF THESIS

THE PREDICTION OF FIRST SEMESTER
GRADE POINT AVERAGE AT
COLORADO STATE COLLEGE

Submitted by
Joseph Edmund Gould

In partial fulfillment of the requirements
for the Degree of Master of Education
Colorado State College
of
Agriculture and Mechanic Arts
Fort Collins, Colorado

August, 1944

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abstract

ABSTRACT

The problem

Normally over 500 men and women are accepted each fall at Colorado State College. These students have a variety of educational backgrounds and vary also in their ability to do college work. The Student Personnel Division administers a battery of tests and turns the percentile scores for each student over to the faculty counselors, who must make subjective rule of thumb judgments on the basis of five criteria. If the most economical combination of these variables were determined and a single composite score supplied to the faculty counselors, together with an objective estimate of the number of chances in 100 each student had to make a passing grade, a bench-mark would be provided by which the faculty counselor could assist the student to choose a curriculum suitable to his abilities, and by which the student's academic progress throughout the critical first semester could be measured.

The method and findings

Raw data for this study comprised the scores made by 601 men and women students who entered Colorado

State College in the fall of 1941, on five criteria:

Title of Criterion	Abbreviation	Variable No.
The American Council on Education Psychological Examination	A.C.E.	2
High school rank in quartiles, weighted. (upper one-fourth = 4 lowest one-fourth = 1)	H.S.R.	3
Iowa Chemistry Aptitude Test	Chemistry	4
The Cooperative English Test	English	5
Iowa Mathematics Aptitude Test	Mathematics	6

Zero order coefficients of correlation were calculated between each of these variables and first semester grade point averages. These were:

ZERO ORDER COEFFICIENTS OF CORRELATION BETWEEN EACH VARIABLE AND ALL OTHER VARIABLES

	A.C.E. (2)	H.S.R. (3)	Chemistry (4)	English (5)	Mathe- matics (6)
Grade Point (1) Average	.6338	.6056	.5890	.5588	.5256
2		.4723	.7167	.7969	.7729
3			.4001	.4960	.4027
4				.5371	.7089
5					.4735

These zero order coefficients of correlation were used in calculating the multiple coefficients by a method suggested by Kelley 1/. The formula is:

$$r_{1.23456} = \sqrt{1 - \frac{\Delta}{\Delta_{11}}}$$

where r = coefficient of correlation
 1 = grade point average
 2 = A.C.E.
 3 = H.S.R.
 4 = Chemistry
 5 = English
 6 = Mathematics

and Δ stands for the determinant,

1	r_{12}	r_{13}	r_{14}	r_{15}	r_{16}
r_{12}	1	r_{23}	r_{24}	r_{25}	r_{26}
r_{13}	r_{23}	1	r_{34}	r_{35}	r_{36}
r_{14}	r_{24}	r_{34}	1	r_{45}	r_{46}
r_{15}	r_{25}	r_{35}	r_{45}	1	r_{56}
r_{16}	r_{26}	r_{36}	r_{46}	r_{56}	1

and Δ_{11} stands for the minor obtained by deleting the first row and first column.

Lesser multiple coefficients of correlation may be obtained by omitting the last row and last column on each determinant.

1/ Kelley, Truman L. Partial and multiple correlation, in Reitz, H. L. ed. Handbook of mathematical statistics. Cambridge, Mass. Houghton-Mifflin, 1924, p. 139-46.

Multiple coefficients of correlation were:

$$r_{1.23456} = .7409$$

$$r_{1.2345} = .7407$$

$$r_{1.234} = .740$$

$$r_{1.23} = .723$$

The most efficient combination of variables (r 1.234, A.C.E., Chemistry and H.S.R.) was used in calculation of the regression equation:

$$\frac{\bar{X}_1 - \bar{x}_1}{\sigma_1} = \frac{\Delta_{12}}{\Delta_{11}} \cdot \frac{x_2 - \bar{x}_2}{\sigma_2} + \frac{-\Delta_{13}}{\Delta_{11}} \cdot \frac{x_3 - \bar{x}_3}{\sigma_3} + \frac{\Delta_{14}}{\Delta_{11}} \cdot \frac{x_4 - \bar{x}_4}{\sigma_4}$$

where \bar{X}_1 = estimated G.P.A.	Δ_{12} = the determinant
\bar{x}_1 = mean of G.P.A.	minus the first
x_2 = A.C.E. raw score	row and second
\bar{x}_2 = mean of A.C.E. scores	column
x_3 = Chemistry raw score	Δ_{13} =
\bar{x}_3 = mean of Chemistry scores	minus the first
x_4 = H.S.R.	row and second
\bar{x}_4 = mean of H.S.R.	column
	σ_1 = standard deviation
	of G.P.A.
	σ_2 = standard deviation
	of A.C.E.
	σ_3 = standard deviation
	of Chemistry
	σ_4 = standard deviation
	of H.S.R.

Then solving for \bar{X}_1 (estimated G.P.A.),

$$\bar{X}_1 = .004419x_2 + .0169x_3 + .18068x_4 - 1.147$$

Substituting raw scores in this formula and multiplying or subtracting where indicated will transform these raw scores into a score in terms of grade point average.

Although it is useful to possess an estimate of a student's grade point average, it is even more useful to be able to assess his chances of success or failure in terms of per cent. Thus, the probable error of estimate (P.E._{est}), a measure of the tendency of a number of actual scores to group around an estimated score was calculated and found to be .344. Using this figure, a table was worked out estimating in percentages the chances of success and failure accompanying various predicted grade point averages.

Conclusions

The best single predictor among the variables is the A.C.E. Psychological Examination, followed by high school rank and the Chemistry Aptitude Test. Intercorrelations indicate that the A.C.E. on the one hand and the English and Mathematics Tests on the other are measuring much the same things. The low correlations between high school rank and the other variables make it an extremely valuable predictor.

Multiple correlations show the A.C.E., high school rank, and Chemistry Aptitude to be the most efficient combination for prediction. The Mathematics Aptitude and English tests, although they may be useful as sectioning devices in the Mathematics and English departments, do not add significantly to the multiple correlation coefficient.

The prediction formula and the probable error table are useful counseling devices, as indicated in Chapter V, and should prove valuable in the academic guidance of students at Colorado State College.

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T H E S I S

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Submitted by
Joseph Edmund Gould

In partial fulfillment of the requirements
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..... August 1 1944

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY
SUPERVISION BY JOSEPH EDMUND GOULD
ENTITLED THE PREDICTION OF FIRST SEMESTER GRADE POINT
AVERAGE AT COLORADO STATE COLLEGE

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF EDUCATION

MAJORING IN GUIDANCE AND COUNSELING

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Permission to publish this thesis or any part of it
must be obtained from the Dean of the Graduate School.

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TABLE OF CONTENTS

Chapter		Page
I	INTRODUCTION	9
	Analysis of the problem	10
	Delimitation and assumptions	11
	Background of the problem	12
II	REVIEW OF THE LITERATURE	15
	Psychological tests and college grades	15
	Other predictive measures	16
	Recent increases in correlation	18
	Studies involving multiple correlation	19
	Inadequacy of predictive measures	21
	Methods	23
	Conclusions	25
III	MATERIALS AND METHODS	27
	Sources of data	27
	Procedures and techniques	29
IV	ANALYSIS OF DATA	31
	Zero order coefficients of correlation	31
	Multiple coefficients of correlation	33
	The regression equation	34
	The probable error of estimate	35
V	DISCUSSION	37
VI	SUMMARY	46
	The problem	46
	The method and findings	46
	Conclusions	48
	APPENDIX	50
	BIBLIOGRAPHY	73

APPENDIX CONTENTS

Appendix	Page
A	SAMPLE SUMMARY PROFILE SHEET. 51
B	SAMPLES OF TESTS USED AS PREDICTIVE MEASURES IN THE STUDY
	The American Council on Education Psychological Examination 53
	Iowa Placement Examination Series CA 1, revised, A, Chemistry Aptitude. 54
	Iowa Placement Examination Series MA 1, revised, A, Mathematics Aptitude. 55
	The Cooperative English Test 56
C	ZERO ORDER CORRELATIONS
	Figure
1	Correlation between first semester grade point average and The American Council on Education Psychological Examination 58
2	Correlation between first semester grade point average and The Cooperative English Test. 59
3	Correlation between first semester grade point average and the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude. 60
4	Correlation between first semester grade point average and the Iowa Placement Examination, Series MA 1, revised, A, Mathematics Aptitude. 61
5	Correlation between first semester grade point average and quartile rank in high school graduating class 62

APPENDIX CONTENTS

Appendix

Page

C ZERO ORDER CORRELATIONS

Figure

6	Correlation between The American Council on Education Psychological Examination and The Cooperative English Test.	63
7	Correlation between The American Council on Education Psychological Examination and the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude.	64
8	Correlation between The American Council on Education Psychological Examination and the Iowa Placement Examination, Series MA 1, revised, A, Mathematics Aptitude.	65
9	Correlation between The American Council on Education Psychological Examination and the quartile rank in high school graduating class.	66
10	Correlation between The Cooperative English Test and the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude.	67
11	Correlation between The Cooperative English Test and the Iowa Placement Examination, Series MA 1, revised, A, Mathematics Aptitude.	68
12	Correlation between The Cooperative English Test and the quartile rank in high school graduating class	69

APPENDIX CONTENTS

Appendix

Page

C ZERO ORDER CORRELATIONS

Figure

13	Correlation between the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude and the Iowa Placement Examination, Series MA 1, revised, A, Mathematics Aptitude.	70
14	Correlation between the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude and the quartile rank in high school graduating class.	71
15	Correlation between the Iowa Placement Examination, Series MA 1, revised, A, Mathematics Aptitude and the quartile rank in high school graduating class.	72

LIST OF TABLES

Table		Page
1	COLLEGE GRADE POINT AVERAGE VERSUS HIGH SCHOOL AVERAGE AND INTELLIGENCE	19
2	STUDIES INVOLVING THE USE OF OTHER VARIABLES.	20
3	ZERO ORDER COEFFICIENTS OF CORRELATION BETWEEN EACH VARIABLE AND ALL OTHER VARIABLES.	31
4	PERCENTAGE OF CHANCES OF A PREDICTED SCORE BEING WITHIN CERTAIN P.E. LIMITS IN RELATION TO A TRUE SCORE.	40
5	CHANCES OF FAILURE AND SUCCESS FOR VARIOUS PREDICTED SCORES USING 1.00 AS THE CRITICAL POINT.	41

Chapter I
INTRODUCTION

The problem of the failing college student is as old as the colleges themselves. There are many implications in the problem: the economic waste to the college and to the student, the social waste involved in withdrawing an individual from productive pursuits in order to give him instruction from which he does not profit, and the effect on the individual's personality of the stigma of failure.

Successful performance in certain high school subjects has been the accepted mode of judging the student's ability to profit from instruction on the college level. That this is not a perfect yardstick is apparent from the large numbers who, having successfully completed the high school course of study, fail miserably in college.

In many institutions of college rank supported in whole or in part by public funds it is necessary to accept for instruction any student who has successfully completed a prescribed course of study in a high school in the state. If those who would fail without some assistance could be parceled out of this group and individual attention be given each one so that potential

reasons for failure could be assessed and remedial measures undertaken, the percentage of failure would be greatly lessened.

To that end, most colleges supplement the high school record of each student with some further measure of ability such as an intelligence test, an aptitude test, or a battery of several similar testing devices.

Scores on such measures are in themselves only indications of a student's standing on that particular measure relative to that of other students in the same class or previous classes. That such scores have a direct relationship to grades attained in college is perhaps an unwarranted assumption until such a relationship is demonstrated and measured. When several such scores are available for each student and his relative standing varies for each measure, prediction with any degree of accuracy is difficult in the extreme.

The problem, then, is: To what extent may predictions of first semester grades be accomplished and how may these data be used in the guidance of freshmen at Colorado State College?

Analysis of the problem.--A. Do scores made by the students in the American Council on Education Psychological Examination, the Iowa Placement Examinations and the Cooperative English Test indicate achievement in the first semester at Colorado State College?

- B. Does the student's quartile rank in his high school graduating class have predictive value?
- C. To what extent are these criteria taken in combination predictive of grade point average?
- D. Would it be feasible to eliminate any of the tests in the future?
- E. Of the criteria retained, what weights should be assigned to secure optimum prediction of a student's first semester grade point average?
- F. Within what limits would such prediction be accurate?
- G. How may the data be used in the guidance program at Colorado State College?

Delimitation and assumptions.--It has been assumed that the raw data from the files of the Student Personnel Division were accurate in that the tests were correctly administered and scores accurately entered in the records.

The study itself has been limited to the prediction of first semester grades for three reasons:

1. The first semester is the most critical one of a student's college career. Mortality among students is greater at that time than at any other.
2. The correlation between grades for the first and succeeding semesters is so strong that an accurate estimate of first semester grades

would normally be an excellent indication of subsequent achievement.

3. The factor of selection is present in later semesters, so that students who remain in college tend to form a more homogeneous group, which diminishes the accuracy of prediction.

Background of the problem

The Student Personnel Division was organized at Colorado State College in 1940 as a central agency for the collection of data concerning the individual student in order to aid him in planning his academic program and to offer him clinical counseling and vocational guidance services. Faculty representatives of each major division of instruction were trained in student guidance techniques, and a panel of students was assigned to each of these faculty counselors.

In the fall of 1940 the American Council on Education Psychological Examination and the Cooperative English Test were administered to entering freshmen. Norms were developed and raw scores with percentile equivalents were entered on the students' summary profile sheets 1/. The following year the Iowa Chemistry and Mathematics Aptitude Tests were added and corresponding norms developed.

1/ See Appendix A

Since September, 1941, faculty counselors have been supplied with information concerning each of their assigned students. They have before them, then, five measures of the student's ability, four of these (American Council on Education Psychological Examination, Iowa Mathematics Aptitude Test, Iowa Chemistry Aptitude Test, and Cooperative English Test) in percentile scores and the fifth, a measure of the student's success in high school, in terms of rank. Using these scores, the faculty counselor must first assist the student in choosing a program suitable to his needs and abilities. Then, throughout the year, he must compare the student's progress in terms of grades he receives with his abilities as estimated by the criteria mentioned above. Whether the faculty counselor will urge the student on to further effort or express satisfaction with his rate of progress will depend on his interpretation of these five criteria. Obviously, estimation of the amount and seriousness of spread between percentile scores on the one hand and instructor's grades on the other is at best a subjective process and will be conditioned by the training, skill, and experience of the observer.

If it were possible to combine several of these variables measuring scholastic aptitude into one objective measurement, and that in terms of the criterion most commonly used to estimate a student's

progress, that of grade point average, then the task of the faculty counselor would be greatly simplified.

The purpose of this study is to provide such an objective measurement by uniting the most efficient combination of variables in a regression equation which will predict a student's probable success or failure in terms of grade point average.

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Chapter II
REVIEW OF THE LITERATURE

The problem of prediction of college grades has been the subject of many studies since World War I. The development of the Army Alpha Psychological Examination put into the hands of investigators an instrument for testing intelligence by groups relatively quickly and easily, and this instrument, together with some measure of high school achievement, was often used as a criterion by which to predict college success.

Psychological tests and college grades

At least five investigators have summarized the results of studies using various criteria of prediction prior to 1943: Douglass (5), Durflinger (8), Mills (29), Segel (38), and Wagner (43). The most complete for the period 1920-34 is Segel. He reports 12 studies of the relationship between various editions of the American Council on Education Psychological Examination (known to educators as the A.C.E.) and general college scholarship, with a total of 34 different correlations, ranging from .37 to .62, the median correlation being .48.

During the same years a number of studies were made investigating the relationship of high school marks to general college scholarship. Twenty-three of these are summarized by Segel. The range of correlation is from .29 to .69 with a median of .55.

Both Odell (30) and Douglass noted in their studies that the coefficient of correlation when college success is predicted from average high school marks is higher than the corresponding coefficient obtained with general mental tests.

Maizie E. Wagner (43) has surveyed the literature of prediction, using high school marks, to 1934, and found a median correlation of .56 with 50 per cent of the cases between .50 and .66. Relationships between the A.C.E. and college averages ranged from .17 to .81, the majority being from .40 to .50.

Both Wagner and Segel found the A.C.E. an adequate predictor in comparison to other instruments of its kind. Quaid (32) found the Ohio State University Psychological Test slightly superior at Phillips University but not sufficiently so to make much difference in prediction using a multiple coefficient of correlation.

Other predictive measures

The Cooperative English Test was found by Gladfelter (19) to predict college grades slightly better than the A.C.E. Psychological Test, the coeffi-

cient of correlation being .589. This finding is relatively unusual, however. Manning (27) in his investigation found the A.C.E. correlation .56 and that of the Cooperative English Test to be .43, and decided further that the high correlation between the two tests (.73) showed that they were measuring much the same type of factors.

Dr. Wagner's findings led her to place most value on some measure of high school success, and she quotes, "Past performance is the best index of ultimate success." Brown and Lofgren (1) found failing students consistently lower in the variable of high school success than any other. Dressel (7) investigated the problem of differences among high schools and found that such differences exist and might be in some measure corrected, but the subsequent improvement in prediction would hardly justify the extra effort. Strang (41) in reviewing the literature, said, "Rank in the graduating class in high school is frequently found to be a more significant index than the means of high school marks." Johnston (23) said, "Those who stand in the lowest quarter of their high school graduating class have one chance in fifty of satisfactorily carrying freshmen work."

In the field of aptitude testing Stoddard (39) found that the Iowa Chemistry Aptitude Test correlated .52 with college grades, and the mathematics test of the same series correlated .42 with the same criterion.

Recent increases in correlation

Durflinger found a considerable increase in the correlations between intelligence and college scholarship in his more recent (1943) survey of the literature. In the older studies Douglass (1931) found the median to be .45 in a review of 130 studies. Segel and Wagner, as shown above, found medians of .48 and .45 respectively. Durflinger in surveying 47 studies since 1932 found the median correlation increased to .52.

He believes the reasons for the increase to be:

1. Newer testing instruments, such as the A.C.E. Psychological Examination, designed for college use, may measure more factors in college success, and
2. The increased use of objective examinations in college may have made college grades more reliable and less subjective.

Concerning high school grades as a measure of college success, Durflinger is skeptical of their value in comparison to that of a test of high school achievement. He points out that the median correlation (.55) for high school grades with college success is approximately the same as the median Segel gives for achievement tests (.545) and says, ". . . therefore, it appears that a two hour achievement test will give a score as predictive of college scholarship as the more laborious method of accumulating the high school record."

This would seem to leave out of consideration the fact that the high school record estimates the student's ability to get a grade and therefore measures such intangibles as diplomacy and tact, which an achievement test cannot do.

Studies involving multiple correlation

Multiple correlations between college grades and a combination of two factors (high school rank and intelligence) are considerably higher than any zero order correlation. These may best be shown by a table.

Table 1.--COLLEGE GRADE POINT AVERAGE VS. HIGH SCHOOL AVERAGE AND INTELLIGENCE

Investigator	Numbers involved in studies	Multiple correlation
Douglass (5)	1196	.63
Drake and Henmon (6)	618, 455	.69, .71
Finch and Nemzek (16)	118	.779
Hepner (22)	382	.561
Quaid (32)	140	.590 (ACE) .605 (Ohio)
Read (33)	415	.643
Reitz (35)	?	.65

Other studies in which different combinations of variables have been used are listed in Table 2.

Table 2.--STUDIES INVOLVING THE USE OF OTHER VARIABLES

Investigator	Variables	Multiple Correlation
Butsch (2)	high school rank, high school content, intelligence	.59, .70
Durflinger (8)	intelligence, English, elementary grades	.54, .55
Hartson (20)	high school average, Ohio Psychological, Ohio study performance test	.74
Leaf (26)	intelligence, English aptitude, high school content, high school marks	.79
Root (37)	intelligence high school rank, college aptitude test, freshmen English grades	.83

These summaries would seem to indicate that the multiple is most useful in prediction and that the later studies show a generally higher correlation, probably due to a refinement of techniques and a general improvement in testing devices.

In the planning of a multiple correlation, Segel, Manning, and others find that the addition of variables beyond the number of three does not produce a sufficient increase in prediction to justify their use.

In studies made concerning the correlation between first semester grades and subsequent semesters, Hurich and Cain (14) and Langlie (25) find the correlation sufficiently high to base college success on success in the first semester.

Inadequacy of predictive measures

Many studies show why prediction of college grades is not and to some extent cannot be completely successful. Feder (15) gives three reasons for this lack of success:

1. The inadequacy of the testing instruments.
2. Lack of control of motivation.
3. The personal factor.

Williamson (44) points out that reasonably high predictive coefficients may be expected to decrease under improved instructional methods and increased guidance efficiency. Strang (41:133) says:

None of the criteria can predict with any certainty that the term implies an individual's success in college. It must not be assumed, however, that the fault lies wholly in the criteria. The unreliability of college marks and the inadequacy of college courses are responsible in large measure for imperfect results.

Rigg (36) found many other factors than mastery of subject matter important in securing grades, such as, diplomacy, attendance in classes, and the like. He found that in one institution about one-quarter of those elected to Phi Beta Kappa actually scored below the

average of the senior class in an achievement test.

Easley (9) says:

It may not be concluded, of course, that intelligence and scholastic ability are . . . unrelated. It may be that school marks, although they may be quite reliable, are very imperfect measures of scholastic ability, or that the intelligence tests do not measure intelligence, or both.

Thorndike's statement (42), made in 1919, represents the most reasonable point of view for the personnel worker to take.

This lack of knowledge of the correlations of standard tests, and the practically large margin between actual correlations and 1.00 are not arguments against the wide use of such tests. On the contrary the test score may almost always be of great value since it is a clear addition to the available impressionistic knowledge; it taps new sources of information. It will be of great value provided we do not misuse it.

Such misuse must carefully be guarded against. Hepner (22) says, "Great reliance upon statistical findings may lead to a failure to view each student as a unique personality worthy of individual and special consideration."

English (11) points out that "correlation with grades all along the line is of minor importance. What is needed is a critical score, and a statement of the probability that a student will reach or exceed the level defined as satisfactory."

Methods

The statistical methods employed in prediction vary from study to study, the majority using the Pearson product moment method of simple correlation (18). To arrive at a multiple, Segel outlines a procedure followed by most investigators. Kelley's system (24) would seem to be more efficient since it does not involve the calculation of partial correlations and lends itself to a constant check for accuracy.

In a study made at Iowa State College in 1939 Cation (3), after arriving at simple correlations between grade point averages, the American Council on Education Psychological Examination divided into sections, and an English placement test and high school averages, did not calculate a multiple coefficient of correlation but worked out a regression equation for predictive purposes. To check his prediction he chose five students at random from what he terms a "low-average" group, five from a "middle-average" group, and five from a "high-average" group. The grade point average is predicted for each student, using the regression equation, and is compared with the actual grade point average. The difference between them he calls the error of estimate, and computes the average error arithmetically.

This empirical method would seem to be rather inadequate in view of the fact that so few were used to check errors. Then, too, wide errors above and below

the actual grade point average would cancel each other, making the average error of estimate relatively insignificant when such is not actually the case.

The device of breaking down the A.C.E. Psychological Examination into sections does not seem to be warranted by increase in predictive value. No section of the test correlated higher than .50 with the grade point average, a coefficient not significantly greater than the gross score correlation which was .49.

Hawksworth (21) at Montana State College based her study of prediction on a weighted formula in terms of the means and standard deviations of the scores made on the criteria, which were:

1. The American Council on Education Psychological Examination.
2. A locally developed biology aptitude test.
3. The Iowa Chemistry Aptitude Test.
4. A locally developed mathematics test.
5. The Oregon English Placement Examination.
6. High school rank.

An adjusted score was assigned to students in terms of the number of standard deviations (or fractions thereof) each score fell above or below the mean of each variable. High school rank was weighted by thirds.

The total weight was determined by taking the algebraic sum of all variables, and a critical score

was set below which students were predicted unsuccessful.

As an index of reliability Hawksworth computed the Pearson product moment correlation between the weighted score and the variable of grade point average, which was .6256, appreciably better than the psychological examination alone, which correlation was .57.

The method is a valuable one and relatively uncomplicated. However, if it were possible to calculate the percentage of chances in 100 each student had to make a given grade point average, the study would be even more valuable.

Conclusions

In conclusion we may state that these factors seem evident after surveying the literature.

1. The American Council on Education Psychological Examination is a relatively reliable predictive instrument.
2. High school rank is a valuable criterion of subsequent college success.
3. A combination of both the above-mentioned variables will improve the predictive value of either taken singly.
4. Special aptitude tests may add to the value of the predictive combination.

5. A device which will predict with a fair degree of accuracy those who fail and those who will succeed, and the number of chances in 100 a student with a predicted grade has of doing either is perhaps more useful than a device which will attempt to predict actual grade point averages.

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Chapter III
MATERIALS AND METHODS

Sources of Data

The class which entered Colorado State College in September, 1941, was chosen as the population for this study, since this was the first class to be given the full battery of entrance tests and the last peace time class of normal size.

Data for this study were collected from the files of the Student Personnel Division and the Registrar's office of the college. Records are kept of raw scores made on each of the tests given during freshmen week. These tests 1/ are:

1. The American Council on Education Psychological Examination, to be referred to as the A.C.E.
2. Iowa Placement Examination Series CA I, revised, A, Chemistry Aptitude, to be referred to as the Chemistry test.
3. Iowa Placement Examination Series MA I, revised, A, Mathematics Aptitude, to be referred to as the Mathematics test.
4. The Cooperative English Test, to be referred to as the English test.

1/ See Appendix B

In addition to these test scores, the student's quartile rank in his high school graduating class was estimated from data available in the Registrar's office. Weights were assigned each quartile score, so that a student graduating in the upper one-fourth of his class was given a score of 4, one graduating in the upper half but not the upper one-fourth received a score of 3, and so on. This score will be referred to as H.S.R. (high school rank).

Letter grades for the first semester of college attendance were obtained for each student from the Registrar's office, and grade points were calculated, weights being assigned each letter grade, so that an "A" equaled 3, a "B" equaled 2, and a "C" equaled 1. These weights were multiplied by the number of semester hours a student had registered for in each case.

Consider a student who received the following grades.

(A) Grades	(B) Grade Points	(C) Number of hours for which registered	(D) (BxC)
B	2	3	6
B	2	3	6
C	1	3	3
C	1	3	3
C	1	1½	1½
C	1	1½	1½
		<u>15</u>	Total grade <u>1½</u>
	Total credit hours	15	points 21

Dividing the total grade points by the total number of credit hours, we get a grade point average (G.P.A.) of 1.4.

To be successful at this institution, a student must maintain a G.P.A. of 1.00. Students who withdraw failing from a course are counted as being still registered in that course.

Procedures and Techniques

Raw data used in this study consist of scores made by the class which entered Colorado State College in the fall of 1941 on each five variables: A.C.E., H.S.R., Chemistry, English, and Mathematics. Numbers involved in the study range from 521 to 605, since scores for every student on every variable were not available.

No attempt was made to differentiate scores made by men and women, since all take the same battery of tests and are subjected to the same grading system. The proportion of men students to women students in the group considered was in the ratio of one to three.

The steps were:

1. Zero order coefficients of correlation were computed to measure statistical relationship between each variable and G.P.A., using the Pearson product moment method, to determine the rank order of variables in terms of predictive value.

2. Intercorrelations were calculated between each of the variables and every other variable, since two variables with a high coefficient of correlation would obviously be measuring many of the same factors.
3. Using these data, a multiple correlation coefficient was arrived at, measuring the relationship between all the criteria taken together and G.P.A.
4. Further multiple coefficients of correlation were calculated, dropping one or another variable, to find the most efficient predictive combination.
5. Using this predictive combination (A.C.E., H.S.R., Chemistry) a regression equation was worked out by a method outlined by Kelley (24:139-43) to estimate the value of the G.P.A. when raw scores on each of the variables are known.
6. The probable error of estimate ($P.E._{est}$) was the device used to gauge the accuracy of the prediction.

Chapter IV
ANALYSIS OF DATA

Zero order coefficients of correlation

The Pearson product moment method was used to calculate zero order coefficients between grade point averages and each variable, as well as between the variables themselves. The basic formula is

$$r = \frac{x_1 x_2}{\sqrt{x_1^2} \sqrt{x_2^2}}$$

r = coefficient of correlation
 x_1, x_2 = summation of the product of the deviations of each measure from its true means.

Coefficients obtained by this method are listed in the table below.

Table 3.--ZERO ORDER COEFFICIENTS OF CORRELATION
BETWEEN EACH VARIABLE AND ALL OTHER VARIABLES

	A.C.E. (2)	H.S.R. (3)	Chemistry (4)	English (5)	Mathe- matics (6)
Grade Point (1) Average	.6338	.6056	.5890	.5588	.5256
2		.4723	.7167	.7969	.7729
3			.4001	.4960	.4027
4				.5371	.7089
5					.4735

It will be noticed that the A.C.E. is the best single predictor, the coefficient of correlation with grade point average being .67. This is somewhat higher than H.S.R., which is contrary to the findings of most of the other investigators.

There are two factors which would tend to give a psychological test, such as the A.C.E., a strong predictive value at Colorado State College. One is the relative unreliability of a criterion based upon performance in high school, due to the wide disparity in size and equipment of the high schools from which the student body is drawn, and the other is the heterogeneity of the student body itself. The range of raw scores on the A.C.E. is from 17 to 344, which indicates the wide spread of abilities to be found in the freshmen class 1/

Intercorrelations between the variables indicate that the A.C.E. and English are measuring much the same factor, as is the case with A.C.E. and Mathematics. Since the A.C.E. is divided into sections, two of which purport to measure number facility and verbal ability, these strong correlations are not surprising.

1/ The mean of the A.C.E. is 150.17 and the standard deviation (σ) is 49.9, indicating that approximately 68 per cent of cases fall between 100 and 200, when the distribution is fairly normal.

Multiple coefficients of correlation

These zero order coefficients of correlation were purposely arranged in descending order to facilitate the calculation of the multiple coefficient by a method suggested by Kelley (24). The formula is:

$$r_{1.23456} = \sqrt{1 - \frac{\Delta}{\Delta_{11}}}$$

where r = coefficient of correlation
 1 = grade point average
 2 = A.C.E.
 3 = H.S.R.
 4 = Chemistry
 5 = English
 6 = Mathematics

and Δ stands for the determinant,

1	r ₁₂	r ₁₃	r ₁₄	r ₁₅	r ₁₆
r ₁₂	1	r ₂₃	r ₂₄	r ₂₅	r ₂₆
r ₁₃	r ₂₃	1	r ₃₄	r ₃₅	r ₃₆
r ₁₄	r ₂₄	r ₃₄	1	r ₄₅	r ₄₆
r ₁₅	r ₂₅	r ₃₅	r ₄₅	1	r ₅₆
r ₁₆	r ₂₆	r ₃₆	r ₄₆	r ₅₆	1

and Δ_{11} stands for the minor obtained by deleting the first row and first column.

Lesser multiple coefficients of correlation may be obtained by omitting the last row and last column on each determinant, so that:

r _{1.23456}	. . . . .	.7409
r _{1.2345}	. . . . .	.7407
r _{1.234}	. . . . .	.740
r _{1.23}	. . . . .	.723

Apparently neither the Mathematics nor the English test raises the multiple correlation to any appreciable extent. In order to check this assumption we change the order, so that:

r 1.26354 . . . . .	.7409
r 1.2635 . . . . .	.7243
r 1.263 . . . . .	.7237
r 1.26 . . . . .	.635

It is obvious that the strongest and most economical predictive combination of variables is that which includes the A.C.E., Chemistry, and high school rank (r 1.234).

The regression equation

The regression equation predicting the individual's grade point average when raw scores on these variables are known is:

$$\hat{z}_1 = \beta 12.34z_2 + \beta 13.24z_3 + \beta 14.23z_4$$

where $\hat{z}_1 = \frac{\bar{x}_1 - \bar{x}_1}{\sigma_1}$, \bar{x}_1 estimated G.P.A.
 \bar{x}_1 mean G.P.A. (1.1146)
 σ_1 standard deviation of G.P.A. (.7575768)

and $\hat{z}_2 = \frac{x_2 - \bar{x}_2}{\sigma_2}$, x_2 A.C.E. raw score
 \bar{x}_2 mean of A.C.E. scores (150.1733)
 σ_2 standard deviation of A.C.E. scores (49.94499)

and $\bar{x}_3 = \frac{x_3 - \bar{x}_3}{\sigma_3}$, x_3 Chemistry raw score
 \bar{x}_3 mean of Chemistry scores (62.02)
 σ_3 standard deviation of Chemistry scores (16.85)

and $\bar{x}_4 = \frac{x_4 - \bar{x}_4}{\sigma_4}$, x_4 High school rank
 \bar{x}_4 mean of high school ranks (3.052)
 σ_4 standard deviation of high school ranks (.9630)

β 12.34 = $\frac{\Delta_{12}}{\Delta_{11}}$, where Δ_{12} is the determinant Δ minus the first row and second column, Δ_{11} is Δ minus the first row and first column.

$$\beta$$
 13.24 = $\frac{-\Delta_{13}}{\Delta_{11}}$, β 14.23 = $\frac{\Delta_{14}}{\Delta_{11}}$

then $\bar{x}_1 = .005834x_2 + .02231x_3 + .23852x_4 - 2.986$

and $\bar{x} = .004419x_2 + .0169x_3 + .18068x_4 - 1.1147$

The probable error of estimate

The probable error is best defined as the median deviations of individual scores from their average, assuming that errors of estimate or measurement tend to form normal distributions. If probable scores are estimated from actual scores, one-half will be in error by more than 1 P.E. and one-half by less than 1 P.E.

For the purpose of this study, the probable error of estimate (P.E._{est}) is most appropriate. This

measures the tendency of a number of actual scores to group around an estimated score.

For example, should a group of students all have a predicted grade point average of 1.00, then obviously some will actually score above this level, and some will score below if the cases are selected at random. Approximately 50 per cent of them will deviate from the predicted score of 1.00 by less than 1 P.E._{est}, and 50 per cent will deviate by more than this amount, in terms of grade point average. Thus, the P.E._{est} measures the tendency of a group of students with the same predicted score to approach that score in terms of actual grades received. In the event that the P.E._{est} is large, a predicted score will have very little significance, since the chances are one to one that the actual score will lie outside the range of 1 P.E. of the point of prediction, whereas if the P.E. is small then 50 per cent of the scores will tend to group themselves within its range.

The probable error of estimate (P.E._{est}) is equal to .6745 times the standard error of estimate (σ_{est}).

$$\sigma_{est} = \sqrt{1 - r_{12}^2} \sqrt{1 - r_{13.2}^2} \sqrt{1 - r_{14.23}^2} = .5113$$

$$\text{P.E.}_{est} \quad .5113 \times .6745 = .3445$$

Chapter V

DISCUSSION

The multiple coefficient of correlation

The multiple coefficient of correlation diminished only from .7409 to .740 when the Mathematics and English tests are excluded, indicating that these tests do not add sufficient strength to the multiple coefficient to warrant their inclusion in the testing program, although they may retain considerable value as sectioning devices in Mathematics and English classes.

The regression equation

For the individual student, perhaps one of the best ways to discuss the use of the regression equation is to demonstrate its use in the prediction of first semester grades for several students selected at random from recent classes.

Student A, male, engineering freshman, made the following scores,

A.C.E.	138 (x_2)
Chemistry Aptitude	43 (x_3)
H.S.R.	4 (x_4)

The regression equation, as derived in Chapter III is:

$$\bar{X}(\text{G.P.A.}) = .004419x_2 + .0169x_3 + .18068x_4 - 1.147$$

Substituting:

$$\begin{aligned}\bar{X} &= (.00419)(138) + (.0169)(43) + (.18068)(4) - 1.147 \\ &= .912, \text{ estimated grade point average.}\end{aligned}$$

.710 is the actual first semester grade point average made by this student.

Student B, a freshman woman, majoring in Home Economics, made these scores:

A.C.E.	239
Chemistry Aptitude	80
H.S.R.	4

Substituting these scores in the above formula,

Estimated G.P.A.	1.98
Actual G.P.A.	1.82

The following scores were made by Student C, freshman woman majoring in Home Economics:

A.C.E.	183
Chemistry Aptitude	57.5
H.S.R.	4

By substitution,

Estimated G.P.A.	1.35
Actual G.P.A.	1.72

Use of the probable error of estimate

The probable error of estimate (P.E._{est}) is rightly employed to gauge errors in measurement when two series of scores are used for predicting one in terms of

the other, assuming that errors of estimate or measurement tend to form normal distributions.

For example, among several students with the same predicted grade point average it is not possible to say this one will fail and this one will not fail. But, employing the $P.E._{est}$, it is possible to estimate the percentage of passing and failing students among such a group provided they are of the same general kind as those upon whom the original regression equation was determined.

In the case of Student B, her estimated G.P.A. was 1.98. This score is .98 above the G.P.A. considered satisfactory at Colorado State College.

In Chapter III the $P.E._{est}$ was found to be .344. Dividing .98 by .344, a quotient of 2.84 is obtained, indicating that the predicted mark of 1.98 is 2.84 $P.E.$ units above the critical point 1.00.

If 50 per cent of cases with a predicted score of 1.98 will fall within 1 $P.E.$ of that point, then only 25 per cent of cases will fall below 1.636, nine per cent below 1.292, and two per cent below .984 1/.

With this device it is possible to estimate, from the number of $P.E.$ units by which his predicted score is above or below the critical point, the percentage of chances a student has of achieving a grade point average at or beyond that point.

1/ See Segel (38:40) Figure 3, normal distribution curve.

Percentages measuring the chances of a predicted score being within certain probable error limits have been calculated and such a table is reproduced below.

Table 4.--PERCENTAGE OF CHANCES OF A PREDICTED SCORE BEING WITHIN CERTAIN P.E. LIMITS IN RELATION TO A TRUE SCORE

P.E. units	Per cent of cases	P.E. units	Per cent of cases
± .5	26	± 2.5	91
± 1.0	50	± 3.0	96
± 1.5	69	± 3.5	98
± 2.0	82	± 4.0	99.3

It can be seen that 2.5 P.E. units represent 91 per cent of cases. A predicted mark more than 2.5 P.E. units above the critical point (1.0) would have more than 95.4 per cent of cases below it. Thus a student with a predicted G.P.A. of 1.86 would have 95.4 chances of success and 4.6 of failure.

From the data in Table 4 it is possible to construct a table from which the chances of success for various predicted marks may be more easily read.

Table 5.--CHANCES OF FAILURE AND SUCCESS FOR VARIOUS
PREDICTED SCORES USING 1.00 AS THE CRITICAL POINT

Grade point average	Probable error rating	Per cent failing	Per cent successful
2.376	4.0	0.4	99.6
2.204	3.5	.9	99.1
2.032	3.0	2.2	97.8
1.860	2.5	4.6	95.4
1.688	2.0	8.9	91.1
1.516	1.5	15.6	84.4
1.344	1.0	25.0	75.0
1.172	.5	36.8	63.2
1.00	.0	50.0	50.0
.828	-.5	63.2	36.8
.656	-1.0	75.0	25.0
.484	-1.5	84.4	15.6
.312	-2.0	91.1	8.9
.140	-2.5	95.4	4.6

Guidance uses of the prediction formula

Problems of student guidance at Colorado State College may be divided into two broad categories, the academic and the personal. Both are handled through the Student Personnel Division, aided by a staff of faculty counselors in their major field of study which

assists them in choosing a curriculum and planning a course of study.

In the event that the results of this study should affect the guidance program at Colorado State College, the Student Personnel Division would begin calculation of predicted grade point averages for entering students as soon as the freshmen testing program was completed. The predicted grade point averages, plus percentage estimates of the chances of success for each student, would be supplied to faculty counselors, and copies entered on the student's summary profile sheet.

Frequently faculty counselors are unfamiliar with technical terms and devices used by trained personnel workers. To supply them with a single measure of predicted academic ability in terms of grade point average, the criterion most used and understood by them, should prove to be advantageous. Further, it may be possible to use the student's predicted grade point average in demonstrating to him the need for application to his studies. The advisability of showing the student his intelligence test percentile score is highly suspect, since he is likely to regard it as evidence of his inability to succeed. However, the predicted G.P.A. is based upon several factors, only one of which (A.C.E.) purports to be a measure of intelligence.

More specifically the formula should help the faculty counselor to:

1. Assist the student to choose a curriculum appropriate to his abilities.
2. Single out for special consideration weak students who might be advised to take a limited program.
3. Make a more objective judgment of the amount of spread between ability and achievement.
4. Differentiate under-achievers who will need to be goaded into further effort from those who, already achieving at maximum capacity, might be discouraged by further reproof.
5. Recommend to the Student Personnel Division for diagnosis and treatment, cases of serious discrepancy between ability and achievement.

The Student Personnel Division should find the device useful in the following guidance functions:

1. As an aid in diagnosing cases of unwise vocational choice.

Many students are influenced in their vocational choice and consequent selection of a curriculum by unrealistic considerations such as the wish to please a parent or to emulate a friend. Poor performance in a chosen curriculum when ability is present may be due to a fundamental lack of interest.

2. As an indicator of a maladjustment to college life.

Unsuitable housing conditions, financial worries and personality conflicts may exist and are likely to be evidenced by performance in college not commensurate with ability. Such discrepancies are indications of a need for counseling procedures.

3. As a basis for restriction of a student's activity program.

Many freshmen unwisely undertake too many activities in their first semester of college. When a discrepancy exists between grades and abilities, as shown by the first four weeks report of failing students, a curtailed program of activities should be prescribed. In cases where predicted grade point average is considerably below the level of safety as shown by the percentage table the student might be placed on probation immediately upon matriculation with consequent curtailment of activities. Probation would also mean a more frequent reporting of grades to the Personnel Office, much in the manner of a physician's reading a fever thermometer where physical illness is known or suspected.

Recommendations for further study

The regression equation as developed on the whole freshman class would seem to predict first semester grade point averages with a fair degree of accuracy. However, it is possible that other combinations of the same variables might predict with even more accuracy if

regression equations were worked out for each division of the College: Agriculture, Engineering, Forestry, Home Economics, Science and Arts, and Veterinary Medicine. The writer plans to investigate this possibility.

Further experiments might be undertaken to discover whether the addition or substitution of new variables to the test battery would increase the multiple coefficient of correlation and thereby improve prediction. This type of investigation must necessarily be postponed until entering classes approach pre-war levels in size.

Chapter VI

SUMMARY

The problem

Normally over 500 men and women are accepted each fall at Colorado State College. These students have a variety of educational backgrounds and vary also in their ability to do college work. The Student Personnel Division administers a battery of tests and turns the percentile scores for each student over to the faculty counselors, who must make subjective rule of thumb judgments on the basis of five criteria. If the most economical combination of these variables were determined and a single composite score supplied to the faculty counselors, together with an objective estimate of the number of chances in 100 each student had to make a passing grade, a bench-mark would be provided by which the faculty counselor could assist the student to choose a curriculum suitable to his abilities, and by which the student's academic progress throughout the critical first semester could be measured.

The method and findings

Raw data for this study comprised the scores made by 601 men and women students who entered Colorado

State College in the fall of 1941, on five criteria:

Title of Criterion	Abbreviation	Variable No.
The American Council on Education Psychological Examination	A.C.E.	2
High school rank in quartiles, weighted. (upper one-fourth = 4 lowest one-fourth = 1)	H.S.R.	3
Iowa Chemistry Aptitude Test	Chemistry	4
The Cooperative English Test	English	5
Iowa Mathematics Aptitude Test	Mathematics	6

Zero order coefficients of correlation were calculated between each of these variables and first semester grade point averages. These were:

Grade point average	2	3	4	5	6
	.6338	.6056	.5890	.5588	.5256

Multiple coefficients of correlation were:

- r 1.234567409
- r 1.23457407
- r 1.2347400
- r 1.237230

The most efficient combination of variables (r 1.234) was used in the calculation of the regression equation:

Grade
point average = $.004419X_2 + .0169X_3 + .18068X_4 - 1.147$,

where X_2 = A.C.E. raw score, X_3 = Chemistry raw score,
and X_4 = H.S.R.

The probable error of the estimate (P.E._{est}) was found to be .344. Using this figure, a table was worked out estimating in percentages the chances of success and failure accompanying various predicted grade point averages.

Conclusions

The best single predictor among the variables is the A.C.E. Psychological Examination, followed by high school rank and the Chemistry Aptitude Test. Intercorrelations indicate that the A.C.E. on the one hand and the English and Mathematics tests on the other are measuring much the same things. The low correlations between high school rank and the other variables make it an extremely valuable predictor.

Multiple correlations show the A.C.E., high school rank and Chemistry Aptitude to be the most efficient combination for prediction. The Mathematics Aptitude and English Tests, although they may be useful as sectioning devices in the Mathematics and English departments, do not add significantly to the multiple correlation coefficient.

The prediction formula and the probable error table are useful counseling devices, as indicated in Chapter V, and should prove valuable in the academic guidance of students at Colorado State College.

Toucher-Bond

A P P E N D I X

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Appendix B.--SAMPLES OF TESTS USED AS
PREDICTIVE MEASURES IN THE STUDY

1937 Edition

AMERICAN COUNCIL ON EDUCATION

Psychological Examination

For College Freshmen

Prepared by L. L. Thurstone and Thelma Gwinn Thurstone
The University of Chicago



	Score	Percentile
Completion.....		
Arithmetic.....		
Artificial Language.....		
Analogies.....		
Opposites.....		
Gross Score.....		

Name.....
 (Last Name) (Given name or initials)

DO NOT MARK
ON TEST

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 —

Completion

DIRECTIONS: Each of the following sentences has a word missing at the place indicated by the parentheses. You are to think of the word that best completes the meaning of the sentence, and write it in the blank at the end of the sentence. The number in the parentheses indicates the number of letters in the most appropriate word.

Look at the first sentence below (Sentence A). The number 4 is in the parentheses in this sentence. This means that there are *four letters* in the missing word. The four-letter word that best completes the meaning of this sentence is *race*. Notice that *race* is written in the blank at the right of the page.

Fill in as many of the blanks as you can in the time allowed. Do not waste too much time on any one sentence, as you will receive credit for every word correctly given.

- A. A (4) is a contest of speed. (4).....*race*.....
1. (6) is the ringing of an evening bell as a signal, as for children to retire from the streets. (6).....
2. A (7) is an establishment for the custody and control of books. (7).....
3. The (7) is the apparent junction of earth and sky. (7).....
4. An (8) is an artificial pond or vessel of water in which living aquatic animals or plants are kept. (8).....
5. The money, goods, or estate which a woman brings to her husband in marriage is called a (5). (5).....
6. A (9) is a book or list containing the names and addresses of the inhabitants of any place. (9).....
7. A quick, sharp reply is called a (6). (6).....
8. A chest for a corpse is a (6). (6).....
9. An (10) is a judicial writ or process requiring a party to do or forbear some act. (10).....
10. A (7) is a scheme for the distribution of prizes by chance. (7).....
11. By (11) in painting is meant the use of colors and lines so as to represent objects in their proper direction and distance. (11).....
12. (10) is the belief that there is only one God. (10).....
13. A (4) is a floating object moored to the bottom to mark a channel, anchor, rock, etc. (4).....
14. (11) is the reduction of an army or navy approximately to a peace footing. (11).....
15. (8) are small yellowish or brownish spots on the skin. (8).....
16. A (9) is used for looking out over the water from a submerged submarine. (9).....
17. A (6) is one who habitually asks for charity. (6).....

Go to the next page. Do not wait for any signal.

18. A (3) is a long-handled implement with a thin, flat blade set transversely, for weeding, etc. (3).....
19. A lighted coal smouldering in ashes is an (5)..... (5).....
20. The sum of the qualities that determine the value of an auditorium as to distinct hearing is called its (9)..... (9).....
21. A (10) is a specified or regular course of study..... (10).....
22. A (8) is a place where railroad lines meet or cross..... (8).....
23. That point of the heavens which is vertically above one is called the (6)..... (6).....
24. A (8) is a subterranean place of burial, especially one consisting of passages with side recesses for tombs..... (8).....
25. A (8) is the highest non-commissioned officer in the army..... (8).....
26. By (13) law is meant the body of rules and precedents by which deliberative assemblies govern their procedure..... (13).....
27. The dark-colored viscid syrup drained from sugar in manufacture is called (8).... (8).....
28. A (5) is a card or die with two spots..... (5).....
29. One without means except such as come from charity is a (6)..... (6).....
30. An (10) is one who maliciously sets fire to a building or other property..... (10).....
31. The part of a military force that serves on horseback is called the (7)..... (7).....
32. A (6) is a writing mimicking the language or style of an author..... (6).....
33. A liquid for drinking is a (8)..... (8).....
34. By (8) is meant a signal, by drum or bugle, at about sunrise, summoning soldiers or sailors to duty..... (8).....
35. (9) is canvas waterproofed with tar..... (9).....
36. A (7) is the natural abode of an animal or plant..... (7).....
37. The network spread by a spider is a (6)..... (6).....
38. A (4) is the point which projects backwards in an arrow, fishhook, etc..... (4).....
39. A (3) is a rope, chain, or rod attached to a thing to steady it..... (3).....
40. (9) is habitual idleness..... (9).....

Stop here. Wait for further instructions.

Arithmetic

DIRECTIONS: Write the answers to as many of these problems as you can in the time allowed.

You may use this space for figuring.

1. If a strip of cloth 24 inches long will shrink to 22 inches when washed, how many inches long will a 36-inch strip be after shrinking?

Answer:inches

2. If a fowl loses $\frac{1}{3}$ in dressing, how many pounds of undressed fowl will be necessary to dress 9 pounds?

Answer:pounds

3. If Frank can ride a bicycle 300 feet while George runs 200 feet, how many feet can Frank ride while George runs 300 feet?

Answer:feet

4. Allowing $2\frac{1}{2}$ ounces of sugar per day for each member of a family of four, how long should 5 pounds of sugar last the family?

Answer:days

5. If a log 20 feet long is to be cut so that one piece is $\frac{2}{3}$ as long as the other piece, how long must the longer piece be?

Answer:feet

6. A housekeeper takes 3 half pints of milk each week day and 1 pint on Sunday. Her bill for the week comes to 65 cents. What is the price of milk per quart?

Answer:cents per quart

7. Mr. Jones made a 250-mile trip. He drove the first 100 miles in 5 hours. If he increased his speed $\frac{1}{4}$ on the remaining distance, how long did it take him to make the whole trip?

Answer:hours

8. If 4 oranges cost as much as 5 bananas, and 1 banana costs as much as 2 plums, how many oranges can be bought for the price of 20 plums?

Answer:oranges

9. When a coal bin is $\frac{5}{6}$ full, the coal costs \$120. What is the value of the coal when the bin is $\frac{1}{4}$ full?

Answer: \$.....

10. Mrs. Brown found that from 6 pints of fruit juice and 4 pints of sugar she got 8 pints of jelly. How much sugar will she need to make 2 dozen half-pint glasses of jelly?

Answer:pints

Go to the next page. Do not wait for any signal.

You may use this space for figuring.

11. In the schools of a certain city there are 2,200 pupils. Of these $\frac{1}{2}$ are in the primary grades, $\frac{1}{4}$ in the grammar grades, $\frac{1}{8}$ in the high school, and the rest in the night school. How many pupils are there in the night school?

Answer:pupils

12. A, B, and C together have \$96. B has twice as much as C, and A has as much as B and C together. How much has B?

Answer: \$.....

13. Mr. Burton bought 100 barrels of potatoes at \$5 a barrel. He lost 20% of them by freezing and decay. At what price per barrel must he sell the remainder to gain 20% on his investment?

Answer: \$.....per barrel

14. The average rate per hour of a boy on a bicycle with a motor attachment is 4 miles less than three times his rate without the attachment. His average rate with the attachment is 41 miles per hour. How many minutes does it take him to go a mile without the attachment?

Answer:minutes

15. If a stable has enough oats to last 25 horses 105 days, how long will the oats last 15 horses?

Answer:days

16. Allen collected 300 foreign stamps. Of this number $\frac{1}{4}$ were stamps from South America, $\frac{4}{15}$ from the Orient, and the remainder from Europe. He sold his European stamps for \$5.80. What was the selling price per stamp?

Answer:cents

17. The length of a steel rod is increased .000,007 of its length for each degree of increase in temperature. By what part of a foot is the length of a steel rod 30 feet long increased if the temperature is increased 100 degrees?

Answer:foot

18. A boy has 63 customers for a city evening paper and 45 for the local afternoon paper. His profit on the city paper is $\frac{2}{3}$ cent a copy and on the local paper 12 cents on 20 copies. How much does he earn in a week (6 days)?

Answer: \$.....

19. A man is travelling from A to B, a distance of 75 miles. He goes by railroad for $\frac{2}{5}$ of the way at an average speed of 45 miles per hour. The rest of the trip he goes by automobile at 20 miles per hour. Allowing 10 minutes for the transfer, how long did the trip take?

Answer:hours.....minutes

20. A steamship left port at the average rate of 15 knots per hour. When it was a certain distance from port it became disabled and returned at the average rate of 4 knots per hour. It left port at 11:30 A.M. and had returned at 2:40 P.M. How far from port was the steamship when the accident happened?

Answer:knots

Stop here. Wait for further instructions.

Artificial Language

Read the vocabulary and rules of the artificial language given below. Do not try to memorize the vocabulary or forms but consult them freely while translating the sentences on the following page.

VOCABULARY

I.....	ar	is.....	janho
me.....	arku	act.....	chelo
he.....	eg	characterize.....	blibo
him.....	egku	energize.....	tucdo
that.....	ip	succeed.....	holgo

RULES

PLURALS:	Add "mo." Only nouns and pronouns have plurals.
PAST TIME:	Place "de" before the verb.
FUTURE TIME:	Place "si" before the verb.
NOUNS:	Substitute "ig" for "o" ending of verb.
ADJECTIVES:	Substitute "ur" for "o" ending of verb.
ADVERBS:	Substitute "ap" for "o" ending of verb.

EXAMPLES

we.....	armo
acted.....	dechelo
will act.....	sichelo
action.....	chelig
active.....	chelur
actively.....	chelap

DIRECTIONS

All the words in sentence A below are correctly translated, so plus signs (+) have been put in each column at the right, thus, +, +, +. The first word in sentence B is wrong. A minus sign (-) in column 1 at the right indicates that "they" is wrong. It is not the translation of "eg." The second and third words are correctly translated so plus signs (+) are placed in columns 2 and 3.

SENTENCES	TRANSLATIONS	1	2	3
A. That was characteristic	Ip dejanho blibur	... + + + ...
B. Eg sijanho chelur	They will be active	... - + + ...

Go through the sentences on the next page, marking a (+) sign at the right for words correctly translated and a (-) sign for words incorrectly translated.

Go to the next page. Do not wait for any signal.






SENTENCES	TRANSLATIONS	1	2	3
1. That is energy	Ip janho tucdo	.....	.....	.....
2. Eg dejanho tucdur	He will be energetic	.....	.....	.....
3. They acted successfully	Armo dechelo holgur	.....	.....	.....
4. Holgig janho chelig	Success is action	.....	.....	.....
5. Energy will be successful	Tucdig siblibo holgap	.....	.....	.....
6. Tucdig blibo chelig	Success characterizes action	.....	.....	.....
7. Energetic characters succeed	Tucdurmo blibig holgo	.....	.....	.....
8. Ip tucdig siholgo	That energy will succeed	.....	.....	.....
9. Action characterized us	Holgig deblibo armo	.....	.....	.....
10. Ip cheligmo holgo	Those actions succeeded	.....	.....	.....
11. They acted energetically	Egmo dechelo tucdig	.....	.....	.....
12. Holgo blibig chelo	Successful characters act	.....	.....	.....
13. Success energized him	Holgig detucdo egku	.....	.....	.....
14. Chelur blibig holgomo	Active characters succeed	.....	.....	.....
15. They will act successfully	Egmo sichelap tucdap	.....	.....	.....
16. Ip deblibo egkumo	That will characterize them	.....	.....	.....
17. Success characterizes energy	Tucdig chelo holgap	.....	.....	.....
18. Armo sijanho holgurmo	We shall be successful	.....	.....	.....
19. Energy acts successfully	Holgig blibo tucdig	.....	.....	.....
20. Egmo chelo tucdap	They acted energetically	.....	.....	.....
21. He succeeded characteristically	Eg siholgo blibap	.....	.....	.....
22. Holgo situcdo egkumo	Success will energize them	.....	.....	.....
23. Energy is active	Tucdig janho chelur	.....	.....	.....
24. Eg deblibo arku	That characterized him	.....	.....	.....
25. Those actions succeed	Ipmo chelurmo holgo	.....	.....	.....
26. Tucdur blibigmo holgo	Energetic characters act	.....	.....	.....
27. I shall act energetically	Ar dechelo tucdap	.....	.....	.....
28. Holgig detucdo ar	Successes energized me	.....	.....	.....
29. Energetic action succeeds	Tucdo chelig holgomo	.....	.....	.....
30. Holgurmo cheligmo tucdo	Successful actions energize	.....	.....	.....

Stop here. Wait for further instructions.

Analogies









DIRECTIONS: In Sample I below figure *A* is a large circle. Figure *B* is a small circle. By what rule is figure *A* changed in making figure *B*? The rule is "making it smaller." Apply this rule to figure *C* which is a large square. The result is a small square. Find the small square in the row of five figures at the right. It is figure 2. Therefore 2 is written in the blank at the right.

Sample I

A	B	C	1	2	3	4	5	_____
								<u>2</u>









In Sample II below the rule is "Figure *A* is turned upside down to make figure *B*." If this rule is applied to figure *C*, the result is figure 4. Therefore 4 is written in the blank at the right.

Sample II

A	B	C	1	2	3	4	5	_____
								<u>4</u>

In Sample III below the rule has two parts, "Make figure *B* larger than figure *A* and of the opposite color." If this rule is applied to figure *C*, the result is figure 1. Write 1 in the blank at the right.

Sample III

A	B	C	1	2	3	4	5	_____
								-----









































































Notice that the rule changes from one example to the next.

You are to do *three* things to each exercise on this page and on the next.

First, decide what rule is used to make figure *B* from figure *A*.

Second, apply this rule to figure *C* and find the resulting figure among figures 1 to 5.

Third, write the number of this figure in the blank at the end of the row.

A	B	C	1	2	3	4	5	_____	(1)
									-----
									-----
									-----
									-----
									-----
									-----
									-----
									-----

Go to the next page. Do not wait for any signal.

A	B	C	1	2	3	4	5	
								----- (9)
								----- (10)
								----- (11)
								----- (12)
								----- (13)
								----- (14)
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								----- (27)
								----- (28)
								----- (29)

Stop here. Wait for further instructions.

Opposites

DIRECTIONS: Each group of four words below contains *two words* which are either the *same* or *opposite* in meaning. If a group does not contain two words of the same meaning, it will contain two words of opposite meaning.

Look at the first group of words below. The *first* and *third* words in this group, "many" and "few," are opposite in meaning. The numbers 1 and 3 are therefore written in the blanks at the right.

Look at the second group of words. This group does not contain two words that are opposite, but it does contain two words that are similar in meaning. These words are "gay" and "happy," the second and fourth words. The numbers 2 and 4 are therefore written in the blanks.

You are to go through each group of words, find the two words that are the same or opposite, and write their corresponding numbers in the blanks at the right.

				<i>Answer</i>
1 many	2 ill	3 few	4 down	.....1.&3.....
1 last	2 gay	3 long	4 happy	.....2.&4.....
1 posthumous	2 humorous	3 adumbrant	4 serious	.....&..... (1)
1 mirthful	2 defective	3 faulty	4 infectious	.....&..... (2)
1 harmful	2 despairing	3 despotic	4 hopeful	.....&..... (3)
1 acrid	2 punctual	3 unctuous	4 tardy	.....&..... (4)
1 envious	2 jealous	3 zealous	4 wicked	.....&..... (5)
1 honorable	2 needful	3 discreet	4 disgraceful	.....&..... (6)
1 hanging	2 executive	3 administrative	4 mineral	.....&..... (7)
1 vicarious	2 viscous	3 aqueous	4 watery	.....&..... (8)
1 silvery	2 romantic	3 odorless	4 aromatic	.....&..... (9)
1 dismal	2 near	3 joyful	4 stubborn	.....&..... (10)
1 careworn	2 stiff	3 limp	4 subordinate	.....&..... (11)
1 plenary	2 congealed	3 polluted	4 undefiled	.....&..... (12)
1 impracticable	2 banqueted	3 feasible	4 farsighted	.....&..... (13)
1 composite	2 sudorific	3 compounded	4 confounded	.....&..... (14)
1 important	2 portable	3 portly	4 immobile	.....&..... (15)
1 paschal	2 ingenious	3 genial	4 jovial	.....&..... (16)
1 patrimonial	2 periodical	3 deterrent	4 recurrent	.....&..... (17)

Go to the next page. Do not wait for any signal.

1 evasive	2 defiled	3 arboreal	4 chaste	.....&.....	(18)
1 reddish	2 prudent	3 rash	4 shrewish	.....&.....	(19)
1 wry	2 gracious	3 free	4 gratuitous	.....&.....	(20)
1 invisible	2 magnified	3 viscous	4 sticky	.....&.....	(21)
1 intemperate	2 stentorian	3 dilute	4 abstemious	.....&.....	(22)
1 mucous	2 clandestine	3 holiday	4 secret	.....&.....	(23)
1 unwarranted	2 beatific	3 pacific	4 bellicose	.....&.....	(24)
1 relentless	2 inexorable	3 lifting	4 exhortatory	.....&.....	(25)
1 transparent	2 colorful	3 opaque	4 slanting	.....&.....	(26)
1 nondescript	2 decrepit	3 discourteous	4 infirm	.....&.....	(27)
1 fatuous	2 lean	3 fateful	4 silly	.....&.....	(28)
1 corporeal	2 patriarchal	3 alcoholic	4 spiritual	.....&.....	(29)
1 emetic	2 equable	3 tranquil	4 transient	.....&.....	(30)
1 redundant	2 distal	3 proximal	4 disgustful	.....&.....	(31)
1 bleary	2 fuzzy	3 downy	4 grizzly	.....&.....	(32)
1 tainted	2 vitiated	3 purple	4 vitalistic	.....&.....	(33)

Stop here. Wait for further instructions.

Name _____ Age _____ Sex _____ Date _____ 51
 (Print) (Last name) (First name)

High school attended _____ City _____ College _____
 year (e.g., LA-1)

IOWA PLACEMENT EXAMINATIONS, Series CA1, Revised, A

**DO NOT MARK
ON TEST**

CHEMISTRY—APTITUDE

Constructed by
 G. D. STODDARD AND J. CORNOG
 under the direction of
 C. E. SEASHORE AND G. M. RUCH

SCORE

Part 1 _____
 Part 2 _____
 Part 3 _____
 Part 4 _____
 Total _____

DIRECTIONS

Do not write anything until told to do so.
 When the signal is given, begin to work on Part 1. Do not work on any other part until told to do so.
 At the beginning of each part will be found directions. Follow them carefully, but do not ask questions.

PART 1

Directions: Solve the following problems, and place the answer to each problem on the dotted line at its right.
 Do not spend much time on any one problem. Use the margins of this page for figuring.
 You have 15 minutes for Part 1.

1. What is 14% of .06?
2. Solve for x: $\frac{x}{3} = 2y^2$
3. How many centimeters in 2.3 meters?
4. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$; what does T_2 equal?
5. $a=24$, $b=12$, and $c=4$; $\frac{a-b}{c} = ?$
6. $s=vt$; what does $\frac{s}{v}$ equal?
7. $x^2=m^2+n^2$; what does n equal?
8. What is the square root of 729?
9. Solve: $(150) \left(\frac{273}{300} \right) \left(\frac{740}{760} \right) = ?$
10. If 2 pounds of 40-cent coffee are mixed with 8 pounds of 30-cent coffee, what is the value per pound of the mixture?
11. Solve for x: $\frac{18.3}{12.2} = \frac{21.9}{x}$
12. A farm of 63 acres is divided equally among 101 persons. What fraction of an acre does each person receive?
13. If a carload of coal weighs 60,000 pounds and the coal is 2% sulfur, how many pounds of sulfur are in the coal?
14. If Cedar Rapids is 28 miles from Iowa City, and one kilometer equals $\frac{2}{3}$ of a mile, what is the distance in kilometers between these two towns?
15. A sample of flour weighing 6 grams, on drying loses 2 grams of water. What per cent water was the original sample?
16. If 10 gal. of ice cream are needed for a party of 75 persons, how many gal. are needed for a party of 250 persons?
17. If coal contains 3% sulfur, how many tons of coal will be needed to get one ton of sulfur?
18. What kind of proportion is represented by the statement, "the higher the temperature the greater the volume?"
19. A man judged a distance of 50 yards to be 85 yards. What was his per cent of error?
20. A certain fuel gives 15% ash. If 76.5 pounds of ash are produced, how much fuel was consumed?

End of Part 1. Score = No. right times 2 =

PART 2

Directions: Below are three paragraphs taken from chemistry text-books. Beneath each paragraph are ten statements. Read Paragraph I, then examine the statements beneath it. *Every statement is to be compared with the material in the paragraph.* If the statement is true, place a T after it on the dotted line; if the statement is false, place an F after it on the dotted line. Then proceed in a similar manner with the other two paragraphs. *Do not guess.*

You have 12 minutes for Part 2.

Paragraph I

The density of iridium is 22.4; it is more dense than platinum. The melting point of platinum is 1755°; it is more easily melted than iridium. Iridium is silver-white, hard, brittle, acid-resisting. Platinum is grayish-white, harder than gold, a good conductor of electricity. Thorium has an atomic weight of 232.15 and a density over 20. It occurs in monazite sand, is heavy, grayish-white. It is rarely found as pure metal. It is used in gas mantles. Tungsten is found in rather large quantities in the ore called scheelite. Its density is 18.72 and melting point 3400°. It is used to temper steel, and in electric light filaments.

- | | | | |
|--|-------|--|-------|
| 1. The melting point of iridium is higher than 1550°. | ..... | 6. Platinum is a better conductor of electricity than iridium. | ..... |
| 2. Platinum is whiter than iridium. | ..... | 7. Acids do not easily attack iridium. | ..... |
| 3. The atomic weight of tungsten is higher than that of thorium. | ..... | 8. Thorium and tungsten are very useful commercially. | ..... |
| 4. Tungsten is fairly common. | ..... | 9. Small particles of metallic thorium are found in scheelite. | ..... |
| 5. Platinum is a hard metal. | ..... | 10. Thorium probably melts very easily. | ..... |

Paragraph II

Radium shoots off the following three types of rays: (1) Alpha rays—these are atoms of helium shot off at the velocity of 30,000 kilometers per second, but they cannot penetrate even thin paper; (2) Beta rays—these are electrons and more penetrating than Alpha rays; (3) Gamma rays—these are X-rays, and can penetrate thick layers of metal. Radium is found only in the ores of uranium. Pure radium would be worth about \$125,000 per gram. The heating effect of the first rays mentioned is much greater than that of the others, and they are capable of ionizing air, thus making it a conductor of electricity. Radium, which is itself a chemical element, constantly decomposes into several other elements, forming successively niton, Radium A, B, C, D, E, and F, the end-product apparently being lead. In this process the atomic weight of successive elements always decreases.

- | | | | |
|---|-------|--|-------|
| 1. Radium shoots off three types of rays. | ..... | 6. Ordinary air is a good conductor of electricity. | ..... |
| 2. It would be possible to stop some of the rays with a metallic plate. | ..... | 7. It is extremely difficult to stop waves traveling 30,000 kilometers per second. | ..... |
| 3. On rare occasions radium is extracted from vanadium. | ..... | 8. Radium-lighted watch dials that can be seen in the dark must contain an extremely small amount of radium. | ..... |
| 4. Most burns from radium are probably due to the gamma rays. | ..... | 9. Gamma rays penetrate more readily than alpha rays. | ..... |
| 5. The atomic weight of lead must be greater than that of niton. | ..... | 10. Lead should not be thought of as radioactive. | ..... |

Paragraph III

The alkali metals (potassium, sodium, etc.) unite with elements like oxygen and chlorine very eagerly, with the evolution of a great deal of heat, and these compounds require a great deal of energy for their decomposition. The resulting compounds are very unlike their component elements. Sodium chloride (common salt) bears no resemblance physical or chemical, to its component elements. On the other hand, elements near together on the metallic scale, like chlorine and oxygen, or chlorine and iodine, form compounds very similar in properties to their component elements and which are readily broken down. The metals form numerous compounds with each other, but usually very little energy is involved in the process, unless the metals are very different, like mercury and sodium, and in many cases the compounds are much like the constituent elements in character.

- | | | | |
|--|-------|--|-------|
| 1. It would require much energy to break up a compound of sodium and chlorine. | ..... | 6. An example of an alkali metal is chlorine. | ..... |
| 2. Sodium and sodium chloride have the same general appearance. | ..... | 7. Mercury and sodium are both metals. | ..... |
| 3. One would expect a compound of gold and silver to be very much unlike either metal. | ..... | 8. The combining of mercury and sodium is in one important respect similar to the combining of potassium and chlorine. | ..... |
| 4. Metals rarely combine with non-metals. | ..... | 9. One of the elements forming the compound, common salt, is a metal. | ..... |
| 5. Oxygen and iodine are close to each other on the metallic scale of elements. | ..... | 10. It would be very difficult to decompose a compound of chlorine and oxygen. | ..... |

End of Part 2. Score = Rights minus wrongs =

PART 3

Directions: You are to answer the questions by writing on the dotted line before the number of the question the number of the bracketed passage which contains the correct answer.

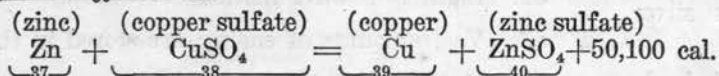
Read the passage as often as necessary. You have 12 minutes for Part 3.

The first two questions are already answered correctly. A 10 is placed before Question 1 because bracket 10 in the passage contains the correct answer. Similarly, the answer to Question 2 is found in bracket 4.

The Daniell Cell serves as an illustration of the most familiar types of cells.

In this combination two plates, one of copper and the other of zinc, each fashioned so as to have a large surface, are arranged in a glass jar. The electrolyte in contact with the zinc plate, is zinc sulphate, while that in contact with the copper plate is copper sulfate.

The action of the Daniell cell can be explained as follows: The zinc atoms have a tendency to give up to the zinc plate A two electrons each, and to pass into solution as zinc ions, the force urging this change being designated as solution tension. But since the zinc ions are positively charged, and their formation leaves the zinc plate negatively charged, the accumulation of these charges soon produces an equilibrium by the attraction of the zinc plate for the positive ions. Copper ions, on the other hand, tend to leave the solution because of their osmotic pressure, and to deposit as metallic atoms upon the copper plate B, each copper ion recovering two electrons from the copper plate. Since this process results in charging the copper plate positively, the accumulated charge soon produces an equilibrium by repelling the positive copper ions. If now the two plates are joined by a wire, the excess electrons on the zinc plate flow through the wire to make up the deficiency upon the copper plate. This prevents an accumulated charge on either plate and results in a current through the wire. The chemical action taking place is represented by the equation:



in which nearly all the heat is transformed into electrical energy. The reaction ceases when the wire connection is broken.

The order of the metals in the electro-chemical series is the order of intensity with which the metals tend to pass into ionic form. Any two metals in a suitable electrolyte will constitute a cell in which the metal highest in the series is the negative pole and the lower one the positive. As a rule, only a part of the chemical energy is converted into electrical energy, the remainder being transformed into heat.

Answers

- ..10.. 1. What does this passage explain?
- ...4.. 2. One of the two metallic plates is copper. What is the other?
- 3. What electrolyte is in contact with the zinc plate?
- 4. What force makes the copper ions leave the solution?
- 5. What force causes zinc to go into solution?
- 6. What becomes of the chemical energy which is not converted into electrical energy?
- 7. Is the zinc plate positively or negatively charged?
- 8. What metals can be used in making an electrolytic cell?
- 9. Do zinc ions carry electric charges?
- 10. What is deposited on the copper plate?
- 11. Does the formation of zinc ions continue indefinitely?
- 12. Under what circumstances do the excess electrons leave the zinc plate?
- 13. What does each copper ion receive from the copper plate?
- 14. What is the formula for copper sulfate?
- 15. What do the copper ions tend to do?
- 16. What is the final form of the zinc?
- 17. In an electrolytic cell, which metal will be the negative pole?

PART 4

Directions: Examine each statement below and decide whether it is true or false. If the statement is true, place a T after it on the dotted line; if the statement is false, place an F after it on the dotted line. *Do not guess.* You have 5 minutes for Part 4.

- | | |
|--|--|
| <p>1. Most metals conduct electricity.</p> <p>2. Lead is a metal which is difficult to melt.</p> <p>3. An atom is about the size of a pin-point.</p> <p>4. Plants breathe in oxygen.</p> <p>5. Ice melts at 32° Fahrenheit.</p> <p>6. All gases must have weight.</p> <p>7. Cast steel will rust.</p> <p>8. An acid usually has a sweet taste.</p> <p>9. Heat may be generated through friction.</p> <p>10. Heat is a form of matter.</p> <p>11. Radium was discovered by Thomas A. Edison.</p> <p>12. Solid iron is, in a sense, "frozen" iron.</p> <p>13. Water boils at 100° Fahrenheit.</p> <p>14. Water is composed of hydrogen and chlorine.</p> <p>15. A man associated with radio is DeForest.</p> <p>16. Incandescent means capable of conducting electricity.</p> <p>17. Electric light filaments are made of tungsten.</p> <p>18. Charcoal is an example of the chemical element carbon.</p> <p>19. A liquid tends to take the shape of the vessel which contains it.</p> <p>20. A molecule is the smallest drop of water which can be seen.</p> <p>21. Mercury contracts when heated.</p> <p>22. A block of aluminum will float on water.</p> <p>23. Photographic films are covered with a silver salt.</p> <p>24. One of the best conductors of electricity is lead.</p> <p>25. The ordinary household thermometer gives degrees centigrade.</p> <p>26. There is a close connection between rusting and burning.</p> <p>27. The modern electric light gives light without heat.</p> <p>28. Platinum costs about sixty times as much as gold.</p> <p>29. An electric motor is used to generate electricity.</p> <p>30. Radium rays affect photographic plates.</p> | <p>31. The like poles of two magnets attract each other.</p> <p>32. All living matter contains carbon.</p> <p>33. Gold leaf can be made that is much thinner than tissue paper.</p> <p>34. About one-third of the volume of an iceberg floats above water.</p> <p>35. When air expands it cools.</p> <p>36. When the air pressure is great the barometer gives a high reading.</p> <p>37. Alcohol has a lower freezing point than water.</p> <p>38. Hydrogen is very inflammable.</p> <p>39. Smoke is chiefly particles of unburnt carbon.</p> <p>40. A sudden contraction of gas forces the bullet through the gun.</p> <p>41. Common salt contains oxygen.</p> <p>42. Acids attack most metals.</p> <p>43. Radium is constantly giving off heat and light.</p> <p>44. Things burn brilliantly in oxygen.</p> <p>45. The shadows in a negative correspond to those in the print.</p> <p>46. Vinegar turns litmus paper blue.</p> <p>47. Carbon dioxide dissolves in water.</p> <p>48. Phosphorescent objects can be seen in the dark.</p> <p>49. Helium is a safe gas for airships.</p> <p>50. 18 carat is 90% gold.</p> <p>51. Cotton dissolves in lye.</p> <p>52. Light is a wave motion.</p> <p>53. Vast amounts of energy are stored in the atom.</p> <p>54. Matter always occupies space.</p> <p>55. Medieval chemistry was chiefly concerned with the discovery of the fundamental principles of the science.</p> <p>56. At the boiling point most substances become liquid.</p> <p>57. A meter is about 100 feet.</p> <p>58. Iron coated with zinc is said to be galvanized.</p> <p>59. Rain water is chemically more pure than spring water.</p> <p>60. A kilogram is about 4 ounces.</p> |
|--|--|

End of Part 4. Score = $\frac{\text{Rights minus wrongs}}{4}$ =

Name _____ Age _____ Sex _____ Date _____

(Print) (Last name) (First name)
 High school attended _____ City _____ College _____
 year (e.g., LA-1) _____

55

IOWA PLACEMENT EXAMINATIONS, Series MA1, Revised, A

MATHEMATICS—APTITUDE

SCORE

DO NOT WRITE ON TEST

Constructed by
 G. D. STODDARD AND E. W. CHITTENDEN
 under the direction of
 C. E. SEASHORE AND G. M. RUCH

Part 1 _____
 Part 2 _____
 Part 3 _____
 Part 4 _____
 Total _____

DIRECTIONS

Do not write anything until told to do so.

When the signal is given, begin to work on Part 1. Do not work on any other part until told to do so.

At the beginning of each part will be found directions. Follow them carefully, *but do not ask questions.*

PART 1

Directions: Each of the following number series is made up according to a rule. Discover the rule for each example and write the next *two* terms on the dotted lines. You have 5 minutes for Part 1.

Sample: $x, 2x, 4x, 8x$ _____ $16x$ _____ $32x$ _____

1. 64, 32, 16, 8, _____
2. 8, 0, 7, 0, 6, 0, _____
3. $\frac{9}{25}, 1\frac{3}{21}, 1\frac{7}{17},$ _____
4. $\frac{2.4}{1.3.5}, \frac{2.4.8}{1.3.5.7},$ _____
5. 7, 11, 16, 22, _____
6. $\frac{1}{4}, \frac{1}{3}, \frac{5}{12}, \frac{1}{2},$ _____
7. 32.24, 16.12, 8.06, _____
8. 1, 4, 9, 16, _____
9. 18, 4, 14, 4, 10, 4, _____
10. $2n, n^2, 3n, n^3,$ _____
11. $x^n, \frac{x^{n-1}}{2}, \frac{x^{n-2}}{4},$ _____
12. $\frac{x^2}{a}, \frac{x^4}{a+b}, \frac{x^8}{a+b+c},$ _____
13. $hk^2, 79281, h^2k^3, 7928, h^3k^4, 792,$ _____
14. $\frac{n(n+1)}{(n-1)(n-2)}, \frac{n(n+1)(n+2)}{(n-1)(n-2)(n-3)},$ _____
15. $11-2z^2-10, 16-12z^{12}-60, 21-22z^{22}-110,$ _____

End of Part 1. Score = No. right = _____

PART 2

Directions: Place the answer to each question on the dotted line at its right. Use the margins of this page for figuring. You have 10 minutes for Part 2.

Sample: A circle is revolved about a diameter as an axis. What geometrical figure is formed?a sphere.....

Answers

1. If a rectangle is revolved using a side as an axis what figure is generated?
 2. A box contains 10 black balls and 20 white balls. A man draws out 9 balls at random. How many are probably white?
 3. A certain polygon has $n+1$ vertices. How many sides has it?
 4. If x is the sum of the base and the altitude of a rectangle, what dimensions of the rectangle will give a maximum area?
 5. A box has two small boxes inside of it, and each one of the small boxes contains three still smaller boxes. How many boxes are there altogether?
 6. A circle is inscribed in a triangle. A small circle is drawn tangent to two sides of the triangle and to the first circle. How many separate sections are now included in the triangle but not in either of the circles?
 7. Pennies are tossed 3 at a time. How many "heads" will occur, on the average, in 50 tosses?
 8. A man judged a distance of 90 feet to be 135 feet. What was his percent of error?
 9. A man travels northeast 12 miles, then east 15 miles, and finally south 12 miles. With respect to his starting point, is he now farther north, farther south, or due east?
 10. Two diagonals intersect at right angles and one is twice the length of the other. Of what geometrical figure are they the two diagonals?
 11. A small square is placed in the corner of a larger one so that two of its sides are continuous with sides of the larger square. Their diagonals are drawn along the same line. What three types of geometrical figures are now represented?
 12. A man walked southwesterly 5 miles, then north 4 miles, and finally east 3 miles. He then found himself at his starting-point. What is the area of the land he walked around?
- Imagine 8 small, equal, wooden cubes stacked together to form a larger cube. Call each face of a small cube f and each small cube c . The entire surface of the larger cube is painted red.
13. How many f 's are painted?
 14. How many f 's are not painted?
 15. How many c 's are painted on three faces only?

End of Part 2. Score = No. right =

PART 3

Directions: Below are 20 examples, each consisting of two statements. *You are to assume that the statement beginning with the word "given" is true.* Read the first statement in each example, and then examine the "conclusion." Decide whether the conclusion is true or false. If the conclusion is true, place a T after it on the dotted line; if the conclusion is false, place an F after it on the dotted line. *Do not guess.* You have 10 minutes for Part 3.

Sample:

Given: A square and a triangle have the same base and altitude.

Conclusion: Therefore the square is larger than the triangle.T....

1. *Given:* A is greater than B, B is greater than C.
Conclusion: Therefore A is greater than C. 1.....
2. *Given:* M^2 is less than N.
Conclusion: Therefore M is less than N. 2.....
3. *Given:* A times B equals C times D.
Conclusion: Therefore A plus B equals C plus D. 3.....
4. *Given:* a is greater than b.
Conclusion: Therefore the mean of a and b is less than a. 4.....
5. *Given:* A piece of cloth was cut into a number of squares. No cloth was left over.
Conclusion: Therefore, the piece of cloth was square. 5.....
6. *Given:* The cube root of a certain number is even.
Conclusion: Therefore the number is even. 6.....
7. *Given:* P minus 5 equals Q plus 2.
Conclusion: Therefore Q is less than P. 7.....
8. *Given:* M is greater than N, N equals O, P equals M.
Conclusion: Therefore P is greater than N. 8.....
9. *Given:* A divided by B equals 10, A divided by C equals 5.
Conclusion: Therefore B is greater than C. 9.....
10. *Given:* All gold glitters. John's ring glitters.
Conclusion: Therefore John's ring is gold. 10.....
11. *Given:* X equals Y. M equals 2Y.
Conclusion: Therefore M equals one-half X. 11.....
12. *Given:* $R+2$ equals $X+5$.
Conclusion: Therefore R is less than X. 12.....
13. *Given:* A telephone pole casts a shadow longer than a lamp-post, and a tree casts a shadow four times as long as the lamp-post.
Conclusion: Therefore the tree is taller than the telephone pole. 13.....
14. *Given:* D is less than C.
Conclusion: Therefore the mean of D and C is greater than D. 14.....
15. *Given:* a^2 equals b.
Conclusion: Therefore a is less than b. 15.....
16. *Given:* x is less than y^2 .
Conclusion: Therefore 2x is greater than y. 16.....
17. *Given:* A man drew 6 balls at random out of an urn containing 1000 balls. Three of those drawn were black and three white.
Conclusion: Therefore one-half the balls in the urn were white. 17.....
18. *Given:* A divided by B equals D divided by C.
Conclusion: AD equals BC. 18.....
19. *Given:* W over Z equals Y over T.
Conclusion: T over Y equals Z over W. 19.....
20. *Given:* H equals K; I equals one-half K.
Conclusion: Therefore I equals 2H. 20.....

End of Part 3. Score = Rights minus Wrongs =

PART 4

Directions: Answer the questions as follows: On the dotted line before the number of the question write the number of the bracketed passage which contains the correct answer.

Read the passage as often as necessary. You have 15 minutes for Part 4.

The first two questions are already answered correctly. A 1 is placed before Question 1 because *bracket 1* in the passage contains the correct answer. Similarly, the answer to Question 2 is found in *bracket 32*.

A symbol which, in a given discussion, is allowed to assume or represent different numerical values is called a variable. Variables are denoted by the later letters of the alphabet. Thus, in the equation of a straight line,

$$x/a + y/b = 1,$$

x and y may be considered as the variable coördinates of a point moving along the line. A quantity whose value remains unchanged is called a constant. Numerical or absolute constants retain the same values in all problems, as 2, 5, $\sqrt{7}$, etc.

Arbitrary constants, or parameters, are constants to which any one of an unlimited set of numerical values may be assigned, and they are supposed to have these assigned values throughout the investigation. They are usually denoted by the earlier letters of the alphabet. Thus, for every pair of values arbitrarily assigned to a and b , the equation

$$x/a + y/b = 1,$$

represents some particular straight line.

When two variables are so related that the value of the first variable depends on the value of the second variable, then the first variable is said to be a function of the second variable. Nearly all scientific problems deal with quantities and relations of this sort, and in the experience of every day life we are continually meeting conditions illustrating the dependence of one quantity on another. For instance, the weight a man is able to lift depends on his strength, other things being equal. Similarly, the area of a square is a function of the length of a side, and the volume of a sphere is a function of its diameter.

The second variable, to which values may be assigned at pleasure within limits depending on the particular problem, is called the *independent variable*, or *argument*; and the first variable, whose value is determined as soon as the value of the independent variable is fixed, is called the *dependent variable* or *function*. Frequently, when we are considering two related variables it is in our power to fix upon whichever we please as the independent variable; but having once made the choice, no change of independent variable is allowed without certain precautions and transformations.

One quantity (the dependent variable) may be a function of two or more other quantities (the independent variables). For example, the cost of cloth is a function of both the quality and quantity; the area of a triangle of the base and altitude; the volume of a rectangular parallelepiped is a function of its three dimensions.

Answers

1. . . 1. Under what conditions does a symbol represent a variable?
2. . 32. What is a technical name for the independent variable?
3. What letters denote variables?
4. What relation does the concept "function" have to everyday experience?
5. What is the equation of a straight line?
6. Are functions rare in science?
7. How are the values of the second variable restricted?
8. What can be said of numerical constants?
9. What are the constants on the left hand side of the equation in the passage?
10. In the statement about the strength of a man, what is the dependent variable?
11. When is the value of a function determined?
12. What example is cited of a variable depending on three variables?
13. The area of a triangle is a function of what variables?
14. The idea of a function involves at least how many variables?
15. Can a function have more than one argument?
16. When several constants appear in a problem, what letters are usually employed to represent them?
17. If y is a function of x , on what does the value of y depend?

COÖPERATIVE ENGLISH TEST

(Usage, Spelling, and Vocabulary)

FORM PM

by

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Do not write on this booklet. Write your name, etc. and mark your answers on the special sheet given to you for this purpose.

General Directions: Do not turn this page until the examiner tells you to do so. This examination consists of three parts, and Part I includes four sections. The directions for each division are printed at the beginning of the division. There is a time limit for each division. If you have not finished a division when the time is up, stop work on that division and proceed at once to the next division. If you should finish before the time is up, you may go to the next division. No questions may be asked after the examination has begun.

You may answer questions even when you are not perfectly sure that your answers are correct, but you should avoid **wild** guessing, since wrong answers will result in a subtraction from the number of your correct answers.

Part	Pages	Minutes
I—English Usage—Section 1 Grammar and Diction Section 2 Punctuation Section 3 Capitalization Section 4 Sentence Structure	2-5	12
	6	15
	7	5
	8-9	8
II—Spelling	10-11	10
III—Vocabulary	12-15	20
Total		70

PART I: ENGLISH USAGE

Section 1: Grammar and Diction
(12 minutes)

Directions: Select from the several choices given in each of the following items the one which you consider best. Then on your answer sheet blacken with your pencil the space between the dotted lines whose **number** is the same as that of your choice.

Sample: That $\left\{ \begin{array}{l} 0-1 \text{ aren't} \\ 0-2 \text{ ain't} \\ 0-3 \text{ isn't} \end{array} \right\}$ right.

Answer Sheet: 1 2 3
0 ⋮ ⋮ ⋮

1. He had $\left\{ \begin{array}{l} 1-1 \text{ tore} \\ 1-2 \text{ torn} \end{array} \right\}$ his coat in several places.
2. They thought that $\left\{ \begin{array}{l} 2-1 \text{ us} \\ 2-2 \text{ we} \end{array} \right\}$ boys were unreliable.
3. Late in the evening the trapper $\left\{ \begin{array}{l} 3-1 \text{ came} \\ 3-2 \text{ come} \end{array} \right\}$ upon a small log cabin in the forest.
4. Why can't they $\left\{ \begin{array}{l} 4-1 \text{ leave} \\ 4-2 \text{ let} \end{array} \right\}$ a fellow have his own way about things that concern him alone?
5. Of course, her sister is a better talker than $\left\{ \begin{array}{l} 5-1 \text{ her,} \\ 5-2 \text{ she,} \end{array} \right\}$ but both girls are clever.
6. That brother of mine couldn't behave $\left\{ \begin{array}{l} 6-1 \text{ proper} \\ 6-2 \text{ properly} \end{array} \right\}$ on any occasion.
7. I had no idea where you $\left\{ \begin{array}{l} 7-1 \text{ was} \\ 7-2 \text{ were} \end{array} \right\}$ that morning.
8. $\left\{ \begin{array}{l} 8-1 \text{ Who} \\ 8-2 \text{ Whom} \end{array} \right\}$ did he write to for permission to use the material?
9. Not so long ago, thirty miles $\left\{ \begin{array}{l} 9-1 \text{ was} \\ 9-2 \text{ were} \end{array} \right\}$ considered a good day's journey.
10. I should be annoyed if I could not do so well as $\left\{ \begin{array}{l} 10-1 \text{ he} \\ 10-2 \text{ him} \end{array} \right\}$ in any game.
11. There $\left\{ \begin{array}{l} 11-1 \text{ wasn't} \\ 11-2 \text{ weren't} \end{array} \right\}$ many ships like the one on which my grandfather sailed long ago.
12. The squirrel held the nut in its paws just $\left\{ \begin{array}{l} 12-1 \text{ like} \\ 12-2 \text{ as} \end{array} \right\}$ a child would hold a ball.
13. I wonder why his sister and $\left\{ \begin{array}{l} 13-1 \text{ he} \\ 13-2 \text{ him} \end{array} \right\}$ disagree.
14. When I went to country school, we $\left\{ \begin{array}{l} 14-1 \text{ use} \\ 14-2 \text{ used} \end{array} \right\}$ to brag about our fathers as we walked home.
15. There were $\left\{ \begin{array}{l} 15-1 \text{ less} \\ 15-2 \text{ fewer} \end{array} \right\}$ people at the meeting this week than at the last one.
16. I haven't a very good ear for music, but even to me that violin sounds very $\left\{ \begin{array}{l} 16-1 \text{ strange.} \\ 16-2 \text{ strangely.} \end{array} \right\}$
17. He spoke neither to Henry $\left\{ \begin{array}{l} 17-1 \text{ nor} \\ 17-2 \text{ or} \end{array} \right\}$ to Joe.
18. The difference between the average grades for the first four weeks and those for the last four weeks $\left\{ \begin{array}{l} 18-1 \text{ was} \\ 18-2 \text{ were} \end{array} \right\}$ quite small.
19. Swimming and boating $\left\{ \begin{array}{l} 19-1 \text{ is} \\ 19-2 \text{ are} \end{array} \right\}$ great fun if one is not afraid of the water.
20. Father was impartial; he never gave Jack more money than $\left\{ \begin{array}{l} 20-1 \text{ I.} \\ 20-2 \text{ me.} \end{array} \right\}$
21. This set of rules $\left\{ \begin{array}{l} 21-1 \text{ serves} \\ 21-2 \text{ serve} \end{array} \right\}$ us quite well.
22. Why should you be $\left\{ \begin{array}{l} 22-1 \text{ accepted} \\ 22-2 \text{ excepted} \end{array} \right\}$ from such a well established rule?

Go on to the next page.

23. These facts and assumptions concerning the situation $\left\{ \begin{array}{l} 23-1 \text{ is} \\ 23-2 \text{ are} \end{array} \right\}$ what he based his reasoning on.
24. Either Fred or Dale always $\left\{ \begin{array}{l} 24-1 \text{ sees} \\ 24-2 \text{ see} \end{array} \right\}$ the difficulty at once.
25. Every one of the boys in these classes $\left\{ \begin{array}{l} 25-1 \text{ is} \\ 25-2 \text{ are} \end{array} \right\}$ skilled in several trades.
26. The gift Johnny said he wanted most $\left\{ \begin{array}{l} 26-1 \text{ was} \\ 26-2 \text{ were} \end{array} \right\}$ some skates.
27. The principal of the school together with all the teachers $\left\{ \begin{array}{l} 27-1 \text{ has} \\ 27-2 \text{ have} \end{array} \right\}$ promised to cooperate in this project.
28. These problems do not really concern people like you and $\left\{ \begin{array}{l} 28-1 \text{ I} \\ 28-2 \text{ me} \end{array} \right\}$ at all.
29. The new amendment is one of those omnibus affairs that $\left\{ \begin{array}{l} 29-1 \text{ include} \\ 29-2 \text{ includes} \end{array} \right\}$ all kinds of provisions.
30. The prize will go to $\left\{ \begin{array}{l} 30-1 \text{ whoever} \\ 30-2 \text{ whomever} \end{array} \right\}$ makes the highest score.
31. A large number of Americans $\left\{ \begin{array}{l} 31-1 \text{ were drowned} \\ 31-2 \text{ drowned} \\ 31-3 \text{ were drowned} \end{array} \right\}$ when the Lusitania sank.
32. You $\left\{ \begin{array}{l} 32-1 \text{ should a} \\ 32-2 \text{ should of} \\ 32-3 \text{ should have} \end{array} \right\}$ known better than to stand up in the canoe.
33. The words $\left\{ \begin{array}{l} 33-1 \text{ were hardly} \\ 33-2 \text{ weren't hardly} \\ 33-3 \text{ hardly was} \end{array} \right\}$ out of my mouth when I saw Tom enter.
34. Mary and I $\left\{ \begin{array}{l} 34-1 \text{ both had the same feeling} \\ 34-2 \text{ had the same feeling} \\ 34-3 \text{ had identically the same feeling} \\ 34-4 \text{ both had identically the same feeling} \end{array} \right\}$ about music lessons.
35. He insisted that we $\left\{ \begin{array}{l} 35-1 \text{ was} \\ 35-2 \text{ were} \\ 35-3 \text{ wasn't} \\ 35-4 \text{ weren't} \end{array} \right\}$ never under obligation to him.
36. I'm afraid $\left\{ \begin{array}{l} 36-1 \text{ they're} \\ 36-2 \text{ their} \\ 36-3 \text{ there} \end{array} \right\}$ not going to get here on time.
37. She says she $\left\{ \begin{array}{l} 37-1 \text{ don't} \\ 37-2 \text{ doesn't} \\ 37-3 \text{ didn't} \end{array} \right\}$ care what you do with the papers.
38. I sometimes think our neighbors $\left\{ \begin{array}{l} 38-1 \text{ aren't scarcely ever} \\ 38-2 \text{ scarce ever stay} \\ 38-3 \text{ are scarcely ever} \end{array} \right\}$ at home.
39. I suppose that I $\left\{ \begin{array}{l} 39-1 \text{ might of done} \\ 39-2 \text{ might have done} \\ 39-3 \text{ might have did} \end{array} \right\}$ something to help them.
40. He glanced through all three of the books, but he didn't think he would like $\left\{ \begin{array}{l} 40-1 \text{ either} \\ 40-2 \text{ neither} \\ 40-3 \text{ any} \\ 40-4 \text{ none} \end{array} \right\}$ of them.
41. Many people have $\left\{ \begin{array}{l} 41-1 \text{ climb} \\ 41-2 \text{ climbed} \\ 41-3 \text{ clumb} \end{array} \right\}$ that mountain.
42. I can see that $\left\{ \begin{array}{l} 42-1 \text{ your} \\ 42-2 \text{ you'r} \\ 42-3 \text{ youre} \\ 42-4 \text{ you're} \end{array} \right\}$ rather upset today.
43. $\left\{ \begin{array}{l} 43-1 \text{ Although} \\ 43-2 \text{ In spite of being} \\ 43-3 \text{ Although I was} \end{array} \right\}$ barely five, my father started me in school that fall.

44. We should have been glad to go if they $\left. \begin{array}{l} 44-1 \text{ would of} \\ 44-2 \text{ had of} \\ 44-3 \text{ would have} \\ 44-4 \text{ had} \end{array} \right\}$ let us know in time.
45. $\left. \begin{array}{l} 45-1 \text{ It is useless to go} \\ 45-2 \text{ It isn't any use of going} \\ 45-3 \text{ There is no use for to go} \end{array} \right\}$ at this time.
46. The cat $\left. \begin{array}{l} 46-1 \text{ which} \\ 46-2 \text{ who} \\ 46-3 \text{ whom} \end{array} \right\}$ I remember most clearly was a big Manx.
47. He told us that $\left. \begin{array}{l} 47-1 \text{ their} \\ 47-2 \text{ they're} \\ 47-3 \text{ there} \end{array} \right\}$ wouldn't be any more work after Friday.
48. It does not look $\left. \begin{array}{l} 48-1 \text{ as though} \\ 48-2 \text{ like} \\ 48-3 \text{ that} \end{array} \right\}$ it would rain.
49. The papers may have $\left. \begin{array}{l} 49-1 \text{ laid} \\ 49-2 \text{ lay} \\ 49-3 \text{ lain} \end{array} \right\}$ on his desk for several weeks.
50. Under such circumstances, I strongly advise against $\left. \begin{array}{l} 50-1 \text{ you} \\ 50-2 \text{ your} \\ 50-3 \text{ you're} \end{array} \right\}$ going.
51. I do not think that this will $\left. \begin{array}{l} 51-1 \text{ in any way affect} \\ 51-2 \text{ effect in any way} \\ 51-3 \text{ in no way affect} \end{array} \right\}$ my earlier decision.
52. They are in trouble; $\left. \begin{array}{l} 52-1 \text{ lets us} \\ 52-2 \text{ let us} \\ 52-3 \text{ let you and I} \\ 52-4 \text{ lets you and me} \end{array} \right\}$ see if we can help them.
53. $\left. \begin{array}{l} 53-1 \text{ Listening} \\ 53-2 \text{ As he listened} \\ 53-3 \text{ While listening} \end{array} \right\}$ carefully, the whole scene came before his eyes as if he had been there.
54. I tell you that I expect everyone to do $\left. \begin{array}{l} 54-1 \text{ his} \\ 54-2 \text{ their} \\ 54-3 \text{ there} \end{array} \right\}$ full duty.
55. The robber $\left. \begin{array}{l} 55-1 \text{ which} \\ 55-2 \text{ who} \\ 55-3 \text{ whom} \end{array} \right\}$ the papers said the police had caught is still free.
56. Of the three, I think this is $\left. \begin{array}{l} 56-1 \text{ much the better} \\ 56-2 \text{ certainly the best} \\ 56-3 \text{ decidedly the better} \end{array} \right\}$ buy.
57. $\left. \begin{array}{l} 57-1 \text{ Whos} \\ 57-2 \text{ Whose} \\ 57-3 \text{ Who's} \\ 57-4 \text{ Who'se} \end{array} \right\}$ been making all this fuss about our week at the lake?
58. I always thought his sister dressed $\left. \begin{array}{l} 58-1 \text{ very nice.} \\ 58-2 \text{ real nice.} \\ 58-3 \text{ real nicely.} \\ 58-4 \text{ very nicely.} \end{array} \right\}$
59. David told us to be sure $\left. \begin{array}{l} 59-1 \text{ to try and} \\ 59-2 \text{ to try to} \\ 59-3 \text{ and try and} \\ 59-4 \text{ and try to} \end{array} \right\}$ get there on time.
60. The reason she returned the book so soon was $\left. \begin{array}{l} 60-1 \text{ that} \\ 60-2 \text{ because} \\ 60-3 \text{ on account of} \end{array} \right\}$ she knew she wouldn't have time to read it.
61. They invited my husband and $\left. \begin{array}{l} 61-1 \text{ I} \\ 61-2 \text{ myself} \\ 61-3 \text{ me} \end{array} \right\}$ to go to the theater.

62. The movie was quite different $\left. \begin{array}{l} \{62-1 \text{ from what} \\ \{62-2 \text{ than} \\ \{62-3 \text{ than what} \end{array} \right\}$ I thought it would be.
63. I really think that you $\left. \begin{array}{l} \{63-1 \text{ hadn't ought} \\ \{63-2 \text{ oughtn't} \\ \{63-3 \text{ shouldn't ought} \end{array} \right\}$ to disobey your father.
64. When we reached home, we found that all the water pipes had $\left. \begin{array}{l} \{64-1 \text{ burst.} \\ \{64-2 \text{ bursted.} \\ \{64-3 \text{ busted.} \end{array} \right\}$
65. The $\left. \begin{array}{l} \{65-1 \text{ youngsters} \\ \{65-2 \text{ youngster's} \\ \{65-3 \text{ youngsters'} \end{array} \right\}$ speaking when he did was a very welcome interruption to our talk.
66. $\left. \begin{array}{l} \{66-1 \text{ Because he knew} \\ \{66-2 \text{ Because of knowing} \\ \{66-3 \text{ Knowing} \end{array} \right\}$ very little about the matter, his replies were necessarily vague.
67. There were several $\left. \begin{array}{l} \{67-1 \text{ Jones's} \\ \{67-2 \text{ Jones'} \\ \{67-3 \text{ Joneses} \\ \{67-4 \text{ Jones} \end{array} \right\}$ in our neighborhood.
68. That's $\left. \begin{array}{l} \{68-1 \text{ sure a} \\ \{68-2 \text{ a real} \\ \{68-3 \text{ a really} \end{array} \right\}$ fine looking racehorse.
69. My father, as well as my uncles and grandparents, $\left. \begin{array}{l} \{69-1 \text{ was born} \\ \{69-2 \text{ were born} \\ \{69-3 \text{ were borned} \\ \{69-4 \text{ was borned} \end{array} \right\}$ in Poland.
70. That gave $\left. \begin{array}{l} \{70-1 \text{ my brother and I} \\ \{70-2 \text{ my brother and me} \\ \{70-3 \text{ myself and my brother} \\ \{70-4 \text{ me and my brother} \end{array} \right\}$ fresh heart for another attempt.
71. I have never used $\left. \begin{array}{l} \{71-1 \text{ this kind of a pencil.} \\ \{71-2 \text{ these kind of pencils.} \\ \{71-3 \text{ this kind of pencil.} \end{array} \right\}$
72. $\left. \begin{array}{l} \{72-1 \text{ If they had of known} \\ \{72-2 \text{ If they had known} \\ \{72-3 \text{ Had they of known} \\ \{72-4 \text{ If they had've known} \end{array} \right\}$ what he intended to do, they would not have helped him.
73. I think that the new system of grading is $\left. \begin{array}{l} \{73-1 \text{ more preferable to} \\ \{73-2 \text{ more preferable than} \\ \{73-3 \text{ preferable than} \\ \{73-4 \text{ preferable to} \end{array} \right\}$ the old one.
74. They told me the name of the person $\left. \begin{array}{l} \{74-1 \text{ which} \\ \{74-2 \text{ whom} \\ \{74-3 \text{ who} \end{array} \right\}$ they believed could give me the information I wanted.
75. If this project proves successful, the lives of many people will be $\left. \begin{array}{l} \{75-1 \text{ saved, thus repaying the city} \\ \{75-2 \text{ saved; in this way, the city will be repaid} \\ \{75-3 \text{ saved, in this way repaying the city} \\ \{75-4 \text{ saved. The city thus being repaid} \end{array} \right\}$ for the expense involved.

Section 2: Punctuation

(15 minutes)

Directions: Read each sentence through first to get its meaning. Then, at each place in which there is a number below the sentence, decide what punctuation, if any, is needed at the place to which the number refers. If no punctuation at all is needed, blacken on your answer sheet with your pencil the space between the dotted lines labeled **N**. If you think some punctuation is required, blacken the space between the dotted lines labeled with the mark or marks of punctuation you believe necessary.

We arrived in Oshkosh, Wisconsin on January 22, 1936 after three days travel.

1 2 3

"We must strive went on the speaker never to forget the three great duties to think clearly to speak honestly to support thought and speech by brave living."

4 5 6 7 8 9

Aware of these damaging dangerous facts I found it difficult to keep still I remained silent nevertheless because of being in his home town the seat of his power.

10 11 12 13 14 15 16

Although my brothers as annoying a lad as any I have seen he can usually win others to his point of view with ease.

17 18 19 20 21

"When you have heard their story answered John I am quite sure knowing you as I do that you will spare neither money nor effort to help them."

22 23 24 25 26

Port wine which takes its name from the city of Oporto in Portugal is also produced in Spain England imports great quantities of this wine.

27 28 29 30 31

"What my esteemed colleagues does this mean demanded the editor I chuckled at his pompous manner Charles snicker was also quite audible"

32 33 34 35 36 37 38

Eager young men may endanger sound plans by impatience yet such impatience dangerous as it may be is better than indifference a common offense nowadays.

39 40 41 42 43

I wonder what hes planning to do whispered Frank to John I do not think he has any real injury do you John thought it best to make no reply

44 45 46 47 48 49 50 51

Men who are gifted with eloquence frequently as you know let that eloquence carry them away hence we should not pay too much attention to their talk.

52 53 54 55

"What an awful thing to say gasped my grandmother I should expect to be struck dead if such awful words came from me"

56 57 58 59 60

Go on to the next page.

Section 3 : Capitalization

(5 minutes)

Directions: After reading each sentence, study each word which has a number printed below it. On your answer sheet find the spaces which are to contain your response on a numbered word. If you decide that this word should begin with a capital letter, blacken with your pencil the space between the dotted lines labeled C. If you think the word should begin with a small letter, blacken the space between the dotted lines labeled s.

Some words which should be capitalized do not have numbers under them. Do not worry about such words. You are to be concerned only with the numbered words.

Mother says that irish linen is a fine birthday gift for a person like aunt sarah.
1 2 3

He sells a patent medicine that according to him will cure spring fever before the great dipper has swung once about the sky.
4 5 6 7 8

After reading " the circle " he remarked, " this play, I think, typifies twentieth century art at its worst."
9 10 11 12 13 14

Poor old captain johnson had bright's disease, but he still sailed the " fury " in defiance of neptune and the elements.
15 16 17 18

" Of all the pictures displayed by the civic art league," john remarked, " the only one I liked was ' the age of innocence.' "
19 20 21

He is a good lutheran deacon and fears all foreign foes, but anti-jewish prejudice offends him; he spoke about it recently at a masonic banquet.
22 23 24

The principal of our high school, a young man fresh from the east, had a high opinion of the value of natural science.
25 26 27 28 29 30

Section 4: Sentence Structure

(8 minutes)

Directions: Read each of the following groups of sentences carefully. Then decide which sentence in each group is better than the other sentences in that group, and on your answer sheet blacken with your pencil the space between the dotted lines whose number is the same as that of the best sentence.

- 1-1 To keep the ball within the tennis court was very hard, as the wind was blowing so hard.
 1-2 So hard blew the wind, that within the tennis court we could not keep the ball.
 1-3 The ball could not be kept within the tennis court by us, for the wind was blowing, and it was blowing hard.
 1-4 The wind was blowing so hard that we could not keep the ball within the tennis court.
- 2-1 The waves sparkled in the sunlight, and as I walked along the shore of the lake, I watched them.
 2-2 The waves sparkled in the sunlight, while I watched them as I walked along the shore of the lake.
 2-3 As I walked along the shore of the lake, I watched the waves sparkling in the sunlight.
 2-4 Sparkling in the sunlight, I watched the waves as I walked along the shore of the lake.
- 3-1 I asked him could he earn enough money so as to be able to pay for his college tuition.
 3-2 Could he earn enough money in order to pay for his tuition at college was what I asked him?
 3-3 I questioned him as to whether he could accrue sufficient funds for discharging his debt to the college.
 3-4 I asked him whether he could earn enough money to pay for his college tuition.
- 4-1 Since he wrote an essay against whipping pupils, this was the reason Robert Southey was expelled from school.
 4-2 Robert Southey was expelled from school because he wrote an essay against whipping pupils.
 4-3 Robert Southey wrote an essay against whipping pupils, and he was expelled from school.
 4-4 The reason Robert Southey was expelled from school was on account of his essay against whipping pupils.
- 5-1 The conductor, a pleasant-faced man, and who seemed to take a personal interest in the welfare of his passengers.
 5-2 The conductor was a pleasant-faced man who seemed to take a personal interest in the welfare of his passengers.
 5-3 The conductor took a personal interest in how his passengers fared and had a face that was pleasant.
 5-4 The conductor had a pleasant face, taking what seemed to be a personal interest in his passengers' welfare.
- 6-1 On a bright morning in spring Sir Launfal put on his armor, mounted his charger, and set out on his quest for the Holy Grail.
 6-2 On a bright morning in spring Sir Launfal, putting on his armor, mounted his charger, setting out on his quest for the Holy Grail.
 6-3 It was a bright spring morning when Sir Launfal put on his armor, then he mounted his steed and set out on his quest for the Holy Grail.
 6-4 When Sir Launfal set out on his quest for the Holy Grail, it was a bright spring morning when he put on his armor and mounted his charger.
- 7-1 In writing stories a writer must learn to develop a power in observation and he must learn to construct his plots carefully and to phrase his thoughts effectively.
 7-2 A writer of successful short stories must learn to observe closely, construct his plots carefully, and phrase his thoughts effectively.
 7-3 Learn to observe things closely, construct your plots carefully, and phrase your thoughts effectively, because if you do these three things, they may help to make of you a successful writer of short stories.
 7-4 Here are three things: close observation, construct your plots carefully, effective phrasing. A successful writer of short stories must learn these three things.
- 8-1 With respect to rainbows, how many people can tell offhand if the red is on the inner edge of the arc or is it on the outer edge of it?
 8-2 How many people can tell offhand is the red of a rainbow on the inner or outer edge of the arc?
 8-3 How many people can tell offhand whether the red of a rainbow is on the inner or outer edge of the arc?
 8-4 In regard to the rainbow, how many people can tell whether the red is on the inner edge or not offhand?

Go on to the next page.

- 9-1 To succeed at radio announcing, a pleasing voice, quick wits, and ready language are essential to have.
- 9-2 To succeed at radio announcing, having a pleasing voice, quick wits, and ready language are what counts.
- 9-3 To succeed at radio announcing, a person needs a pleasing voice, quick wits, and ready language.
- 9-4 To succeed at radio announcing, you should be possessed of a pleasing voice, have quick wits, and be in command of ready language.
- 10-1 The volcanic explosion that destroyed the island of Krakatoa was probably the most terrific blast the world has ever known.
- 10-2 The destruction of the island of Krakatoa by a volcanic explosion probably was the most terrific blast ever known to the world.
- 10-3 The island of Krakatoa, the destruction of which was caused by a volcanic explosion, was probably the most terrific blast ever heard by man.
- 10-4 The explosion of a volcano on the island of Krakatoa destroyed it, and it was in all probability the most terrific blast that the world has ever known.
- 11-1 As he sat at his desk, he was meditating upon what he would say when the principal questioned him about the escapade.
- 11-2 He was meditating, as he sat at his desk, upon what he would say to the principal when he questioned him about the escapade.
- 11-3 Sitting at his desk, what he would say to the principal when the latter questioned him about the escapade was what he was meditating on.
- 11-4 As he sat at his desk, he was meditating upon what should be said to the principal upon being questioned by him about the escapade.
- 12-1 The emperor trembled with rage, summoned his sculptor, and pointed to the words which had offended him on the walls of the palace.
- 12-2 Trembling with rage, the sculptor was summoned to the emperor, pointing at the words on the wall of the palace which had offended him.
- 12-3 Trembling with rage, the emperor summoned his sculptor and pointed to the offending words on the wall of the palace.
- 12-4 With rage the emperor trembled as he pointed, after calling his sculptor, to the words on the palace wall which had offended him.
- 13-1 The creek overflowed its banks due to heavy rainfall.
- 13-2 The creek overflowed its banks, heavy rainfall being the cause.
- 13-3 The overflowing of its banks by the creek was owing to heavy rainfall.
- 13-4 The creek overflowed its banks because of heavy rainfall.
- 14-1 We had not been on our way very long before we met Father.
- 14-2 We had not been on our way very long until we met Father.
- 14-3 We had not traveled long until encountering Father.
- 14-4 We had not gone very long when we met Father.
- 15-1 Robert Frost was born in California, but has spent most of his life in New England—many people consider him America's most beloved poet.
- 15-2 Robert Frost, considered by many people to be America's most beloved poet, was born in California, although he has spent most of his life in New England.
- 15-3 Although Robert Frost was born in California, he has spent most of his life in New England and he is considered to be America's most beloved poet by many people.
- 15-4 Robert Frost was born in California, but he has spent most of his life in New England. He is considered by many people to be America's most beloved poet.

PART II: SPELLING

(10 minutes)

Directions: In each of the following groups of words, select the word that is misspelled. Then on your answer sheet blacken with your pencil the space between the dotted lines whose number is the same as that of the misspelled word. If you think that all four words in the group are correctly spelled, blacken the space labeled 0.

- 1-1 violence
- 1-2 volition
- 1-3 vulgar
- 1-4 appetite
- 1-0 *none wrong*

- 10-1 remedied
- 10-2 prejudices
- 10-3 politicians
- 10-4 guidance
- 10-0 *none wrong*

- 19-1 sympathetic
- 19-2 statutes
- 19-3 suffrage
- 19-4 strenuous
- 19-0 *none wrong*

- 2-1 recommended
- 2-2 prior
- 2-3 laboratory
- 2-4 apprehension
- 2-0 *none wrong*

- 11-1 memoranda
- 11-2 accustomed
- 11-3 vegetation
- 11-4 tragedy
- 11-0 *none wrong*

- 20-1 candidacy
- 20-2 cited
- 20-3 emphasised
- 20-4 coincidence
- 20-0 *none wrong*

- 3-1 assessment
- 3-2 appology
- 3-3 burlesque
- 3-4 communion
- 3-0 *none wrong*

- 12-1 rheumatism
- 12-2 guarantee
- 12-3 cafeteria
- 12-4 maxem
- 12-0 *none wrong*

- 21-1 attaching
- 21-2 ascertain
- 21-3 appropriation
- 21-4 pereodical
- 21-0 *none wrong*

- 4-1 transferred
- 4-2 forebade
- 4-3 triple
- 4-4 exquisitely
- 4-0 *none wrong*

- 13-1 privileged
- 13-2 adviser
- 13-3 yacht
- 13-4 vigilance
- 13-0 *none wrong*

- 22-1 mustashe
- 22-2 physician
- 22-3 loneliness
- 22-4 accommodate
- 22-0 *none wrong*

- 5-1 specifying
- 5-2 solemn
- 5-3 chauffeur
- 5-4 sandwich
- 5-0 *none wrong*

- 14-1 preceeding
- 14-2 humane
- 14-3 incredible
- 14-4 imperative
- 14-0 *none wrong*

- 23-1 criticisms
- 23-2 passionate
- 23-3 necessarily
- 23-4 monotony
- 23-0 *none wrong*

- 6-1 pronunciation
- 6-2 thesis
- 6-3 tenants
- 6-4 recipracate
- 6-0 *none wrong*

- 15-1 censorship
- 15-2 embarrassment
- 15-3 acquaintences
- 15-4 distinctive
- 15-0 *none wrong*

- 24-1 lieutenant
- 24-2 negotiations
- 24-3 rhymes
- 24-4 council
- 24-0 *none wrong*

- 7-1 magnificent
- 7-2 curiosity
- 7-3 judgments
- 7-4 initiated
- 7-0 *none wrong*

- 16-1 gauge
- 16-2 accompanying
- 16-3 affliction
- 16-4 breeches
- 16-0 *none wrong*

- 25-1 inaugurated
- 25-2 identity
- 25-3 afiliated
- 25-4 bronchitis
- 25-0 *none wrong*

- 8-1 violinist
- 8-2 variable
- 8-3 mahoghany
- 8-4 trivial
- 8-0 *none wrong*

- 17-1 siezed
- 17-2 usable
- 17-3 ultimo
- 17-4 tulips
- 17-0 *none wrong*

- 26-1 delicacy
- 26-2 depleted
- 26-3 unnecessarily
- 26-4 bridal
- 26-0 *none wrong*

- 9-1 achievement
- 9-2 applicable
- 9-3 essentialy
- 9-4 buffet
- 9-0 *none wrong*

- 18-1 opponent
- 18-2 opportune
- 18-3 paralyzed
- 18-4 scandle
- 18-0 *none wrong*

- 27-1 deficiency
- 27-2 suspence
- 27-3 debit
- 27-4 corsage
- 27-0 *none wrong*

28-1 scheduals
28-2 destiny
28-3 diplomacy
28-4 erroneous
28-0 *none wrong*

29-1 bouquet
29-2 cowardice
29-3 conscious
29-4 amatur
29-0 *none wrong*

30-1 auspices
30-2 cello
30-3 alternitive
30-4 proficient
30-0 *none wrong*

31-1 aggressive
31-2 infinite
31-3 preface
31-4 valet
31-0 *none wrong*

32-1 unsophisticated
32-2 tonsillitis
32-3 ingenuety
32-4 tension
32-0 *none wrong*

33-1 laurel
33-2 likable
33-3 malicious
33-4 forcably
33-0 *none wrong*

34-1 ingredients
34-2 kindergardeners
34-3 inevitable
34-4 cataloging
34-0 *none wrong*

35-1 vacuum
35-2 sorority
35-3 recipient
35-4 hereditary
35-0 *none wrong*

36-1 countenance
36-2 equivalent
36-3 acountant
36-4 formidable
36-0 *none wrong*

37-1 clerical
37-2 accrude
37-3 boulevard
37-4 taffeta
37-0 *none wrong*

38-1 volumenous
38-2 feasible
38-3 adequate
38-4 aforesaid
38-0 *none wrong*

39-1 furvor
39-2 prophecy
39-3 pageant
39-4 misapprehension
39-0 *none wrong*

40-1 unanimously
40-2 remnant
40-3 souvenir
40-4 continuence
40-0 *none wrong*

41-1 miscellaneous
41-2 exaggerated
41-3 pursuent
41-4 discretion
41-0 *none wrong*

42-1 withal
42-2 facination
42-3 canceled
42-4 conscientious
42-0 *none wrong*

43-1 verifying
43-2 subtle
43-3 prevalent
43-4 disasterous
43-0 *none wrong*

44-1 superfluous
44-2 concede
44-3 javelin
44-4 integrity
44-0 *none wrong*

45-1 psychology
45-2 carbruetor
45-3 medieval
45-4 maintenance
45-0 *none wrong*

PART III: VOCABULARY

(20 minutes)

Directions: In each group below, select the numbered word which most nearly corresponds in meaning to the word at the head of that group. Then on your answer sheet blacken with your pencil the space between the dotted lines whose number is the same as that of your choice.

1. **resistant**
1-1 confusing
1-2 conjunctive
1-3 systematical
1-4 assisting
1-5 opposing
2. **cottontail**
2-1 squirrel
2-2 poplar
2-3 boa
2-4 marshy plant
2-5 rabbit
3. **handicraft**
3-1 cunning
3-2 sailing ship
3-3 utility
3-4 manual skill
3-5 guild
4. **shortcake**
4-1 condiment
4-2 pastry
4-3 fruit
4-4 sweetmeat
4-5 vegetable
5. **listlessness**
5-1 aggressiveness
5-2 adaptability
5-3 indifference
5-4 sorrow
5-5 ugliness
6. **marketable**
6-1 partisan
6-2 jocular
6-3 marriageable
6-4 salable
6-5 essential
7. **tasteless**
7-1 benign
7-2 changeable
7-3 poisonous
7-4 colorless
7-5 insipid
8. **hardtack**
8-1 nail
8-2 textile
8-3 weapon
8-4 wood
8-5 biscuit
9. **crossbow**
9-1 ornament
9-2 rafter
9-3 weapon
9-4 knapsack
9-5 caldron
10. **boggy**
10-1 afraid
10-2 false
10-3 marshy
10-4 dense
10-5 black
11. **budgetary**
Pertaining to
11-1 the civil government
11-2 capital punishment
11-3 the calendar
11-4 a bulletin
11-5 a financial estimate
12. **commendable**
12-1 pleasurable
12-2 charitable
12-3 lucrative
12-4 proscriptive
12-5 laudable
13. **unobservant**
13-1 analytic
13-2 conclusive
13-3 heedless
13-4 ignorant
13-5 timid
14. **gruesomeness**
14-1 blackness
14-2 falseness
14-3 vindictiveness
14-4 drunkenness
14-5 ghastliness
15. **crescendo**
15-1 repeat
15-2 treble clef
15-3 decrease in time
15-4 eighth note
15-5 increase in volume
16. **nonchalant**
16-1 sarcastic
16-2 discourteous
16-3 noble
16-4 unconcerned
16-5 unsophisticated
17. **acceptableness**
17-1 affectedness
17-2 suitability
17-3 comeliness
17-4 geniality
17-5 adulation
18. **loathing**
18-1 diffidence
18-2 laziness
18-3 abhorrence
18-4 cleverness
18-5 comfort
19. **perambulator**
19-1 coffee pot
19-2 drunkard
19-3 baby carriage
19-4 liar
19-5 camel
20. **coloration**
20-1 pigmentation
20-2 alteration
20-3 configuration
20-4 prevention
20-5 taint
21. **ejection**
21-1 restoration
21-2 expulsion
21-3 surroundings
21-4 bisection
21-5 exposition
22. **bantam**
22-1 fowl
22-2 ridicule
22-3 cripple
22-4 vegetable
22-5 ensign
23. **morbidity**
23-1 morality
23-2 attractiveness
23-3 gloominess
23-4 affinity
23-5 mordacity
24. **aridity**
24-1 bitterness
24-2 surface
24-3 sonority
24-4 dryness
24-5 torridity
25. **gritty**
25-1 frigid
25-2 windy
25-3 cohesive
25-4 granular
25-5 unwieldy
26. **evoke**
26-1 wake up
26-2 surrender
26-3 reconnoiter
26-4 transcend
26-5 call forth

Go on to the next page.

27. **masticate**
 27-1 chew
 27-2 massage
 27-3 manufacture
 27-4 create
 27-5 pollute
28. **demoniacal**
 28-1 aloof
 28-2 mythical
 28-3 thoughtful
 28-4 fiendish
 28-5 eccentric
29. **trilogy**
Series of
 29-1 four lyrics
 29-2 wooden shoes
 29-3 vibrations
 29-4 interjections
 29-5 three dramas
30. **unobtrusive**
 30-1 unintelligent
 30-2 epileptic
 30-3 illogical
 30-4 lineal
 30-5 modest
31. **insulin**
 31-1 metal
 31-2 drug
 31-3 rubber
 31-4 slander
 31-5 spice
32. **highroad**
 32-1 mountain road
 32-2 right of way
 32-3 main road
 32-4 roadbed
 32-5 concrete road
33. **alignment**
 33-1 formation
 33-2 accusation
 33-3 emblem
 33-4 brightness
 33-5 buoyant
34. **terrain**
 34-1 ice cream
 34-2 final test
 34-3 tractor
 34-4 area of ground
 34-5 weight
35. **insatiable**
Incapable of
 35-1 satisfaction
 35-2 unity
 35-3 disgrace
 35-4 love
 35-5 fear
36. **befog**
 36-1 dampen
 36-2 forget
 36-3 whip
 36-4 mystify
 36-5 belittle
37. **yawl**
 37-1 tropical storm
 37-2 fog horn
 37-3 carousal
 37-4 sail boat
 37-5 launch
38. **capriciousness**
 38-1 stubbornness
 38-2 courage
 38-3 whimsicality
 38-4 amazement
 38-5 greediness
39. **furtiveness**
 39-1 coldness
 39-2 merriment
 39-3 stealth
 39-4 fusilade
 39-5 instability
40. **platoon**
 40-1 table-land
 40-2 bridge of boats
 40-3 body of soldiers
 40-4 commonplace remark
 40-5 frigate
41. **hauteur**
 41-1 discordance
 41-2 arrogance
 41-3 languor
 41-4 ignorance
 41-5 utility
42. **maelstrom**
 42-1 slander
 42-2 whirlpool
 42-3 enmity
 42-4 armor
 42-5 majolica
43. **smugness**
 43-1 amicability
 43-2 complacency
 43-3 jealousy
 43-4 anger
 43-5 aridness
44. **dullard**
 44-1 peon
 44-2 duck
 44-3 braggart
 44-4 thief
 44-5 dunce
45. **drollery**
 45-1 enigma
 45-2 argument
 45-3 fable
 45-4 brogue
 45-5 jest
46. **tentative**
 46-1 critical
 46-2 conclusive
 46-3 authentic
 46-4 provisional
 46-5 apprehensive
47. **compatibility**
 47-1 abridgment
 47-2 congeniality
 47-3 compulsion
 47-4 association
 47-5 communism
48. **momentously**
 48-1 frivolously
 48-2 moderately
 48-3 weightily
 48-4 momentarily
 48-5 modishly
49. **poignancy**
 49-1 peignoir
 49-2 gloominess
 49-3 keenness
 49-4 gluttony
 49-5 barony
50. **placate**
 50-1 rehabilitate
 50-2 plagiarize
 50-3 depredate
 50-4 apprise
 50-5 conciliate
51. **camaraderie**
 51-1 battleship
 51-2 philanthropy
 51-3 surrender
 51-4 clique
 51-5 comradeship
52. **corroboratory**
 52-1 plausible
 52-2 anticipatory
 52-3 confirmatory
 52-4 explanatory
 52-5 esoteric
53. **inclement**
 53-1 balmy
 53-2 happy
 53-3 righteous
 53-4 severe
 53-5 apprehensive
54. **surcease**
 54-1 enlightenment
 54-2 cessation
 54-3 inattention
 54-4 censor
 54-5 substitution
55. **alpenstock**
 55-1 animal
 55-2 baton
 55-3 weed
 55-4 mountain
 55-5 staff
56. **figurine**
 56-1 metaphor
 56-2 wine
 56-3 poem
 56-4 organ
 56-5 statuette

57. **malignancy**
 57-1 deliberateness
 57-2 superiority
 57-3 delirium
 57-4 malevolence
 57-5 fragrantcy
58. **apathetic**
 58-1 wandering
 58-2 impassive
 58-3 hateful
 58-4 prophetic
 58-5 overflowing
59. **gullibility**
 59-1 familiarity
 59-2 fallacy
 59-3 sagacity
 59-4 credulity
 59-5 retentivity
60. **aesthetics**
Science of
 60-1 motion of air
 60-2 insensibility
 60-3 the beautiful
 60-4 wireless telegraph
 60-5 heredity
61. **nihilism**
 61-1 psychology
 61-2 optimism
 61-3 anarchism
 61-4 biology
 61-5 socialism
62. **paternoster**
 62-1 paternalism
 62-2 patricide
 62-3 malediction
 62-4 benediction
 62-5 prayer
63. **controversial**
 63-1 revival
 63-2 contentious
 63-3 conversational
 63-4 polite
 63-5 disagreeable
64. **rancorous**
 64-1 malignant
 64-2 jubilant
 64-3 abashed
 64-4 inglorious
 64-5 careless
65. **badinage**
 65-1 asylum
 65-2 hazard
 65-3 song
 65-4 command
 65-5 banter
66. **opalescence**
 66-1 opulence
 66-2 senescence
 66-3 bankruptcy
 66-4 iridescence
 66-5 assiduity
67. **delete**
 67-1 erase
 67-2 delay
 67-3 injure
 67-4 glaze
 67-5 charm
68. **inveteracy**
 68-1 habitualness
 68-2 migration
 68-3 bravery
 68-4 covering
 68-5 hatefulness
69. **salaam**
 69-1 salivation
 69-2 salmon
 69-3 salutation
 69-4 ransom
 69-5 brigand
70. **lush**
 70-1 stupid
 70-2 succulent
 70-3 hazy
 70-4 putrid
 70-5 languishing
71. **catamount**
 71-1 horse
 71-2 mountain
 71-3 cougar
 71-4 whirlpool
 71-5 ravine
72. **cholera**
 72-1 anger
 72-2 chorister
 72-3 guard
 72-4 saliva
 72-5 refrigerator
73. **jocose**
 73-1 factitious
 73-2 morose
 73-3 intemperate
 73-4 facetious
 73-5 inveterate
74. **curtailment**
 74-1 expenditure
 74-2 abandonment
 74-3 abridgment
 74-4 improvement
 74-5 forgery
75. **appreciably**
 75-1 gratefully
 75-2 perceptibly
 75-3 legally
 75-4 apprehensively
 75-5 sparingly
76. **vacillation**
 76-1 purification
 76-2 wavering
 76-3 expulsion
 76-4 tempting
 76-5 foolishness
77. **esperanto**
 77-1 bandit
 77-2 equator
 77-3 furnace
 77-4 language
 77-5 official
78. **perversity**
 78-1 adversity
 78-2 perviousness
 78-3 travesty
 78-4 waywardness
 78-5 gentility
79. **abjectness**
 79-1 greediness
 79-2 slavishness
 79-3 drunkenness
 79-4 desertion
 79-5 obstinacy
80. **aggrandizement**
 80-1 theft
 80-2 impeachment
 80-3 derision
 80-4 amazement
 80-5 enlargement
81. **virulent**
 81-1 difficult
 81-2 uneasy
 81-3 noxious
 81-4 torrid
 81-5 lavish
82. **calumnious**
 82-1 complimentary
 82-2 analogous
 82-3 slanderous
 82-4 tempestuous
 82-5 magnanimous
83. **homogeneity**
 83-1 superiority
 83-2 similarity
 83-3 immaturity
 83-4 friendship
 83-5 domesticity
84. **effulgence**
 84-1 prominence
 84-2 outline
 84-3 change
 84-4 radiance
 84-5 energy
85. **numismatics**
 85-1 properties of air
 85-2 nummulation
 85-3 science of coins
 85-4 astrology
 85-5 nunciature
86. **illiberality**
 86-1 bigotry
 86-2 imbecility
 86-3 illegibility
 86-4 cautery
 86-5 immaturity

87. **punctiliousness**
87-1 carelessness
87-2 punctuality
87-3 fortitude
87-4 seriousness
87-5 exactitude
88. **aphasia**
88-1 loss of speech
88-2 drunkenness
88-3 anemia
88-4 loss of memory
88-5 rash
89. **marmoset**
89-1 woodchuck
89-2 martinet
89-3 marsupium
89-4 monkey
89-5 puppet
90. **clabber**
90-1 rejoice
90-2 gossip
90-3 curdle
90-4 crow
90-5 hobble
91. **baroque**
91-1 slanderous
91-2 grotesque
91-3 tyrannical
91-4 humorous
91-5 angular
92. **panoplied**
92-1 philosophical
92-2 dressed in armor
92-3 panting
92-4 frenzied
92-5 atavistic
93. **neap**
Pertaining to
93-1 weaving
93-2 low tides
93-3 Naples
93-4 chemistry
93-5 necrology
94. **sacrosanct**
94-1 sacrificial
94-2 dormant
94-3 inviolable
94-4 superficial
94-5 gullible
95. **tarantella**
95-1 spider
95-2 snake
95-3 dance
95-4 duet
95-5 homage
96. **pomaceous**
Relating to
96-1 exercises
96-2 notes
96-3 apples
96-4 pomegranates
96-5 lessons
97. **peccadillo**
97-1 perfection
97-2 petty fault
97-3 peculiarity
97-4 delectation
97-5 peacefulness
98. **sedulousness**
98-1 diligence
98-2 credulousness
98-3 seduction
98-4 perilousness
98-5 frankness
99. **byre**
99-1 autopsy
99-2 cow shed
99-3 funeral home
99-4 dock
99-5 bird
100. **prurience**
100-1 modesty
100-2 sapience
100-3 provender
100-4 lust
100-5 security

Appendix C.--ZERO ORDER CORRELATIONS

Voucher Bond

Figure 1.--CORRELATION BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION

	2.75-3.00	2.50-2.74	2.25-2.49	2.00-2.24	1.75-1.99	1.50-1.74	1.25-1.49	1.00-1.24	.75-.99	.50-.74	.25-.49	0-.24	F	D	PD	PD ²
0- 19													3	3	-6	108
20- 39													6	12	-5	300
40- 59					1	1		3	2	1	3	4	15	-4	-60	240
60- 79							2	4	4	4	10	16	40	-3	-120	360
80- 99													26	88	-2	352
100-119		1		2	1	3	4	13	8	11	19	26	88	-2	-176	352
120-139			1	2	2	5	13	13	17	15	18	17	103	-1	-103	103
140-159		2	2	4	4	10	11	15	12	14	7	6	87	0	0	0
160-179	1	7	3	6	8	6	10	11	10	11	7	3	83	1	83	83
180-199	1	3	3	11	10	6	9	9	6	4	2	1	65	2	130	260
200-219	4	2	3	4	8	4	5	2	4	2			38	3	114	342
220-239		3	1	7	2	6	3	1					23	4	92	368
240-259	2	3	2			1		1					9	5	45	225
260-279	1	1	1		1	1							5	6	30	180
280-299		1				1							2	7	14	98
300-319	1	1											2	8	16	128
320-339	1		1										2	9	18	162
F	11	24	17	36	37	44	57	72	63	63	71	82	577			
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4				
PD	77	144	85	144	111	88	57	0	-63	-126	-213	-328	-24			
PD ²	539	864	425	576	333	176	57	72	63	252	639	1312	5308			
ΣXY	336	390	245	248	174	114	28	0	21	66	330	704	2656			

Figure 2.--CORRELATION BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND THE COOPERATIVE ENGLISH TEST

	2.75-3.00	2.50-2.74	2.25-2.49	2.00-2.24	1.75-1.99	1.50-1.74	1.25-1.49	1.00-1.24	.75-.99	.50-.74	.25-.49	0-.24	F	D	FD	FD ²
1- 14																
15- 29											1	1	2	-10		162
30- 44												1	1	-9	-18	64
45- 59								1	2			4	7	-8	-8	
60- 74					1	1		1	1			4	12	-7	-49	343
75- 89								3	2	1		6	10	-6	-72	432
90-104					2	1	1	4	5	3	10	11	22	-5	-110	550
105-119			1	1	1	3	2	6	4	8		7	12	-4	-148	592
120-134		1	2	2	2	2	3	17	7	11	11	15	45	-3	-135	405
135-149	1	1	1	2	3	6	15	4	7	11	11	15	71	-2	-142	284
150-164	6	1	1	5	2	3	4	6	8	11	11	12	75	-1	-75	75
165-179	1	1	4	4	3	7	8	6	10	5	9	1	47	0	0	0
180-194	1	2	4	8	3	7	8	9	16	12	4	7	77	1	77	77
195-209		3	4	8	8	4	8	7	4	5	1		48	2	96	192
210-224		3	4	2	7	3	6	3	6	4	5	2	45	3	135	405
225-239	2	6	1	4	4	9	9	4	2	1		1	43	4	172	688
240-254	1	3	2	3	4	3	1	4	1				22	5	110	550
255-269	2	2	1	2	3	3		1					14	6	84	504
270-284	2	1				2	3						8	7	56	392
285-299				1	1	1							2	8	16	128
F	10	23	18	34	39	48	60	70	68	61	69	81	581	9	27	243
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4				
FD	70	138	90	136	117	96	60	0	-68	122	-207	324	-14			
FD ²	490	828	450	544	351	192	60	0	68	244	621	1296	5144			
ΣXY	308	474	185	272	237	172	73	0	29	72	408	896	3126			

Figure 3.--CORRELATION BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND THE IOWA PLACEMENT EXAMINATION, SERIES CA1, REVISED, A. CHEMISTRY APTITUDE

	2.75-2.99	2.50-2.74	2.25-2.49	2.00-2.24	1.75-1.99	1.50-1.74	1.25-1.49	1.00-1.24	.75-.99	.50-.74	.25-.49	0-.24	F	D	FD	FD ²
5- 14												2	2	-5	-10	50
15- 24								1	1			2	4	-4	-16	64
25- 34								1	2	5	9	6	23	-3	-69	207
35- 44				2	2		4	6	8	13	10	17	62	-2	-124	248
45- 54		1	1	4	4	4	9	11	13	13	19	25	104	-1	104	104
55- 64			4	1	9	10	17	19	14	17	14	13	118	0	0	0
65- 74		9	2	5	11	19	11	16	22	11	6	8	120	1	120	120
75- 84	2	4	4	13	6	3	13	7	3	5	3	2	65	2	130	260
85- 94	3	7	7	8	5	5	3	4	1				43	3	129	387
95-104	4	5	1			1							11	4	44	176
F	9	26	19	33	37	42	57	65	64	64	61	75	552		100	1616
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4				
FD	63	156	95	132	111	84	57	0	-64	-128	-183	-300	23			
FD ²	441	936	475	528	333	168	57	0	64	256	549	1200	5007			
ΣXY	203	342	170	188	90	80	29	0	8	66	162	332	1670			

Figure 4.--CORRELATION BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND THE IOWA PLACEMENT EXAMINATION, SERIES MA1, REVISED, A. MATHEMATICS APTITUDE

	2.75-3.00	2.50-2.74	2.25-2.49	2.00-2.24	1.75-1.99	1.50-1.74	1.25-1.49	1.00-1.24	.75-.99	.50-.74	.25-.49	0-.24	F	D	FD	FD ²
1- 4											1		1	-5	-5	25
5- 9					2			2	3	2	5	8	22	-4	-88	352
10-14		1			1		3	6	6	7	15	14	53	-3	-159	477
15-19				1	1	1	3	11	7	11	20	22	77	-2	-154	308
20-24	1	4	1	5	3	5	5	9	13	16	12	13	87	-1	-87	87
25-29	1	4	4	2	7	17	16	16	14	13	10	15	119	0	0	0
30-34	2	1	1	11	13	7	17	10	9	6	4	4	85	1	85	85
35-39	2	2	3	7	9	8	9	3	9	8	2	2	64	2	128	256
40-44	1	2	1	6	1	5	7	4	3	1			31	3	93	279
45-49	1	6	2	3	1	4	2	3	1				23	4	92	368
50-54	2	2	3	1	1			1					10	5	50	250
55-59													0	6	0	0
60-64		2	1										3	7	21	147
F	10	24	16	36	39	47	62	65	65	64	69	78	575			
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4			-24	2634
FD	70	144	80	144	117	94	62	0	-65	-128	-207	-312			-1	
FD ²	490	864	400	576	351	188	62	0	65	256	621	1248			5121	
ZXY	140	240	195	212	81	79	44	0	17	84	346	492			1930	

Figure 5.--CORRELATION BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND QUARTILE RANK IN HIGH SCHOOL GRADUATING CLASS

	2.75-3.00	2.50-2.74	2.25-2.49	2.00-2.24	1.75-1.99	1.50-1.74	1.25-1.49	1.00-1.24	.75-.99	.50-.74	.25-.49	0-.24	F	D	FD	FD ²
1					1	1		3	3	4	14	20	46	-2	-92	184
2					2	1	3	12	12	14	20	32	96	-1	-96	96
3		1	2	13	7	13	14	28	30	24	23	16	171	0	0	0
4	10	21	11	26	26	29	34	17	12	12	6	5	209	1	209	209
F	10	22	13	39	36	44	51	60	57	54	63	73	522			489
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4				
FD	70	132	65	156	108	88	51	0	-57	-108	-189	-292	24		21	
FD ²	490	792	325	624	324	176	51	0	57	216	567	1168	4790			
ΣXY	70	126	55	104	66	52	31	0	6	20	126	268	924			

Figure 6.--CORRELATION BETWEEN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION AND THE COOPERATIVE ENGLISH TEST

	320-339	300-319	280-299	260-279	240-259	220-239	200-219	180-199	160-179	140-159	120-139	100-119	80-99	60-79	40-59	20-39	0-19	F	D	FD	FD2
1- 14																			10	0	0
15- 29														1	1			2	-9	-18	162
30- 44												1						1	-8	-8	64
45- 59													2	2	1	2	1	8	-7	-56	392
60- 74											1	4	1	4	4			14	-6	-84	504
75- 89											6	5	9	1	2	2		25	-5	-125	625
90-104										3	7	15	11	1	2			39	-4	-156	624
105-119									3	2	15	16	7	5	1			49	-3	-147	441
120-134								2	4	20	16	19	8	3	1			73	-2	-146	292
135-149						1		3	9	24	21	13	5					76	-1	-76	76
150-164								3	9	12	18	10	1					53	0	0	0
165-179						2	4	11	22	18	10	6						73	1	73	73
180-194	1				1	3	7	11	16	5	7	2	1					54	2	108	216
195-209					1	2	10	14	13	7	3	1						51	3	153	459
210-224					3	5	7	17	9	2	1							44	4	176	704
225-239			1	1	2	4	8	2		3								21	5	105	525
240-254				3	1	4	1	3										12	6	72	432
255-269		1	1	1	1	2	1											7	7	49	343
270-284					1		1											2	8	16	128
285-299	1	1				1												3	9	27	243
F	2	2	2	5	10	24	39	66	85	96	105	92	45	17	12	4	1	607		-37	6303
D	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7				
FD	18	16	14	30	50	96	117	132	85	0	-105	-184	-135	-68	-60	-24	-7	-25			
FD2	162	128	98	180	250	384	351	264	85	0	105	368	405	272	300	144	49	3545			
ΣXY	99	128	84	180	240	400	411	328	103		125	406	447	308	315	144	49	3767			

Figure 7.--CORRELATION BETWEEN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION AND THE IOWA PLACEMENT EXAMINATION, SERIES CA1, REVISED, A. CHEMISTRY APTITUDE

	5- 14	15- 24	25- 34	35- 44	45- 54	55- 64	65- 74	75- 84	85- 94	95-104	F	D	FD	FD ²	ΣXY
320-339									1	1	2	9	18	162	63
300-319									1	1	2	8	16	128	56
280-299							1		1	1	2	7	14	98	28
260-279							2		2	1	5	6	30	180	72
240-259								3	4	3	10	5	50	250	150
220-239						1	7	5	9	1	23	4	92	368	192
200-219					2	3	14	8	8	2	37	3	111	333	180
180-199				1	2	11	17	24	14	2	71	2	142	284	222
160-179				2	11	15	33	18	1		80	1	80	80	57
140-159				9	19	24	34	3	4		93	0	0	0	0
120-139		1	1	8	28	41	19	5			103	-1	-103	103	22
100-119		2	3	23	28	25	7	2			90	-2	-180	360	160
80-99		1	9	15	6	5	1				37	-3	-111	333	198
60-79			5	5	4	1	1				16	-4	-64	256	112
40-59	1		3	5	1	2					12	-5	-60	300	125
20-39	1	1					1				3	-6	-18	108	48
0-19			1								1	-7	-7	49	21
F	2	5	22	68	101	128	137	68	45	11	587		10	3392	1706
D	-5	-4	-3	-2	-1	0	1	2	3	4					
FD	-10	-20	-66	-136	-101	0	137	136	135	44	119				
FD ²	50	80	198	272	101	0	137	272	405	176	1691				

Figure 8.--CORRELATION BETWEEN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION AND THE IOWA PLACEMENT EXAMINATION, SERIES MA1, REVISED, A. MATHEMATICS APTITUDE

	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	F	D	FD	FD ²	ΣXY
320-339											1	1		2	8	16	128	88
300-319									1		1			2	7	14	98	56
280-299									1		1			2	6	12	72	48
260-279						1			1	1	1			4	5	20	100	60
240-259								2	2	2	2		1	9	4	36	144	140
220-239					1	3	5	3	3	6	1			22	3	66	198	144
200-219				2	1	5	6	14	6	4	1		1	40	2	80	160	150
180-199					7	12	24	9	7	6	1			66	1	66	66	85
160-179			2	3	13	18	21	13	9	3				82	0	0	0	0
140-159			4	13	20	27	13	14	1					92	-1	-92	92	14
120-139		1	8	19	21	39	11	5	1					105	-2	-210	420	126
100-119		5	17	28	21	9	3	4						87	-3	-261	783	411
80-99		8	12	14	3	3	1							41	-4	-164	656	392
60-79	2	4	4	3	1									14	-5	-70	350	225
40-59		3	7		2									12	-6	-72	432	210
20-39	1	1	1	1		1								5	-7	-35	245	98
F	3	22	55	83	90	118	84	64	32	22	9	1	2	685		594	3944	2247
D	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7					
FD	-15	-88	-165	-166	-90	0	84	128	96	88	45	6	14		-63			
FD ²	75	352	495	332	90	0	84	256	288	352	225	36	98		2683			

Figure 9.--CORRELATION BETWEEN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION AND THE QUARTILE RANK IN HIGH SCHOOL GRADUATING CLASS

	4	3	2	1	F	D	FD	FD ²
0- 19		1			1	-7	-7	49
20- 39		2		1	3	-6	-18	108
40- 59		4	3	3	10	-5	-50	250
60- 79	1	5	2	4	12	-4	-48	192
80- 99	3	10	14	8	35	-3	-105	315
100-119	15	27	27	10	79	-2	-158	316
120-139	25	30	25	12	92	-1	-92	92
140-159	35	32	11	4	82	0	0	0
160-179	36	30	9	2	77	1	77	77
180-199	37	17	2		56	2	112	224
200-219	24	12	1		37	3	111	333
220-239	13	4		1	23	4	92	368
240-259	9			1	10	5	50	250
260-279	4	1			5	6	30	180
280-299	2				2	7	14	98
300-319	2				2	8	16	128
320-339	2				2	9	18	162
F	213	175	94	46	528		42	3221
D	1	0	-1	-2				
FD	213	0	-94	-92	27			
FD ²	213	0	94	184	491			
ΣXY	303	0	128	164	595			

Figure 10.--CORRELATION BETWEEN THE COOPERATIVE ENGLISH TEST AND THE IOWA PLACEMENT EXAMINATION, SERIES CA1, REVISED, A. CHEMISTRY APTITUDE

	95-104	85- 94	75- 84	65- 74	55- 64	45- 54	35- 44	25- 34	15- 24	5- 14	F	D	FD	FD ²
1- 14											0	0	0	0
15- 29								1		1	2	-9	-18	162
30- 44					1						1	-8	-8	64
45- 59					3		1	1	1	1	7	-7	-49	343
60- 74					1	3	4	4	1		13	-6	-78	468
75- 89			1	3	5	5	5	1		1	21	-5	-105	525
90-104				3	6	14	10	2			35	-4	-140	560
105-119				8	10	15	10	4			47	-3	-141	423
120-134		1	7	18	15	12	9	6	1		69	-2	-138	276
135-149		3	10	14	15	18	11	1			72	-1	-72	72
150-164		3	3	13	16	10	3	1	1		50	0	0	0
165-179	2	7	9	17	25	11	3		1		75	1	75	75
180-194	2	7	9	11	14	4	4				51	2	102	204
195-209	2	6	11	15	8	4	3				49	3	147	441
210-224	1	7	10	14	5	3	2				42	4	168	672
225-239	1	5	6	7	3	2					24	5	120	600
240-254	1	3	3	3	2	1					13	6	78	448
255-269	1	2	2	3							8	7	56	392
270-284				2							2	8	16	128
285-299	2			1							3	9	27	243
F	12	44	71	132	129	102	65	21	5	3	584		40	6088
D	4	3	2	1	0	-1	-2	-3	-4	-5				
FD	48	132	142	132	129	-102	-130	-63	-20	-15	253			
FD ²	192	396	284	132	0	102	260	189	80	75	1710			
ZXY	208	357	266	138	0	127	254	234	52	105	1741			

Figure 11.---CORRELATION BETWEEN THE COOPERATIVE ENGLISH TEST AND THE IOWA PLACEMENT EXAMINATION, SERIES NA1, REVISED, A. MATHEMATICS APTITUDE

	60-64	55-59	50-54	45-49	40-44	35-39	30-34	25-29	20-24	15-19	10-14	5-9	1-4	F	D	FD	FD ²
1- 14															-10	0	0
15- 29											1		1	2	-9	-18	162
30- 44											1			1	-8	-8	64
45- 59								1		1	2		1	7	-7	-49	343
60- 74								1		3	8			14	-6	-84	504
75- 89						1	1	4	7	4	4	4		25	-5	-125	625
90-104			1				1	5	6	11	7	2		33	-4	-132	528
105-119					1	2	5	9	6	17	4	8		52	-3	-156	468
120-134			1	1	1	6	9	7	14	18	10	3		70	-2	-140	280
135-149				1	3	9	12	20	10	7	8	1		71	-1	+71	71
150-164				1		9	4	17	12	4	4	2		53	0	0	0
165-179			1	3	5	9	16	19	11	6	3	1		74	1	74	74
180-194			2	6		6	8	11	5	4	3			45	2	90	180
195-209	1		2	1	2	9	13	9	6	2	2			47	3	141	423
210-224	1		1	2	7	8	9	8	4	2	1			43	4	172	688
225-239			1	5	5	4	2	2	2	1				22	5	110	550
240-254			2	3	2	3			4					14	6	84	504
255-269			1	1	2		2	2						8	7	56	392
270-284					1	1								2	8	16	128
285-299		1	1					1						3	9	27	243
F	2	1	13	24	29	67	82	116	87	80	38	25	2	586			
D	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5			-13	6227
FD	14	6	65	96	87	134	82	0	-87	-160	-114	-100	-10	13			
FD ²	98	36	324	384	261	268	82	0	87	320	342	400	50	2653			
ΣXY	49	54	210	282	270	188	77	0	26	308	444	336	80	1924			

Figure 12.--CORRELATION BETWEEN THE COOPERATIVE ENGLISH TEST AND THE QUARTILE RANK
IN HIGH SCHOOL GRADUATING CLASS

	4	3	2	1	F	D	FD	FD ²
1- 14					0	-10	0	
15- 29				2	2	-9	-18	162
30- 44			1		1	-8	-8	64
45- 59	1	3	2		6	-7	-42	294
60- 74	2	6	2	2	12	-6	-72	432
75- 89	3	5	7	6	21	-5	-105	525
90-104	2	6	12	8	28	-4	-112	448
105-119	6	15	10	7	38	-3	-114	342
120-134	13	22	21	8	64	-2	-128	256
135-149	19	27	13	5	64	-1	-64	64
150-164	10	28	7	1	46	0	0	0
165-179	31	24	10	4	69	1	69	69
180-194	26	14	2		42	2	84	168
195-209	24	15	4	1	44	3	132	396
210-224	26	9	1	1	37	4	148	592
225-239	18	3			21	5	105	525
240-254	10	1	1		12	6	72	432
255-269	6	1			7	7	49	343
270-284	2				2	8	16	128
285-298	3				3	9	27	243
F	202	179	93	45	519		39	5483
D	1	0	-1	-2				
FD	202	0	-93	-90	19			
FD ²	202	0	93	180	475			
ΣXY	389	0	166	246	801			

Figure 13.--CORRELATION BETWEEN THE IOWA PLACEMENT EXAMINATION, SERIES CA1,
 REVISED, A. CHEMISTRY APTITUDE AND THE IOWA PLACEMENT EXAMINATION SERIES MA1,
 REVISED, A. MATHEMATICS APTITUDE

	5- 14	15- 24	25- 34	35- 44	45- 54	55- 64	65- 74	75- 84	85- 94	95-104	F	D	FD	FD ²	ΣXY
60-64										2	2	7	14	98	56
55-59										1	1	6	6	36	24
50-54								3	4	2	9	5	45	225	130
45-49						1	1	6	7	2	17	4	68	272	168
40-44						2	11	13	11	1	38	3	114	342	222
35-39				1	3	12	27	8	10	3	64	2	128	256	160
30-34			1	1	7	16	28	19	8		80	1	80	80	78
25-29		1		5	23	45	30	8	5		117	0	0	0	
20-24			1	13	24	25	21	7			91	-1	-91	91	18
15-19	1		6	16	25	17	11	2			78	-2	-156	312	130
10-14	1	4	9	15	18	8	2				57	-3	-171	513	282
5- 9			3	14	5	2					24	-4	-96	384	168
1- 4	1		1								2	-5	-10	50	40
F	3	5	21	65	105	128	131	66	45	11	580		-69	2659	1476
D	-5	-4	-3	-2	-1	0	1	2	3	4					
FD	-15	-20	-63	-130	-105	0	131	132	135	44	109				
FD ²	75	80	189	260	105	0	131	264	405	176	1685				

Figure 14.--CORRELATION BETWEEN THE IOWA PLACEMENT EXAMINATION, SERIES CA1, REVISED, A. CHEMISTRY APTITUDE AND THE QUARTILE RANK IN HIGH SCHOOL GRADUATING CLASS

	5- 14	15- 24	25- 34	35- 44	45- 54	55- 64	65- 74	75- 84	85- 94	95-104	F	D	FD	FD ²	ΣXY
4		1	1	10	21	44	59	35	30	10	211	1	211	211	211
3	1	2	7	20	35	35	44	20	10		174	0	0	0	0
2		2	7	18	26	20	16	4			93	-1	-93	93	67
1	1		3	11	9	12	6		2		44	-2	-88	176	66
F	2	5	18	59	91	111	125	59	42	10	522		30	480	344
D	-5	-4	-3	-2	-1	0	1	2	3	4					
FD	-10	-20	-54	-118	-91	0	125	118	126	40	116				
FD ²	50	80	162	236	91	0	125	236	378	160	1518				

Figure 15.--CORRELATION BETWEEN THE IOWA PLACEMENT EXAMINATION, SERIES MA1, REVISED, A. MATHEMATICS APTITUDE AND THE QUARTILE RANK IN HIGH SCHOOL GRADUATING CLASS

	4	3	2	1	F	D	FD	FD ²
1- 4				1	1	-5	-5	25
5- 9	1	6	8	4	19	-4	-76	304
10-14	9	17	16	6	48	-3	-144	432
15-19	11	22	25	11	69	-2	-138	276
20-24	27	33	15	6	81	-1	-81	81
25-29	42	40	14	9	105	0	0	0
30-34	45	22	5	2	74	1	74	74
35-39	32	13	8	4	57	2	114	228
40-44	19	10	2		31	3	93	279
45-49	15	7			22	4	88	352
50-54	8	2			10	5	50	250
55-59	1				1	6	6	36
60-64	2				3	7	21	147
F	212	172	94	43	521		2	2484
D	1	0	-1	-2				
FD	212	0	-94	-86	32			
FD ²	212	0	94	172	478			
ΣXY	206	0	118	114	438			

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