THE UNIVERSITY OF MANITOBA

MUSICAL APTITUDE COMPARED WITH INTELLIGENCE AND ACHIEVEMENT IN MATHEMATICS

BEING A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION

BY

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P R O B L E M

The purpose of this study was to determine the relationship existing between musical aptitude factors and intelligence, and between musical aptitude factors and mathematical achievement. Musical aptitude factors were measured by the Seashore Measures of Musical Talents, and by the Drake Musical Aptitude Tests; intelligence by the Chicago Tests of Primary Mental Abilities and the Dominion Tests; and mathematics achievement by the Iowa Tests of Basic Arithmetic Skills.

M E T H O D

The experimental subjects were drawn from the students attending Andrew Mynarski Junior High School in Winnipeg, Manitoba, Canada. Two samples of experimental subjects were selected by a method of randomization. The first sample which consisted of thirty-five boys and thirty-three girls was used for the t-test in determining the significance of difference between the boys and girls in the investigation.

The second sample consisted of thirty-five students and was used for the correlations.

The testing program included the administration of tests of musical aptitude, mental capacity, and mathematical achievement. The tests used in the study were administered in the latter part of the school term of 1955-56, and provided the data for the t-test and for the correlations.

It was established that no significant difference existed between the sexes on the various tests.

To investigate the possible relationships, fifty-three correlations were calculated.

C O N C L U S I O N S

1. There is a relationship between the Seashore Memory and Chicago Verbal Meaning Tests significant at the five per cent level.
2. There is a relationship between Seashore Memory and Chicago Reasoning significant at the one per cent level.
3. There is a relationship between the Seashore Pitch and achievement in mathematics in the Iowa Tests of Basic Arithmetic Skills significant at the one per cent level.
4. There is also a relationship between Drake Rhythm and Chicago Reasoning Tests significant at the one per cent level.

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CHAPTER I

INTRODUCTION

Purpose of the study.- The purpose of the present investigation is three-fold. An attempt is made:

1. To discover whether any factors of the Seashore and Drake tests of musical aptitude are more highly related than others to certain mental abilities in the factorial intelligence test, as measured by the Chicago Tests of Primary Mental Abilities.

2. To discover the relationship existing between musical aptitude, as measured by the aptitude tests of Seashore and Drake, and general intelligence, as measured by the composite score of the Dominion Tests.

3. To discover the relationship between musical capacity as measured by the pitch and time tests of the Seashore battery and the rhythm and memory tests of the Drake battery, and the achievement in mathematics, as measured by the total score on the Iowa Tests of Basic Skills.

Definition of terms.- Certain terms used in the foregoing statement require definition. It is important that the meaning intended be clear for the terms: intelligence, relationship, capacity, and aptitude.

When the term "intelligence" is used it will refer to the individual's native intelligence whether this is measured by the so-called general intelligence test or by the factorial intelligence test. The general intelligence tests are far less general than was originally supposed. During recent years it has become increasingly evident that "intelligence" itself is not a single trait but should be regarded as a composite of special aptitudes. Through use of techniques of factor analysis, intelligence has been differentiated into a number of special aptitudes such as numerical reasoning, verbal comprehension, memory, and the like.

"Relationship" in the study will be shown through the use of correlations.

The term "capacity" has reference to inborn or native power. Thus each of us has a certain native capacity for memory, but we develop various degrees of ability in the use of this capacity.

The term "aptitude" is by no means consistently and clearly used in studies. Its meaning varies. It is used in either of two ways: (1) when we say that a person has a great deal of aptitude for music, meaning that he has in high degree many of the characteristics which make for success in musical activities, or (2) when we say that a person lacks a special aptitude, meaning that he lacks this one specialized aptitude which is of varying importance in

different tasks. In the former instance the word is used to designate a combination of traits or abilities which result in a person being qualified for some type of occupation. In the latter case the word "aptitude" is intended to convey the idea of a unitary characteristic which is important in varying degrees, in a variety of occupations. In this study, the term will be used in its narrower sense, except when expressly defined otherwise, as in the phrase "aptitude for music".

Seashore uses the word talent in place of aptitude and the word is used to denote a combination of traits. He says:

> Musical talent is not a single talent; it is a hierarchy of talents, many of which are entirely independent of one another . . . . . Musical talent is a gift bestowed very unequally upon individuals. Not only is the gift of music inborn, but it is inborn in specific types. These types can be detected early in life, before time for beginning serious musical education.[1]

Each group of talents fulfills a function in the artistic musical performance. Certain musical talents lend themselves to identification and measurement. The results indicate the amount of musical endowment possessed by the person or the total index of an individual's innate capacity.

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[1] Carl Emil Seashore, The Psychology of Musical Talent. Boston: Silver, Burdett and Company, 1919. p. 6.

Null hypothesis.- In statistical analysis, a relationship is hypothesized as non-existent. Then, as a consequence of the results revealed by the experimental data, this hypothesis is either accepted or rejected. Such a hypothesis is referred to as the "null hypothesis". The following will be tested in this thesis:

1. There is no relationship between the factors, memory, time, intensity, pitch, and consonance in the Seashore battery and number, verbal meaning, space, word fluency, reasoning, and memory in the Chicago Tests of Primary Mental Abilities.

2. There is no relationship between the factors, memory and rhythm, in the Drake Tests and number, verbal meaning, word fluency, reasoning, and memory in the Chicago Tests of Primary Mental Abilities.

3. There is no relationship between musical aptitude in the Seashore Tests and general intelligence in the Dominion Tests.

4. There is no relationship between musical aptitude in the Drake Tests and general intelligence in the Dominion Tests.

5. There is no relationship between the pitch and time tests of the Seashore battery and achievement in mathematics in the Iowa Tests of Basic Arithmetic Skills.

6. There is no relationship between the rhythm and memory tests of the Drake battery and achievement in

mathematics in the Iowa Tests of Basic Arithmetic Skills.

7. There is no difference between boys and girls on the various tests: Seashore Memory, Seashore Time, Seashore Intensity, Seashore Pitch, Seashore Consonance, Drake Rhythm, Drake Memory, Dominion Tests, Chicago Reasoning, Chicago Memory, and Iowa Mathematics.

The subjects of the study.- The total population in this study consisted of two hundred and sixteen grade seven children enrolled in the Andrew Mynarski Junior High School in Winnipeg, Manitoba, during the school year 1955 - 56. Every reasonable effort was made to secure complete returns. Children who were unable to attend the group tests at the times arranged were given one or more opportunities to take the tests at a later date. When all records had been assembled, it was found that two hundred and five of these subjects had complete records for all of the tests.

Experimental material.- The majority of the tests were administered in the latter part of the school term. A two month testing program was organized and carried out. The tests used were: The Seashore Music Tests, The Drake Music Tests, The Chicago Tests of Primary Mental Abilities, The Dominion Tests, and The Iowa Tests of Basic Arithmetic Skills.

Experimental design.- The writer carried out a testing program which involved the entire grade seven population in the school. The population was divided into six unselected groups. There were three groups of girls and three groups of boys. Not wishing to upset the school program, and knowing the large amount of time involved in administering five tests, the writer used the natural existing groups or classes.

Many investigations have developed in the field of music education which deal with correlations between musical capacity and intelligence. The fact that the correlation is often positive but low, would seem to lend support to the "common belief that musicians are likely to be ignorant and even stupid in everything except their special field of accomplishment".[2] Mursell[3] reported that American studies have found correlations ranging from zero to less than .60 between scores on the individual tests of the Seashore battery and intelligence test scores. A review by Farnsworth[4] which covered the earlier studies of

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[2] Lewis M. Terman, Genetic Studies of Genius, Vol. III, Stanford: Stanford University Press, 1930. p. 322.

[3] J. L. Mursell, The Psychology of Music. Norton, 1937. As found in Walter S. Monroe, Encyclopedia of Educational Research. New York: Macmillan Co., 1952. p. 764.

[4] P. R. Farnsworth, An Historical, Critical, and Experimental Study of the Seashore-Kwalwasser Test Battery. Genetic Psychological Monograph, IX, 1931. pp. 291-389. As found in Donald E. Super, Appraising Vocational Fitness. New York: Harper and Brothers, 1949. p. 325.

this topic, sixteen in all, reported a median correlation of .10, the range being -.08 to .45. Fracker and Howard[5] found no correlation between intelligence scores of college students and scores on the five Seashore Tests, a slight correlation with the pitch test.

In contrast to the foregoing findings, Mursell[6] reported that correlations found in European studies were high as compared with those found in American studies. Then, too, complete agreement with these findings of low correlation does not appear in the results of the studies by Lehman[7] and Terman[8]. The former reported in a study of Musically Superior and Inferior subjects only a low positive correlation between IQ and musical talent. Yet there seems to be some difference in correlation when subjects are taken from extremes of the curve on the basis of talent. Children from the upper talent bracket tend to

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[5] C. C. Fracker and V. M. Howard, Correlation between intelligence and musical talent among university students. Psychological Monograph Supplement, Iowa Studies, Vol. 39, No. 2, 1928. pp. 157-161. As found in Ruth Crewdson Larson, Studies on Seashore's "Measures of Musical Talent". University of Iowa Studies, Vol. II, No. 6. Iowa: University of Iowa, 1917. p. 10.

[6] J. L. Mursell, Psychological Research in Music Education. Adv. Sch. Digest 5: 73-76, 1940. As found in Walter S. Monroe, op. cit., p. 764.

[7] Charles F. Lehman, "A Study of Musically Superior and Inferior Subjects as Selected by the Kwalwasser-Dykema Music Tests," Journal of Educational Research, XLV (March, 1952), p. 522.

[8] Lewis M. Terman, op. cit., pp. 481-482.

have a better IQ than children from the extreme low bracket, as revealed by their means. In his study, Terman says:

> At the present time nearly all the subjects we have who show any real promise in these special fields of accomplishment are those who qualified for the group on the basis of general intelligence instead of on the basis of special talent. This, we believe, is significant in the highest degree, for it suggests the important role played by general intelligence in making possible superior accomplishment in a special field.[9]

Does musical ability pertain largely to a field of its own? It may be, however, that there is an over-lap between the more elemental components of intelligence and fundamental abilities peculiar to the music domain.

The newer intelligence tests have split up the measure of general intelligence into special measures of its parts. Such instruments yield, not a single, over-all measure such as an IQ, but a set of scores of different aptitudes. The last fifteen years have witnessed a rapid increase in the development and application of instruments which permit an analysis of an individual's performance with regard to different aspects of "intelligence". Thurstone's most extensive factorial investigations of human abilities and organization of special aptitudes have probably had more influence in America than have any other.

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[9] Id., ibid., pp. 481-482.

Using the centroid method of factor analysis he isolated the following special aptitudes: number, visualization, memory, word fluency, verbal relations, perceptual speed, and induction. This research has borne fruit in the Chicago Tests of Primary Mental Abilities, which measure six factors, number, verbal meaning, space, word fluency, reasoning, and memory.

Only one study was uncovered which attempted to determine basic traits by factor analysis through use of music and intelligence tests. Karlin[10] administered twenty-seven auditory tests, together with four visual-memory tests and an intelligence test to two hundred high-school pupils. No general auditory factor appeared and it was concluded that for high-school subjects neither age nor intelligence play any important part in most of the auditory functions.

The author investigated possible relationships between each of the factors of the Thurstone intelligence test with the factors of the music tests. Within the knowledge of the writer there is no published investigation which deals with comparisons of these different factors, and this study will partially fill the gap in this field of educational literature.

The next chapter of this study is devoted to a review of the different tests used by the author and a

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[10] J. E. Karlin, "A Factorial Study of Auditory Functions," Psychometrika, Vol. 7, No. 4, December, 1942, pp. 251-279.

study of relationships involving art and music. This outline of the tests is followed by a discussion of the experiment, and Chapter IV contains a statement of the results of the test. Chapter V is devoted to the conclusions of the study and is followed by the Bibliography.

CHAPTER II

THE NATURE OF APTITUDE MEASUREMENT AND STUDIES OF RELATIONSHIPS INVOLVING MUSIC

Too much in music education depends upon showmanship. Individuals who play an instrument or sing may or may not possess a high degree of innate musical talent. In the field of education it is becoming increasingly more important that we have a means of identifying talent other than personal opinion based on performance. Because many years of training are necessary to perfect a technique, and because much study is required to become familiar with the extensive literature of music, it is important to discover musical aptitude early in life. Many studies have been attempted in the measurement of music.

Measurement of Musical Aptitude

A considerable amount of work has been done in the construction and standardization of tests and the pursuit of experimental studies. Music tests are of two kinds: first, those intended to measure native endowment; and second, those intended to measure the use made of this endowment, or the achievement in music. Tests of the first type, usually referred to as aptitude tests or as tests of musical ability, may be divided into three groups: (1) those intended to measure sensory capacities; (2) those intended to measure musical feeling; and (3) those intended to measure motor

abilities. This study is limited to the consideration of tests of sensory capacities. These were the earliest type of music aptitude tests formulated and presented to music educators and psychologists.

Of the musical tests available, the Seashore Measures of Musical Talent and the Drake Aptitude Tests were selected for use in this study.

The Seashore tests.- The Measures of Musical Talent by Dr. Carl Seashore of the Iowa State University were chosen because these tests are still the foremost tests of this type. Dr. Seashore was the pioneer in this field. His tests first appeared in 1919. The fact that these Measures grew by experimental procedure over a long period of time puts them in contrast with many tests today which are made almost overnight. Because of their experimental foundation and their basic nature the Seashore Measures have been long lived. The Measures are of such a nature that they can be given to groups, to children and adults, to the musically untrained as well as to the musically trained. Since they are measurements of capacities and not of achievement, they measure the innate talent which one has regardless of training.

The five Seashore tests used in this investigation are memory, pitch, time, intensity, and consonance. The tests are as follows:

1. Memory. A number of consecutive notes which

form no particular melody are sounded. Then these notes are played again, but in the second playing one note is changed. The candidate is asked to give the number of the altered note.

2. Pitch. Two notes are sounded consecutively. The candidate is required to say whether the second note is lower or higher than the first note.

3. Time. Three clicks marking off two intervals of time will be heard. The candidate is required to state whether the second interval (that is, the time between the second and third clicks) is longer or shorter than the first interval.

4. Intensity. The same note is sounded twice. The candidate is required to say whether the second note played is weaker or stronger than the first note.

5. Consonance. Two combinations of two tones each are played. The candidate is required to say whether the second combination is better or poorer than the first combination.

These measures as now recorded on phonograph records have reached probably the peak of technical excellence in so far as presentation of stimuli are concerned. The whole series takes about an hour. Full directions for administering and scoring the tests are available. The instructions are short, clear, and, except for the practice items, standardized. In the manual, complete directions

are given for the making of an answer sheet which can be used for all tests. Practice sections are taken off the actual test record. This procedure has the disadvantage that if they are taken from a place towards the middle of the record, there is some possibility of damage to the record, while if they are taken at the beginning, they may help the candidate to do the first few items.

Extensive and intensive standardization and validation studies were carried out with Seashore music tests by Seashore, his students, and other psychologists interested in music. Table I shows coefficients of reliability obtained by various investigators as summarized by Larson[1] and More[2].

TABLE I

COEFFICIENTS OF THE RELIABILITY OF THE SEASHORE TESTS

Investigator	Pitch	Intensity	Time	Consonance	Memory	Rhythm
Brown	.71	.65	.48	.43	.59	.28
Lanier	.68	.60	.50	.54	.67	.43
Peterson				.68		
Gaw			.56	.57		
			.46	.49		
Weaver	.70	.66	.53	.35	.66	.50
Larson	.80	.75	.68	.71	.92	.68
Ruch & Stoddard	.70	.66	.53	.35	.66	.50
Farnsworth	.53-.72	.44-.56	.54-.55			
Highsmith	.76	.50	.52	.52	.82	

[1] Ruth Crewdson Larson, op. cit., pp. 24-25.

[2] Grace Van Dyke More, "Prognostic Testing in Music on the College Level: An Investigation Carried on at the North Carolina College for Women." Journal of Educational Research, XXVI (November, 1932), p. 201.

Among the many studies concerned with the Seashore tests were found three investigations which report the Seashore tests to be of a high degree of accuracy. In these investigations by Dr. Hazel Stanton[3] of Eastman School of Music, Flora Mercer Brennan[4], and Dr. Max Schoen[5], the reliability of the tests was taken for granted. But other investigators, as shown in Table I, have found their reliability to be low or moderate. Several very careful and thorough studies of the reliability of these tests have been made with results sufficiently similar to make them highly significant. The differences found in the results of various investigators might be attributed to the skill of the investigator or to numerous uncontrolled factors. Ruth Crewdson Larson[6] quotes Dr. Howard Hanson, director of the Eastman School of Music, as follows:

> 'As a practical musician I have been convinced of their (the Seashore tests) efficacy. I should wish, however, to add my belief that such testing is only of value when undertaken by thoroughly trained psychologists under conditions where control of experimentation is absolute. The undertaking of such a testing program by inexperienced and untrained persons could only be a calamity.'

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[3] H. M. Stanton, Measurement of Musical Talent. Studies in the Psychology of Music, Vol. II. Iowa: University of Iowa, 1935. As found in Grace Van Dyke More, op. cit., p. 200.

[4] F. M. Brennan, The Relationship between Musical Capacity and Performance. Psychological Monographs, XXXVI, 1927. pp. 190-248. As found in Grace Van Dyke More, op. cit., p. 200.

[5] M. Schoen, "The Validity of Tests of Musical Talent." Journal of Comparative Psychology, III (April, 1923), 101-121. As found in Grace Van Dyke More, op. cit., p. 200.

[6] Ruth Crewdson Larson, op. cit., p. 26.

Some difficulty has been experienced in determining the validity of the Seashore tests. Brennan[7] published some validity coefficients using as a criterion the ranking of expert judges on the basis of musical performance. These correlations were low, ranging from .17 to .47 for the six tests used, with four of them falling below .30. Brown[8], using rank by music instructor on "natural talent", reports even lower correlations. He secured coefficients of validity varying from .11 to .17 with the exception of the test of tonal memory, which was .41. The coefficient of validity for the average of the tests was .35. McGinnis[9], using a similar criterion, found correspondingly low validity coefficients for the tests when applied to pre-school children. McCarthy[10], using three groups, reported coefficients of validity varying from .23 to .93. Wing[11], in some recent testing of 150 students obtained the ranking for thirteen from the music lecturers. He reported a validity coefficient of .4 with the total of the

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[7] F. M. Brennan, op. cit., pp. 190-248. As found in Dorothea McCarthy, "A Study of the Seashore Measures of Musical Talent," Journal of Applied Psychology, XIV, No. 5 (1930), p. 438.

[8] A. W. Brown, "The Reliability and Validity of the Seashore Tests of Musical Talent," Journal of Applied Psychology, XII (Oct., 1928), 468-476. In Grace Van Dyke More, op. cit., p. 202.

[9] E. McGinnis, "Seashore's Measures of Musical Ability," American Journal of Psychology, XL (1928), 620-623. As found in Dorothea McCarthy, op. cit., p. 438.

[10] Dorothea McCarthy, op. cit., p. 451.

[11] H. D. Wing, "Tests of Musical Ability in School Children," Master's thesis, London, Eng.: University of London, 1936. As found in Oscar Krisen Buros, The Fourth Mental Measurements Yearbook. New Jersey: The Gryphon Press, 1953. p. 230.

Seashore tests. He also pointed out the fact that validity coefficients in music are notoriously difficult to obtain. It should be borne in mind that the reliability of the tutor's judgment is not high and that the group is so highly selected that even this low figure can be taken as an indication that the tests have some value. Wing urges that users of the tests should place more emphasis on results from the total series rather than on those from single tests.

Studies of McCarthy[12], Brown[13], and Brennan[14] indicate such similar results as to the relative standing of different tests in validity as measured in this way. It is notable that the memory test yields the highest correlations with the criteria used in all three studies. Thus it seems safe to say that whether or not these criteria are adequate as measures of musical talent, they do give us something with which to compare the different tests one with another.

Regarding these tests, Stanton and Koerth[15] go as far as to say: "Measurements such as Seashore Measures of Musical Talent, scientifically devised and standardized, can well be used as compass points in charting the all too little known sea of human potentialities."

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[12] Dorothea McCarthy, op. cit., p. 452.

[13] Andrew W. Brown, op. cit. As found in Dorothea McCarthy, loc. cit.

[14] F. M. Brennan, op. cit. As found in Dorothea McCarthy, loc. cit.

[15] H. M. Stanton and W. Koerth, Musical Capacity Measures of Children Repeated after Musical Training. University of Iowa Studies, No. 42. Iowa: University of Iowa, 1933. p. 45.

The Drake tests.- The second music test selected and used in the study was the Drake Musical Aptitude Tests by Raleigh M. Drake. These tests which were copyrighted in 1954 do not as yet possess the reputation of the old Seashore tests. In years to come they will have the opportunity of proving their worth.

The Drake tests measure two critical aptitudes: musical memory and musical rhythm. They help to identify genuine or inherent musical talent. Drake[16], himself, says: "These data indicate that the tests are measures of "pure" aptitude, and not measures of achievement, intelligence, age, or any other spurious factors that often influence scores on so-called aptitude tests." Drake regards musical memory and rhythm as the two most important factors related to achievement in music. He believes that the success of the musician is dependent upon the degree to which he possesses these two abilities.

The Musical Memory test consists of original two-bar melodies which are played on the piano. The student has to remember these melodies and then compare them to possible changes with respect to time, key, or note. The two forms of the Musical Memory test are approximately equal.

In the case of the Rhythm test, however, the two forms are not equivalent except in a general way. Form A

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[16] Raleigh M. Drake, Examiner Manual for the Drake Aptitude Tests. Chicago, Illinois: Science Research Associates, 1954. p. 19.

measures rhythm in a simple form. A tempo is established and then faded out. The subject continues with the tempo until he is told to stop. In Form B the student is required to maintain a consistent beat in spite of a second distracting tempo. Thus Form B is much more difficult than Form A.

To date, most tests of musical rhythm have assumed that the perception of difference and sameness between two series of beats is an adequate measure of rhythm. Drake feels that such a task can be performed almost as well by the unrhythmical as by the rhythmical person. Drake's Rhythm test has been constructed on the principle that the performer must not only feel rhythm strongly but that he must also be able to maintain a set tempo despite distractions.

These measures are recorded on one long playing microgroove phonograph record. This one record includes the test items for the two Drake tests and all practice exercises. The tests can be easily administered in two forty-minute sessions. Complete directions for administering, scoring, and interpreting test results are available. Quick scoring pads are available for the test. Then, too, practice excercises are given and these may be replayed as often as necessary.

Drake reports reliabilities, .56 to .93, for his tests. He further reports validity coefficients which range from .31 to .91, with a majority attaining a value greater than .58.

Measurement of Intelligence

The Dominion Tests, Group Tests of Learning Capacity and the Chicago Tests of Primary Mental Abilities were selected for this investigation. These two intelligence tests are two different types.

The Dominion tests.- The Dominion Tests were used for two reasons. First, this test is of the old type and the measurement of general intelligence can be obtained in the form of an IQ. Second, the Dominion Tests were used because these were the intelligence tests that the Winnipeg School Board was administering to all the Grade Seven students in the city of Winnipeg.

The advanced forms of the Dominion tests are of the omnibus, self-administering type. Total testing requires approximately forty-five minutes. The manual includes complete directions for administering and scoring the tests.

Reliability coefficients, obtained by the equivalent-form method, are usually reported by both grade and levels. The reliability coefficient for the Intermediate form, .95, is based on 1000 students in one grade. The probable errors of scores were very consistent, ranging from 2.5 to 3.0. The standard deviation of scores ranged from 9.36 to 13.38.

The Chicago tests.- The second intelligence test used in the study was the Chicago Tests of Primary Mental Abilities by L. L. Thurstone and Thelma Gwinn Thurstone. It

was selected for use because a factorial test of intelligence was required and because the only published tests of this type are the Thurstone Tests of Primary Mental Abilities. The battery of tests represent six primary mental abilities, namely, Number N, Verbal Meaning V, Space S, Word Fluency W, Reasoning R, and Rote Memory M. They enable the tester to tabulate six linearly independent scores instead of a single measure, such as the intelligence quotient.

The tests are arranged in one booklet of 24 pages. The battery (1943 edition) can be administered in a total of two hours of testing time. This time may be spaced according to the demands of the school schedule. The tests have been arranged so that hand scoring can be quickly and easily accomplished.

Although Thurstone's experimental tests were published in 1938 and the definite battery only in 1941, scores of studies regarding their reliability and validity have appeared. Traxler[17] ascertained that the reliabilities of the original Primary Mental Abilities Tests were high, judging by both the retest and split half techniques. The reliabilities for the tests quoted in the Thurstone Manual range from .63 to .98. Using one hundred and four male high school students as subjects, a study on reliability of the tests was conducted

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[17] A. E. Traxler, Stability of Scores on Primary Mental Abilities Tests. Sch. and Soc., 1941, LIII, 255-256. As found in Donald E. Super, op. cit., p. 135.

under the direction of Anastasi[18]. For some of these tests, the reliabilities obtained were considerably lower than those reported in the manual. The Space reliability dropped from .96 to .75 and that of the Word Fluency test from .90 to .72. The Reasoning and Number tests showed a smaller amount of decrease in the reliabilities, and the Verbal Meaning test showed virtually no change, .90 to .92.

The manual shows validity coefficients which range from .14 to .97. In a footnote, Anastasi gives an excellent reason for disagreeing with these validities. The reason follows:

> A table of factorial validities is included in the manual for the single-booklet edition, but the values in this table are identical to those given for the separate-booklet edition. It is therefore apparent that these validities were not recomputed and are inapplicable to the shorter single-booklet edition.[19]

Measurement of Mathematics

The Iowa tests.- The mathematics test selected for use in the study is the Iowa Every-Pupil Tests of Basic Skills, Test D: Advanced Basic Arithmetic Skills, Form O by H. F. Spitzer. The test consists of three parts, involving the arithmetic skills of Vocabulary and Fundamental Knowledge, Fundamental Operations, and Problems. The items in Part I,

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[18] Anne Anastasi, Psychological Testing. New York: The Macmillan Co., 1954. pp. 366-367.

[19] Id., ibid., p. 368.

intended to test vocational and fundamental knowledge, are well selected. Part II measures computational skills in the four fundamental processes as applied to whole numbers, fractions, percentage, and decimals. The examples in this section seem to agree with current practice for grades five to nine. Part III of the test deals with the direct solution of problems. A special effort has been made to make these problems relate to common experiences of children and to common social applications.

The test as a whole calls for sixty-eight minutes of working time and may be administered in a single testing period of eighty minutes or in two periods of forty-five and thirty minutes respectively. The pupils use an answer sheet for this test. The answer sheet, which is the first page of the test booklet, includes a place for raw scores and grade equivalents for the three parts separately and for the tests as a whole. All conversion tables are relegated to the Manual. Although the manual lacks the customary data on reliability and validity of the tests, it is otherwise complete and helpful. Simple, clear directions are given for administering and scoring the tests. Age norms based upon grade equivalents are provided. Percentile tables for grade equivalents are also provided for each grade. The last few pages of the manual contain a valuable discussion on the interpretation of test results, as well as suggestions for both initial and remedial teaching. With regard to the Iowa Basic Arithmetic

Skills tests, Brownell[20] makes the following statement: "There is probably no better battery of arithmetic tests on the market."

Review of the Literature

Foregoing portions of this chapter have outlined the various tests used in this study. The remainder of the chapter will be devoted to, first, a brief review of some of the studies concerning the relationships of aptitude in art and intelligence and second, studies of relationships involving music.

Investigations in art.- Since both music and art are regarded as special abilities, it seems worthwhile to consider what relationship exists, if any does, between intelligence and art ability. One investigator, Heather Dewar makes the following statement: "Coefficients of correlation between art ability and intelligence vary somewhat but seldom have exceeded .40, the majority being much lower."[21] Then, Monroe states that the following fact seems to be fairly well established: "a low positive correlation

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[20] W. A. Brownell, Tests and Reviews. As found in Oscar Krisen Buros, The Third Mental Measurements Yearbook. New Brunswick: Rutgers University Press, 1949. p. 334.

[21] H. Dewar, "A Comparison of Tests of Artistic Appreciation," British Journal of Educational Psychology, VIII (Feb., 1938), 29-49. As found in Walter S. Monroe, op. cit., p. 58.

is found between intelligence test scores and scores earned on so-called art appreciation tests."[22] In the excellent study conducted by Tiebout and Meier[23] on the relationship between artistic ability and intelligence we find that the results of different investigations are similar to the results reported in the investigations dealing with music ability and intelligence. Two types of findings are reported. It is pointed out that the studies of Ayer[24], Elderton[25], and Fischlovitz[26] have shown low, positive correlations. Then, on the other hand, the investigations of Terman[27], Kerschensteiner[28], and Kik[29] indicate that general intelligence is functioning in artistic performance and, to such an extent, that those showing marked accomplishment in art are invariably of high intelligence.

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[22] Walter S. Monroe, op. cit., p. 61.

[23] C. Tiebout and N. C. Meier, Artistic Ability and General Intelligence. Princeton: Psychological Review Co., 1936. pp. 95-125.

[24] F. C. Ayer, The Psychology of drawing. As found in C. Tiebout and N. C. Meier, op. cit., p. 95.

[25] E. Elderton, On the association of drawing with other aptitudes in school children. In C. Tiebout and N.C. Meier, loc. cit.

[26] A. Fischlovitz, An inductive study of the abilities involved in drawing. In C. Tiebout and Meier, loc. cit.

[27] L. M. Terman and B. S. Burks, The gifted child. As found in C. Tiebout and N. C. Meier, loc. cit.

[28] I. G. Kerchensteiner, Die Entwickelung der zeichnerischen Begabung. In Tiebout and Meier, loc. cit.

[29] C. Kik, Die übernormal Zeichbegabung bei Kindern. As found in C. Tiebout and N. C. Meier, loc. cit.

In his investigations of gifted children Terman[30] attempted to locate children of only average or moderately superior IQ who were outstanding in certain special abilities, including art. Only twenty-six children who showed unusual promise were found in a school population of a quarter-million. There were fifteen children showing art ability. A follow-up of these subjects showed that the early promise was not fulfilled in a single case. Terman, therefore, concluded that "without superior general intelligence, special ability in music and art inevitably falls short of really great achievement. All the young musicians and artists of genuine accomplishment whom the writer has studied, "he adds "have had without exception, high intelligence quotients."[31]

Kerschensteiner[32] and Kik[33], who report findings similar to those of Terman, seem to have located children demonstrating definite creative, rather than copyist, ability in art. According to Tiebout and Meier[34], their conclusion, that great talent for graphical expression is regularly connected with good intellectual endowment, is questionable. Intellectual endowment in their study was based solely on the

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[30] L. M. Terman, et al., Genetic studies of genius. Vol. I. As found in C. Tiebout and N. C. Meier, op. cit., p. 111.

[31] Id., ibid., pp. 11-112.

[32] I. G. Kerschensteiner, op. cit., p. 112.

[33] C. Kik, op. cit., p. 112.

[34] Carolyn Tiebout and Norman C. Meier, op. cit., p. 112-123.

child's status in general school work. Tiebout and Meier question also the degree of artistic ability of the children selected by Terman for the special ability group.

In the study conducted by Tiebout and Meier, the findings were based on measurements with a standardized test of a large number of subjects selected for their artistic superiority in creative, rather than copyist, activities. In the normal group it was found that artistic ability is only somewhat related to general intelligence as measured by established tests. While in the case of the selected groups it was found that there is a tendency for artistically superior subjects at the junior and senior high school level to be somewhat superior in intelligence, although not to the degree suggested by Terman. This same tendency is apparent in the adult artist group although more markedly than in the case of high school subjects. The study of Tiebout and Meier also shows, however, that the artistically superior need not necessarily be intellectually superior.

In an attempt to discover whether certain types of tests included in the different intelligence tests were more highly related to artistic ability than others, analyses were made of each, treating scores on the component tests or items separately. In this analysis it was discovered that the majority of items presenting difficulty for the artists involve mathematical abilities. It was also found that the smallest number of errors of the more difficult items were made on

items of verbal and reasoning abilities.

Tiebout and Meier state: "Tests of special aptitudes, such as those recently developed by Thurstone, would have been more valuable for analytical purposes, but these are devised for the college level and are also quite time-consuming in their administration."[35]

In considering the results of the investigations in art, it is evident that artistic ability is only somewhat related to general intelligence as measured by established tests and also that marked success in art is dependent to a certain extent on intellectual capacity.

Investigations in music.- A large number of studies have developed in various aspects of investigation in music. Included in these investigations are such studies as racial characteristics in music, the inheritance of musical talent, the effects of musical training on test scores, prediction of success in music, surveys of musical talent, the relationship between musical and mathematical talent, and the relationship between musical capacity and intelligence.

1. Racial characteristics.- Peterson and Lanier[36] conducted an investigation concerning the comparative musical abilities of Whites and Negroes. The six Seashore Measures of Musical Talent were used with about 375 White

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[35] Id., ibid., p. 119.

[36] J. Peterson and L. H. Lanier, Studies in the comparative abilities of whites and negroes. As found in R. Streep, "A Comparison of White and Negro Children in Rhythm and Consonance," Journal of Applied Psychology, XV (1931), p. 55.

students from the Middle State Teachers College at Murfreesboro, and with about 290 Negro students of the agricultural and Industrial Normal College in Nashville. The results tend to show a superiority of White adults over Negro adults in all phases of musical ability except rhythm.

Streep[37] made a comparative study with 1300 White and Negro children using the Seashore rhythm and consonance tests. The results would seem to indicate a very slight but, nevertheless, consistent superiority of Negro children over White children in regard to the two phases of musical ability tested. Correlations were also computed on intelligence.

Garth and Candor[38] employed the Seashore pitch and rhythm tests in a study of Mexican and White children. The study indicated that the Mexican children were inferior to the White children in pitch, and that they were superior to the White children in rhythm. Doubt was expressed, however, about the fairness of the measures to the Mexican children.

Johnson[39] made a study using five of the Seashore Measures of Musical Talent on 3300 American Negroes in fifth and eighth grades and adult groups and found that small differences existed between the Negroes and Whites. However,

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[37] Rosalind Streep, op. cit., p. 67.

[38] T. R. Garth and E. Candor, "Musical Talent of Mexicans," American Journal of Psychology, XLIX (1937), pp. 298-301.

[39] C. B. Johnson, "A Study of the Musical Talent of the American Negro," Univ. of N. C. Thesis, 1927. As found in Ruth Crewdson Larson, op. cit., p. 6.

he did notice a trend toward Negro superiority in the sense of rhythm.

Gray and Bingham[40] found White children superior to both Mulattoes or Negroes, and the Mulattoes superior to the Negroes. The scores on the consonance test favored the Negroes.

Peacock[41] made a comparative study on White and Negroes. He concluded that in musical talent as measured by the Seashore tests the Whites surpass Negroes.

Lenoir[42] in an investigation with about 200 White and 200 colored children from the fifth grade concluded from a study of the difference of the means that the colored children are superior to the White children in both rhythm and time.

Sanderson[43] using the pitch, memory, and intensity tests of the Seashore battery and the Kwalwasser-Dykema battery on approximately one hundred grade eight children of five

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[40] C. T. Gray and C. W. Bingham, "A Comparison of certain phases of musical ability of colored and white public school pupils," Journal of Educational Psychology, XX (1929), pp. 501-506.

[41] W. Peacock, "A comparative study of musical talent in whites and negroes and its correlation with intelligence," As found in Ruth Crewdson Larson, op. cit., p. 6.

[42] Z. D. Lenoir, "Measurement of racial differences in certain mental and educational abilities," University of Iowa Thesis, 1925. In R. C. Larson, op. cit., p. 6.

[43] H. E. Sanderson, "Difference in Musical Ability in Children of Different National and Racial Origins," In M. T. Whitley, "Music," Review of Educational Research, Vol. IV (1934), p. 502.

different national origins found Jewish children scoring highest, German next, Italians generally third, and the Polish and Negro lower. The only exception discovered was that the Negroes excelled in rhythmic discrimination.

Merrifield[44], using 340 subjects at the junior high school level, found no reliable superiority for the Negroes on any test of the Kwalwasser-Dykema battery. However, the non-Jewish White subjects ranked higher than the Jewish groups.

Drake[45] reported three separate studies in the manual concerning this relationship. The first study compared the Drake Musical Memory scores of Negro and White high school students in the United States. The data indicate no statistically significant differences. In the second study, Indian, Negro, and White groups were compared with the Drake Rhythm scores. The data indicate no significant differences. In the third study, Seward[46] compared the Drake Musical Memory scores of Jewish and non-Jewish students. In this study also, no significant differences were found.

Several studies have compared Negro and White children as to musical ability on the Seashore, Kwalwasser-Dykema, and Drake tests. The findings at the elementary and

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[44] N. L. Merrifield, Racial Differences in Musical Aptitude. School of Education Series, No. 10. Evanston, Ill.: The University, 1933. As found in M. T. Whitley, op. cit., p. 502.

[45] Raleigh M. Drake, op. cit., p. 20.

[46] Keith Seward, "Jewish Musicality in America," Journal of Applied Psychology, XVII (1933), 675-712. As found in Raleigh M. Drake, op. cit., p. 20.

junior high school levels generally favor the assertion that the Negroes are superior in rhythm and consonance.

2. Inheritance of musical talent.- Stanton[47] made a study of six of the foremost musical families in America in which eighty five members were examined. Four of the Seashore Measures of Musical Talent were used and it was concluded that there was a tendency for the inheritance of musical talent.

3. The effects of musical training on test scores.- Stanton and Koerth[48] found negligible change on scores made in the Seashore Measures of Musical Talent after three years of intensive training of adults from the Eastman School of Music. Stanton and Koerth[49] in a study of retest scores of children on the Seashore Measures of Musical Talent, after three to nine years of musical training in the Eastman School of Music found negligible change.

Graff[50] in a study with fifth grade, eighth grade, and adult groups found that rhythmic discrimination as

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47 H. M. Stanton, The inheritance of specific musical capacities. Psychol. Rev. Mon. Supp. (Iowa Studies), XXXI, 1922, 157-204. As found in R. C. Larson, op. cit., pp. 5-6.

48 H. M. Stanton and W. Koerth, Musical Capacity Measures of Adults Repeated after Music Education. University of Iowa Studies, No. 31, Iowa: University of Iowa, 1930. pp. 3-18.

49 H. M. Stanton and W. Koerth, Musical Capacity Measures of Children Repeated after Musical Training. University of Iowa Studies, No. 42, Iowa: University of Iowa, 1933. pp. 5-45.

50 L. H. DeGraff, "Norms of the Sensitiveness to Rhythm." As found in R. C. Larson, op. cit., p. 8.

measured by the Seashore rhythmic test is not much affected by training.

Klauer[51] made a study to determine whether rhythmic training tended to improve rhythmic discrimination in the intermediate grades. No significant relationship was found between training and discrimination.

4. Prediction of success in music.- McCarthy[52], working with five of the Seashore tests, showed high reliability for pitch and memory on retest and low validity for intensity. She concluded that the tests are of greater value to predict failure musically than success.

Stanton[53] conducted in 1921-31 at the Eastman School of Music a most elaborate study of the prediction of success in music. A combination of the Seashore tests and a group intelligence test provided the basis for classifying the students. The predictive value of the Seashore tests probably cannot be determined from data in this study but the experiment shows that the Measures approach the ideal of being measurements of musical capacities. In this same experiment it was also found that the amount and quality of training had

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[51] N. J. Klauer, "The Effects of Training in Rhythm Upon Rhythmic Discrimination in the Intermediate Grades," University of Iowa Thesis, 1924. As found in Ruth Crewdson Larson, op. cit., pp. 7-8.

[52] Dorothea McCarthy, op. cit., p. 454.

[53] Hazel Martha Stanton, Measurement of Musical Talent. University of Iowa Studies, Studies in the Psychology of Music, Vol. II, Iowa: University of Iowa, 1935. pp. 1-141.

little or no effect on retest scores of adults in the Seashore tests.

Mosher[54] tried to determine the relationship between sight singing and sensory capacity in a study. Correlations were computed between the scores of the Seashore Measures and the Mosher sight-singing achievement scores. He stated that the data show that measures of native capacity do not predict success in singing but that the recognition of the limit of capacity for individuals might aid in defining the possible ultimate achievement in sight singing.

In the Encyclopedia of Educational Research, Hendrickson and Stratemeyer[55] state: "To date little has been done, however, to investigate the prognostic power of the revised Seashore tests, the Drake tests, or various other tests reported in literature."

5. Surveys of musical talent.- Windhorst[56], using about 400 sixth grade children, made a study of the sixth grade attainments as stated in the Standard Course of Study. Five of the Seashore tests were used. The groups

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[54] R. M. Mosher, A study of group methods of measurement of sight singing. Teachers College, Columbia Univ. Contrib. to Ed. No. 194, 1925. Bureau of Publications. As found in Ruth Crewdson Larson, op. cit., pp. 14-15.

[55] G. Hendrickson and C. G. Stratemeyer, Music Education. As found in Walter S. Monroe, op. cit., p. 764.

[56] E. L. Windhorst, "A Study of sixth grade attainments stated in the standard course of study adopted by the Music Supervisors National Conference in 1921," University of Iowa Thesis, 1925. As found in Ruth Crewdson Larson, Op. cit., p. 7.

studied failed to come up to the standards expected. It was concluded, therefore, that standards of attainment should be related to measures of capacity.

6. The relation between musical and mathematical talent.- Haecker and Ziehen[57] in a study with 227 musical and 72 absolutely unmusical females, found that only in 2% of cases of males was a pronounced musical aptitude linked with a distinct mathematical talent, while 13% of the unmusical males showed mathematical ability. Very few women showed mathematical talent. In connection with this study Révész states: "According to this there would actually appear to be a negative relationship between musicality and mathematical aptitude."[58]

Pannenborg's[59] study verified the findings of Haecker and Ziehen. He found that only 15.4% of 52 subjects of pronounced musical talent showed mathematical aptitude. Of 371 subjects of average musical talent, 12.3% showed mathematical talent.

Révész[60] considered the relationship between musi-

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[57] V. Haecker and Th. Ziehen, Zur Vererbung and Entwicklung der musikalischen Begabung, 1922. As found in G. Révész, Introduction to the Psychology of Music. Norman: University of Oklahoma Press, 1954. p. 162.

[58] G. Révész, loc. cit.

[59] H. J. Pannenborg and W. A. Pannenborg, "Die Psychologie der Musiker." Zeitschrift für Psychologie, LXXIII, 1915. As found in G. Révész, loc. cit.

[60] G. Révész, op. cit., p. 163.

cal and mathematical talent in two ways. First, he conducted an investigation to discover what relation pronounced musical talent bears to the mathematical talent; and second, he conducted a study to discover what relation pronounced mathematical talent bears to musical talent. In the first investigation Révész considered the question with professional musicians. His findings agreed with the reports of Haecker and Ziehen and Pannenborg, only the percentage of musicians with mathematical aptitude was still lower. Révész found "mathematical aptitude or interest in mathematics, in only 9% of the musicians."[61]

In the second study Révész attempted to determine the relationship between pronounced mathematical talent and musical talent. Questionnaires were sent to a large number of Dutch mathematicians, physicists, physicians, and writers. The result was striking. A higher percentage of musically talented persons was found in the other three professional groups than among the mathematicians. Révész concludes that he has exploded the prevailing theory that mathematicians are ordinarily more musical than other groups of intellectuals.

7. The relationship between musical capacity and intelligence.- Studies concerned with this relationship have already been under discussion in chapter I.

The foregoing review of the literature has presented the points of view of several writers. These studies have provided a setting for this thesis as well as indications for

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[61] Id., ibid.

the direction of the research. The following chapters constitute a record of the design, procedure, results, and conclusions for a local investigation of the relationships between musical aptitude as compared with intelligence and achievement in mathematics.

CHAPTER III

THE EXPERIMENT

General plan.- The experiment was conducted in the Andrew Mynarski Junior High School in the city of Winnipeg, Manitoba, during the latter part of the school year, 1955-56. All subjects were enrolled in Grade Seven. The group of 205 students who were tested consisted of one hundred girls and one hundred and five boys. As will be noted there are an approximately equal number of boys and girls in the grade.

The testing was done, for the most part, during the regular music periods. The tests were administered at approximately the same time so that the constant interval in age and school development would be kept.

The objective measurements which have been applied to a practical school situation are the five Seashore measures: namely, pitch, intensity, consonance, memory, and rhythm; the two Drake Tests, rhythm and memory; the Chicago Tests of Primary Mental Abilities; the Dominion Tests; and the Iowa Tests of Basic Arithmetic Skills. These tests have been discussed in the previous chapter.

Testing rooms.- The same rooms were used for testing all individuals. Test rooms located at the far end of the T shaped building, were free from disturbing school and street noises. This freedom of the test room from disturbing sounds is essential when giving measurements which involve the thres-

hold of hearing. Light, ventilation, and temperature were favorable for efficient working conditions. Adequate equipment was provided by individual desks for the testees, blackboard, table for supplies, piano, phonograph, and clock.

Supplies for test program.- Test supplies included the Seashore Measures and the Drake Tests recorded on phonograph records, test booklets for the Chicago, Dominion, and Iowa Tests, recording blanks for the music tests, manuals of instructions for each of the tests, and a supply of pencils.

Test procedure.- Materials were distributed as soon as all pupils were seated. Directions for the test were definite but brief. Practice examples were given in the music tests. Beside the practice exercises on the records the examiner often made use of the piano to help the students understand the directions. Individual assistance was given whenever necessary. When the test proceeded the room was perfectly quiet, and the examiner remained at the front of the room most of the time. When once the music test was in progress no further directions were necessary. Test papers were collected immediately at the completion of the test.

When the Chicago Tests of Primary Mental Abilities, the Dominion Tests, and the Iowa Tests of Basic Arithmetic Skills were administered, the examiner closely followed the directions in the manual and carefully timed each section. The total testing time took 385 minutes or about six and one half hours.

The music test forms and the intelligence and

mathematics tests, as submitted to the pupils, are herewith attached in Appendixes A, B, and C.

At the close of the testing program the author marked the test papers. Results obtained through the use of these measures of musical capacity, intelligence, and achievement in mathematics were compiled in tabular form for all subjects used in the study. The raw scores obtained by the boys on all tests are fouhd in Table II and the raw scores obtained by the girls are found in Table III. These tables appear in the Appendix, pages 75 and 78.

In order to establish the absence of sex bias in the relationships found, it will be necessary to show that no sex difference exists in music aptitudes, mental capacities, and mathematical achievements measured by these tests.

Treatment of data.- The results from the testing were used in two ways:

1. The author ran a "t" test[1] for significance of differences between the means of boys and girls.

2. The results of the music tests were correlated with the scores on intelligence and mathematics tests.

Selection of students for the t-test.- From the group of 205 students tested a random sample consisting of thirty-three girls and thirty-five boys was drawn. The

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[1] Palmer O. Johnson, Statistical Methods in Research. New York: Prentice-Hall, 1949. p. 74.

names of all students were written on separate cards. The cards of the boys were kept separate from those of the girls. Each pack was thoroughly shuffled so that they might not be in alphabetical or any other order. Then, a serial number was assigned to each card starting with 000 to 100 for the girls and from 000 to 105 for the boys.

Using a table[2] of random numbers which consisted of 75 lines and 25 columns of ten figure numbers, thirty-three girls were selected. The first three digits of each entry were used. The author began with column one, line six, and read down. Numbers were passed if they were greater than one hundred or if already chosen.

Thirty-five boys were selected in the same manner. However, the reading of the numbers began with column ten, line one.

These selected names of boys and girls were listed on separate sheets. Then, the marks for each student were entered on these sheets for each of the following tests; Dominion Tests, total IQ, Drake Memory, Drake Rhythm, Seashore Memory, Seashore Time, Seashore Intensity, Seashore Pitch, Seashore Consonance, Chicago Reasoning, Chicago Memory, and Iowa Mathematics.

Tables IV and V in Appendix E contain the raw scores of the various tests for the boys and girls selected for the

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[2] Wilfred J. Dixon and Frank J. Massey, Introduction to Statistical Analysis. New York: McGraw-Hill Book Company, Inc., 1951. pp. 290-294.

t-test.

The t-test formula.- Using the marks obtained by random selection the author ran the t-test. The formula[3] used is:

$$t_o = \frac{\bar{B} - \bar{G}}{\sqrt{\frac{\mathcal{E}(B - \bar{B})^2 + \mathcal{E}(G - \bar{G})^2}{n}\left(\frac{N_1 + N_2}{N_1 N_2}\right)}}$$

$\bar{B}$ = mean of the boys

$\bar{G}$ = mean of the girls

N_1 = number of boys

N_2 = number of girls

$n = (N_1 + N_2) - 2$

Careful scrutiny of the data showed few marked tendencies that could be ascribed to sex differences, so it seemed feasible to present the group as a whole regardless of the sex factor.

Selection of students for the correlations.- The next step in the experiment was to take all the cards containing the names of the students and to shuffle them thoroughly so that the boys and girls would be mixed. Then, a serial number starting with 000 to 205 was assigned to each card.

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[3] Palmer O. Johnson, op. cit., p. 74.

Table 23[4] of random numbers which consists of 60 lines and 14 columns of five figure numbers was used for the selection of a random sample. The last three digits of each entry were used. The selection was made by reading down, beginning with column three, line eleven. Numbers were passed by if they were greater than 205 or if repeated and already chosen. Thirty-five students were drawn.

These names were listed and the marks on all tests were recorded for each student. The raw scores of the students chosen for the correlations between music and intelligence and mathematics are reproduced in Appendix F.

The correlation formula and correlations.- The raw scores were used to calculate the coefficients of correlation. The formula[5] for the calculation of the coefficient of correlation from ungrouped data used in the study is:

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left[N\Sigma X^2 - (\Sigma X)^2\right]\left[N\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

A calculating machine was used to compute the different corre-

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[4] Helen M. Walker and Joseph Lev, Statistical Inference. New York: Henry Holt, 1953. pp. 484-485.

[5] C. H. Richardson, An Introduction to Statistical Analysis. Enlarged Edition. New York: Harcourt, Brace and Company, 1934. p. 144.

lations. In all, fifty-three correlations were calculated. These correlations are as follows:

1. Seashore Memory and Chicago Number
2. Seashore Time and Chicago Number
3. Seashore Intensity and Chicago Number
4. Seashore Pitch and Chicago Number
5. Seashore Consonance and Chicago Number
6. Seashore Memory and Chicago Verbal Meaning
7. Seashore Time and Chicago Verbal Meaning
8. Seashore Intensity and Chicago Verbal Meaning
9. Seashore Pitch and Chicago Verbal Meaning
10. Seashore Consonance and Chicago Verbal Meaning
11. Seashore Memory and Chicago Space
12. Seashore Time and Chicago Space
13. Seashore Intensity and Chicago Space
14. Seashore Pitch and Chicago Space
15. Seashore Consonance and Chicago Space
16. Seashore Memory and Chicago Word Fluency
17. Seashore Time and Chicago Word Fluency
18. Seashore Intensity and Chicago Word Fluency
19. Seashore Pitch and Chicago Word Fluency
20. Seashore Consonance and Chicago Word Fluency
21. Seashore Memory and Chicago Reasoning
22. Seashore Time and Chicago Reasoning
23. Seashore Intensity and Chicago Reasoning
24. Seashore Pitch and Chicago Reasoning
25. Seashore Consonance and Chicago Reasoning
26. Seashore Memory and Chicago Memory
27. Seashore Time and Chicago Memory
28. Seashore Intensity and Chicago Memory
29. Seashore Pitch and Chicago Memory
30. Seashore Consonance and Chicago Memory
31. Drake Memory and Chicago Number
32. Drake Rhythm and Chicago Number
33. Drake Memory and Chicago Verbal Meaning
34. Drake Rhythm and Chicago Verbal Meaning
35. Drake Memory and Chicago Space
36. Drake Rhythm and Chicago Space
37. Drake Memory and Chicago Word Fluency
38. Drake Rhythm and Chicago Word Fluency
39. Drake Memory and Chicago Reasoning
40. Drake Rhythm and Chicago Reasoning
41. Drake Memory and Chicago Memory
42. Drake Rhythm and Chicago Memory
43. Seashore Memory and Dominion IQ
44. Seashore Time and Dominion IQ
45. Seashore Intensity and Dominion IQ
46. Seashore Pitch and Dominion IQ
47. Seashore Consonance and Dominion IQ
48. Drake Memory and Dominion IQ

49. Drake Rhythm and Dominion IQ
50. Seashore Pitch and Iowa Arithmetic
51. Seashore Time and Iowa Arithmetic
52. Drake Memory and Iowa Arithmetic
53. Drake Rhythm and Iowa Arithmetic

Correlations obtained were tested for significance by reference to Statistical Tables[6]. For purposes of this thesis a correlation will be accepted as significant at the five percent or less than five percent level. That is to say, when the table indicates a significance level of five percent the chances are only five in one hundred that the observed correlation could have arisen by chance alone. Further, a significance level of one percent indicates the chances are only one in one hundred that the observed correlation has arisen by chance alone.

In the following chapters the results of the experiment are presented together with the conclusions based on these results.

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[6] Ronald A. Fisher and Frank R. Yates, Statistical Tables for Biological, Agricultural, and Medical Research. Third Edition. New York: Hafner Publishing Co., 1948. p. 46.

CHAPTER IV

PRESENTATION OF EVIDENCE

The experiment described in Chapter III produced two sets of results: first, the results from the "t" test, and second, the results from the correlations.

Sex differences.- To determine the difference between the sexes on the various tests, the t test was run. Differences in means of boys and girls on the Dominion IQ, Drake Memory, Drake Rhythm, Seashore Memory, Seashore Time, Seashore Intensity, Seashore Pitch, Seashore Consonance, Chicago Reasoning, Chicago Memory, and Iowa Mathematics were tested. The results are presented in Table VII.

It is readily seen from this table that the difference in means of the scores of the boys and girls for the tests listed was not significant. In Table VII, N_B indicates the number of boys and N_G the number of girls in the sample selected. Then, in the table, $\overline{B}$ indicates the mean of the boys and $\overline{G}$ indicates the mean of the girls. The statistic t_o is the result of the application of the formula given on page 42 of this thesis. P represents the probability that such values of t_o as listed in the table could have arisen by chance. Thus a P of .2 to .3 in the Dominion IQ indicates that there are from twenty to thirty chances out one hundred that the observed value for t_o, 1.129, could have arisen from chance factors. In the case of Drake Memory the probability is seventy to eighty chances out of one hundred that the

TABLE VII

SIGNIFICANCE OF DIFFERENCE IN MEANS OF SAMPLES OF BOYS' AND GIRLS' SCORES IN THE VARIOUS TESTS

Test	N_B	N_G	$\overline{B}$	$\overline{G}$	Absolute Difference in Mean	t_o	P	Significance
Dominion IQ	35	33	100.7	96.6	4.1	1.129	.2 to .3	Not Significant
Drake Memory	35	33	63.3	64.5	1.2	0.341	.7 to .8	Not significant
Drake Rhythm	35	33	76.4	79.5	3.1	0.248	.8 to .9	Not significant
Seashore Memory	35	33	23.5	23.4	.1	0.000	.9 to 1.	Not significant
Seashore Time	35	33	69.0	71.0	2.0	0.859	.3 to .4	Not significant
Seashore Intensity	35	33	77.5	78.0	.5	0.146	.8 to .9	Not significant
Seashore Pitch	35	33	62.2	58.9	3.3	1.225	.2 to .3	Not significant
Seashore Consonance	35	33	31.0	30.2	.8	0.838	.4 to .5	Not significant
Chicago Resoning	35	33	27.9	28.1	.2	0.107	.9 to 1.	Not significant
Chicago Memory	35	33	6.7	7.3	.6	0.762	.4 to .5	Not significant
Iowa Mathematics	35	33	57.0	50.5	6.5	2.124	.02 to .05	Not significant

observed t_o, 0.341, arose by chance. The other values of P are similarly interpreted. In order for t_o to be significant, that is, to indicate a difference in means not arising from chance factors the value of P should be 0.01 or less. Under these circumstances all the values for t_o turned out to be not significant, and the general conclusion must be that there is no sex difference in achievement on all the tests listed in Table VII for the groups used in this experiment.

Correlations.- Detailed study of the fifty-three correlations in Table VIII below, yields some interesting information. Each factor of the Seashore Measures, namely, Memory, Time, Intensity, Pitch, and Consonance and the two factors, Rhythm and Memory of the Drake Test are correlated with each of the factors of the Chicago Tests of Primary Mental Abilities, namely, Number, Verbal Meaning, Space, Word Fluency, Reasoning, and Memory, with the total IQ of the Dominion Tests, and with the total score of the Iowa Tests of Basic Arithmetic Skills. The correlations were obtained through the application of the formula given on page 43 of this thesis. Correlations marked with a single asterisk are significant at the five per cent level, and correlations marked with a double asterisk are significant at the one per cent level.

For the Seashore battery, correlations were found to be significantly greater than zero at the one per cent level between: (a) Seashore Memory and Chicago Reasoning,

TABLE VIII

CORRELATIONS BETWEEN VARIOUS TESTS

	Chicago Number	Chicago Verbal Meaning	Chicago Space	Chicago Word Fluency	Chicago Reasoning	Chicago Memory	Dominion IQ	Iowa Maths.
Seashore Memory	-.090	.335 *	.150	.143	.500 **	.086	.164	-.247
Seashore Time	.318	.020	.258	.120	.138	.185	.047	.283
Seashore Intensity	-.289	.034	.052	-.032	.237	-.000	.017	--
Seashore Pitch	-.090	.189	.236	-.226	.293	.016	.107	.419 **
Seashore Consonance	-.058	.039	-.038	.289	-.089	.117	.120	--
Drake Rhythm	-.079	-.090	-.186	-.045	-.411 **	.072	-.173	-.261
Drake Memory	.042	-.173	-.080	.171	-.265	.009	-.111	-.274

* significant at the 5% level.

** significant at the 1% level.

and (b) Seashore Pitch and Iowa Mathematics. Thus a correlation of .500 for (a) and .419 for (b) means that the chances are only one in one hundred that the observed correlations have arisen by chance alone. Also for the Seashore battery, significance at the five per cent level was found between Seashore Memory and Chicago Verbal Meaning. The figure was .335 and the chances are only five in one hundred that the correlation arose by chance alone. Three correlations, then, were found to be significant. This may be considered evidence that music is somewhat related to intelligence and mathematics.

For the Drake battery, a correlation was found to significantly greater than zero at the one per cent level between Drake Rhythm and Chicago Reasoning (negatively). The figure was -.411 and the chances are only one in one hundred that the correlation has arisen by chance alone. Correlations with the Drake battery are all negative with the exception of the correlations between Drake Memory and Chicago Number, between Drake Memory and Chicago Word Fluency, and between Drake Memory and Chicago Memory, which are positive but non-significant. The conclusion here is that there is a slight relationship between musical memory and intelligence.

The negative correlations with the Drake Rhythm test might be due partly to the fact that in the Rhythm test the score is the sum of the differences between the examinee's

answer and the correct answer. All differences are counted as positive. The positive number obtained in this manner is used as the raw score for the test.

Chapter V consists of a summary of the entire investigation, the conclusions reached, and some recommendations for further study in the field of music.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

General Summary

The problem.- The purpose of this study was to determine the relationship existing between musical aptitude factors and intelligence, and between musical aptitude factors and mathematical achievement. Musical aptitude factors were measured by the Seashore Measures of Musical Talents, and by the Drake Musical Aptitude Tests; intelligence by the Chicago Tests of Primary Mental Abilities and the Dominion Tests; and mathematics achievement by the Iowa Tests of Basic Arithmetic Skills. The relationships of the results of the tests were investigated by correlation techniques.

Specification of the subjects and the samples.- The experimental subjects were students attending the Andrew Mynarski Junior High School in the north-west of the city of Winnipeg, Manitoba, Canada. The sample for this study consisted of thirty-five pupils who were chosen by a random method. A second sample consisting of thirty-three girls and thirty-five boys was drawn by the random method and used to run a t-test for significance of differences between the sexes on various tests.

Randomization.- The two samples of experimental subjects were selected by a method of randomization which

required two steps. 1. The pupils' names were entered on separate cards, and these cards were thoroughly shuffled; then the cards were numbered serially beginning with 001. 2. Tables of random numbers were used to select the required number of students.

Experimental material.- The five tests selected for this study were: The Seashore Music Tests, The Drake Music Tests, The Chicago Tests of Primary Mental Abilities, The Dominion Tests, and The Iowa Tests of Basic Arithmetic Skills. These tests were administered in the latter part of the school term of 1955-56.

Experimental plan.- The tests used in the study provided the data for the t-test and for the correlations. The author ran a t-test for significance of differences between the means of the boys and girls in the investigation. No significant difference was discovered between the sexes on the various tests. To investigate the possible relationships, fifty-three correlations were computed with the aid of a calculating machine. Formulas for the t-test and for the correlations were presented.

Conclusions

Correlations between music and intelligence.- The findings in this study with regard to the relationship between the factors of music and intelligence disclose three correlations which are statistically significant. Two of these

correlations were statistically significant at the one per cent level of significance and one correlation was statistically significant at the five per cent level of significance. The Seashore Memory factor shows some relation to the factors of Reasoning and Verbal Meaning in the Chicago Tests of Primary Mental Abilities. The Drake Rhythm factor also shows some relation to the Reasoning factor in the Chicago Tests of Primary Mental Abilities. The conclusion here is that two music factors, the Seashore Memory and the Drake Rhythm, respectively, are more highly related than others to certain mental abilities, Reasoning and Verbal Meaning, in the factorial test as measured by the Chicago Tests of Primary Mental Abilities.

No significant relationship was observed between the musical aptitude tests of Seashore and Drake and general intelligence as measured by the composite score of the Dominion Tests.

Correlation between music and mathematics.- Only one finding of consequence was discovered in this study with regard to the relationship between music and mathematics. A positive correlation, significant at the one per cent level, is revealed between the Seashore Pitch test and the Iowa Mathematics Test. This finding does indicate a slight, but definite relationship between sensitivity to musical pitch and mathematical talent.

Musical capacity is a special aptitude in the sense of being only somewhat related to intelligence and mathe-

matics as measured by established tests. This conclusion, however, applies to the students of the Andrew Mynarski School.

Speculations and Implications

Use of tests.- The correlations, even those significant at the one per cent level, are not sufficiently great to warrant depending on intelligence and mathematics tests for indications of possible musical aptitude. For this reason all children in the schools should be given music tests. Children who have little or no musical training may have great capacities to be used in training.

No music tests are as precise as the Stanford Binet scale but they are helpful to the teacher. In the work of teaching the teacher constantly makes comparisons on the basis of quantity. The teacher is often required to decide whether one child is more musical than another. These objective tests help to remove the teacher's judgments of amount of talent of a student from the realm of guess into the realm of reasonable certainty.

In using any of these music tests, great caution should be exercised in interpreting results. If the Seashore Measures were employed, two members of the battery might be more valuable than the other members. According to Farnsworth's[1]

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[1] Paul R. Farnsworth, An Historical, Critical, and Experimental Study of the Seashore-Kwalwasser Test Battery. Genetic Psychological Monograph, IX, 1931. pp. 291-389. As found in Max Schoen, The Psychology of Music. New York: The Ronald Press Company, 1940. pp. 184-185.

conclusions concerning the use of the tests, the pitch and memory tests are the most reliable members of the Seashore battery. This thesis has shown that the Seashore memory and pitch tests yield the highest correlations with the criteria used. Because of their high reliability and fairly high validity, these two tests would probably prove to be the most useful tests for practical use in schools.

The blind procedure of forcing the untalented child to perform as if he were talented is one of the most cruel practices in music education. Conversely, many a person of superior talent is not taking his music seriously because he is not aware of his exceptional powers.

Not only do these music tests locate talent but they clearly characterize various kinds of talent. This recognition of difference in kinds of talent is the crying need of musical education today. Few people realize that such enormous differences in musical gifts exist. Let us assume, as did Seashore[2], that the possession of the sense of pitch, of time, and of intensity are basic powers for the musician. A good score in pitch is essential for a person who expects to play the violin but this ability need not be possessed in such high degree by the pianist. Likewise, the time and intensity tests are of greater importance to drummers than to some other musicians. Only in the highest types of

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[2] Carl Emil Seashore, A Survey of Musical Talent in the Public Schools. Studies in Child Welfare, Vol. 1, No. 2. Iowa: University of Iowa, 1920. p. 19.

musicians are many abilities to be found in one person. Educational and vocational advice and decisions should never be given solely on the basis of test results. These test results must be considered along with numerous other factors, such as conflicting interests, home background, the will to achieve, and especially the power of application and of continuous and hard work.

The time will and must come when a music psychologist will be placed in the public schools to attempt to discover talent through the use of tests and auditions. The knowledge of the pupils' basic capacities from a survey could serve to direct pupils into music classes and ensemble groups in singing or playing. The students could then be given musical activities in proportion to their capacities for achievement.

Because music makes such a lasting impression and has such a tremendous effect on people, we, the teachers of music, must seize every opportunity to bring the students in contact with it.

Summary of Conclusions

From the data submitted it becomes evident that the null hypothesis will have to be accepted for the following:

1. There is no relationship between musical aptitude in the Drake Tests and general intelligence in the Dominion Tests.

2. There is no relationship between musical aptitude in the Seashore Tests and general intelligence in the Dominion Tests.

3. There is no relationship between the rhythm and memory tests of the Drake battery and achievement in mathematics in the Iowa Tests of Basic Arithmetic Skills.

4. There is no difference between boys and girls on the various tests: Seashore Memory, Seashore Time, Seashore Intensity, Seashore Pitch, Seashore Consonance, Drake Rhythm, Drake Memory, Dominion Tests, Chicago Reasoning, Chicago Memory, and Iowa Mathematics.

On the other hand, the null hypothesis is rejected for parts of the remaining hypotheses and the following conclusions are drawn:

1. There is a relationship between the Seashore Memory and Chicago Verbal Meaning Tests significant at the five per cent level.

2. There is a relationship between Seashore Memory and Chicago Reasoning significant at the one per cent level.

3. There is a relationship between the Seashore Pitch and achievement in mathematics in the Iowa Tests of Basic Arithmetic Skills significant at the one per cent level.

4. There is also a relationship between the Drake Rhythm and the Chicago Reasoning Tests significant at the one per cent level.

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APPENDIX A

Music Test Forms

Room _____

Name _____ Test _____

Hour _____ Date _____

School _____ Grade _____ Age _____ yrs. _____ Mos.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

DRAKE

MUSICAL MEMORY TEST

Name _____ Grade _____ Age _____

City _____ School _____ Date _____

What musical instruments do you play ? _____ Years studied _____

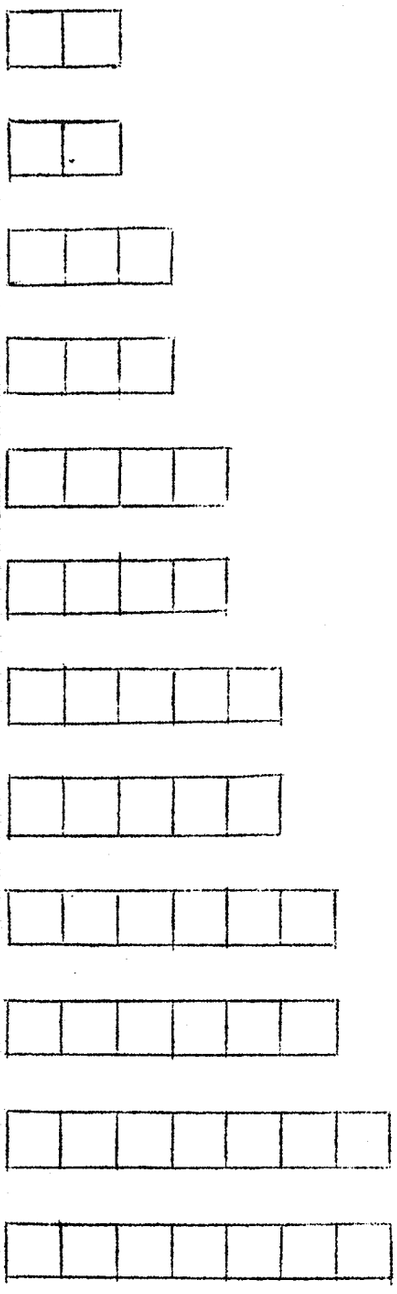
Have you had singing lessons? _____ Years studied _____

FORM A

Mark in each answer box one of the following letters:

S = SAME
K = KEY changed
T = TIME changed
N = NOTES changed

Make your answers clear and dark.



FORM B

Mark in each answer box one of the following letters:

S = SAME
K = KEY changed
T = Time changed
N = NOTES changed

Make your answers clear and dark.

I.
2.
3.
4.
5.
6.
7.
8.
9.
IO.
II.
I2.

DRAKE

RHYTHM TEST

Room _____

Name _____ _____ _____ Grade _____ Age _____

ity _____ School _____ Date _____

hat musical instruments do you play? _____ _____ Years studied _____

ave you had singing lessons ? _____ Years studied _____ Where ? _____

FORM A

Mark your answers in
the answer boxes below.

MAKE YOUR ANSWERS CLEAR AND DARK!.

	26.
	27.
	28.
	29.
	30.
	31.
	32.
	33.
	34.
	35.
	36.
	37.
	38.
	39
	40
	41.
	42.
	43.
	44.
	45.
	46.
	47.
	48.
	49.
	50.

FORM B

Mark your answers in
the answer boxes below.

MAKE YOUR ANSWERS CLEAR AND DARK !

I.	26.
2.	27.
3.	28.
4.	29.
5.	30.
6.	31.
7.	32.
8.	33.
9.	34.
I0.	35.
11.	36.
12	37
13.	38.
14.	39.
15.	40.
16.	41.
17.	42.
18.	43.
19.	44.
20.	45.
21.	46.
22.	47.
23.	48.
24.	49.
25.	50.

APPENDIX B

Intelligence Tests

THE DOMINION TESTS

GROUP TEST OF LEARNING CAPACITY

INTERMEDIATE—GRADES 7, 8, 9

(1950 OMNIBUS EDITION) FORM B

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

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

Name.....Boy or Girl.....
(IN CAPITALS) LAST FIRST

Age.....Birthdate.....Grade.....
MONTH DATE YEAR

School.....Teacher.....Today's Date.....

City, Town, or Municipality.....Province.....

Five sample questions are given below to show you what this test is like. In questions such as 1, 2, and 3, you must in each case select the best answer from the five choices presented, and write the number of your choice in the brackets following the question. In questions in which no choices are given, such as 4 and 5 below, it will be quite clear what you are expected to do. The sample questions have all been answered for you. The questions in the test must be answered in the same manner.

In doing this test you must work as rapidly as possible, since you are not likely to do all the questions in the 30 minutes allowed for it. Each question is worth one point. Skip any questions which appear to be too difficult, or which take up too much of your time, and return to them later if you have any time left. Spend your time now studying the samples below. **Do not open the booklet until you are told to do so.**

1. Which word does not belong in this list?
(1) green (2) purple (3) red (4) sweet (5) yellow.....(4)

2. **Fish** is to **Swim** as **Bird** is to
(1) feathers (2) fly (3) nest (4) chirp (5) egg.....(2)

3. Which word means the opposite of **Come**?
(1) late (2) home (3) run (4) ride (5) go.....(5)

4. What number comes next in this list?
12, 11, 10, 9, 8, ...(7)

5. Jim spent half of his money and has 15 cents left. How much did he have at first?.....(30)

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SCORE..... M.A..... C.A..... I.Q.....

1. **Iron** is to **Sink** as **Cork** is to
(1) bottle (2) heavy (3) axe (4) water (5) float..... (

2. What number comes next in this list?
3, 13, 4, 14, 5, 15, 6, 16, ...(

3. Which word does not belong in this list?
(1) school (2) bank (3) church (4) teacher (5) theatre.....(

4. What is the smallest number that may be added to 46 to make the sum exactly divisible by 7?.....(

5. **Trout** is to **Fish** as **Eagle** is to
(1) nest (2) bird (3) fly (4) canary (5) feathers.....(

6. Which word means the opposite of **Seldom**?
(1) rarely (2) promptly (3) often (4) certainly (5) never.....(

7. It is 68 yards around a square hall. How many yards is it along each side?.....(

8. Which word does not belong in this list?
(1) well (2) rut (3) groove (4) furrow (5) trench.....(

9. **Bee** is to **Sting** as **Dog** is to
(1) pup (2) bark (3) cat (4) bite (5) play.....(

10. **Dismal** means the same as
(1) damp (2) lonely (3) far (4) alarming (5) gloomy.....(

11. What number must be added to 8 to give a number 3 less than one-half of 40?....(

12. What fraction comes next in this list?
$\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, ...(

13. **Bread** is to **Man** as **Grass** is to
(1) lawn (2) cow (3) green (4) baker (5) hay.....(

14. Which word means the opposite of **Knowledge**?
(1) ignorance (2) belief (3) memory (4) error (5) wisdom.....(

15. I have 7 marbles and John has 9 marbles. If I give him 3 of mine, how many will he then have more than I?.....(

16. Which word does not belong in this list?
(1) president (2) party (3) club (4) clan (5) society.....(

17. What number comes next in this list?
8, 9, 10, 9, 10, 11, 10, ...(

18. Which word means the opposite of **Unjust**?
(1) jealous (2) clever (3) fair (4) criminal (5) sweet.....(

19. What number is 3 less than the number that 4 is one-half of?.....(

GO ON TO PAGE

52. What number comes next in this list?
7, 19, 9, 17, 11, 15, ...( )

53. What is the number one-fifth of which is 10?.....( )

54. **Bird** is to **Robin** as **Tree** is to
(1) cedar (2) root (3) leaf (4) lumber (5) bark.....( )

55. What number comes next in this list?
13, 12, 10, 9, 7, 6, ...( )

56. To **Interrogate** is to
(1) interrupt (2) recall (3) question (4) contradict (5) threaten....( )

57. What number is 6 less than the number that 19 is 3 more than?.....( )

58. What number comes next in this list?
4, 5, 7, 10, 14, ...( )

59. **June** is to **April** as **September** is to
(1) November (2) August (3) July (4) October (5) January.....( )

60. **Wary** means the same as
(1) tired (2) angry (3) trusting (4) troubled (5) cautious.....( )

61.  is to  as  is to

(1)  (2)  (3)  (4)  (5)  .....( )

62. What number comes next in this list?
162, 54, 18, 6, ...( )

63. Jack types faster than Maude, and Maude types more slowly than Tom. Therefore of the three
(1) Tom types fastest (2) Maude types slowest (3) Jack types fastest
(4) Tom types slowest (5) Maude types fastest.....( )

64. Yesterday I took a jeweller the watch I broke 3 days before. He said, "It will be ready the day after tomorrow—that's Thursday." The watch was broken on
(1) Thursday (2) Monday (3) Friday (4) Sunday (5) Saturday....( )

65. What number is 2 more than the number that 4 is 3 less than?.....( )

66. A **Knave** is a
(1) hut (2) rogue (3) fairy (4) knight (5) slave.....( )

67. Jim spent half his money and 7 cents besides. He has 15 cents left. How many cents did he have in the beginning?.....( )

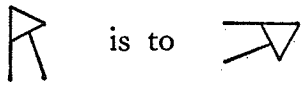
68. **Goose** is to **Geese** as **She** is to
(1) they (2) me (3) her (4) us (5) him.....( )

GO ON TO PAGE 5

69. **Placid** means the same as
(1) cautious (2) rough (3) lovely (4) solid (5) calm.....(

70. Which word does not belong in this list?
(1) gate (2) hedge (3) fence (4) railing (5) wall.....(

71. If Ann had 5 cents more, she would have twice as much money as Ruby, and if Ruby had 10 cents less she would have half as much money as Ethel. Ethel has 30 cents. How many cents has Ann?.....(

72.  is to as  is to

(1)  (2)  (3)  (4)  (5)  .....(

73. What number comes next in this list?
2, 3, 5, 9, 17, ...(

74. Jack and Tom ride to meet each other from places 200 miles apart. Jack travels 30 miles per hour and Tom 20 miles per hour. In how many hours will they meet?..(

75. FGHIJK EFGHI DEFG CDE
What would be the next group of letters in the above series?.....(

END OF TEST

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HE CHICAGO TESTS OF PRIMARY MENTAL ABILITIES

For ages 11 to 17

Prepared by

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PRACTICE EXERCISES

2

ADDITION

Below are two columns of numbers which have been added. Add the numbers for yourself to see if the answers are correct.

	16	42
	38	61
	45	83
	99	176
Right	✓	=
Wrong	=	✓

The first answer is right so the space in the R row is marked. The second answer is wrong so the space in the W row is marked.

Check the sums of the columns below. If the answer is right, mark the space in the R row. If the answer is wrong, mark the space in the W row.

	17	35	63
	84	28	17
	29	61	89
	140	124	169
Right	=	=	=
Wrong	=	=	=

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

P R A C T I C E E X E R C I S E S

3

MULTIPLICATION

Below are two multiplication problems. Multiply the numbers for yourself to see if the answers are correct.

	64	39
	7	4
	448	166
Right	✓	=
Wrong	=	✓

The first answer is right so the space in the R row is marked. The second answer is wrong so the space in the W row is marked.

Check the answers in the problems below. If the answer is right, mark the space in the R row. If the answer is wrong, mark the space in the W row.

	57	46	29
	6	8	7
	342	358	193
Right	=	=	=
Wrong	=	=	=

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

Add each column. If the sum is right, mark the space in the **R** row. If the sum is wrong, mark the space in the **W** row.

NUMBER ABILITY 4 ADDITION

S	W	R	T

	61	31	66	73	13	48	88
	34	59	73	29	39	45	29
	78	52	15	56	99	17	69
	53	68	38	33	32	82	98
	226	200	202	211	183	192	284
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	86	69	71	44	75	26	99
	49	44	37	49	54	44	77
	54	89	66	23	36	75	82
	22	84	55	48	17	51	68
	111	286	129	164	162	196	316
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	25	43	31	59	52	68	78
	46	34	73	29	56	33	56
	92	89	13	39	99	32	76
	57	32	48	45	17	82	35
	220	198	185	192	124	225	245
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	95	79	89	97	13	26	44
	49	22	64	35	92	99	77
	44	84	61	66	31	26	86
	37	55	34	73	36	62	68
	205	240	258	271	172	213	275
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	97	13	26	44	75	51	81
	92	99	77	82	68	39	46
	26	86	32	84	39	92	43
	86	79	99	32	57	32	48

	32	97	23	71	48	24	89
	98	63	36	46	59	85	95
	22	76	41	67	17	94	55
	91	57	65	62	16	47	79
	243	303	165	236	150	250	218
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	26	81	75	18	59	64	83
	86	39	47	15	44	61	34
	34	84	55	57	78	34	41
	99	79	19	96	89	19	16
	345	293	196	186	280	188	174
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	32	98	22	91	28	81	89
	97	63	76	57	63	39	86
	23	36	41	65	62	67	69
	71	46	67	62	87	52	71
	243	243	196	295	260	239	315
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	75	51	43	31	59	52	68
	82	68	73	29	56	33	47
	99	32	39	99	32	55	56
	87	23	17	82	19	33	58
	243	174	182	251	146	173	239
Right	:::::	:::::	:::::	:::::	:::::	:::::	:::::
Wrong	:::::	:::::	:::::	:::::	:::::	:::::	:::::
	31	59	42	68	75	78	23
	43	73	29	56	33	47	56
	92	43	13	39	45	32	55
	79	57	32	48	99	17	82

space in the **W** row.

	68 × 3	82 × 3	72 × 9	57 × 4	65 × 9	92 × 4	58 × 7
Right	204	236	658	208	585	368	406
Wrong							
	81 × 3	47 × 8	84 × 3	48 × 8	68 × 3	47 × 7	46 × 9
Right	233	376	242	384	194	329	404
Wrong							
	42 × 8	78 × 4	76 × 6	54 × 4	63 × 6	87 × 3	97 × 6
Right	336	312	446	206	368	241	582
Wrong							
	73 × 8	92 × 3	32 × 8	64 × 7	58 × 7	86 × 4	67 × 6
Right	604	276	246	448	406	344	402
Wrong							
	52 × 8	38 × 4	67 × 3	73 × 7	89 × 6	32 × 7	73 × 6
Right	406	142	201	491	524	214	458
Wrong							

	89 × 6	69 × 4	43 × 9	26 × 6	26 × 8	73 × 4	29 × 8
Right	534	286	387	146	198	292	252
Wrong							
	98 × 4	36 × 6	59 × 3	95 × 6	37 × 9	54 × 4	76 × 8
Right	382	236	177	570	353	236	608
Wrong							
	78 × 7	56 × 9	72 × 8	24 × 8	42 × 6	94 × 9	89 × 6
Right	566	504	586	182	272	846	534
Wrong							
	36 × 8	82 × 7	98 × 6	38 × 7	36 × 9	98 × 6	93 × 7
Right	268	574	598	286	304	588	641
Wrong							
	65 × 6	79 × 8	56 × 6	52 × 7	34 × 8	87 × 7	76 × 4
Right	390	632	316	344	292	589	304
Wrong							

STOP HERE

P R A C T I C E E X E R C I S E S

6

VOCABULARY

The first word in the following line is "big."

big	ill	large	down	sour

One of the other words means the **same** as "big." The word "large" has been marked because it means the same as "big."

The first word in the following line is "ancient." Mark one of the other words that means the **same** as "ancient."

ancient	dry	long	happy	old

You should have marked "old" because it means the same as "ancient."

In each of the following lines mark the word that means the **same** as the first word.

quiet	blue	still	tense	watery
safe	secure	loyal	passive	young
brave	hot	cooked	red	courageous

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

P R A C T I C E E X E R C I S E S

7

COMPLETION

Read the definition below. Think of the word which fits the definition. The **first** letter of the word is in the row of letters under the definition.

> The first meal of the day.
>
> A = B = C = D = E =

The word is "Breakfast." "B" is marked because it is the first letter of the word "Breakfast.

Do the following example:

> A place or building for athletic exercises.
>
> D = G = H = T = V =

The word is "Gymnasium." You should have marked "G" because it is the first letter of the word "Gymnasium."

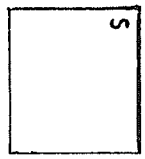
Do the following examples in the same way:

> The red fluid which circulates in the veins and arteries of man.
>
> B = C = D = F = G =
>
> A one-cent piece made of copper.
>
> A = B = E = H = P =
>
> A small or portable bed, as of canvas stretched on a frame.
>
> A = C = G = N = T =

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

In each row of five words below, mark the word which means the **same** as the first word in that row.

VERBAL MEANING ABILITY 8 VOCABULARY



moist	curt	humane	damp	moderate
quick	major	hasty	narrow	vigorous
annual	variable	yearly	listless	untenable
splendid	expansive	gay	rigid	excellent
customary	nocturnal	radial	prime	usual

fluid	livid	dead	liquid	talkative
idle	lazy	cross	wild	useful
deserted	drab	absurd	disturbed	abandoned
rare	holy	crass	infrequent	weak
contented	nasty	continuous	defamatory	satisfied

enraged	pleasing	poor	angry	domestic
beneficial	artificial	tamable	helpful	piquant
moldy	tonic	musty	shapeless	mute
rasping	harsh	minute	kinaesthetic	marshy
dietary	diagrammatic	amorphous	dietetic	grammatical

sober	dirty	cloudy	serious	fitting
droll	delightful	odd	forceful	foreign
stately	dignified	thin	digestible	valid
disreputable	shameful	forensic	horticultural	susceptible
genteel	wealthy	urban	polite	ignorant

original	oral	derelict	first	reliable
novel	expensive	new	gloomy	radical
famous	celebrated	faithful	renewed	nimble
systematic	laudatory	orderly	jubilant	ambitious

resplendent	phonetic	tart	brilliant	fearless
generous	oblivious	ardent	liberal	defiant
kingly	bland	facial	recent	regal
flexible	pitiable	formal	pliant	peaceful
sagacious	exotic	apparent	wise	mild

heedless	patient	eligible	parallel	rash
deficient	constant	dreary	lacking	peculiar
vigilant	watchful	indulgent	valorous	nascent
minimum	humid	restricted	tranquil	least
gallant	chivalrous	authentic	treacherous	probable

giddy	feminine	casual	dizzy	comical
discreet	caustic	redolent	honorable	prudent
destined	simplified	fated	directional	lucky
eternal	momentous	benign	priceless	perpetual
lavish	combined	ribald	worthy	extravagant

defective	concealed	mythical	faulty	external
vague	numb	obscure	indecent	vermiculate
essential	classical	indispensable	deplorable	candid
impulsive	impetuous	petrified	immature	compulsory
diffident	fabulous	shy	valuable	alphabetical

erroneous	solemn	false	ironic	tragic
benevolent	kind	native	suitable	modest
grimy	stern	filthy	grim	colorful
lacerated	disgruntled	mangled	fringed	stricken

The wife of a king.
F ..... N ..... P ..... Q ..... V .....

The headpiece in armor.
D ..... H ..... K ..... P ..... T .....

A song to quiet babies.
D ..... F ..... G ..... K ..... L .....

A keen-edged instrument for shaving.
C ..... D ..... H ..... R ..... T .....

A mark to shoot at, as for practice.
F ..... H ..... J ..... R ..... T .....

A short sleep or doze.
B ..... F ..... K ..... N ..... P .....

A war ax used by North American Indians.
C ..... K ..... N ..... T ..... V .....

A box or room for keeping food cool.
D ..... H ..... N ..... Q ..... R .....

A dealer in foodstuffs.
A ..... E ..... G ..... L ..... N .....

The metal tube of a gun.
B ..... F ..... N ..... P ..... U .....

A ticket used in voting.
B ..... N ..... P ..... W ..... Y .....

A piece of cloth sewed on a garment to mend it.
F ..... H ..... J ..... N ..... P .....

The price of transportation for a person.
B ..... F ..... H ..... J ..... K .....

A sack or pouch for holding something.
B ..... F ..... L ..... N ..... W .....

Timber which is split or sawed into boards.
D ..... L ..... M ..... R ..... V .....

The art of shooting with bows and arrows.
A ..... B ..... I ..... L ..... R .....

An enclosure containing fruit trees.
B ..... E ..... F ..... O ..... R .....

A mark remaining after a wound is healed.
F ..... J ..... N ..... S ..... V .....

A strip of material used in dressing wounds.
A ..... B ..... E ..... F ..... H .....

A magnetic instrument for determining direction.
B ..... C ..... G ..... L ..... N .....

A liquid used in rinsing the throat.
G ..... J ..... K ..... Q ..... T .....

A lure to catch fish or other animals.
B ..... G ..... H ..... M ..... V .....

A very strong wire rope.
A ..... C ..... F ..... K ..... P .....

A large swallow, a mouthful.
C ..... D ..... E ..... G ..... N .....

A trembling of the earth's surface.
C ..... E ..... G ..... I ..... P .....

A house for a dog.
E ..... G ..... H ..... J ..... K .....

A window in a roof.
F ..... H ..... J ..... R ..... S .....

A short brisk leap, especially on one foot.
D ..... H ..... O ..... P ..... T .....

The part of the day between noon and evening.
A ..... B ..... C ..... E ..... F .....

An excavation for obtaining building stone.
J ..... L ..... O ..... Q ..... T .....

A place where money is coined.
J ..... K ..... L ..... M ..... N .....

A window above a door or another window.
G ..... J ..... L ..... Q ..... T .....

The horn of a deer.
A ..... D ..... F ..... K ..... U .....

One who habitually asks for charity.
B ..... J ..... N ..... Q ..... U .....

One who works in stone.
D ..... J ..... M ..... R ..... Y .....

A musical composition for two performers.
C ..... D ..... F ..... N ..... S .....

A field on which grass is grown for hay.
J ..... K ..... M ..... N ..... R .....

A tenth part of a cent.
K ..... L ..... M ..... N ..... O .....

The coat of wool that covers a sheep.
D ..... F ..... G ..... K ..... M .....

A frame to hold a painter's canvas upright.
B ..... E ..... G ..... I ..... L .....

Love of one's country.
H ..... K ..... P ..... S ..... W .....

The lading or freight of a ship.
C ..... D ..... E ..... H ..... I .....

The very hard outer layer of teeth.
A ..... B ..... E ..... F ..... G .....

A liquid for drinking.
B ..... F ..... H ..... Q ..... U .....

The pin or spindle on which a wheel revolves.
A ..... D ..... L ..... M ..... V .....

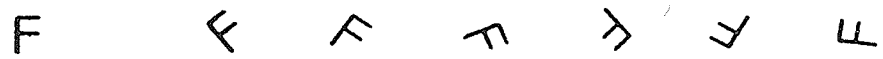
STOP HERE

PRACTICE EXERCISES

10

FIGURES

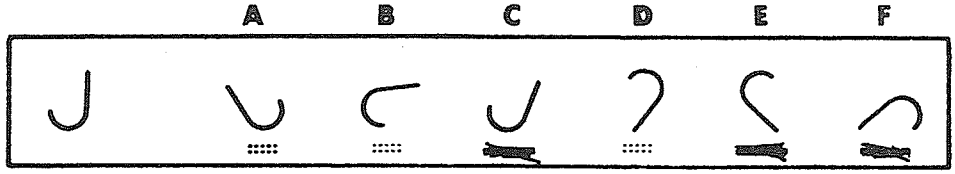
Look at the row of figures below. The first figure is like the letter **F** which is right side up. All the other figures are like the first but they have been turned in different directions.



Satisfy yourself that all of these figures look like the first one if they are turned right side up.

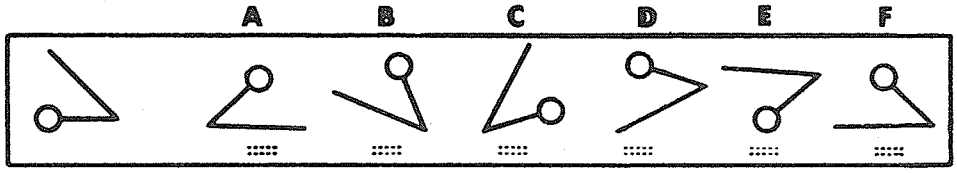
Now look at the next row of figures. The first one looks like an **F**. But none of the other figures would look like an **F** even if they were turned right side up. They are all made backward.

Some of the figures in the next row are like the first figure. Some are made backward. The figures like the first figure are marked.



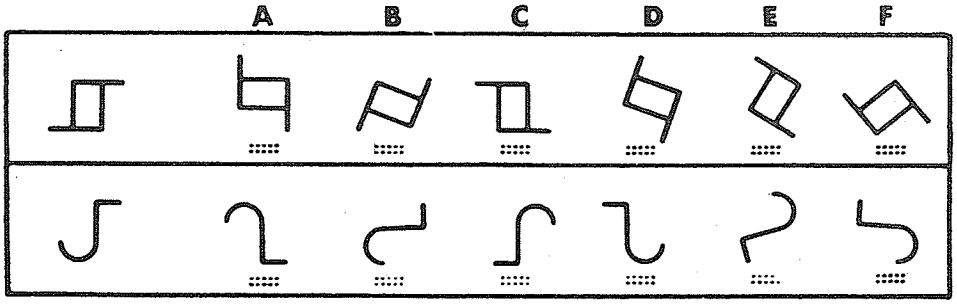
Notice that all the figures like the first figure are marked.

In the row of figures below, mark every figure which is **like** the first figure in the row. Do not mark the figures which are made backward.



You should have marked figures **A** and **E**

In each row below mark every figure which is **like** the first figure in the row.



STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

P R A C T I C E E X E R C I S E S

11

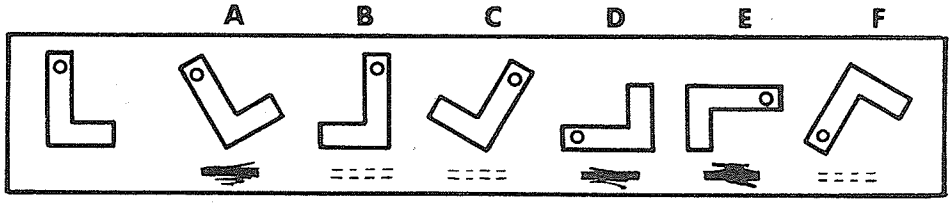
CARDS

Here is a picture of a card. It looks like an **L**, and it has a hole in one end.

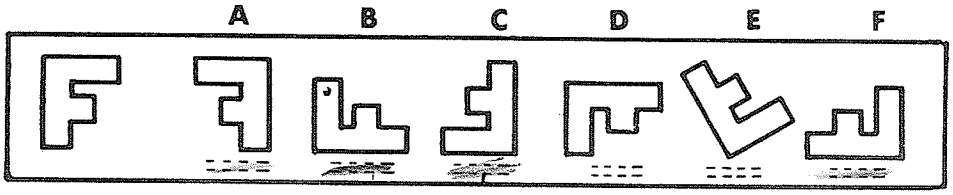
The two cards below are alike. You can slide one around on the page to fit the other exactly.

Now look at the next two cards. They are different. You cannot make them fit exactly by sliding them around on the page.

Here are more cards. Some of the cards are marked. The cards which are like the first card in this row are marked.

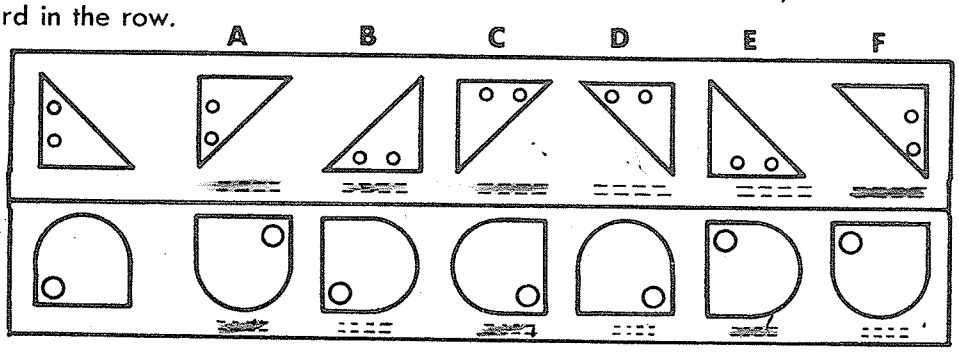


Below is another row of cards. Mark all the cards which are **like** the first card in the row.



You should have marked cards **B** and **C**.

Here are some more cards for you to mark. In each row mark every card that is **like** the first card in the row.

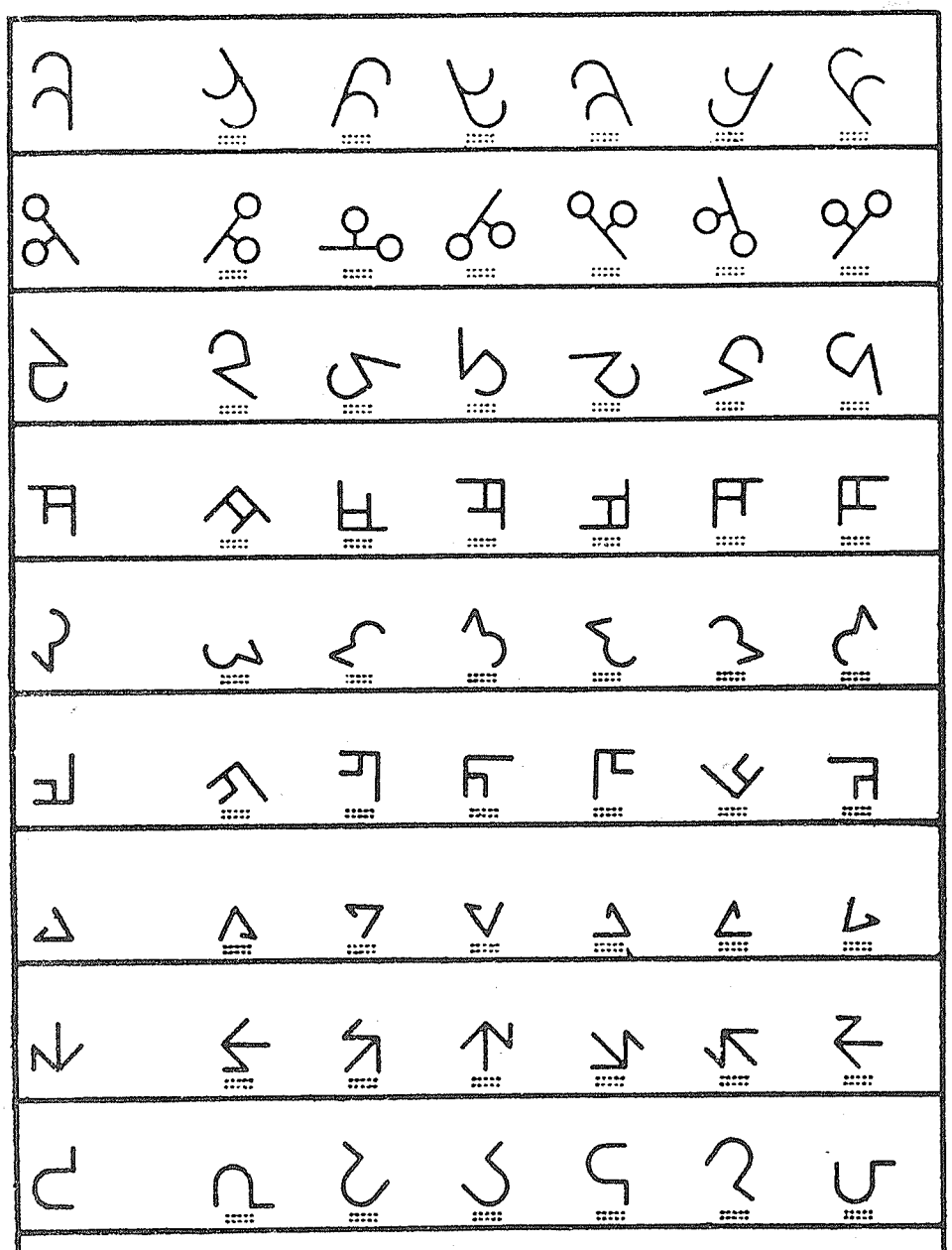


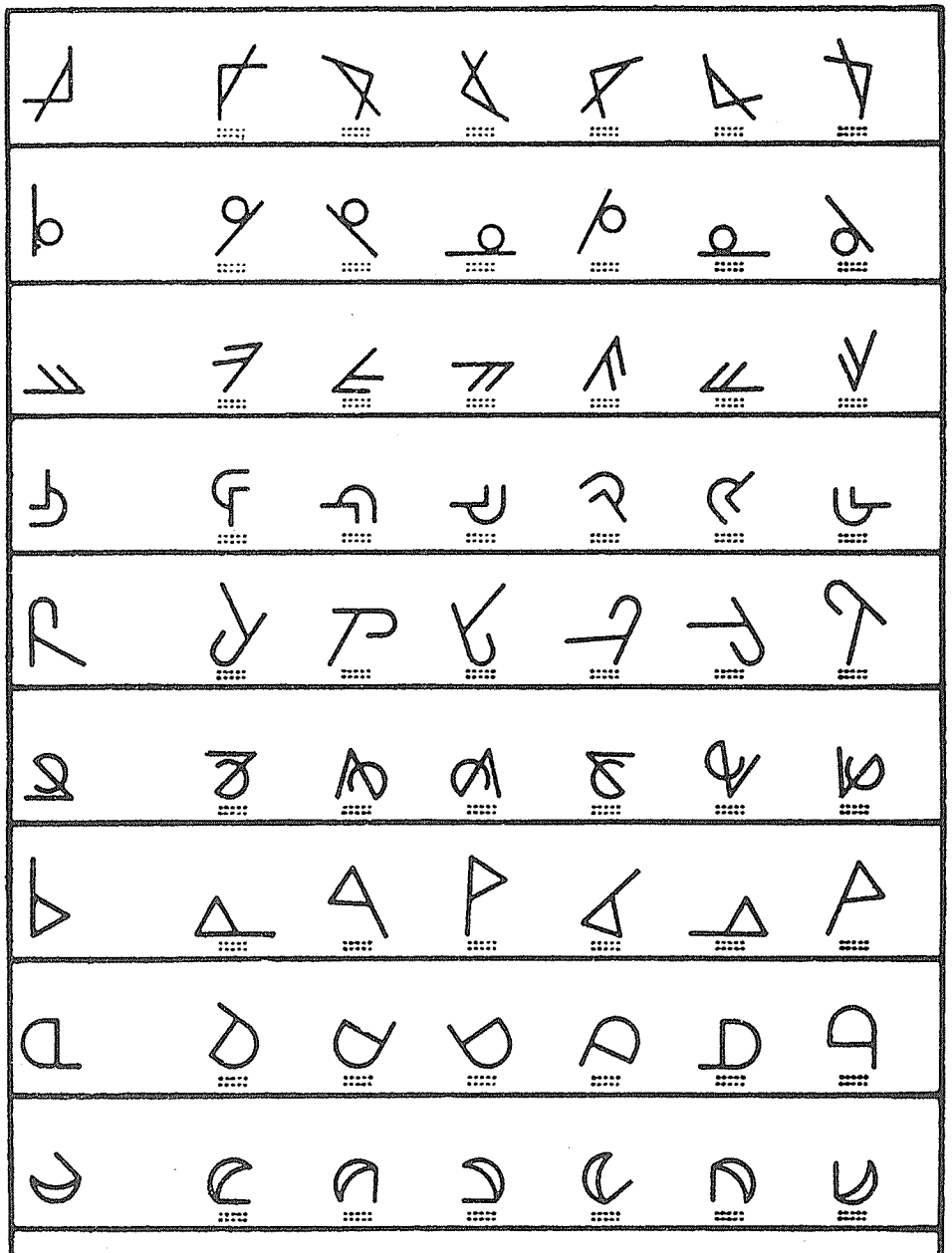
STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

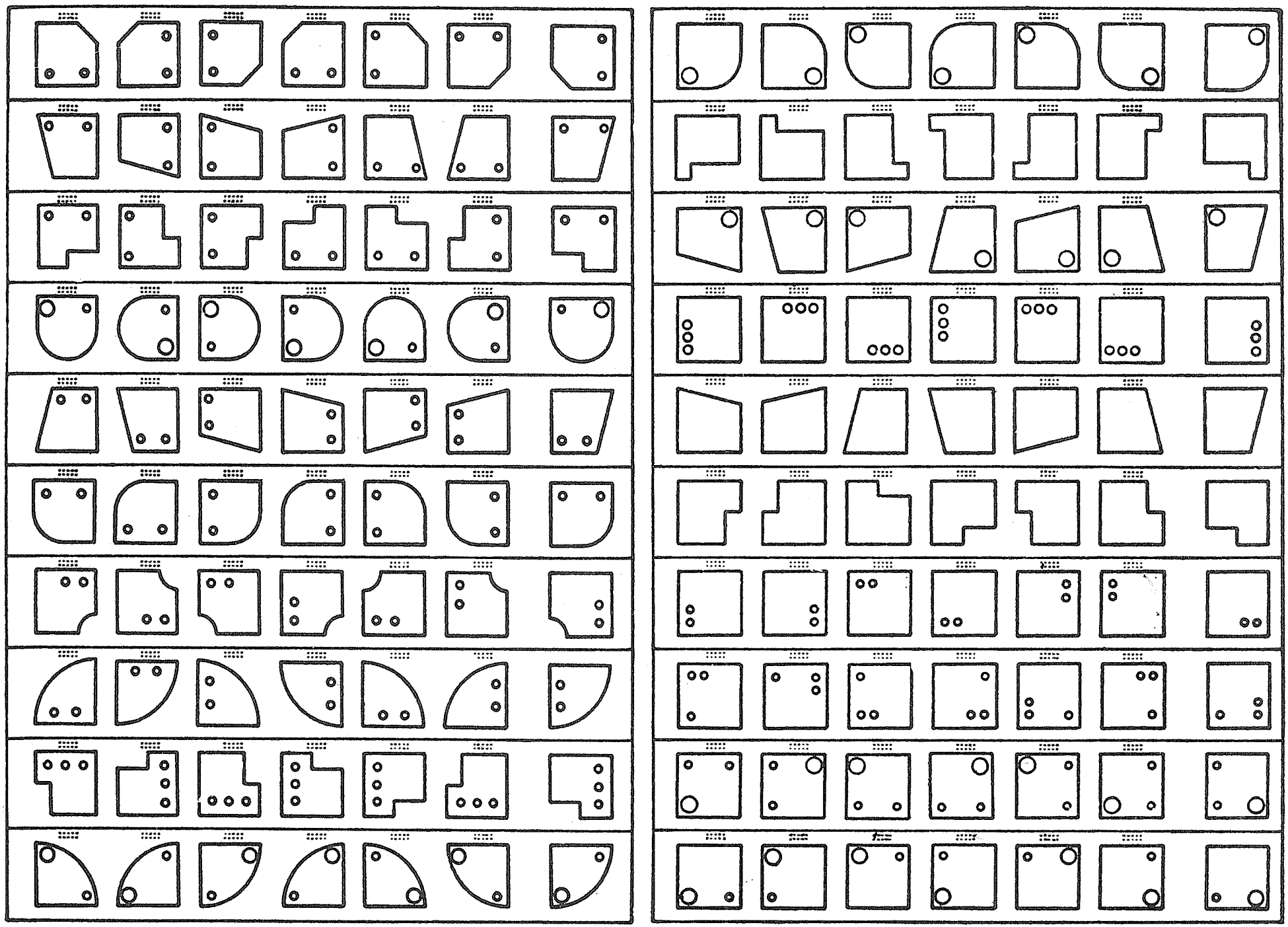
In each row put a mark under every figure which is like the first figure in the row.

SPACE ABILITY 12 FIGURES

S	W	R	T







P R A C T I C E E X E R C I S E S

14

FIRST LETTERS

Look at the words in the following list. Each word **begins** with **D**.

doll

dinner

daisy

doughnut

On the blanks below write several words which **begin** with **P**. One word you might write is **pretty.** Go ahead and write more words which **begin** with **P**.

When the signal is given (not yet), you will be given a **new letter**. Write as many words as you can which begin with the **new letter**. Write the words as fast as you can.

STOP HERE. WAIT FOR THE SIGNAL

P R A C T I C E E X E R C I S E S

15

FOUR-LETTER WORDS

Look at the words in the following list. Each word has **four** letters and **begins** with **B**.

bear

bone

bold

bent

On the blanks below write several **four-letter** words which **begin** with **M**. One word you might write is **most**. Go ahead and write more **four-letter** words which **begin** with **M**.

When the signal is given (not yet), you will be given a **new letter**. Write as many four-letter words as you can which begin with the **new letter**. Write the words as fast as you can.

STOP HERE. WAIT FOR THE SIGNAL

S

WORD FLUENCY ABILITY 16 FIRST LETTERS

The new letter is **S**. Write as many words as you can which **begin** with **S**.

1.	21.	41.	61.
2.	22.	42.	62.
3.	23.	43.	63.
4.	24.	44.	64.
5.	25.	45.	65.
6.	26.	46.	66.
7.	27.	47.	67.
8.	28.	48.	68.
9.	29.	49.	69.
10.	30.	50.	70.
11.	31.	51.	71.
12.	32.	52.	72.
13.	33.	53.	73.
14.	34.	54.	74.
15.	35.	55.	75.
16.	36.	56.	76.
17.	37.	57.	77.
18.	38.	58.	78.
19.	39.	59.	79.
20.	40.	60.	80.

STOP

WORD FLUENCY ABILITY 17 FOUR-LETTER WORDS

ew letter is **C**. Write as
words as you can which
four letters and **begin**
:.

_____	21._____	41._____
_____	22._____	42._____
_____	23._____	43._____
_____	24._____	44._____
_____	25._____	45._____
_____	26._____	46._____
_____	27._____	47._____
_____	28._____	48._____
_____	29._____	49._____
_____	30._____	50._____
_____	31._____	51._____
_____	32._____	52._____
_____	33._____	53._____
_____	34._____	54._____
_____	35._____	55._____
_____	36._____	56._____
_____	37._____	57._____
_____	38._____	58._____
_____	39._____	59._____
_____	40._____	60._____

STOP HERE

P R A C T I C E E X E R C I S E S

18

LETTER SERIES

Study the series of letters below. What letter should come next?

a b a b a b a b a b c d e f

The next letter in this series should be **a**. The letter **a** has been marked in the answer row at the right.

Now study the next series of letters and decide what the next letter should be. Mark the letter in the answer row at the right.

c a d a e a f a a c d e f g

You should have marked the letter **g**.

Now study the series of letters below. In each series decide what the next letter should be and mark the letter in the answer row at the right.

c d c d c d a b c d e f

a a b b c c d d a b c d e f

a b x c d x e f x g h x h i j k x y

You should have marked **c**, **e**, and **i**.

Now work the following problems for practice. Mark the correct letters in the answer rows.

a a a b b b c c c d d a b c d e f

a x b y a x b y a x b a b c x y z

a b m c d m e f m g h m g h i j m n

r s r t r u r v r w r x r r s t w x y

a b c d a b c e a b c f a b c a b c f g h

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

P R A C T I C E E X E R C I S E S

19

LETTER GROUPING

Look at the groups of letters below.

AABC ACAD ACFH AACG

Three of the groups have two **A**'s. The group which does not have two **A**'s is marked.

Here is another problem. Three of the groups are alike in some way. Can you find three groups which are alike? Mark the one that is different.

XURM ABCD MNOP EFGH

In three of the groups the letters are arranged in alphabetical order. The first group is not in alphabetical order. You should have marked it to show that it is different.

Three of the groups in the next row are alike in some way. Mark the group that is different.

KABC KEFG LOPQ KUVW

Three of the groups start with **K**. You should have marked the third group, which is different.

Here is another problem. Mark the group that is different.

BDEF ILMN LNOP QSTU

Three of the groups omit only one letter. You should have marked the second group, which is different.

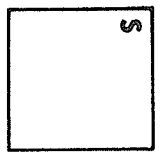
Here are more problems for you to work. In each row three of the groups are alike in some way. Mark the group that is different. Go right ahead.

AAAB	AAAM	AAAR	AATV
DCBA	HGFE	MRUX	PONM
RSTT	LMNL	FGHF	BCDB
ABCE	FGHJ	KLMO	RSTW

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER.

In each series of letters decide what the next letter should be and mark the letter in the answer row at the right.

REASONING ABILITY 20 LETTER SERIES



a a b c c d e e f g g	a	b	c	f	g	h	a b c n o d e f n o g h i n o	i	j	k	n	o	p
a x a y b x b y c x c y d x d	d	e	f	x	y	z	a b b b c d d d e f f f g h h	g	h	i	j	k	l
a b c a b c d e f d e f g h i	g	h	i	j	k	l	h g f e d c b	a	b	c	g	h	i
a b c x y z d e f x y z g h i	j	k	l	x	y	z	a c e g i k m	j	k	l	m	n	o
a b c a b d a b e a b f	a	b	c	f	g	h	a x b y c z a x b y c z a x b	a	b	c	x	y	z
x y z a x y z b x y z c x y z	x	b	c	d	e	y	a b b c d d e f f g h	e	f	g	h	i	j
e f c g h c i j c k l c m n c	c	d	m	n	o	p	g h j k m n p q s t v w	u	v	w	x	y	z
c b a c b a c b a c b	a	b	c	d	e	f	a b c a d e f d g h i g j k l	i	j	k	l	m	n
a m b c m d e f m g h i j	h	i	j	k	l	m	a s b t c u d v e w f x g	f	g	h	x	y	z
a a c c e e g g i i	h	i	j	k	l	m	a a b b c d d e e f g g h	h	i	j	k	l	m
e f e f c d g h g h c d i j	c	d	i	j	k	l	a a b a b c c d c d e e f	e	f	g	h	i	j
a b b c c c d d d d e e e e	d	e	f	g	h	i	a c f h k m p r	p	q	r	s	t	u
a b c a b c d a b c d e	a	b	c	d	e	f	v v v v v w w w w x x x y	u	v	w	x	y	z
a b c c d e f f g h i i j k l	j	k	l	m	n	o	a b c c b a d e f f e d g h i	h	i	j	k	l	m

is different.

AAAM	AACA	AAAD	AAAK
ABCD	EFGH	IJKL	OPST
BXYC	FPQG	JXYK	LXYM
DFDF	KLKL	STVW	BCBC
ABCP	CBAQ	ABCR	ABCS
DCCJ	DBBJ	DNNJ	DRSJ
CXYZ	CFGH	DPQR	CLMN
BEFE	HIJI	NOPO	TUVU
BCDD	FFGH	JKLL	PQRR
KLMN	BCDE	FGHE	RSTE
CBAL	BCAL	CFBA	BCLA
UVWU	ABCA	IJKI	FGHG
PQRS	MLKJ	NMLK	ZYXW
DAJA	DUJU	DEJN	DIJI
SSMD	BSHS	YNSR	TSWS

BCCD	FGHH	JKKL	PQQR
MNOP	DEFG	GIKL	STUV
BCBD	FGFH	LMLN	PQPX
AEIK	AKIE	IOKU	EIAK
ABDE	FGJK	LMOP	QRTU
DABC	HEFG	MIJK	ROPQ
AMBN	CWDP	EQFR	GSHT
ABDC	EFHG	IJMK	OPRQ
RSAC	TUXY	MNEF	HILM
ARSB	CTUD	EVWG	JOPK
NNOP	QRSS	TTUV	WWXY
PXAM	SPCD	DXMF	SAMY
MBAN	ODCP	QFER	SGHT
MLLM	DCCD	RSSR	HGGH
STTT	RRRS	SSST	QRRR

STOP HERE

P R A C T I C E E X E R C I S E S

22

FIRST NAMES

In the first row the correct first name has been marked. Mark the correct first name for each last name. Mark only one name in each row. Go right ahead.

Last Name	First Name				
Preston	Fred	John	Mary	Nancy	Ruth
Brown	John	Mary	Nancy	Ruth	Walter
Smith	Fred	John	Mary	Nancy	Walter
Davis	Fred	John	Nancy	Ruth	Walter

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS FROM THE EXAMINER

LAST NAME	FIRST NAME						
Lynn	Charles	Dorothy	Edith	Frank	Harry	Helen	Howard
Harvey	Charles	David	Dorothy	Edith	Lillian	Louise	Robert
Carson	George	Harry	Hazel	Helen	Howard	Jane	Louise
Thompson	Charles	Dorothy	Edith	Frank	Helen	James	Lena
Johnson	Alice	Edward	George	Hazel	Jane	Lillian	Louise
Richards	David	Edward	George	Hazel	James	Lena	Lillian
Morrison	David	Edith	Edward	George	Helen	James	William
King	Charles	Dorothy	Frank	Harry	Howard	Lena	Lillian
Nelson	Dorothy	Edith	Frank	Harry	Helen	Lena	Louise
Gray	David	Edward	George	Hazel	James	Jane	Louise
Wilson	Alice	Ann	Hazel	Howard	James	Jane	Lillian
Palmer	Dorothy	Edward	Edith	George	Harry	Helen	James
Webster	Ann	David	Frank	Howard	Lena	William	Robert
Mitchell	Alice	Edith	Harry	Hazel	Helen	James	Jane
Jones	Ann	Charles	David	Dorothy	Frank	Robert	William
Perry	Edith	Edward	Frank	Hazel	James	Jane	Lillian
Stewart	Dorothy	George	Harry	Helen	Howard	Lena	Louise
Adams	Ann	David	Dorothy	Edith	Frank	James	Lillian
Wright	Edward	George	Harry	Hazel	Helen	Jane	Lena
Irwin	Ann	David	Dorothy	Edward	Frank	Lillian	Robert

STOP HERE

Single Booklet Edition

THE CHICAGO TESTS OF PRIMARY MENTAL ABILITIES

PROFILE OF SCORES

Name _____ Date of test _____ (Year / Month / Day)

School _____ Birthday _____ (Year / Month / Day)

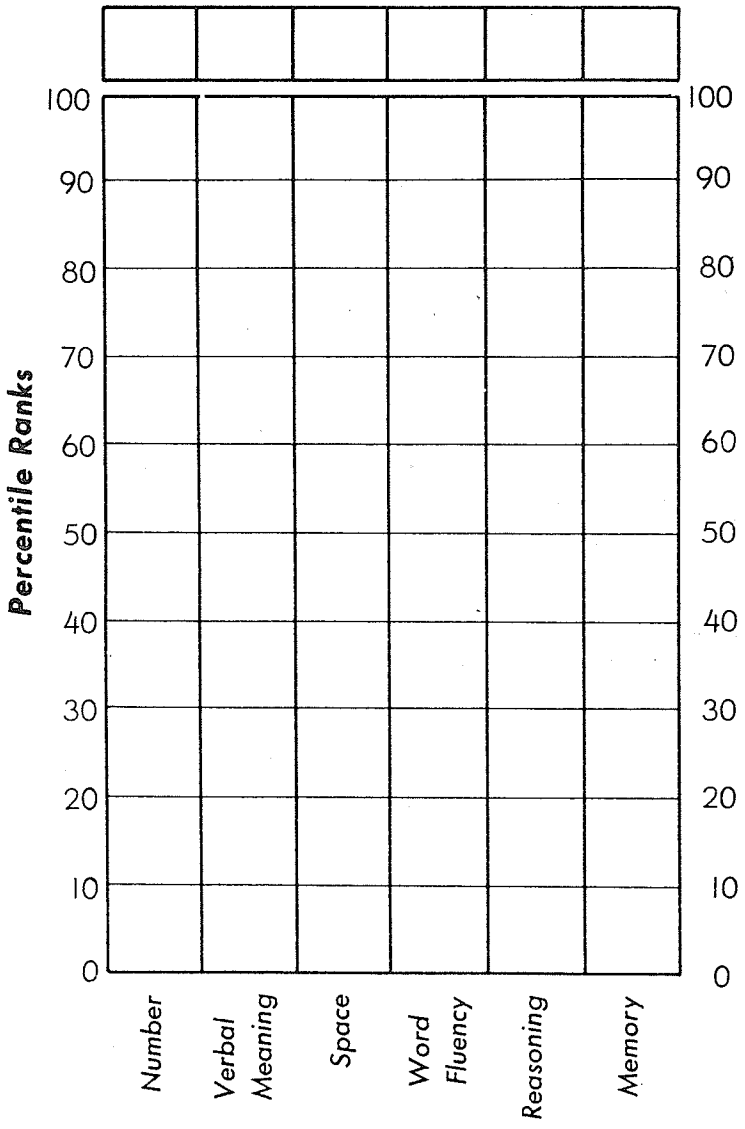
Grade _____ Sex _____ Age _____

CA

PROFILE OF PERCENTILE RANKS

N V S W R M

Raw Scores



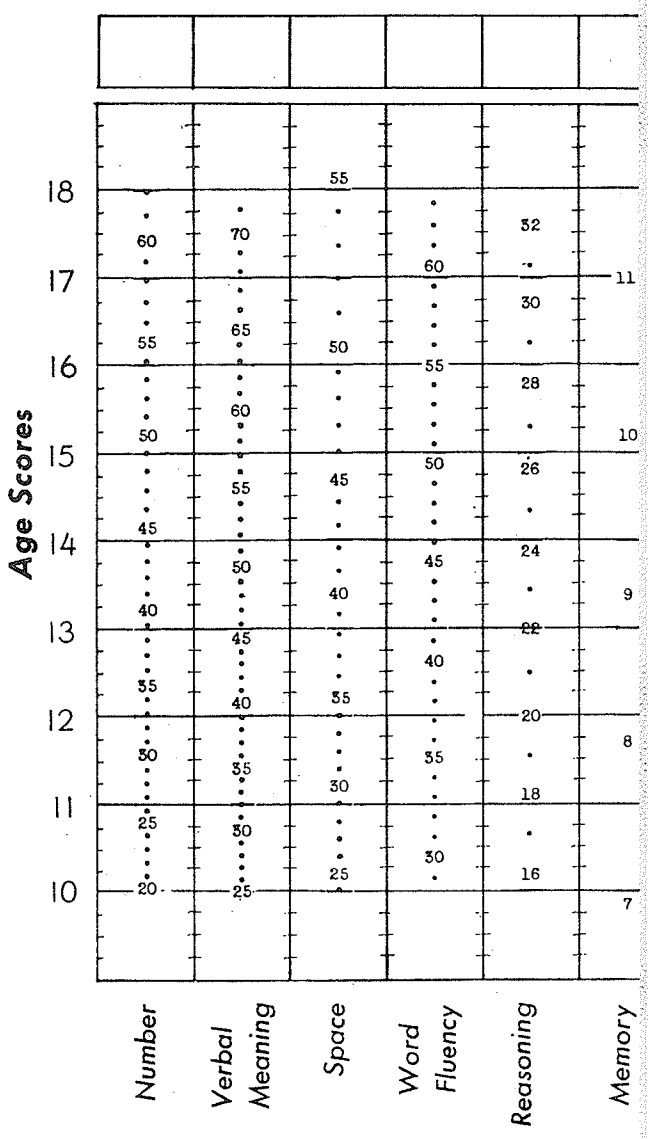
Percentile Ranks

N V S W R M

PROFILE OF AGE SCORES

N V S W R M

Raw Scores



Age Scores

N V S W R M

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Washington, D. C.

APPENDIX C

Mathematics Test

IOWA EVERY-PUPIL TESTS OF BASIC SKILLS

New Edition

TEST D: BASIC ARITHMETIC SKILLS — FORM O

ADVANCED BATTERY — GRADES 5-6-7-8-9

By

H. F. SPITZER, in collaboration with ERNEST HORN, MAUDE MCBROOM, H. A. GREENE, and E. F. LINDQUIST (General Editor), all of the College of Education, State University of Iowa, with the Assistance of the Faculty of the University Experimental Schools.

---

rections: The other side of this page is an *answer sheet* on which you will mark your answers to all of the questions in this st. To use this answer sheet, you will have to tear it off. Do this now, tearing very carefully along the perforation at the t-hand side of this page.

* * * * *

Each question in Part I of the test is followed by four possible answers, only one of which is correct or definitely better an any of the others. To answer a question, first decide which is the best answer, then look at the rows of boxes under rt I on the answer sheet and find the *row* of boxes numbered the same as the *question*. Then place an **X** in one of these ur boxes, as follows:

If you think the *first* answer is best, mark the *first* box in the row.

If you think the *second* answer is best, mark the *second* box in the row.

If you think the *third* answer is best, mark the *third* box in the row.

If you think the *fourth* answer is best, mark the *fourth* box in the row.

Mark only one box in each row. If you change your mind about an answer, erase your first mark very thoroughly.

Directions for Parts II and III of the Test will be given to you after you finish Part I.

Answer the questions in all parts of the test in the order in which they are given, but do not linger too long over difficult estions or problems. Skip them, and return to them later if time permits. If you do skip any questions, be sure to skip e corresponding boxes on the answer sheet also.

Do not begin work until you are told to do so.

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BOSTON · NEW YORK · CHICAGO · DALLAS · ATLANTA · SAN FRANCISCO

The Riverside Press Cambridge

PRINTED IN THE U.S.A.

ANSWER SHEET: ARITHMETIC TEST

Name _____ Grade _____
(Last Name) (First Name)

Age on Last Birthday _____ (Years) Number of Months Since Last Birthday _____ Sex _____ (Boy or Girl)

Town or City _____

School _____

Teacher _____ Date _____

SCORES

	Poss. Score	Raw Score	Grade Equivalent*
Part I	(40)		
Part II	(33)		
Part III	(31)		
Total	(104)		

*See page 10 in Examiner's Manual for Conversion Table for Form

PAGES 1-2. PART I

1		21	
2		22	
3		23	
4		24	
5		25	
6		26	
7		27	
8		28	
9		29	
10		30	
11		31	
12		32	
13		33	
14		34	
15		35	
16		36	
17		37	
18		38	
19		39	
20		40	

PAGES 3-4. PART II

Section A

Samples:

0	☐ 3	☒ 4	☐ 5	☐ N
00	☐ 2	☐ 4	☐ 5	☒ N
41	☐ 1916	☐ 2017	☐ 1918	☐ N
42	☐ 1086	☐ 186	☐ 86	☐ N
43	☐ 4340	☐ 42400	☐ 43500	☐ N
44	☐ $20\frac{3}{5}$	☐ $2\frac{8}{13}$	☐ 21	☐ N
45	☐ 130	☐ 129	☐ 132	☐ N
46	☐ 1751	☐ 1641	☐ 1741	☐ N
47	☐ 2437140	☐ 262740	☐ 2427140	☐ N
48	☐ $40\frac{8}{85}$	☐ 38	☐ 308	☐ N
49	☐ $\frac{7}{12}$	☐ $1\frac{1}{6}$	☐ $1\frac{1}{3}$	☐ N
50	☐ $36\frac{2}{3}$	☐ $36\frac{1}{3}$	☐ $37\frac{2}{3}$	☐ N
51	☐ $\frac{3}{5}$	☐ $\frac{2}{5}$	☐ $\frac{1}{3}$	☐ N
52	☐ $6\frac{3}{4}$	☐ 12	☐ 27	☐ N
53	☐ $12\frac{1}{2}$	☐ $13\frac{1}{3}$	☐ $12\frac{2}{3}$	☐ N
54	☐ $\frac{2}{3}$	☐ $1\frac{2}{3}$	☐ $1\frac{1}{3}$	☐ N
55	☐ 28	☐ 30	☐ 60	☐ N
56	☐ $\frac{2}{7}$	☐ 7	☐ $3\frac{1}{2}$	☐ N
57	☐ $8\frac{5}{24}$	☐ $8\frac{11}{24}$	☐ $8\frac{3}{8}$	☐ N
58	☐ $7\frac{17}{24}$	☐ $8\frac{2}{3}$	☐ $8\frac{17}{24}$	☐ N
59	☐ $\frac{1}{2}$	☐ $\frac{9}{16}$	☐ $\frac{3}{4}$	☐ N
60	☐ 10	☐ $15\frac{1}{2}$	☐ $5\frac{4}{5}$	☐ N
61	☐ $8\frac{3}{4}$	☐ $8\frac{1}{4}$	☐ $8\frac{3}{8}$	☐ N
62	☐ $2\frac{1}{4}$	☐ $1\frac{1}{4}$	☐ $2\frac{1}{2}$	☐ N
63	☐ $10\frac{1}{2}$	☐ $12\frac{3}{4}$	☐ 13	☐ N

Section B

64	☐ 792	☐ 782	☐ .792	☐ N
65	☐ 1.22	☐ 122	☐ 12200	☐ N
66	☐ 80	☐ 20	☐ 8000	☐ N
67	☐ 80	☐ 800	☐ 25	☐ N
68	☐ $500	☐ $50	☐ $100	☐ N
69	☐ $\frac{3}{4}$%	☐ 25%	☐ 75%	☐ N
70	☐ $\frac{495}{1000}$	☐ 49.5%	☐ 4.95%	☐ N
71	☐ $\frac{76}{100}$	☐ .076	☐ .76	☐ N
72	☐ .9	☐ $\frac{9}{10}$	☐ $\frac{9}{100}$	☐ N
73	☐ $44.63	☐ $44.60	☐ $4463.00	☐ N

PAGES 5-6. PART III

74	☐ 41	☐ 52	☐ 111	☐ N
75	☐ 108	☐ 110	☐ 112	☐ N
76	☐ 6	☐ 7	☐ 8	☐ N
77	☐ 2	☐ 4	☐ 5	☐ N
78	☐ 74	☐ 84	☐ 147	☐ N
79	☐ 47	☐ 49	☐ 52	☐ N
80	☐ $1.36	☐ $1.62	☐ $1.72	☐ N
81	☐ $.40	☐ $4.00	☐ $6.00	☐ N
82	☐ 40%	☐ 50%	☐ 60%	☐ N
83	☐ $7\frac{1}{2}$¢	☐ 11¢	☐ $12\frac{1}{2}$¢	☐ N
84	☐ 3	☐ 60	☐ 120	☐ N
85	☐ 12	☐ 20	☐ 32	☐ N
86	☐ 2,500 tons	☐ 3,000 tons	☐ 6,000 tons	☐ 50,000 tons
87	☐ 3 times	☐ 4 times	☐ 5 times	☐ 6 times
88	☐ 105 per cent	☐ one-half	☐ two-thirds	☐ three-fo
89	☐ one-third	☐ one-fifth	☐ one-tenth	☐ three-fo
90	☐ 6 hours	☐ $7\frac{1}{2}$ hours	☐ $8\frac{1}{2}$ hours	☐ 9 hours
91	☐ 40 miles	☐ 47 miles	☐ 50 miles	☐ N
92	☐ 3 miles	☐ 6 miles	☐ 7 miles	☐ 10 mile
93	☐ 15%	☐ 40%	☐ 55%	☐
94	☐ $132,000	☐ $1,300,000	☐ $1,320,000	☐ N
95	☐ 7 miles	☐ 20 miles	☐ 91 miles	☐ N
96	☐ 96	☐ 97	☐ 99	☐
97	☐ 51 sq. mi.	☐ 120 sq. mi.	☐ 240 sq. mi.	☐ 480 sq.
98	☐ 108 sq. ft.	☐ 680 sq. ft.	☐ 720 sq. ft.	☐ N
99	☐ 9 feet	☐ 108 feet	☐ 20 feet	☐ N
100	☐ $129.20	☐ $387.60	☐ $1162.80	☐ N
101	☐ $\frac{1}{18}$	☐ $\frac{1}{10}$	☐ $\frac{1}{8}$	☐
102	☐ None	☐ $1.50	☐ $.50	☐ N
103	☐ $185	☐ $260	☐ $285	☐
104	☐ $9	☐ $15	☐ $18	☐

pil's Name.....

PART I

VOCABULARY AND FUNDAMENTAL KNOWLEDGE

rections: After each question in this part of the test ere are four possible answers, only one of which is rect or definitely better than the others. Decide ich is the best answer and then place an **X** in the per box on the answer sheet.

75 minutes is how many hours?
1) $\frac{3}{4}$ 2) $1\frac{1}{4}$ 3) $1\frac{1}{2}$ 4) $2\frac{1}{2}$

How should two hundred twenty-two and thirteen thousandths be written?
1) 20022.13
2) 222 13000
3) 222.13000
4) 222.013

About how high is an average dining table?
1) $2\frac{1}{2}$ feet.
2) $3\frac{1}{2}$ feet.
3) 4 feet.
4) 5 feet.

Which of these represents the largest value?
1) .6 2) .400 3) .3841 4) .0893

Which of these is used in measuring an angle?
1) Meters.
2) Cubic feet.
3) Degrees.
4) Centimeters.

Two and a half hours after midnight would be what time?
1) 12 A.M.
2) 2:30 P.M.
3) 9:30 P.M.
4) 2:30 A.M.

How should 5″ be read?
1) Five feet.
2) Five degrees.
3) Five inches.
4) Five hours.

Which of these fractions is the largest?
1) $\frac{5}{12}$ 2) $\frac{11}{18}$ 3) $\frac{12}{25}$ 4) $\frac{1}{3}$

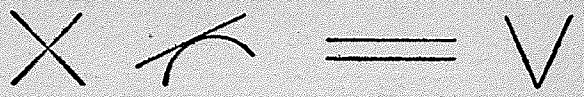
How many square feet are there in a square yard?
1) 3 2) 4 3) 6 4) 9

How many faces or sides does a cube have?
1) 4 2) 6 3) 8 4) 12

How would you read 100.001?
1) One hundred and one.
2) One hundred and one-tenth.
3) One hundred and one-hundredth.
4) One hundred and one-thousandth.

A ton of coal is about equal in weight to how many men?
1) 4 2) 9 3) 13 4) 20

13. In which of these figures is there a horizontal line?



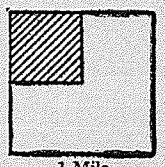
1) 2) 3) 4)

14. In which of the figures above do the lines form a right angle?
1) 1 2) 2 3) 3 4) 4

15. How many digits are used in writing the number four hundred twenty thousand seven?
1) 3 2) 5 3) 6 4) 9

16. About how many acres are in the shaded area in this diagram?

1) About $\frac{1}{4}$.
2) About 16.
3) About 160.
4) About 320.



17. How many $\frac{1}{6}$'s are in $\frac{2}{3}$?
1) Less than one.
2) 2
3) 3
4) 4

18. A tree 24 feet high is about how many times as high as a tall man?
1) 2 2) 3 3) 4 4) 6

19. Which of the following represents the largest quantity?
1) M 2) C 3) XL 4) XII

20. Why do we write the zero in 3.05?
1) Because arithmetic books say we should.
2) Because it holds the tenths place and shows that the 5 means 5 one-hundredths.
3) Because it shows that there are no fractions in the number.
4) Because the tenths place is always a zero when there are hundredths in a number.

21. 1000 B.C. is about how many years ago?
1) 1000 2) 940 3) 1940 4) 2940

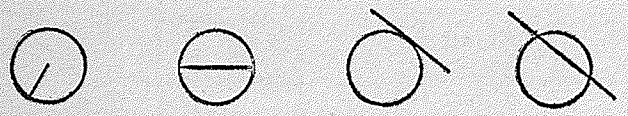
22. In looking at three groups of calves, one man said, "There are 6 in the first group, 6 in the second, and 8 in the third." A second man said, "There are 20 calves." If you only wanted to know how many calves there were, why was the second man's answer best?
1) Because it is easier to think of one group of 20 than of three groups of 6, 6, and 8.
2) Because 20 tells you how many calves there were.
3) Because 20 does not leave out any of the calves.
4) Because the first man did not tell how many calves there were.

(Go on to the next page.)

23. Which is equal to 4%?
1) $\frac{4}{10}$ 2) $\frac{1}{4}$ 3) $\frac{4}{100}$ 4) .40

24. In telling how long a certain bridge is, four children gave the following answers. Each answer is correct, but one is better than any other. Which is best?
1) About three times the distance across the school lawn.
2) About 40 times the length of this room.
3) About 12 times as far as the distance around the school room.
4) A person can run across it in about 2 minutes.

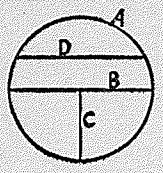
25. Which of these shows a diameter?



1) 2) 3) 4)

26. The length of the air field runway is 1800 feet. How many miles is this?
1) Less than half a mile. 3) 1 mile.
2) $\frac{1}{2}$ mile. 4) 2 miles.

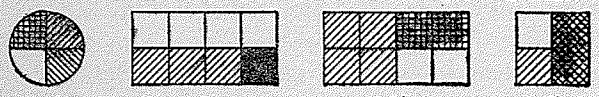
27. Which line is the circumference of the circle?
1) A
2) B
3) C
4) D



28. In which number does the 3 represent hundreds?
1) 431 2) 3826 3) 5319 4) 300000

29. In the number 555, how does the first 5 compare in value with the last 5?
1) It is the same.
2) It is twice as great.
3) It is 10 times as great.
4) It is 100 times as great.

30. Which of these figures shows what $\frac{1}{4} \times \frac{1}{2}$ equals?



1) 2) 3) 4)

31. In the word "eighty-one," what does the "ty" mean?
1) It is used to make the word sound rhythmical.
2) It means tens.
3) It means to add 80 and 1 together.
4) It means less than nine and more than eight.

32. What is the perimeter of a rectangle?
1) The distance around it.
2) Its area.
3) The distance from one corner to the opposite corner.
4) One-half the base times the altitude.

33. The population of city A is 161,832; that of city B is 43,126. What is the best way of expressing the relationship between the two populations?
1) A has 118,706 more people than B.
2) A is many times larger than B.
3) A is about four times as large as B.
4) A is about six times as large as B.

34. In what units would the volume of a box be given?
1) In centimeters.
2) In square inches.
3) In degrees.
4) In cubic inches.

35. In which of these situations would π be used? ($\pi = 3.14$)
1) In finding the thickness of a tree.
2) In finding the area of a triangle.
3) In finding the perimeter of a hexagon.
4) In finding the volume of a cube.

36. Which of these is a measure of area?
1) An acre. 3) A peck.
2) A rod. 4) A cubic foot.

37. In the last election, candidate A beat candidate B "two to one." If A received about 15,000 votes, approximately how many votes did B receive?
1) 7,500 3) 30,000
2) 10,000 4) 45,000

38. About how long would it take an eighth grade boy walking at a fast rate to walk a mile?
1) 5 minutes. 3) $\frac{1}{2}$ hour.
2) 15 minutes. 4) 1 hour.

39. If a farmer asks for the capacity of a grain bin, what units of measurement should a salesman use in answering?
1) Gallons. 3) Bushels.
2) Cubic feet. 4) Tons.

40. About how many 850-pound steers can be hauled in a truck with a load limit of 5 tons?
1) 6 2) 11 3) 16 4) 20

(Do not turn to the next page until you are told to do so.)

PART II

SECTION A: WHOLE NUMBERS AND FRACTIONS

ctions: In this section are a number of examples which you are to solve. On the answer sheet, after the num- f each example, you will find three possible answers and an N. The N means that the correct answer for the ıple is not given on the answer sheet.

ou are to do your work right on this page. First solve the example. Then turn to the answer sheet and find umber of that example. Compare your answer with those given on the answer sheet. If one of the three ers given is exactly like your own, place an **X** in the box in front of it. If none of the three answers given is ours, place an **X** in the box in front of the N. Do not rework a problem simply because your answer is not ıny of those given on the answer sheet. Instead, mark the box in front of the N and go on to the next ex- e.

educe all fractions to *simplest* form.

ıe two sample items have been marked correctly on the answer sheet.

ıple 0 Add

$$\begin{array}{r} 2 \\ 2 \\ \hline 4 \end{array}$$

ıple 00 Subtract

$$\begin{array}{r} 9 \\ 3 \\ \hline 6 \end{array}$$

Add

$$\begin{array}{r} 706 \\ 394 \\ 817 \\ \hline \end{array}$$

Subtract

$$\begin{array}{r} 3005 \\ 2919 \\ \hline \end{array}$$

Multiply

$$\begin{array}{r} 217 \\ 200 \\ \hline \end{array}$$

44 Divide

$$52\overline{)1072}$$

45 Add

$$\begin{array}{r} 4 \\ 16 \\ 20 \\ 7 \\ 15 \\ 9 \\ 30 \\ 31 \\ \hline \end{array}$$

46 Subtract

$$\begin{array}{r} 4736 \\ 2089 \\ \hline \end{array}$$

47 Multiply

$$\begin{array}{r} 3020 \\ 807 \\ \hline \end{array}$$

48 Divide

$$85\overline{)3230}$$

49 Add

$$\frac{5}{6} + \frac{2}{6} =$$

50 Subtract

$$\begin{array}{r} 42 \\ 5\frac{1}{3} \\ \hline \end{array}$$

51 Multiply

$$\frac{2}{3} \times \frac{1}{2} =$$

52 Divide

$$9 \div \frac{3}{4} =$$

53 Add

$$\begin{array}{r} 5\frac{5}{6} \\ 7\frac{2}{3} \\ \hline \end{array}$$

hen you have finished exercise 53 go on to the next page and work the exercises 54 through 63. Do not do Section B until told to do so.)

54 Subtract

$8\frac{1}{3}$

$7\frac{2}{3}$

---

55 Multiply

$12 \times 2\frac{1}{3} =$

56 Divide

$\frac{7}{12} \div \frac{1}{6} =$

57 Add

$3\frac{2}{3}$

$\frac{1}{8}$

$4\frac{2}{3}$

---

58 Subtract

$13\frac{7}{8}$

$5\frac{1}{6}$

---

59 Multiply

$\frac{2}{3} \times 1\frac{1}{2} \times \frac{3}{4} =$

60 Divide

$6\frac{1}{5} \div \frac{2}{5} =$

61 Subtract

$10\frac{5}{8}$

$1\frac{7}{8}$

---

62 Subtract

31

$29\frac{3}{4}$

---

63 Divide

$8\frac{1}{2} \div \frac{2}{3} =$

(Do not work Section B until told to do so

SECTION B: PERCENTAGE AND DECIMALS

Directions: Do your work on this page if there is room; otherwise, use scratch paper. Mark the proper box answer sheet as you did in Section A.

64 Multiply .66 by .12.

65 Divide 244 by .02.

66 What is 20% of 400?

67 16 is 50% of what number?

68 What is 200% of $250?

69 Change $\frac{3}{4}$ to per cent form.

70 Change .495 to per cent form.

71 Change 76% to decimal form.

72 Change 90% to a common fraction and reduce it to its lowest terms.

73 What is 5% of $892.60?

(Do not turn to the next page until you are told to

PART III. PROBLEMS

ections: Read each problem carefully. Do your
k on scratch paper. Compare your answer with
se given on the answer sheet and mark the proper
, as you did in Part II.
n some problems, you are asked to give only an *ap-*
ximate answer. For these particular problems, no
given on the answer sheet, but you are to mark the
in front of the answer that is *most nearly* like your
.

---

t the beginning of the year, there were 13 girls and
oys in the third grade, 15 girls and 12 boys in the
th grade, 11 girls and 16 boys in the fifth grade,
13 girls and 13 boys in the sixth grade of the Jack-
School.

How many girls were in the four grades?

How many more boys than girls were there in all four grades?

At the end of the year, there were 34 children in the fifth grade. How many more children were in the fifth grade at the end of the year than at the beginning?

The absences in the fifth grade during one week were as follows: Monday 3, Tuesday 0, Wednesday 5, Thursday 2, Friday 5. What was the average number of absences for each day?

---

n an automobile trip with his father, Tom kept a
rd of the speedometer readings as they drove
g. At home it read 9209; at Salem the reading was
'; at Vale City, 9291 miles; and at Greenville,
miles.

How far was it from Salem to Vale City?

If it took 3 hours to make the trip from home to Greenville, how many miles per hour did they travel?

Before he started, Tom's father bought 8 gallons of gasoline at 17¢ per gallon and a quart of oil at 36¢ per quart. What was his bill?

---

he Girls' Club sold Christmas cards at $1.00 per
The cards cost them 60¢ per box.

How much profit did they make on each box of cards they sold?

82 Their profit was what per cent of the selling price?

---

83 How much would it cost to send a letter weighing $2\frac{1}{2}$ ounces to Australia if postal rates are 5¢ for the first ounce and 3¢ for each additional ounce or fraction of an ounce?

84 How many tons of coal can be stored in a bin 4 feet wide, 10 feet long, and 3 feet deep? (Coal weighs about 50 pounds per cu. ft.)

85 The seventh grade planned to take a trip to an Indian reservation. The teacher said, "Mr. Brown is taking 5 of the children in his car, and I can take 3. That means we have rides for one-fourth of the class." How many children were in the seventh grade?

86 Ship A is rated as of 12,480 tons. If ship B is about one-fourth as large, what is its tonnage? (Note that in this problem no *exact* relationship is stated. Therefore, your answer will be only an approximation.)

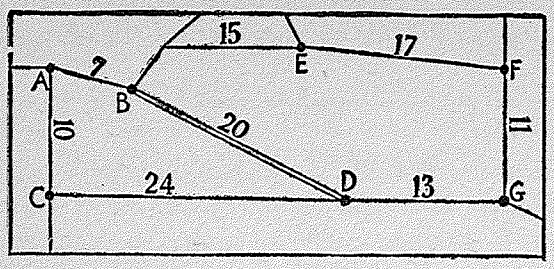
87 A certain airplane has a top speed of 435 miles per hour. The airplane is how many times as fast as an automobile which has a top speed of 90 miles per hour? (Only an *approximate* answer is required.)

88 If a man plants 105 of his 160 acres in corn, about what part of his farm does he plant in corn? (Only an *approximate* answer is required.)

89 A dress in a store window has these two prices marked on it: "Was $12.98 — Now $10.25." The amount that the dress was reduced is what part of the original price? (Only an *approximate* answer is required.)

90 John is waiting for a train that is scheduled to arrive at 9:35 A.M. but has been marked 8 hours late. John looks at his watch and sees that it is 9:00 A.M. About how much longer must he wait for the train? (Only an *approximate* answer is required.)

(Go on to the next page.)



This is a section of a road map. The numbers between points indicate the number of miles between those points. The solid line indicates paved road. The double line indicates gravel road.

91 What is the shortest road distance from A to G?

92 In going from D to A, how many miles farther is it to go the all paved road than to go over part that is gravel?

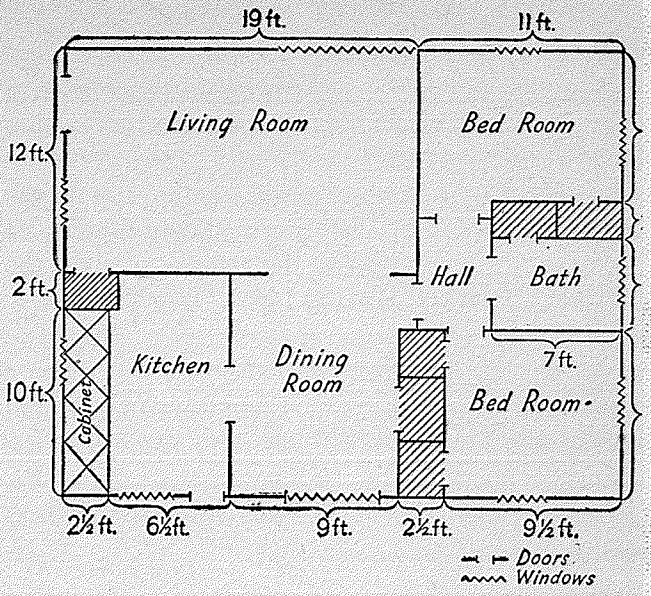
93 About what per cent of the most direct road from B to G is paved? (Only an *approximate* answer is required.)

94 If the cost of building a paved road is $55,000 per mile, what was the total cost of the road from C to D?

95 If the cost of building a gravel road is only $6,000 per mile, how many miles of gravel road can be built for the same amount of money that one mile of paved road costs ($55,000)?

96 On an auto trip, Mr. Brown goes from C to F by way of G. He returns by way of A. How many miles did he drive on the trip?

97 What is the approximate area in square miles of the region enclosed by the road from A to C to D and then back to A by way of B?



This is a simplified floor plan of a house. (You n consider the dimensions given as the inside dim sions of the room, and you need pay no attentior the thickness of walls and partitions.) The sha areas represent space used for closets. Problem to 104 are based on this diagram.

98 What is the total area of this floor plan?

99 The kitchen floor and cabinet top are to be c ered with linoleum which comes only in 6-f widths. How many feet of this 6-foot wi material should be purchased?

100 The floor carpeting for the living room of house costs $5.10 a square yard. What be the cost of this carpeting?

101 About what fraction of the total area is use closets? (Only an *approximate* answer requir

102 The builder of this house thought that the e mate on the cost of doors was too high. contractor pointed out that outside doors w $15 each, standard interior doors were $ each, and closet doors were $3.00. The e mate for doors was $70.00. How much *too l* was this estimate?

103 If the large living room and dining room w dows together cost $85.00 and the other w dows cost $25.00 per unit, what was the cos windows in this house?

104 The loan on this house is $5,000, on which owner pays $30.00 per month. If the rat interest is 5%, what is the approximate amo of the principal that is paid the first mon (Only an *approximate* answer is required.)

(Turn your booklet over and wait until the papers are collect

APPENDIX D

Raw Scores for Boys and Girls on All Tests

TABLE II

RAW SCORES FOR BOYS ON ALL TESTS

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	54	68	26	58	84	49	29	89	47	42	28	58	22	7	59
2	84	79	27	70	78	61	33	85	41	32	35	58	27	5	50
3	57	67	31	78	52	71	35	107	30	53	30	35	25	7	42
4	56	70	18	58	79	56	23	89	45	32	20	69	31	5	55
5	97	82	13	67	71	62	28	84	44	36	25	58	23	7	39
6	59	68	11	79	75	63	28	87	45	36	26	61	21	8	43
7	55	50	32	69	83	54	26	107	39	39	37	48	24	8	30
8	51	65	31	85	94	68	28	84	43	49	63	40	22	4	64
9	36	76	25	67	78	50	29	83	42	35	81	36	20	5	47
10	57	53	24	69	74	77	28	107	0	34	26	49	32	4	30
11	58	85	10	63	73	68	26	83	49	22	37	67	24	1	51
12	78	72	32	73	93	52	31	105	42	45	51	81	30	9	43
13	50	47	23	78	70	77	25	114	31	53	24	70	23	5	53
14	73	62	23	72	84	68	31	86	41	41	44	65	27	4	35
15	76	74	22	65	85	62	29	84	16	37	34	66	25	6	35
16	66	49	31	74	87	79	38	89	33	23	29	18	22	9	45
17	65	62	11	76	70	56	32	84	23	46	48	84	22	9	61
18	128	78	16	73	85	62	31	102	60	46	0	70	25	3	57
19	70	72	21	71	77	40	36	93	17	43	33	67	22	5	44
20	63	75	19	84	84	52	26	95	68	44	31	44	24	8	70
21	49	77	11	48	81	59	27	99	63	41	27	66	28	6	54
22	64	76	21	69	67	50	25	124	34	43	39	58	33	6	69
23	50	80	22	78	99	66	28	109	59	52	34	53	32	3	65
24	63	65	22	67	85	79	37	84	36	44	11	61	26	2	59
25	62	75	17	65	79	50	36	75	45	30	19	74	16	5	41
26	59	72	27	87	38	46	30	103	68	45	60	47	29	3	63
27	67	77	23	65	62	59	27	111	59	54	24	65	32	5	59
28	77	47	39	84	91	73	34	95	28	55	36	49	20	1	46
29	51	75	21	50	81	37	31	100	41	50	59	62	30	11	63
30	52	65	17	60	57	57	28	113	58	57	66	101	35	7	68
31	83	74	24	67	83	52	38	115	67	58	55	86	38	8	80
32	73	69	18	89	69	51	35	104	21	45	19	48	22	7	44
33	67	83	20	68	80	40	27	91	67	41	17	45	28	7	60
34	72	72	32	67	89	71	38	115	38	56	51	80	35	8	73
35	54	67	21	57	66	60	30	99	26	43	14	32	27	7	54
36	52	73	27	72	87	40	27	109	55	37	50	77	35	4	67
37	48	48	24	85	88	82	33	121	43	56	65	37	47	8	90
38	68	66	25	70	85	44	26	107	16	34	41	59	30	7	49
39	42	50	32	65	87	76	31	104	56	58	48	36	35	6	67
40	39	54	26	67	65	54	31	110	75	38	64	40	38	9	70
41	134	81	22	60	80	53	29	88	56	40	38	33	24	10	48
42	49	24	32	68	90	77	36	114	31	53	30	40	36	2	71
43	73	74	21	76	87	57	37	79	31	33	16	29	34	11	52
44	107	74	18	69	58	46	32	105	53	34	2	56	28	8	66

TABLE II -- Continued

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
45	94	80	25	55	65	74	26	91	54	39	30	52	21	10	67
46	82	69	26	60	81	53	28	100	78	31	19	32	28	10	66
47	36	67	26	71	81	69	19	98	66	37	47	77	42	6	73
48	90	75	22	73	75	74	23	109	33	38	67	29	29	2	68
49	71	45	21	48	69	63	31	115	22	48	40	26	28	9	61
50	54	68	24	71	85	50	37	114	84	48	55	43	21	8	77
51	44	68	17	60	85	48	21	99	76	31	35	36	27	13	71
52	100	65	26	76	81	58	27	104	41	45	52	58	30	9	58
53	122	68	16	54	84	49	33	98	44	31	20	40	28	7	78
54	69	68	22	69	88	48	28	122	36	77	70	58	35	9	82
55	87	75	21	65	90	73	33	114	34	42	44	62	25	20	60
56	79	82	19	68	78	56	36	110	55	48	62	47	31	6	71
57	84	51	29	72	85	78	33	110	31	49	60	56	35	6	67
58	44	62	29	69	87	67	32	110	59	63	46	57	34	5	64
59	40	74	26	78	78	62	26	99	67	31	45	64	28	5	57
60	352	81	16	67	58	48	25	121	35	47	36	66	36	12	71
61	56	72	19	70	92	47	36	111	24	30	35	39	24	1	47
62	108	76	9	62	80	53	29	96	66	48	34	50	26	8	51
63	66	59	18	76	88	74	31	92	82	50	7	58	25	3	40
64	68	62	20	69	86	74	32	136	22	59	53	42	33	6	62
65	55	44	29	69	87	73	24	120	33	55	32	46	25	5	68
66	101	42	28	64	62	62	30	114	32	49	41	52	30	4	68
67	51	77	24	55	84	49	28	72	90	42	34	55	28	9	57
68	49	58	22	74	92	77	29	102	53	43	76	38	31	6	85
69	59	60	30	58	74	60	27	118	53	48	18	49	28	5	72
70	41	53	32	56	88	74	30	103	51	35	41	66	36	6	55
71	41	64	32	75	86	69	29	96	34	44	39	22	19	0	42
72	32	20	36	84	82	74	32	125	35	82	48	50	26	13	63
73	48	78	18	65	83	55	29	106	83	37	43	56	25	2	67
74	57	78	23	66	80	51	27	89	55	45	7	35	25	6	54
75	50	34	43	80	91	78	34	115	99	53	45	68	31	15	75
76	102	75	28	51	73	47	32	98	30	43	15	46	21	6	36
77	57	36	40	85	86	83	34	121	85	46	48	77	41	2	79
78	125	32	44	82	91	79	29	114	39	57	42	54	22	5	71
79	86	69	29	69	80	55	38	90	45	31	32	43	14	4	42
80	68	63	34	66	77	71	36	101	29	44	16	38	30	4	60
81	95	44	34	72	89	82	28	96	48	52	45	49	14	4	33
82	61	58	34	82	72	72	32	109	49	58	54	47	25	7	69
83	366	69	21	58	62	61	26	70	6	43	46	33	16	3	25
84	56	77	15	68	77	54	26	107	71	46	46	61	29	10	52
85	46	70	25	66	52	74	27	93	31	52	46	59	35	3	59
86	52	73	28	74	63	62	30	99	71	41	0	49	22	5	57
87	62	55	39	46	86	67	37	101	29	44	16	48	28	2	49
88	45	66	13	68	60	58	28	88	26	46	15	49	25	6	42
89	86	82	22	57	83	44	34	98	55	51	5	71	22	7	35
90	75	76	20	54	77	54	33	82	30	45	19	62	22	6	48

TABLE II -- Continued

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
91	57	51	31	75	48	47	28	82	67	35	18	54	21	7	51
92	65	73	28	79	72	60	26	111	43	37	25	25	16	5	52
93	53	82	21	42	84	55	25	97	46	45	9	34	32	4	57
94	51	48	30	81	95	66	28	119	116	62	71	65	40	7	80
95	62	79	20	69	66	44	21	104	96	38	28	25	27	5	60
96	51	63	28	78	77	74	35	108	83	51	5	53	38	7	68
97	63	54	28	53	64	64	32	99	89	45	8	45	22	7	55
98	81	39	41	71	71	82	30	109	19	53	0	48	25	6	51
99	102	65	21	58	91	71	37	78	80	58	3	55	37	5	71
100	42	65	21	57	73	59	35	114	44	38	24	55	27	4	60
101	38	68	25	58	75	56	28	90	56	45	10	48	27	8	63
102	133	73	25	47	61	57	26	98	64	48	37	43	21	2	51
103	80	61	22	53	62	60	29	108	19	52	6	50	30	4	61
104	68	68	25	74	44	57	24	88	55	45	9	47	27	5	49
105	72	52	21	81	77	44	26	119	53	77	47	48	26	10	78

Key

A = Drake Rhythm
B = Drake Memory
C = Seashore Memory
D = Seashore Time
E = Seashore Intensity
F = Seashore Pitch
G = Seashore Consonance
H = Dominion IQ
I = Chicago Number
J = Chicago Verbal Meaning
K = Chicago Space
L = Chicago Word Fluency
M = Chicago Reasoning
N = Chicago Memory
O = Iowa Mathematics

TABLE III

RAW SCORES FOR GIRLS ON ALL TESTS

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	54	63	22	76	65	43	32	77	57	26	35	57	22	4	36
2	28	53	28	78	83	45	28	104	52	52	41	51	34	6	60
3	39	66	18	64	70	47	27	80	57	36	17	58	26	4	42
4	65	68	21	71	77	40	36	97	20	43	33	45	27	5	52
5	44	55	37	78	69	45	32	79	32	50	22	34	30	8	40
6	96	58	24	48	71	58	29	85	28	50	72	65	39	7	22
7	48	76	12	65	55	58	27	75	17	45	42	57	24	9	43
8	51	63	29	71	76	52	31	106	47	43	20	54	35	6	54
9	56	56	10	76	93	54	31	105	50	51	11	49	29	2	55
10	86	65	28	73	87	55	35	71	66	48	12	46	28	14	50
11	64	65	18	65	84	54	30	81	29	43	59	44	30	5	44
12	39	64	17	67	97	43	30	109	59	41	33	50	34	7	65
13	58	50	27	60	89	49	32	93	29	40	32	43	21	8	52
14	58	57	26	73	89	46	27	110	59	53	29	68	36	4	49
15	102	82	15	59	76	58	22	91	44	52	14	23	19	11	57
16	92	61	24	56	80	49	32	114	23	36	32	59	27	8	49
17	57	56	34	67	82	52	32	114	95	70	7	48	39	5	52
18	87	76	26	58	82	51	27	106	34	53	0	69	34	5	53
19	70	77	18	76	78	54	28	74	54	33	19	48	26	5	44
20	69	51	21	56	87	52	29	120	28	66	40	80	28	10	58
21	78	51	23	56	68	50	32	81	23	29	26	42	21	7	31
22	119	74	17	60	75	52	27	103	48	52	37	48	23	15	47
23	44	39	29	71	84	61	35	116	82	55	32	50	43	10	80
24	86	61	23	63	80	55	25	97	38	42	46	52	38	8	64
25	79	68	19	71	84	57	37	87	51	45	23	45	37	6	63
26	57	66	24	64	75	52	30	80	40	38	3	24	29	4	59
27	54	31	34	67	92	52	32	101	40	32	28	59	27	8	57
28	62	55	19	77	57	54	21	99	5	52	7	48	32	4	33
29	71	79	18	68	75	45	28	79	53	49	0	91	22	6	55
30	118	80	17	75	15	45	37	104	56	49	15	63	21	9	46
31	91	81	10	77	75	53	30	111	57	61	43	49	28	11	55
32	80	76	27	78	61	49	33	91	62	35	24	62	42	9	69
33	46	46	26	79	88	59	34	82	48	25	0	47	20	10	47
34	33	61	31	66	83	57	25	102	71	39	36	35	31	12	63
35	42	83	14	77	95	69	30	93	61	24	43	45	34	11	59
36	113	77	16	61	60	44	34	102	26	25	22	26	25	6	45
37	55	42	36	63	82	87	30	99	44	26	17	33	30	10	50
38	54	59	19	74	63	70	30	89	62	33	33	55	37	15	58
39	47	40	31	85	88	70	30	110	82	48	38	44	44	9	74
40	81	52	20	74	87	66	32	120	37	53	37	51	45	13	70
41	143	43	27	75	86	65	29	113	30	69	31	58	49	8	68
42	45	46	30	66	73	66	32	104	92	47	29	70	46	10	54
43	66	66	23	68	81	57	37	117	41	45	0	46	51	5	66
44	57	63	35	69	77	80	31	113	55	45	6	44	35	10	61

TABLE III -- Continued

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
45	29	34	32	79	92	74	38	115	30	57	30	63	44	14	61
46	71	79	14	59	79	39	32	78	28	27	0	44	16	5	40
47	65	67	24	52	79	56	32	107	41	43	14	59	33	8	54
48	61	79	23	58	60	41	30	68	57	21	0	36	13	8	44
49	49	48	22	63	67	65	27	110	91	49	16	64	27	4	69
50	61	62	26	64	77	62	30	115	61	58	48	83	37	4	65
51	71	53	19	67	75	51	27	113	71	51	52	53	43	9	71
52	81	73	20	53	54	43	24	88	24	35	23	42	26	7	37
53	101	59	17	49	47	44	30	92	15	44	11	42	34	3	52
54	57	53	38	84	92	75	38	107	61	28	26	71	31	11	66
55	30	43	34	75	80	70	30	117	66	51	40	68	41	11	69
56	81	71	22	75	87	66	31	97	43	36	40	43	31	2	50
57	119	72	21	65	74	66	27	106	32	28	15	43	25	7	50
58	236	84	23	60	77	49	27	70	47	27	6	45	18	5	38
59	195	66	23	59	71	55	24	83	54	36	15	45	14	4	41
60	60	50	27	70	90	77	30	120	63	71	43	98	44	10	91
61	62	75	18	69	72	53	30	116	115	68	68	71	42	5	79
62	181	59	13	73	86	58	34	85	55	18	0	40	2	11	55
63	53	86	18	69	85	64	33	83	29	30	4	48	31	5	41
64	79	45	9	67	79	50	29	83	55	20	5	45	13	5	53
65	90	72	23	74	84	62	30	101	48	26	53	45	35	7	38
66	38	43	31	75	83	56	35	115	47	58	39	58	25	8	68
67	30	31	36	62	84	77	29	117	51	43	20	90	29	6	67
68	58	74	36	66	69	64	31	88	37	50	43	57	23	6	63
69	45	61	27	74	74	63	33	108	46	61	29	51	36	7	56
70	67	71	28	75	93	56	26	90	31	37	9	43	33	9	47
71	45	38	34	54	94	76	34	102	41	61	56	61	32	10	68
72	68	66	20	60	82	58	27	87	38	34	16	45	29	3	49
73	100	77	25	62	92	55	26	98	49	50	46	48	26	6	50
74	43	50	32	75	85	78	28	116	77	58	42	75	40	13	67
75	70	68	33	65	81	55	24	89	45	35	32	59	20	9	43
76	158	93	14	77	70	54	24	84	45	29	30	43	17	6	44
77	46	50	33	65	87	70	28	127	54	59	38	72	38	6	59
78	92	72	28	71	79	58	24	113	22	43	47	56	29	8	58
79	110	71	27	70	85	48	33	78	6	43	56	50	22	3	33
80	40	54	28	70	83	64	29	101	33	44	45	64	27	4	45
81	69	76	13	62	92	46	32	112	37	34	42	56	30	7	61
82	60	73	18	73	94	55	25	108	83	49	4	46	33	12	57
83	44	53	27	74	95	85	29	125	58	81	41	70	27	13	82
84	103	63	30	69	87	54	29	111	56	44	0	68	28	4	63
85	70	82	26	70	52	55	30	76	33	26	0	69	19	16	62
86	49	42	24	75	76	70	28	79	34	48	46	65	39	5	68
87	70	75	26	67	92	54	25	93	27	48	22	63	22	8	52
88	75	56	27	55	89	58	32	87	49	48	29	31	25	10	60
89	71	71	38	82	85	74	29	83	64	44	4	42	29	7	43
90	124	53	28	74	85	78	27	108	40	71	41	59	37	6	72

TABLE III -- Continued

Pupil	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
91	73	71	25	80	89	51	28	96	28	51	27	57	35	8	55
92	92	72	22	63	81	55	26	81	31	37	0	34	19	5	53
93	77	41	32	60	90	68	24	102	37	55	37	74	29	5	48
94	93	61	29	78	96	88	31	102	72	50	20	43	30	13	46
95	69	63	27	64	79	84	29	108	52	44	21	60	29	5	70
96	101	48	25	69	85	86	27	102	41	56	32	44	27	7	65
97	57	52	33	76	80	77	25	96	30	42	20	31	34	11	50
98	73	66	30	75	93	60	28	83	42	27	19	39	27	14	47
99	100	55	21	62	78	53	28	90	40	39	9	66	35	13	48
100	42	40	44	81	86	80	37	98	29	53	29	57	35	8	48

Key

A = Drake Rhythm
B = Drake Memory
C = Seashore Memory
D = Seashore Time
E = Seashore Intensity
F = Seashore Pitch
G = Seashore Consonance
H = Dominion IQ
I = Chicago Number
J = Chicago Verbal Meaning
K = Chicago Space
L = Chicago Word Fluency
M = Chicago Reasoning
N = Chicago Memory
O = Iowa Mathematics

APPENDIX E

Raw Scores of Boys and Girls for t-Test

TABLE IV

RAW SCORES OF BOYS FOR t-TEST

Pupil	A	B	C	D	E	F	G	H	M	N	O
1	66	49	31	74	87	79	38	89	22	9	45
2	65	62	11	76	70	56	32	84	22	9	61
3	36	76	25	67	78	50	29	83	20	5	47
4	51	65	31	85	94	68	28	84	22	4	64
5	97	82	13	67	71	62	28	84	23	7	39
6	76	74	22	65	85	62	29	84	25	6	35
7	55	50	32	69	83	54	26	107	24	8	30
8	128	78	16	73	85	62	31	102	25	3	57
9	64	76	21	69	67	50	25	124	33	6	69
10	59	72	27	87	38	46	30	103	29	3	63
11	73	69	18	89	69	51	35	104	22	7	44
12	63	75	19	84	84	52	26	95	24	8	70
13	52	65	17	60	57	57	28	113	35	7	68
14	68	66	25	70	85	44	26	107	30	7	49
15	122	68	16	54	84	49	33	98	28	7	78
16	42	50	32	65	87	76	31	104	35	6	67
17	73	74	21	76	87	57	37	79	34	11	52
18	107	74	18	69	58	46	32	105	28	8	66
19	49	24	32	68	90	77	36	114	36	2	71
20	87	75	21	65	90	73	33	114	25	20	60
21	48	48	24	85	88	82	33	121	47	8	90
22	94	80	25	55	65	74	26	91	21	10	67
23	66	59	18	76	88	74	31	92	25	3	40
24	84	51	29	72	85	78	33	110	35	6	67
25	56	72	19	70	92	47	36	111	24	1	47
26	51	77	24	55	84	49	28	72	28	9	57
27	68	62	20	69	86	74	32	136	33	6	62
28	62	55	39	46	86	67	37	101	28	2	49
29	68	63	34	66	77	71	36	101	30	4	60
30	71	45	21	48	69	63	31	115	28	9	61
31	32	20	36	84	82	74	32	125	26	13	63
32	45	66	13	68	60	58	28	88	25	6	42
33	366	69	21	58	62	61	26	70	16	3	25
34	80	61	22	53	62	60	29	108	30	4	61
35	51	63	28	78	77	74	35	108	38	7	68

Key

A = Drake Rhythm
B = Drake Memory
C = Seashore Memory
D = Seashore Time
E = Seashore Intensity
F = Seashore Pitch
G = Seashore Consonance
H = Dominion IQ
M = Chicago Reasoning
N = Chicago Memory
O = Iowa Mathematics

TABLE V

RAW SCORES OF GIRLS FOR t-TEST

Pupil	A	B	C	D	E	F	G	H	M	N	O
1	56	56	10	76	93	54	31	105	29	2	55
2	86	65	28	73	87	55	35	71	28	14	50
3	48	76	12	65	55	58	27	75	24	9	43
4	78	51	23	56	68	50	32	81	21	7	31
5	91	81	10	77	75	53	30	111	28	11	55
6	54	31	34	67	92	52	32	101	27	8	57
7	58	57	26	73	89	46	27	110	36	4	49
8	118	80	17	75	15	45	37	104	21	9	46
9	62	55	19	77	57	54	21	99	32	4	33
10	69	51	21	56	87	52	29	120	28	10	58
11	70	77	18	76	78	54	28	74	26	5	44
12	71	79	14	59	70	39	32	78	16	5	40
13	47	40	31	85	88	70	30	110	44	9	74
14	113	77	16	61	60	44	34	102	25	6	45
15	66	66	23	68	81	57	37	117	51	5	66
16	57	63	35	69	77	80	31	113	35	10	61
17	42	83	14	77	95	69	30	93	34	11	59
18	119	72	21	65	74	66	27	106	25	7	50
19	181	59	13	73	86	58	34	85	2	11	55
20	195	66	23	59	71	55	24	83	14	4	41
21	57	53	38	84	92	75	38	107	31	11	66
22	66	63	22	67	73	59	31	95	24	5	58
23	49	48	22	63	67	65	27	110	27	4	69
24	53	86	18	69	85	64	33	83	31	5	41
25	46	50	33	65	87	70	28	127	38	6	59
26	90	72	23	74	84	62	30	101	35	7	38
27	158	93	14	77	70	54	24	84	17	6	44
28	110	71	27	70	85	48	33	78	22	3	33
29	73	71	25	80	89	51	28	96	35	8	55
30	70	75	26	67	92	54	25	93	22	8	52
31	71	71	38	82	85	74	29	83	29	7	43
32	57	52	33	76	80	77	25	96	34	11	50
33	42	40	44	81	86	80	37	98	35	8	48

Key

A = Drake Rhythm
B = Drake Memory
C = Seashore Memory
D = Seashore Time
E = Seashore Intensity
F = Seashore Pitch
G = Seashore Consonance
H = Dominion IQ
M = Chicago Reasoning
N = Chicago Memory
O = Iowa Mathematics

APPENDIX F

Raw Scores of Students Selected for the Correlations

TABLE VI

RAW SCORES OF STUDENTS SELECTED FOR THE CORRELATIONS

Pupil	Sex	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	M	54	68	26	58	84	49	29	85	41	32	35	58	27	5	50
2	F	51	63	29	71	76	52	31	106	47	43	20	54	35	6	54
3	F	78	51	23	46	56	68	32	81	23	29	26	42	21	7	31
4	F	87	76	26	58	82	51	27	106	34	53	0	69	34	5	53
5	M	59	72	27	87	38	46	30	103	68	45	60	47	29	3	63
6	M	83	74	24	67	83	52	38	115	67	58	55	86	38	8	80
7	F	118	80	17	75	15	45	37	104	56	49	15	63	21	9	46
8	F	47	40	31	85	88	70	30	110	82	48	38	44	44	9	74
9	F	46	46	26	79	88	59	34	82	48	25	0	47	20	10	47
10	F	113	77	16	61	60	44	34	102	26	25	22	26	25	6	45
11	M	49	24	32	68	90	77	36	114	31	53	30	40	36	2	71
12	F	143	43	27	75	86	65	29	113	30	69	31	58	49	8	68
13	M	68	66	25	70	85	44	26	107	16	34	41	59	30	7	49
14	M	90	75	22	73	75	74	23	109	33	38	67	29	29	2	68
15	M	71	45	21	48	69	63	31	115	22	48	40	26	28	9	61
16	F	181	59	13	73	86	58	34	85	55	18	0	40	2	11	55
17	F	65	67	24	52	79	56	32	107	41	43	14	59	33	8	54
18	F	81	73	20	53	54	43	24	88	24	35	23	42	26	7	37
19	F	71	53	19	67	75	51	27	113	71	51	52	53	43	9	71
20	F	79	45	9	67	79	50	29	83	55	20	5	45	13	5	53
21	F	195	66	23	59	71	55	24	83	54	36	15	45	14	4	41
22	M	40	74	26	78	78	62	26	99	67	31	45	64	28	5	57
23	M	59	60	30	58	74	60	27	118	53	48	18	49	28	5	72
24	M	49	58	22	74	92	77	29	102	53	43	76	38	31	6	85
25	F	67	71	28	75	93	56	26	90	31	37	9	43	33	9	47
26	M	45	66	13	68	60	58	28	88	26	46	15	49	25	6	42
27	F	110	71	27	70	85	48	33	78	6	43	56	50	22	3	33
28	F	70	75	26	67	92	54	25	93	27	48	22	63	22	8	52
29	F	49	42	24	75	76	70	28	79	34	48	46	65	39	5	68
30	M	42	65	21	57	73	59	35	114	44	38	24	55	27	4	60
31	F	55	52	33	76	80	77	25	96	30	42	20	31	34	11	50
32	M	62	79	20	69	66	44	21	104	96	38	28	25	27	5	60
33	M	53	82	21	42	84	55	25	97	46	45	9	34	32	4	57
34	F	70	82	26	70	52	55	30	76	33	26	0	69	19	16	62
35	F	73	66	30	75	93	60	28	83	42	27	19	39	27	14	47

Key

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