A THESIS.

Submitted as graduate work in Education.

A STUDY OF SOME TEST RESULTS AND GRADES AT V.P.I.

by

Arthur E. Shannon.

VIRGINIA POLYTECHNIC INSTITUTE.

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A STUDY OF SOME TEST RESULTS AND GRADES AT THE V. P. I.

The purpose of this study is to discover the significance of certain standard tests given at the V.P.I to freshmen, the relation of test results to grades, and especially the indications of the test given in the English department. For this reason high school grades in English were included. The data available were not entirely such as would be obtained in a controlled experiment, and the result saught was the utilization of data at hand.

The tests used were as follows:
The Iowa State Test for Chemical Aptitude.
" " " " " " training.
" " " " " Physics Aptitude.
" Cross English Test: scores in this test had been used as the basis for a division of the freshman class into three groups.

The procedure followed was to compute correlations by the Otis method, and to make distribution curves for the several groups of data. Average high school grades in English were secured from the college records. The effect of the use of test scores in a hypothetical program for college entrance requirement was also considered. Comparisons were made with significant results from the University of Virginia and from other sources.

While this work was done under the department of education at the V. P. I., assistance and advice are to be acknowledged from the Dean of the college, the departments using the tests, and University department of education. Some data are inserted from a previous study of intelligence tests by the writer.

Test Forms and Distributions.

The Cross English Test: (Curve shown in plate I.)

This test calls for knowledge of the proper use of English but not for knowledge of English literature. Nearly half of it refers to spelling and punctuation. Inspection gives the impression of an exam in high school English, and the mean score made was 72% of the possible score, or above the freshman grade in English. Dr. Ferguson calls attention to the fact that is to a considerable degree a test of mental alertness.

The distribution curve of scores is very one-sided, the lower one third of the scores being included in a long slope and the remainder rather closely bunched. On the assumption that an educational measure is most accurate near the middle of its range, this test is too easy for the majority of the students and its correlations would be lowered in consequence. If used for an elimination test for a lower fraction of the cases, the distribution found was suitable.

The normal course of study for freshman English was modified to form three variations suited to as many groups. They were as follows;

0 star, a "sub-freshman course."
1 star, the usual freshman course.
2 star, a "more literary course."

The students were classified on the basis of the test, but on account of conflicts students of certain courses were grouped as follows;

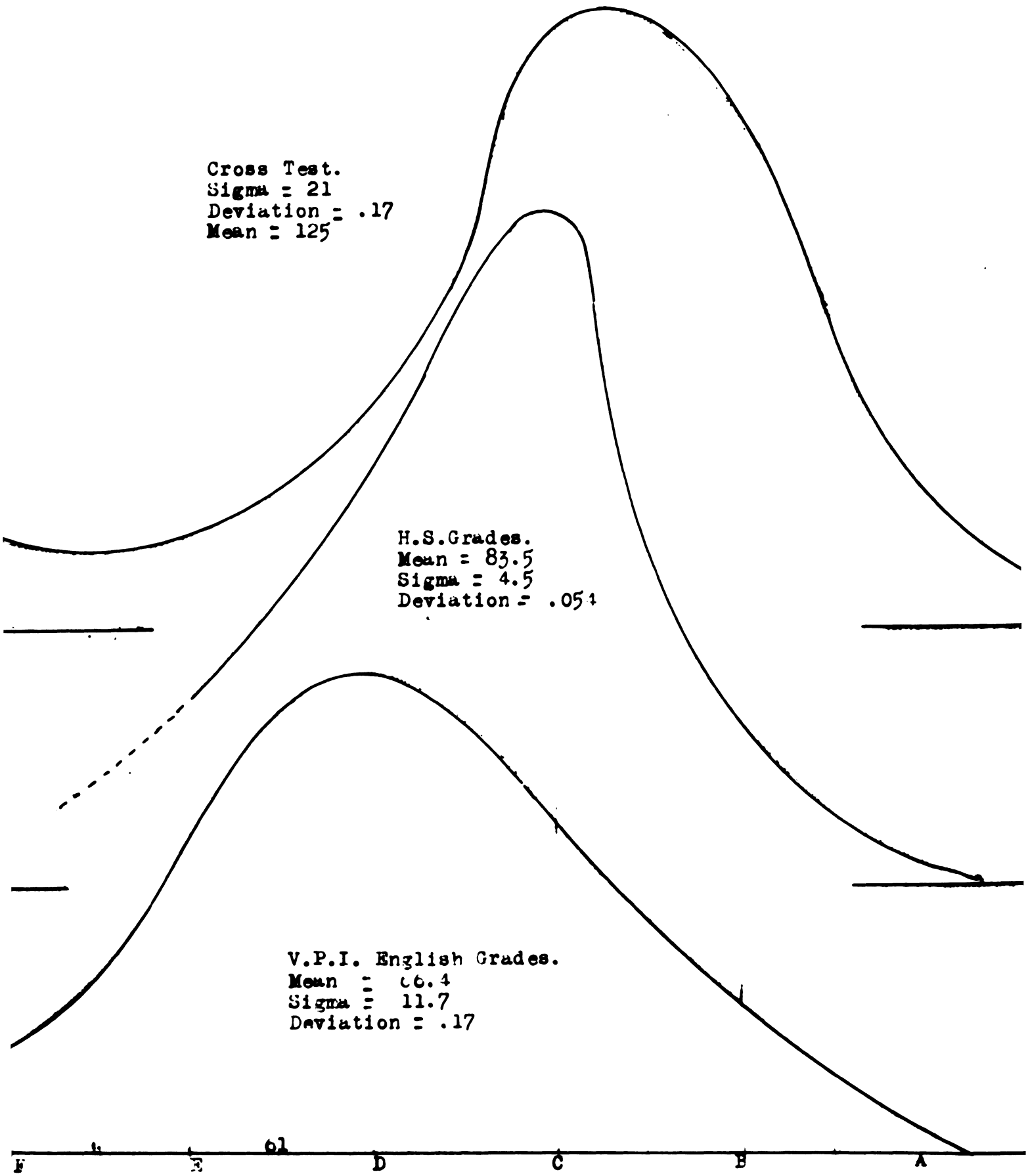
Home economics, 2 star, (with some agricultural pupils.)
Business administration, 1 star and 2 star.
Agricultural, 0 star, (some with home economics.)

The Iowa State Tests for Chemistry Aptitude and Training:(plate II)

The aptitude test is in the nature of an intelligence test measuring fitness for a particular branch of study. The true-false type of question is responsible for one fourth of the total score, and may be responsible for some of the defects noted. The distribution is very ragged, also compressed, the curve having one sharp peak and two lesser peaks, too pronounced for chance cause, and therefore no attempt was made to smooth the curve. This form would indicate that much room for improvement was present, but the correlation with grades was .50 The lower 25% of scores, considered later, happily coincided with the first sharp eminence of the curve.

The chemistry training test results showed the lack of any considerable training on the part of most of the freshmen, and of course it could not be considered as fair to the group.

Distribution Curves of measurements in English.
(Freshmen, 1925-26)



The curve shows a long extension on the right, indicating those cases which had received training and benefitted by it. The correlation for this area appeared high on the checker board plot. There was a considerable body of chemical information gained from incidental sources, and the correlation of .40 with third term grades indicates that aptitude or interest figured largely in what is nominally an attainment test.

The Iowa State Test for Physics Aptitude. (Curve on plate II.)

This is a companion of the chemistry aptitude test and was given to sophomores who were for the most part included in the cases tested for chemistry in their freshman year. Low test scores had been eliminated to a considerable extent by casualties, as is evident from the graph. There is somewhat less irregularity than in the chemistry test, but both of the distributions seem to show characteristic lack of symmetry, which is probably due to uneven calibration on the measure.

The four parts of the test may be described as follows:

1 Math,(mostly algebra,) corresponding to the math questions common to intelligence tests generally. Time, 15 minutes.

2 Reading and apprehension; questions to be answered after reading paragraphs of text book nature. Time, 15 minutes.

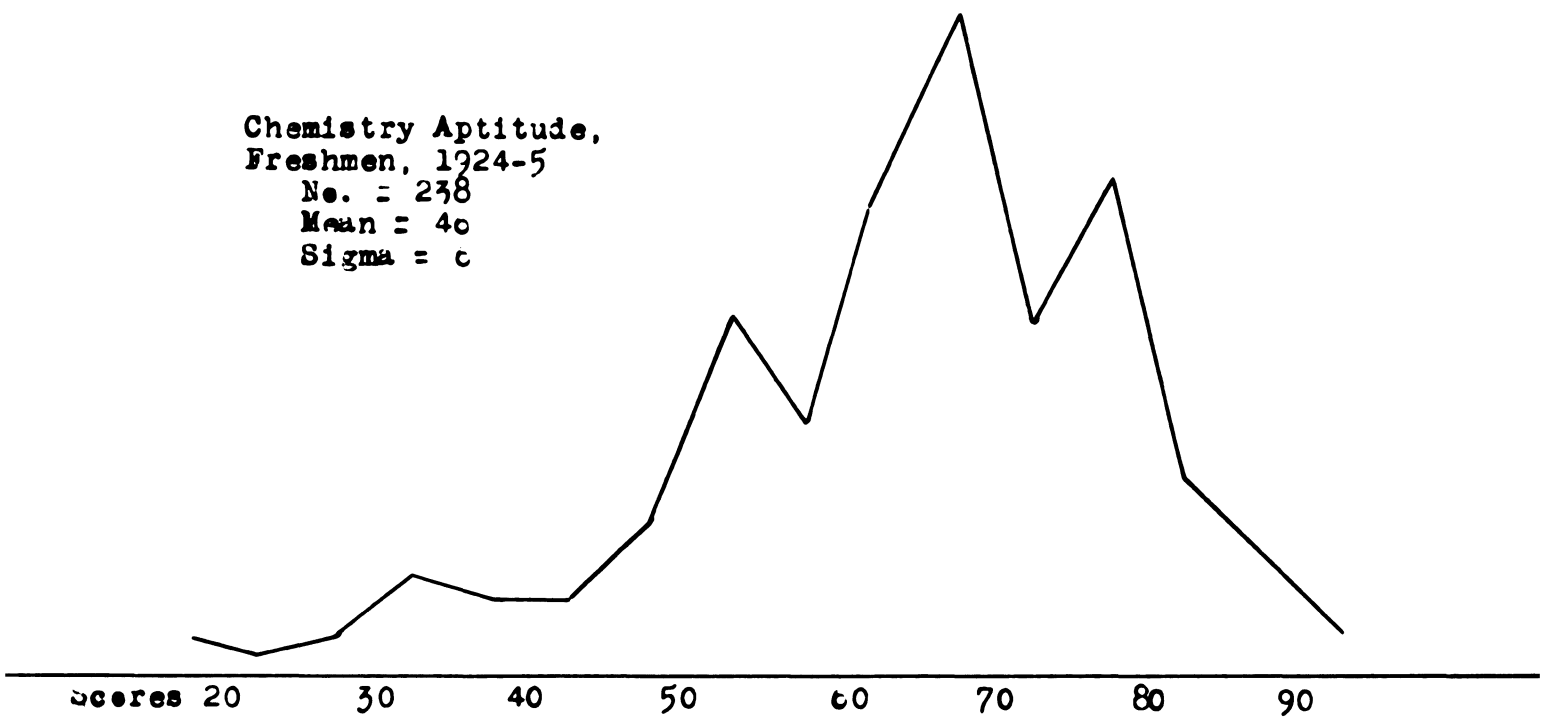
3 A. Number series, usual in intelligence tests.
B. Logical conclusions to be drawn from statements given, arranged as a "true and false type test. Time, 10 minutes.

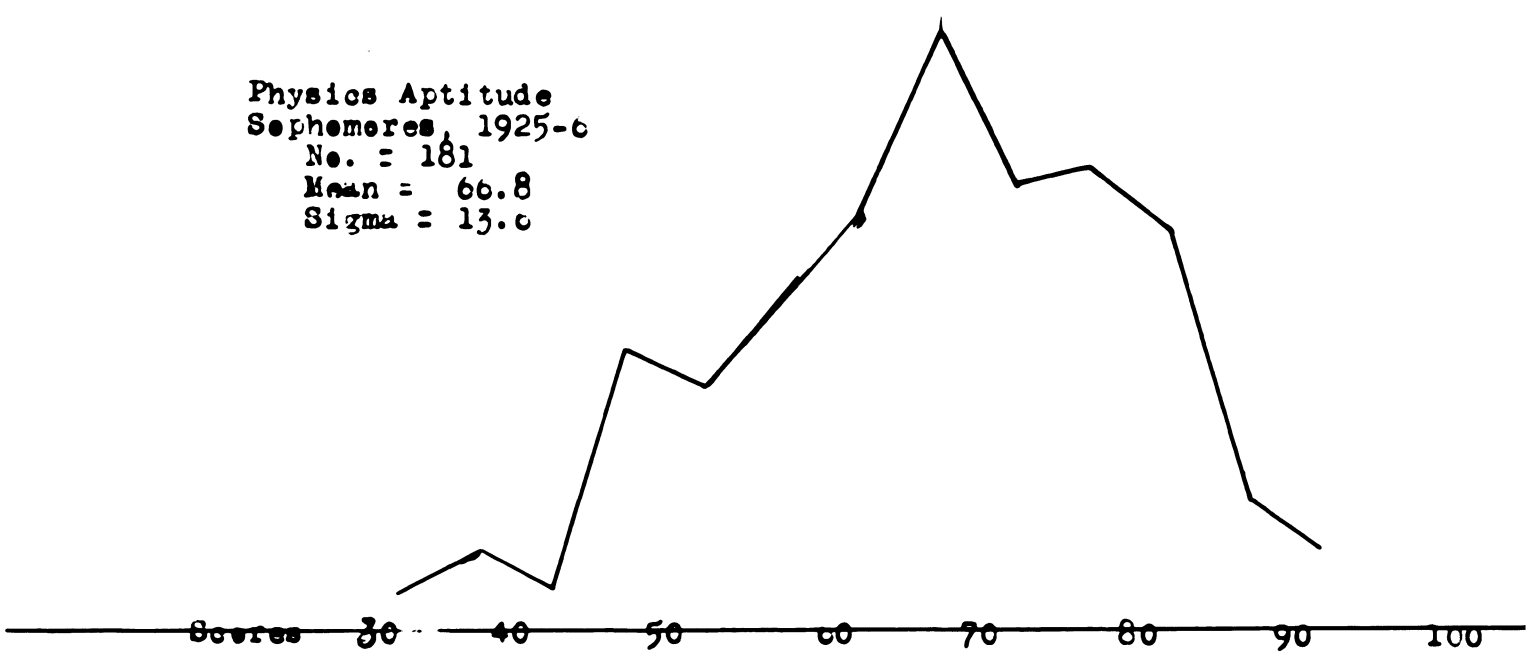
4 General information on subjects related to physics, true and false type, fifty questions, Time 5 minutes.

The total time allowance of fourty five minutes evidently requires fast work, but this is not greatly different from the usual test scheme. The large proportion of true and false type questions must be considered a disadvantage, but the general impression given is that the test would well measure present ability, and that this ability would partly represent previous opportunity or training.

The self-correlation of the Iowa tests is given by the Iowa State College as .88, which would rank it in the class of standard intelligence tests in this respect.

Distribution of Iowa State Tests, V.P.I.





The Thurstone Test.

This test, prepared by Mr L. L. Thurstone of the University of Chicago, is published by the American Council on Education as their "Psychological Examination." It has been given two years at the University of Virginia and is to be repeated (in the fall of 1926,) but with change of form.

Judging from the sample it is an intelligence test with a short exam. in English and arithmetic included. Besides being key subjects, these give special aspects shown in the detail scores. The whole test seems not greatly different from intelligence tests like the Otis or Terman, but is on a larger scale and requires a longer period for administration.

High School Grade Distributions. (Plate I)

The distribution curve for average high school grades in English includes, of course, none of the failures. The curve is very much constricted, with few cases much above the mean, (it is too concave on that side,) and with too few A grades for a normal curve. Naturally the grades for a single year would show more deviation.

As these grades are based generally on a passing grade of 75, the numerical range is small, and practically from 75 to 95. On this curve sigma equals 4.5, which brings two thirds of the grades within that range both ways from the mean of 83.5 It would seem that grades within such a small range could not properly differentiate pupil attainment. The general tendency of teachers to grade toward an average is commonly recognised.

The total effect of the narrow range is that any small difference of standard between schools reverses the order of grades for some pupils. Even a ranking system, if perfect, should utilise the whole range, and in a wider range some adjustment could be made for good and poor classes. It is suggested that one difficulty found with objective tests in these schools lies in the custom of high percentage grades, where a true test tendency is to distribute scores thru a wide range.

Correlations. (See Table I, page 6)

In figuring correlations the Otis chart was used for convenience, and the effect is that of the Pearson product-moment formula. The two formulas are:

$$\text{Pearson;} \quad r = \frac{\text{sum } xy}{\sqrt{\text{sum } x^2 \cdot \text{sum } y^2}}$$

$$\text{Otis;} \quad r = \frac{\text{sum } X^2 - \text{sum } y^2 - (y-x)^2}{2\sqrt{\text{sum } x^2 \cdot \text{sum } y^2}}$$

The checker board plotting of the data serves to locate the correlation where it is not uniform over the variables. There seems to be a general tendency of low numbers to show less correlation than the average or the high numbers. The usual rule that extreme scores on tests are less reliable than medium scores might account for some of this effect, but instances noted below apparently indicate specific characters of the variables. It is to be assumed that in any large number of test results some will be low from temporary and accidental causes affecting the students.

In general the results at the University of Virginia harmonise with those at the V. P. I. where they are comparable. The University results were from an organised program for the testing of a psychological measure, and in the table on the following page are listed correlations which seem to throw light on the results obtained here.

Correlations of the Cross Test.

The tabulation shows that the correlation of this test with grades was .45 for the first term and .36 for the second term. The University result was .48 for the first term with Cross scores and for the Thurstone test the correlations were .63 and .48 for the two terms. These relations are certainly significant, but not high for the Cross test. The two tests are not similar and they do not measure the same thing. Doctor Fergusons view that the Cross test indicates mental alertness seems justified to some degree, and there is in effect a short exam in English in the Thurstone test. However, in spite of much overlapping of function, it seems impossible to conclude that the Cross test, specifically in English, does not reflect mainly the effect of training in that subject.

Table I

Correlations.

	Correlation.	Sigma.	Mean.	Co-ef. of Dev.	No.
Cross English test and	.446±027	21.9	123.6	.18	369
1st. term grades in English		11.7	66.4	.17	
Cross English test	.357±031	21.1	125.8	.17	326
2nd. term grades in English		12.6	69.1	.186	
Cross English test	.487±027	22	123.2	.178	341
Av. H.S. grades in English		4.5	83.7	.054	
1st term grades in English	.333±033	11.9	66.8	.178	325
Av. H.S. " " "		4.	83.5	.048	
1st term grades in English	.555±027	10.9	67.5	.162	304
2nd " " " "		11.6	70.5	.165	
Chemistry training test	.396±037	11.8	52.2	.227	238
3d. term grades, 1925		12.8	71.3	.177	
Chemistry aptitude test	.496±033	6	46	.13	238
3d term grades 1925		12.8	71.3	.177	
Physics aptitude test	.480±038	13.6	66.8	.20	181
" grades, 1st term, 1925-6					

Physics and chemistry grades above	r = .65
" " " aptitude tests	r = .48
" letter grades and physics test	r = .45
Ag. class chem. grades and Otis I.Q.	r = .43, .65, .55

Comparison of V.P.I. and U. of Va. Results.

	V.P.I.	University.
r for English 1st term and Cross test	.445	.48
r " " " " psycholog. test		.63
r " " " " Eng. 2nd term	.55	.66
r " " " " av. H.S Eng.	.33	.35
r " Cross test " " "	.487	
r " psychol." " " "		.12
r " av. college grade " "		.27
r " chemistry and English grades	.50	.32
r " " " psychol. test	.	.41
r " " " Cross "	.20	

The V. P. I. correlations are unavoidable lessened by the segregation into groups of the students. As the division is made on the test basis the natural tendency is to neutralise whatever variable is measured by the test. This is nominally training, or the effect of training. The actual residual correlation found would include correlation within the groups, any not sufficiently neutralised, and any factor like interest or ability that might vary with the test result and act as a multiplyer.

Relationships of College Grades in English.

Grades for two terms are given below: (Session of 1925-6)

Fall;	No.	A grades.	A,B,C,%	E,F,%	Mean.	Sigma.	Dev.co-ef.
0 star	180	4	28	43	63	15	24
1 star	105	0	22	31	64	12	18
2 star	135	4	63.5	9.6	73	12	20
Winter;							
o star	122	0	33	32	65	13	20
1 star	92	0	48	25	68	14	21
2 star	136	10	61	18	72	15	21

(Means and deviation co-efficients from letter grades.)

As the means and per cent of failures for the two lower grades are nearly the same, we must infer a difference of grading standard as to attainment equal to the mean difference of their ratings on the Cross test. (This is,however, subject to the incomplete segregation of the agricultural groups, but a separate calculation showed that their grades conformed to this general result.)

If the grading standard was one of increment of attainment during the term, we should expect some degree of difference owing to the lower rate of attainment of more backward pupils, especially as the test operates to some degree as an intelligence test,and unavoidably so. It seems a not unreasonable conclusion that the grades of the lower groups at least do not represent the same quantity of attainment for either the term work or for total capacity in English. It would also appear that a slow student who made a higher group because of previous drill, would have more required of him than is required of a better student with poor preparation.

The highest,(2 star,) group,showed grades more nearly approaching the placement we should expect if they had been given to the same pupils in a course alike for all pupils. It is

Table II

Educational Measurements in English.

Cross test scores.	V.P.I. Grades for fall term, 1926-7						
140-165	A	B	C	D	E	F	T
140-165	4	25	33	22	7	2	93
125-139	0	8	18	45	18	11	100
110-124	0	5	16	31	24	11	87
65-109	1	3	12	28	26	16	86
Total	5	41	79	126	75	40	366
H.S. Grades, 4 yr. average							
A	0	4	1	1	0	0	6
B	2	23	22	13	7	3	70
C	2	9	39	64	36	13	163
D	0	4	17	28	23	15	87
Total.	4	40	79	106	66	31	326

H.S. Grades as above.	Cross Test Scores.				
	140-165	125-139	110-124	65-109	T
A	3	1	2	1	7
B	35	22	10	8	75
C	39	52	47	30	168
D	14	23	20	33	90
Total	91	98	79	72	340

Note.- Numbers in above tabulation do not correspond exactly because of missing data for some cases.

possible that interest in the subject to a special degree accompanied the higher tests. It is also possible, judging from the shape of the Cross test distribution curve, that these pupils were not sufficiently measured by the test, (it was too easy for them), and that the course was not suficiently differentiated from the one star course, ability as well as attainment being considered. However, there is no reason why the group should furnish any given proportion of failures.

The two star grade distribution represents one that could quite possibly result after a rather rigid sorting of college entrants by a thoro test for preparation, with an element of intelligence test added.

Theoretically the fitting of the English class work to the pupils should have produced a narrower distribution of the grades. Actually it is about the same as in chemistry, when figured from letter grades. The correlation of first and second term grades was .55 at the V. P. I. and .66 at the University. A wider range of grades here would have increased the correlation and this wider range would result from a uniform course for all pupils.

High School Grade Correlations. (See tabulation, page 8)

The correlation of average high school grades in English and Cross test scores was .49, practically the same as V.P.I. grades and scores. Considering the variety of schools represented this is high enough to remove some of the criticism directed against high school grades. However, the lower test scores were more random with respect to grades than the better test scores.

Average high school English grades and V.P.I. grades correlated only .33 and the lower college grades seemed quite random on the checker board plot. The corresponding University result was .35 for English. (For math r equalled .25) The element of industry, at least, ought to remain reasonably constant for both college and high school work, and ability quite certainly would, but not ability at a different task. It is difficult to account for these low correlations as due to merely errors of measurement.

The results we have from plotting high school and college grades are what we should have if we plotted two hundred ratings that were reasonably consistent, and then added one hundred more that were low on a college standard, but which had been given high school grades all the way from D to A or the equivelent.

Table III

Cross English Test Results, 1926

	V.P.I. Boys.	V.P.I. Girls.	V.M.I.	U. of Va.	W. & M. Boys.	W. & M. Girls.
High 10%	151	152	156	158	156	157
1st Quartile	136	139	149	148	149	154
2nd "	124	128	136	135	132	144
3d "	112	119	125	125	120	137
4th "	96	101	106	115	101	120
Low 10%	71	84	95	99	89	110
Q. Average	117	122	129	130	125	139
σ Deviation	12.5	12	11.5	9.9	13.4	7.4

Summarized Results of State High School Survey.

	No.	Intelligence.	English.	Read. & Com.	Math.
(Norm for Seniors,)		147#	37.6	20.7	19.4
Jefferson H.S.	225	153	50	23	28.9
Staunton "	33	149	43.6	24.2	25.5
Petersburg "	55	176	47.2	23	17.8
Average	313	155	48.8	23.3	26.6
10 low schools	112	100	23.3	12.2	12.2
Total average,	1182	136		17.7	20.2

Correlations: (from weighted medians)

	No	r	P.E.
Intelligence scores and math.,	1130	.50	.05
" " " read.& com.	"	.837	.02

#(Terman intelligence test was used, and median scores are given.)

This is not only evident from an inspection of the plot, but we find that we have no gain in selectivity by combining high school grades with low test scores to indicate probable college failures. The correlation is therefore localised among the better students, and this seemed true whether these were picked by the Cross test or by college grades. If the better pupils came from better schools, then the grades were defective in the poorer schools.

If we take a school grade as representing usually a rate of attainment, and college work as being at a different rate, or on a higher level of difficulty, this may account for some of the apparent contradiction. Quite possibly the test may be a better criterion of school grading than the college grades.

The University of Virginia report gives the data below:

Students from;	Mean psychological score.	Courses passed, %
Va. non-city schools,	28	55
" city "	47	70

The report states; There are reasons for believing that the difference in the scores of these groups is due more to the natural ability of the students than to the character of the schools from which they come.

The writer would suggest, as a hypothesis only, the following:

1 That low correlations are due largely to certain high school classes which produce cases found at the bottom of the test and of the college grade distributions;

2 That the high school grades of these classes are the result of a ranking method of grading, applied in a course of study adopted to low group capacity;

3 That these classes will be found usually in certain school populations of low intelligence on an average, which may be regionally distributed.

The only sufficient test for this would be direct measurements of adequate numbers. A condition of extreme variation was found by the writer in a previous study of agricultural classes.

Results of the State High School Survey.

The figures from this survey, which is yet unpublished, were furnished thru the courtesy of Mr Dabney Lancaster of the state board. The survey was limited to certain schools,or divisions, assumed to be typical, seniors being measured. The figures in table III are from the medians furnished and are mathematically approximate.

The correlation of median scores in math and in the Terman intelligence test was .50 The correlation for intelligence with "reading and comprehension" was .84. This is high enough to give strong endorsement of the test accuracy, (not validity.)

The ratio of scores in the large schools to the small school scores was about two to one in a large number of cases, and this ratio obtained in all the tests used. This wide ratio of score medians has probably more significance as to the reliability of high school grades than has the average score.

The following inferences from the survey seem justified:

1 Low academic standards accompany low intelligence ratings with some noticeable exceptioms.

2 Promotion policies and presumably graduation requirements vary to an extreme degree.

3 Since the scores in math and English represent a long course of study in these subjects, both attainment and rate of attainment vary with the intelligence score.

4 The attainment score must be considered with reference to the number of years in school to get rate of attainment, and this number will vary with the promotion policy.

Correlations for Chemistry.

The correlation of the Iowa State Test for Chemical Aptitude with third term grades in the session of 1924-5 was .50 The test was given in October of 1924, but third term grades were used to get away from the highly variable factor of preparation, and in consequence not all courses or entering pupils are represented. The correlation of first term grades at the University of Virginia was .41 with the Thurstone test. In this case the special subject test is clearly superior to the general psychological test, but the University correlations were lower for chemistry than for other subjects.

The correlation of second and third term grades at the University was .57 and at the V.P.I., it was .50 In this case a special test given six months before, in an hours time, was about as good an indication of future grades as a previous terms work, and we have now no better predictive measure than a previous terms work in the same subject.

The correlation of English and chemistry grades at the University was .32 and at the V.P.I. it was .50 This surprising difference must indicate more of consistency here. It is possible that a technical school presents a special case, and it is probable that the division of the English classes gives gives more of fitness of pupil to class work, and a better chance for industry to count, with more tolerance for difference of preparation.

The Cross test scores and chemistry grades correlated only .20 This makes the Cross test one with a limited field, and not highly significant of general ability.

The correlation of the test for chemistry training was .40 for third term grades. The checker board plot clearly showed the correlation as localised in the better half of the scores. Since formal preparation was largely lacking, it is to be inferred that interest, general information, and aptitude were the main factors concerned.

The Otis test for intelligence was given by the writer to agricultural and agricultural education freshmen for two years. Correlations found were .43, .65, and .55 The intelligence ratings were found by the writer and others an aid in estimating the possible progress of pupils who were not making good progress, and in stimulating certain pupils.

Correlations of the Physics Aptitude Test.

This test was given to sophomores who had previously taken the corresponding chemistry test in their freshman year.(1924-5) The correlation of the test scores with physics grades was .45 using letters, and .48 using numbers. Because of certain uneven conditions due to difference of courses and similar causes, the grades furnished would not give the best possible correlation. It is therefore doubtful if the test should be judged less significant than the chemistry test because the correlation is lower. It is also to be considered that low test scores to be expected from some of the freshmen were eliminated in the process of promotion. The sophomore preparation, however, would be more uniform than the widely variable freshman preparation.

The correlation of the two test scores and grade correlations with the respective scores are about the same. This seems to indicate that the two tests did not indicate the same thing, that is, the difference between test rankings and grades, due to such factors as industry, was not greater than the difference of the test rankings for the two subjects.

The correlation of grades in the two subjects was .65 which shows a large common factor that might be industry combined with general ability. This is in fact equal to the average correlation found at the University for grades in two successive terms of the same subject.

Apparently the value,or need, of the sophomore physics test would be greater if there were not previous college records of the same students available, but the test results would still afford a ratio of indicated ability and accomplishment. The writer would rate the efficiency of this test for its purpose as equal to that of the chemistry test.

Effect of Group Segregation of Classes in English.

The main purposes served by the division into three groups of freshman English Classes, with a corresponding difference in courses, are as follows:
1 To give the training needed by each group.
2 To improve class room instruction by methods possible with a homogeneous group.

It is assumed here that these purposes were realised in fact. In this connection the bulletin for March, 1927, of the American Society of University Professors makes the following statement; "The practice of sectioning classes is developing rapidly."

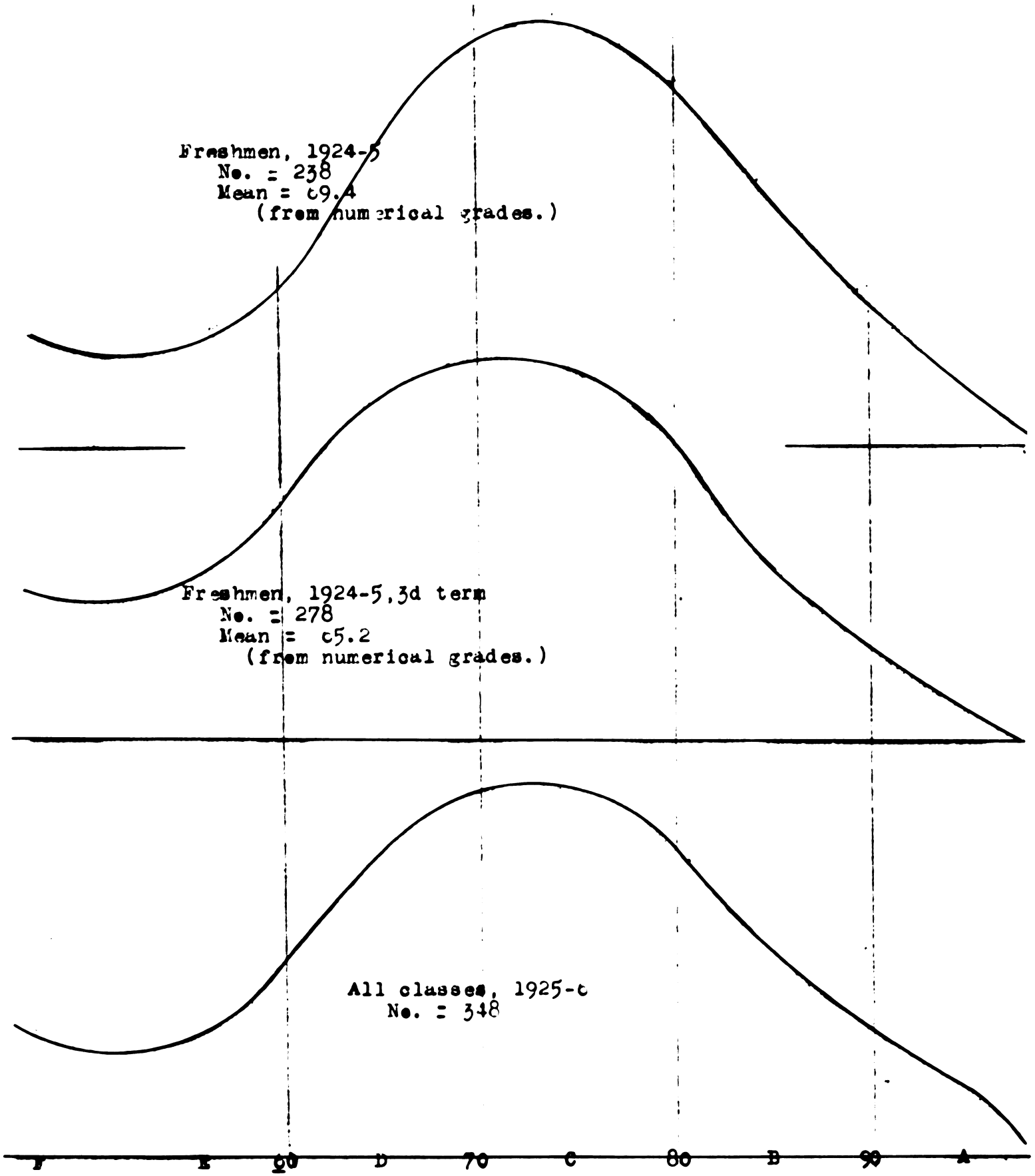
Clearly, if the purpose of the grouping is to remove a variable like training, the test used is suited rather than a psychological test. If a permanent rating of ability is wanted, then the test used is only indirectly useful, and for the purpose of the course adviser the results are only suggestive as to ability.

If the English course required for graduation is only a required period of study, common to all of the same curriculum, then the division into starred groups is permanent in its effect on the material of the required course. It is not desired to criticise the method for the condition and purpose as they exist, but this method of segregation does not seem to follow a grading principle generally applicable thru the college.

The courses in physics and chemistry offered in certain curricula are shorter than in engineer courses, and generally assumed to be easier. This makes a segregation of groups similar to that of the English department but based on student choice, under the course adviser, and adopted to vocation. To be consistent we must assume that capacity in English is independent of vocational purpose.

Plate III

Chemistry Grade Curves.
(Numbers reduced to per cent of total.)



College Grade Curves.

All grade distributions studied showed an upward bend at the very low F grades, doubtless due to students who made no effort to pass. With this probably inevitable exception, the combined English grades made almost an ideal bell shaped curve, letter grades only being available. The chief defect is that there are not enough A grades and too many just below, in proportion. The mean is 66.4 (See plate I)

The chemistry grades for two successive years show a greater deficiency in the upper grades of the curve. It is what would result if some of the best students in a fair sampling had removed elsewhere, but it might also result from an insufficient distinction between the best and the good students. The per cent of A grades would be increased by the elimination of any number of failures and is so increased in the upper classes. The curve of total grades for all except lab classes shows a less proportion of failures but the same characteristic at the upper end. This portion, in fact, tends toward a straight line for a considerable space, where it should have a reversed curve. (See plate III)

The College Examination Board uses for their letter A grades the best 7% of the scores, and Dr. Ferguson, in the U. of V. report suggests 10%, five classes being formed in each case. The freshman grades examined in the three subjects gave 3% to 5% of A grades.

If it is true that any educational measure tends to be less accurate at the extremes, then our grades tend to be less accurate as the students work becomes better. With a limit at one hundred all the deviations from the true grade tend to be in one diraction as the limit is approached.

The only definition discovered for an A student was, "one who knows as much as the instructor thinks an A student should know."

Selectivity of Test Results.

Selection by the Cross Test:

The effect of a hypothetical selection of freshman students by the Cross test is shown below;

Cross scores:	E & F	Ratio.	Av. quality credits.	Ratio.
Fall, 1925				
Low 25%	50%		.25	
Upper 75%	25%	2 : 1	.55	1 : 2.2
Winter.				
Low 25%	39		.38	
	16	2.4 : 1	.78	1 : 2

An effort to combine high school grades with test results to get better selectivity was a complete failure. This is in spite of the positive correlation found previously, but as was noted correlation failed in just this area of low test scores and low college grades.

Since the test applies to a subject in which the students have had a long period of preparation, and since the test applies to attainment rather than to aptitude, the selectivity seems low. But the segregation into groups makes the grade reliability also low. In an effort to secure light on this factor, as many cases as possible were traced from the 0 star freshman sections into the following sophomore course in English. Of the 61 cases found, only 17 passed in the fall term of 1926. (28%)

The grades in this course were highly variable, and extremely low in the case of one instructor. We have therefore no positive standard by which to judge the test results, but on the face of the returns 17 pupils passed the sophomore fall English on schedule time from an initial group of 180 cases in the 0 star freshman sections.

It seems reasonable to draw the following conclusions:
1 That the Cross test selectivity would be much greater than indicated above if there were any accurate basis for measurement.
2 That the effect of the course given had not made the low group as a whole capable of the usual work in English.

From a report of the results of the Cross test in a number of Virginia schools the following figures are inserted: (See table II)

	V.P.I.	Boys.	Girls.	W.& M.	Boys.	Girls.	U. of V.
Average score		117	122		125	139	130
Q. deviation		12.5	12		13.4	7.4	9.9

The report includes the teachers colleges and the results run consistently higher for girls and leave the V.P.I. at the bottom. The quartile deviation here is only exceded by that for W.& M. boys. In this connection it is to be noted that the curve shown on plate I indicates a fair rating for the majority of the students, but a very low rating for the fraction constituting the abnormal long slope at the low score end of the curve. Elimination of this group would give a fair average score, a reduced deviation, and a more normal curve.

Referring again to the hypothesis of a group of schools low in both academic standards and average ability, it will be seen that this will satisfy all the conditions noted in both high school and Cross test data compared with college data.

Selectivity of the Chemistry Aptitude Test.

The results of elimination by the chemistry aptitude test are illustrated below, the grades used being those for the third term of the session of 1924-5.

Test score.	E & F grades.	Ratio	Quality credits.	Ratio
Low 25%	34%		.43	
Upper 75%	11%	1 : 3	1.09	2.5 : 1

No better selectivity was gained with a smaller percentage, as the low 25% coincided with the lower sharp peak of the curve. The chemistry training test gave results too poor to be of any predictive value here, and because of its low correlation in the low test scores mainly.

As a comparison there is given the record of a repeating section which took second term chemistry during the third term. 35% of this section passed and 65% failed. The repetition was due to accident of circumstance in some cases and grades up to A were secured.

The cost of teaching pupils of this group who passed is twice the normal on account of the repetition, and this is to be multiplied by approximately two on account of the low per cent of returns. But the showing of the low test group would approach this. The disappointing feature of the test showing is that low test scores go with grades up to B. If the self correlation of the test is .88 and that of grades 70 to 80 as given by most investigators, there would be some cases of marked discrepancy due to the inaccuracies of both measures, and there is some presumption that such cases as are found in the most unlikely places represent inaccuracies of grades.

Selectivity of the Physics Aptitude Test.

The selectivity of the physics aptitude test is largely affected by the previous selection by promotion. Of the ten cases of physics students rated below 60 on the previous terms work in chemistry, only two made a grade as high as D.

Below are given the computed results:

Test scores	E & F grades.	Ratio.	Quality credits.	Ratio.
Low 25%	58%		.18	
Upper 75%	26%	1 : 2.2	.69	3.7 : 1

This is about equal to the chemistry test results, but a test applied to freshmen might have given higher selectivity than the chemistry test. A selection on a test basis in the sophomore year is, in effect, a selection on a combination basis.

A selection of the low 10% of the scores shows 60% of failures and no grade higher than C.

Test Selection at Other Schools.

By making computations from the University of Virginia report of the Thurstone test we have the following:

	Probable term hrs. passed.	Remainder.	Ratio.
Low 10%	5	32	1 : 6.4
Low 25%	12	34	1 :2.8

At Bryn Mawr College the Thurstone test was given to four successive freshman classes, and with it an attainment test of a general nature. The following is taken from the report in the Journal of Educational Psychology:

Low scores with the tests were compared college grades on three different plans as given below;
1 Elimination of the low 10% of the attainment scores.
2 Eliminatiom of the low 10% of the intelligence scores.
3 Elimination of cases common to the low 25% of both tests and about equal in number to the other groups.

The figures following give the placement of the low groups in the class ranking system used in this college; totals of the four freshman classes are used.

Plan.	Rank, 0-24	25-49	50-74	75-100	Withdrawn.
1	23	12	7	1	3
2	17	19	7	3	0
3	19	13	7	0	1

At Bryn Mawr College the Thurstone test was given to four successive freshmanc classes, and with it an attainment test of a general nature. Low scores with the tests were compared with college grades on three different plans as given below;
1 Elimination of the low 10% of the attainment scores.
2 Elimination of the low 10% of the intelligence scores.
3 Elimination of cases common to the low 25% of both scores and about equal in number to the other two groups.

The figures below give the placement of the low groups in the class ranking system used in this college; totals of the four freshman classes are used:

Plan.	Rank, 0-24	25-49	50-74	75-100	Withdrawn.
1	2*	12	7	1	3
2	17	19	7	3	0
3	19	13	7	0	1

The sedond plan is clearly inferior to the other two, altho when the work of succeding years was considered the selectivity tended to increase greatly. The third plan gave better results than either of the first two, altho the intelligence scores gave better predictive effects with the advanced classes. Using the third plan, student records for two full years showed one "above average" for nine "below average" for the group considered, withdrawels counting as below average.

The following is inserted from the Manual of Scholastic Aptitude Tests by The College Entrance Examination Board:
"A combination of board examinations, school records, and test scores, worked out at Princeton, gave an actual correlation of .75 with academic grades over a period of two years, indicating the presence of an admission criterion correlating about .80 with academic success for all applicants."

None of the measures used at the V.P.I approached this predictivity and none developed any sharp distinction. We have at present, however, low high school grades occurring with good college grades, in English at least, and the successive terms in English show considerable discrepancy. Presumably physical condition is responsible for part of this.

There are not the data at hand for discovering the possible results at the V.P.I of such combinations as are described above. As noted, our high school records must be affected by known variations of standard. With all the discrepancies found to make selection imperfect, it would seem that the only present basis for policy in college entrance requirement is one of cost and probable return, to pupil and college, with a limit somewhere the point of diminishing returns.

High School English Teaching.

It is desirable to draw any deductions as to the methods of high school English teaching that may be shown by the data.

The need for one "sub-freshman" course certainly indicates deficient attainment for a considerable part of the class. The judgement of the department head was, "They need more formal grammar; they do not know how to make sentences." It has also been urged in some quarters that drill in parsing, etc., developed the analytical faculties.

If the deficient pupils came from classes where English was generally deficient, then more time given to training would not be unjust to brighter pupils. Aside from more careful and skillful teaching, the question is one of the returns to be gained from more time to be given certain lines. If the backwardness of the class as a whole is due to low average intelligence, the returns will be proportionately low with all subjects, but not to the same degree with all subjects.

A survey of some western schools for attainment in arithmetic showed that, with extreme variation in method and result, the factor of time given to the subject was submerged in other factors. With the present demand for time for diverse purposes, it is important to remember that school time given to drill is only one factor in the development of a capacity, and a diminishing factor beyond a certain point. Probably a chief demand from other college departments would be for the capacity to read and understand English, something akin to the analytical faculty. But this faculty is usually considered not as an attainment, but as a mental endowment, capable of considerable cultivation.

The disproportionate number of failures in the lower English groups indicates a low rate of increment in a course supposed to be adapted to their needs; but there are also many good grades of students who started from a low initial attainment as measured by the test. It is also to be considered that freshmen represent a selected group of high school graduates, in which selection interest is highly important.

The need of better English in many schools is therefore clearly indicated. There is nothing in the data here to indicate the method of teaching needed, more formal grammar or other method, but it may be assumed that with the demand from other subjects, not too much time will be given.

Practice in reading "to get the idea" is a development in many schools, and noted at Blacksburg as particularly successful. This begins in the lower grades. The agricultural class study lesson is also practice along this line.

High School Grading.

Tha narrow range of high school grades is an obvious cause Of overlapping and consequent confusion. The coefficient of distribution of all these grades represented in the freshman course was .054 That for the college letter grades was .17 In the high school grades sigma equals 4.5 and the mean 83.7 Therefore two thirds of the grades are from 79.5 to 87.5, and even a small variation of standard would reverse grade as between schools.

The Cross test correlates .48 with average high school grades in English. This approaches all we could expect with the conditions just noted, but the correlation broke down in the region of the low test scores. Therefore the inaccurate grades appear localised in the schools of low attainment standards. The history of low test scores in the college work indicates a low rate of progress on the average. The University study considered cases from classified groups of preparatory schools and reported as follows; "Any given group did about as well or as poorly in the more distinctly psychological tests as in the tests of subject matter." The trend of all the data in general is toward a grouping of low attainment scores, low psychological scores, unreliable high school grades, and low college success.

We have to consider the actual problem of a teacher who may have a class of low I.Q. This class may be augmented by repeaters from the class above, but probably not by acceleration from the class below because there is little acceleration in fact. The natural and probably the proper course for the teacher to pursue is to adapt the amount and character of the work to the class capacity. Grading will approach a ranking, and any attempt to impose a standard will require strong support from authority and precedent. The effect of a high standard under certain conditions may be that of unfortunate discouragement to interested pupils.

In so far as the function of such a class is to prepare pupils for higher schools, it can give no better preparation than the modified course mentioned above, unless to exceptional pupils. The deficiency then is in the opportunity for pupils much above the local average, and in the grades compared to a standard. The ideal of equal opportunity for all is not an ideal of equal standards, and the local class is as much entitled to a course fitted to local needs, as is the special class in a large school with segregated groups.

A state wide standardised course must be predicated on a certain evenness of material in human form. Elimination from a class to this end may leave any residue down to zero. The large schools have wisely sought relief by diversity of course and by

special segregated classes. The rural school can have little diversity and the group type is nearly fixed by the majority. Repetition of a standard grade course for two years hardly meets the needs of the pupil, tho a reduced number of studies may, in some cases. The age of these slow pupils is also to be considered and the question whether high school graduation should be made unattainable for most of them.

The necessary inference from all this woud seem to be, that a state system must assume local and temporary variation in class material; that courses taught will be modified accordingly; and that grades given will be uncalibrated if a ranking basis is tolerated. Any lowering of standard should be accompanied by an acceleration of bright pupils thru the grades. Also an attempt to make the system more elastic would call for an independent measure of ability as a guide. The effect of a standard exam would be a continual redistribution of classes, with or without discretion.

The above is in effect an apology for grades not warranted by state standards, but evidently such grades are not a departure from the present practice. The problem from the college standpoint seems to be not in the natur of the course offerred to high school pupils, but in the credits for college entrance from such courses, and this must always be a subordinate consideration in high school work.

It is true that there is in New York the example of the state regents exam, which is charged with making a system of education subordinate to a system of grades. But any degree of real local autonomy will tend to make the grades subordinate.

The following suggestions, obtained from various sources, are offerred as aids to meet local conditions:

1 A reduced number of studies to be carried by some pupils of slow attainment.

2 Much more acceleration thru grades of exceptionally bright pupils.

3 A direct measure of intelligence, systematically used as a guide to pupil tasks and available for college inspection.

4 The junior high school type of curriculum.

5 A final year preparatory to college in some school suited to that purpose.

6 High school graduation to be independent of fitness or certification for college work.

Reliability of Grades.

It seems a proper part of this study to estimate the reliability of the means of grades considered. The chemistry freshman third term grades for two years are at hand and the means are 69.4 in 1925 and 65.3 in 1926 with numerical grades. The formula offerred by McCall for the chance variation of a difference is;

$$\text{S.D.(= sigma) Diff.} = \sqrt{\left(\frac{\text{S.D. Measure I}}{\sqrt{N}}\right)^2 + \left(\frac{\text{S.D. Measure II}}{\sqrt{N}}\right)^2}$$

Substituting for the two chemical grades we have;

$$\text{S.D. Diff.} = \sqrt{\left(\frac{17.6}{\sqrt{238}}\right)^2 + \left(\frac{15.2}{\sqrt{292}}\right)^2} = 1;42$$

Three times the standard deviation is taken as practical certainty, and three times 1.42 equals 4.26, just over the grade difference. Therefore the difference is substantially impossible if errors of sampling are considered alone, and half the difference would be improbable.

There were in fact small factors known that might affect the grades, but the writer feels unable to have formed an estimate of either the direction of amount of any change from a knowledge of the conditions. There is also the possible influence of changing factors which affect the freshman personnel, since the formula considers only the tidal effect of chance movement of permanent factors, and not a change of factors.

The example indicates that any deductions from a difference of grades such as the above must be very cautious. There are at hand figures compiled in 1920 by Mr Hibsman, showing comparative grades for the agricultural groups of the freshman class and for pupils from agricultural high school classes. These grades show differences up to three or four points, and in general in favor of the agricultural work. But sigma, computed for these smaller groups, is about two, and there differences in the courses graded. In the absence of any direct measure it seems that such differences can be no more than suggestive.

The Cross Test furnishes a direct measure for attainment in one subject. The mean score for agricultural groups was 101 and the mean of total scores 123.0 In this case the standard deviation of the difference was 2.5, and the difference must be significant of training or special ability, perhaps of high school grading, in the cases considered.

Effect of School Age on Grade Averages.

The state report on elementary schools calls attention to the effect of "number of years in school" on data for the progress of pupils. The younger pupils in any grade commonly raised the grade score for attainment, and of course promotion policies affected the number of years required to reach any given grade. A grade mean of attainment therefore does not represent a rate of progress, credited to either pupil or teacher, unless the number of years required are considered.

This variable factor may explain some of the discrepancies in the correlation of intelligence and attainment, It would presumably bear on the question of college and high school correlations as well.

If a strict standard is to be maintained the age for grade and average high school graduation age will vary inversely with intelligence. But if the graduation age is to be kept down to some age suitable for the conditions of local community life, the standard will vary. It was noted that in a personal survey of four local high schools, the two smaller schools, of lower mean intelligence quotient, showed no consistently greater age for grade than the two larger schools.

In one case in the above survey a pupil of intelligence quotient 112 showed an evident history of lack of opportunity. But in most cases the retarded pupils had a low quotient. The average age of high school seniors found was 17.4 years, figured for Sept 1st. The average age of V.P.I. freshmen was given at the Deans office as 18 years and 10 months.

Conclusions.

(The conclusions below are based on the data mentioned and their validity is limited to this extent.)

The predictive value of such tests as the Cross and the Iowa State tests is demonstrated. Scores of such tests, or of more comprehensive tests, should be available to the course adviser. The long range effect is significant.

The data considered show a wide variation in the preparation of college freshmen, and an equal variation in ability.

The segregation of English class groups at the V.P.I. is apparently beneficial and necessary because of uneven preparation. The permanent effect does not equalise training, preparation in the subject, or the requirement for college promotion.

We need some measure of ability. The nearly complete absence of correlation between high school grades and the Thurstone test, and the low correlation between such grades and college grades, show that ability is not sufficiently indicated by our college entrance requirements. Presumably we are offering lower standards for entrance to graduates of small high schools than to graduates of large city schools.

The privilege of selection of students for college work must be accompanied by the responsibility. It is unfair to make the high school course a college preparatory course, or to make graduation depend on college fitness. The co-ordination of college and high school should be on of co-operation, rather than one of common function and universal transfer.

The present college grades in the subjects considered do not show the presence of a superior fraction characteristic of the curve usually assumed. This might result from the grading system or from some factor of selection in the student body. The presumption is that the grading is defective, and that this should be modified to show more discrimination between the good and the best.

High school grades have a narrow range, a considerable proportion of unreliable grades, and indicate attainment better than ability. Direct standard measures of both intelligence and attainment are needed.

The difficulties surrounding high school grading are such as to make grades imperfect for predicting college success. The variations in both attainment and ability are largely unmeasured and probably unappreciated.

CROSS ENGLISH TEST

By E. A. Cross, A.M., Ph.D.

Professor of Literature and English and Dean
State Teachers College, Greeley, Colorado

MANUAL OF DIRECTIONS

Purpose of the Test

The Cross English Test is designed primarily for high school seniors and college freshmen, to measure their ability to use the correct grammatical forms of English and acceptable sentence structure in speaking and writing. It is suitable, however, for all grades of junior and senior high schools.

The day has passed when high school teachers or college instructors will regard themselves as capable of judging the ability of students in the use of English without the aid of scientific measurement. It is generally conceded that the teacher's judgment of a student's ability in any subject, when supplemented by a knowledge of the score of the student in a standardized test in that subject, is far more likely to be accurate than when not so supplemented. The present test is not intended to take the place of judgment of ability on the part of the instructor, but to aid him in making that judgment — to furnish an objective, impartial measure of ability, one not subject to the so-called personal factor in judgment.

The purpose of the test is to obtain an accurate, objective measure of the ability of a student to use correctly the common English forms in order to compare the ability of the individual with others of the class, to determine the special needs of the students for certain kinds of instruction, to measure the progress of a student or a class in learning the correct forms of English, to compare the ability of one class with that of another, etc. The teacher may compare not only the relative progress of different individuals but also the relative efficiency of different methods of instruction.

Nature of the Test

The Cross English Test is issued in three similar and equivalent forms, designated as Form A, Form B, and Form C. The test covers the use of the expressions commonly employed in speaking and writing. It makes no attempt to test the student's knowledge of authors and pieces of literature; neither does it touch upon paragraph writing, the construction of a whole composition, or upon the finer points of rhetoric. Its field is the sentence, the fundamental unit of composition. The author has observed that there are certain "key" errors. The person who pronounces *then* as if it were spelled *thin*, or says genu*wine* and *labatory*, or writes *fourty* and *seperate*, will

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probably exhibit all the way through the test similar evidences of crudity or lack of education. In every section of the test the author has drawn upon his extensive observation of what young people say and write, and has selected as far as possible these " key " errors. Care has been taken also to introduce no item concerning which there is doubt or difference of opinion.

Some sacrifice has been made in order to reduce the whole test to objective forms. The author is well aware that students will not make exactly the same errors in choosing the correct spelling of a word from two possible printed spellings, or in choosing the correct pronunciation of a word from two printed phonetic spellings, that they would make if they were writing the spellings from oral dictation or orally pronouncing a series of printed words. But the large advantages of a wholly objective test more than compensate for the slight disadvantages which accompany the selecting and checking of printed spellings and pronunciations.

The obvious errors of the uneducated person in spelling, in pronunciation, in the recognition of what constitutes a sentence, in punctuation, in the use of the past tense and past participle forms of verbs, in the use of nominative and objective forms of pronouns, in the use of English idioms, especially those involving a choice of prepositions, and in a few other commonly recognized miscellaneous faults are the materials from which this test is made. These are all of the common and typical errors, and all of these are fully represented in each of the three forms of the test.

Standardization

The test in various preliminary forms has been used by the author for the past six years as an exemption test for college freshmen. High school graduates coming into college wished to be excused from taking the required elementary course in English composition. Tests were made up for these groups. These were kept in mimeographed forms, and finally the best items of all of them were combined into two printed forms which were used for three years. Some additions were then made to the two printed forms and the whole thrown together into one, which was then divided into three tests by taking the first, fourth, seventh, etc., item for Form A; the second, fifth, eighth, etc., item for Form B; and the third, sixth, ninth, etc., item for Form C. Thus difficulty was equalized in the three forms.

An investigation was made of the correspondence between unweighted scores and scores obtained by weighting the various sections of the test in such a way as to give more weight to those containing fewer items. The correlation between weighted and unweighted scores, however, was found to be .99 for college freshmen. It was decided, therefore, to use unweighted scores in the interest of simplicity.

Uses of the Test

Diagnosis. For a number of reasons it is desirable to have an accurate measure of the ability of a student in English, in comparison with that of the other members of the class. Thus, knowledge obtained at the beginning of the course will enable the teacher to know earlier than is otherwise possi-

ble which students are most in need of instruction and what kind of instruction they most need. Some students make many errors in pronunciation, others practically none. Some students are more lacking than others in the "sentence sense." Some need to give special attention to improving their spelling.

Classification. A wide range of ability between the best and the poorest members of a class encourages laxity and idleness on the part of the best pupils because they are not obliged to put forth their best efforts to keep pace with the average of a class. It also causes the depressing conviction among the slower pupils that effort is useless. No matter how hard they try, they cannot keep within hailing distance of the faster students. For this reason it is highly desirable to divide students into groups which are approximately homogeneous in ability. Thus a large group of students might be divided into three classes: the best third in one class, the third who represent median ability in another class, and the poorest third in another. When the abilities of the members of a class are approximately the same, competition is keener and instruction is very much easier than in a class including students of all levels of ability, since all may progress at approximately the same rate. A class of superior students is not held back by the presence of mediocre or inferior students, and, similarly, a class of inferior students may progress as slowly as is necessary in order to do thorough work without doing injustice to those who can progress more rapidly. Classification into homogeneous groups is advantageous both in high school and college.

Measurement of progress. An accurate measure of the ability of students of a class by one form of a test at the beginning of a term or year and by a second form at the end of the term or year furnishes a valuable measure of individual and class progress. By this means one may compare not only the relative progress of different individuals but also the relative efficiency of different methods of instruction.

College entrance examinations. The traditional entrance examinations in English have been found unsatisfactory for a number of reasons. It has been found that no two instructors will rate a composition or other examination paper of the usual type in the same way. It has also been found difficult to test a wide variety of aspects of English ability in the time available for the examination. The time required to read and grade the ordinary entrance examination in English is very great. The Cross English Test obviates many of the disadvantages of the older type of entrance examination in English. It is objective and must be scored in the same manner by all scorers. It covers a wide range of aspects of ability in English and can be scored in very much less time than the ordinary examination.

There has been a deepening conviction among college officials also that a high school diploma, as now frequently given, does not give assurance that the student has the ability in English to do satisfactory work in that subject or to warrant a college diploma without additional study in English. For this reason there is a distinct need for a new type of examination in English, such as the Cross test, as a college entrance examination in the use of correct forms in speaking and writing.

Comparison of classes. By means of a test, such as the present one, which can be given uniformly to students in different schools in different cities, it is possible for any teacher to know how his or her students compare in ability in English with students of the same status in other schools, both as they come into the school and as they leave it. A comparison of the progress of one's own students with the progress of students in other schools is also possible.

Teachers' examinations. Examinations for teachers' certificates given by commissioners of education and by state and county superintendents always include grammar. These examinations are usually based upon technical grammar facts which may be learned without affecting the speech or writing of the student. The real purpose of the examination is to determine whether the applicant for a teacher's certificate speaks and writes the English language well enough to qualify him to appear before children as a teacher. This can be determined much more effectively by the use of the Cross English Test than by the old type of grammar examination. The test is recommended for that purpose. The facts that it is in three forms, providing different tests for different examination dates, that it is scored uniformly, and that it tests the knowledge the examiner really wants to test, make it a very desirable substitute for the old form of grammar examinations.

Exemption. The test may also be used for selecting students for exemption from the required freshman English course in colleges where this course deals with grammar and composition only; or, combined with a test covering the external facts about authors and pieces of literature, it may well be used as an exemption test, no matter what the nature of the course may be. It is suggested that a certain score be determined upon as the exemption level, and that any student having reached that level be exempted at once upon entrance into college from taking the required freshman English course. Others reaching that level at the close of the first semester, or at the end of the first or second quarter, should be exempted from taking the remainder of the course. But the exemption principle should apply as well to those who do not reach the required level at the close of the freshman year. Such students should be asked to repeat the course until they can pass the Cross test with a satisfactory score.

Directions for Administering

The test may be given to any number of students at one time. Each student should have a sharp pencil with an eraser, and no other equipment. The students should be seated at school desks or in tablet armchairs a sufficient distance apart so that they cannot communicate with each other or see other papers than their own. After the students have been seated and all adjustments made, say:

"We shall now pass out the test booklets. As soon as you receive one you may begin filling the blanks in the upper part of the first page, giving your name, class, etc. When you have finished, lay your pencil down and wait for further directions. Do not open or turn over the booklet."

Have a test booklet laid right side up on the desk before each student. Allow time for all to fill the blanks; then say:

"The time allowed for this test is 45 minutes. You need not hurry. The time is ample. First, go through the test rapidly, checking all the items you are sure of; then go back over it, using the remainder of your time upon items that you need to think over. Do not allow yourself to become excited or nervous. There is time enough for the whole test. Each part is preceded by directions telling exactly how to answer the questions. Read these carefully before you begin to answer the questions. Let all marks be definite so there will be no mistaking your answer. Now turn over to Part I and begin."

At the end of exactly 45 minutes, say, "**Stop,**" and have the papers collected at once.

Directions for Scoring

A Key containing the right answers is furnished with each package of test booklets. The Key is arranged so that the correct answers to each column may be brought adjacent to the responses. The manipulation of the Key is slightly different from the usual method and is described below.

To score the test, compare each response with the correct answer, and, using a colored pencil, place a check mark after each correct response or a cross after each incorrect response, or both checks and crosses.

In all cases except that of Part IV, Punctuation, each item is numbered and the maximum score corresponds to the highest number in the part. In Part IV, however, each correct punctuation mark (period, comma, semicolon, colon, beginning quote marks, ending quote marks, dash, or question mark) or capitalization counts as one point. Since the number of punctuation marks is not the same in the three forms, a perfect score in Part IV is arbitrarily called 30 points. Hence, deduct from 30 points the number of errors made; the remainder is the score.

Each correct punctuation mark omitted and each punctuation mark wrongly entered (either where there should be some punctuation or where there should not) counts as an error. For example, failure to place the period after "difficult" in Item 8 in Form A counts as an error, and failure to indicate that "did" should begin with a capital counts as another error. To place a comma after "sound" in Item 10, for example, instead of a semicolon, or to enter any punctuation mark not indicated in the Key counts as an error.

In certain cases — as, for example, Item 9 in Form A — certain alternative responses are counted as correct.

It is suggested that Part IV be scored by drawing a line with a colored pencil diagonally through each error (omission or wrong punctuation). The marks thus made may then be counted (or may be counted as made) and the number subtracted from 30. The result is the score in Part IV.

Enter the score in each part in the lower right-hand corner of the page.

The manipulation of the Key is very simple when one has become familiar with the method and when the creases which are to be made in the Key have been broken in a little. Before attempting to use the Key, lay the sharp edge of a ruler along each of the four vertical lines and bend up the Key so as to make a crease on that line. Then turn the Key over and bend it up on each line on the other side. Each of the four creases must work freely both ways.

When the Key is being used, it is folded on only one crease at a time. Begin by laying the Key down wrong side up and folding back one column at the right. This will expose the answers to the first column of Part I. Score that column; then draw this flap over to the left, exposing the next column of answers; and so on until Group D of Part III has been scored.

It is suggested that Part IV be scored next by simply turning over the whole Key while unfolded. Next score Group E, beginning with the fold at the left, and continuing in the same manner as before. It will be seen that after scoring Part VIII with the Key unfolded, the Key is ready to turn over the fold at the right and begin the next paper.

Recording Scores

Class Record. There is included in each package of examinations a Class Record on which the scores of 50 students may be entered for convenience in filing. This is to be kept by the examiner or school principal. When filling in the data, a carbon copy should be made on the attached Report to Author.

Report to Author. The establishment of reliable norms awaits the receipt of data from examiners. A sheet called the Report to Author is provided in each package of examinations for reporting scores to the author. This is to be a carbon copy of the Class Record. Coöperation of examiners in aiding in the establishment of comprehensive norms by sending reports will be appreciated both by the author and the users of the test. Address Professor E. A. Cross, care of World Book Company, Yonkers-on-Hudson, New York.

Interpretation of Results

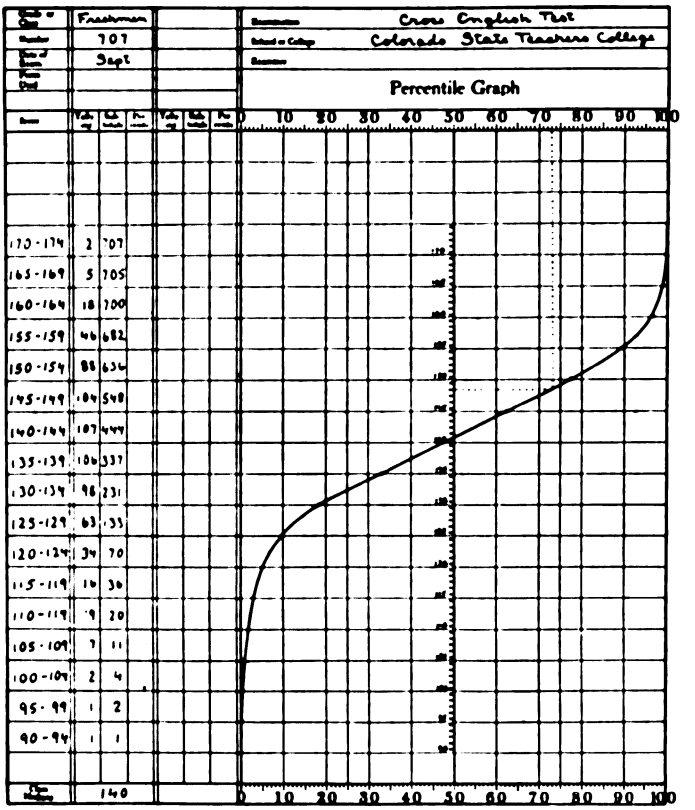
Tentative norms. The accompanying table gives tentative percentile norms based on a group of 707 entering college freshmen.

Tentative Percentile Norms

A student scoring 155 exceeds 90% of entering freshmen	
A student scoring 149 exceeds 75% of entering freshmen	(Upper quartile)
A student scoring 140 exceeds 50% of entering freshmen	(Median)
A student scoring 132 exceeds 25% of entering freshmen	(Lower quartile)
A student scoring 125 exceeds 10% of entering freshmen	

The percentile graph. The data given in the table are represented graphically in the accompanying figure, which is called a Percentile Graph. The curve drawn in the figure represents the whole of the distribution of scores of the 707 cases of which only selected percentile scores are given in

UNIVERSAL PERCENTILE GRAPH



the table. From the curve it is possible to determine the score that is exceeded by any given percentage of the 707 cases. Thus, the scales at the top and bottom of the chart indicate percentile ranks. The vertical scale is the scale of scores. In this scale the five scores in each interval are represented by the five graduations between each two horizontal lines. The curve cuts the 50-percentile line at approximately the point representing the score of 140. This means that 50 per cent of the 707 entering freshmen are exceeded in score by a student making a score of 140. The curve cuts the 40-percentile line at a height opposite the point on the vertical scale representing a score of 137, showing that a student making a score of 137 exceeds 40 per cent of the entering freshmen. A horizontal line drawn to the curve from the point on the vertical scale representing a score of 148, for example, meets it at a point representing a percentile rank of 73 according to the scales at the top and bottom. This means that a student making a score of 148 has a percentile rank of 73 among entering freshmen. In a similar way the percentile rank of a student making any other score may be found.

It will be helpful in interpreting the scores of one's own class to draw a percentile curve representing them, similar to that shown in the figure. This may be done on the Universal Percentile Graph,[1] of which the figure

[1] Published by World Book Company, Yonkers-on-Hudson, New York.

is a reproduction. Complete directions for drawing and interpreting percentile curves accompany the graphs.

The percentile curve drawn for one's own class will show at a glance the median score of the class, the percentile rank of any student among its members, etc., as well as the comparison between the class as a whole and the group of students on whom the norms are based. Curves representing the scores of two or more classes may be drawn on the same graph and conveniently compared.

Practice Effect

A careful study has been carried through in order to determine what allowance should be made for practice effect. The effect was found to be so small as to be almost negligible. Students with high intelligence scores showed no practice effect at all. Students with low scores showed a slight practice effect, a median gain of 4 points in the second test over the first, and no gain for the third test over the second.

Correlation of Test Scores with Intelligence

A comparison of test scores with scores for intelligence (Thorndike College Entrance Intelligence Test) was computed for 98 students. The correlation is .63. This is low enough to show that the test measures an ability that is quite apart from intelligence.

Reliability of the Test

The average correlation between two forms of the test was found to be .70 for college freshmen. From this coefficient the probable error of a score was found to be 6 points. This means that the chances are even that any student's score is correct within 6 points.

Acknowledgments

The author of the tests is greatly indebted to Dr. J. D. Heilman, Head of the Department of Psychology in Colorado State Teachers College, for directing the statistical work necessary in standardizing the tests; to three students in statistics, Mrs. Margaret Sanderson, Mr. John Albright, and Mr. Clark Frasier, for much patient and accurate statistical work; to his colleagues, the members of the English department, for their friendly cooperation in giving and scoring tests; and to the hundreds of students who have lent themselves during the past six years as more or less willing subjects to be practiced upon. Special mention should be made of the invaluable assistance rendered by Dr. Arthur S. Otis in the way of suggestions for standardizing the test and for making up the Manual, and in devising the Key.

Name..... Age..... Sex..... Date.....
(print)

High school attended..... City..... College.....

IOWA FRESHMEN PLACEMENT EXAMINATIONS, Series CA1
(Tentative Edition)

CHEMISTRY—APTITUDE
DIRECTIONS

Do not write anything until told to do so.

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

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

PART 1

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

Answers

1. 17 is what fraction of 21? .....
2. 5 is what per cent of 50? .....
3. Solve: $\frac{16-5}{4}$? .....
4. Solve: $150 \times 273/300 \times 740/760 =$? .....
5. a—24, b—12, and c—4. Solve: $\frac{a-b}{c} =$? .....
6. 34/102 divided by 12/18 = ? .....
7. A farm of 63 acres is divided equally among 101 persons. What fraction of an acre does each person receive? .....
8. If a pound and a half of candy costs a dollar and a half, what will one pound cost? .....
9. If a carload of coal weighs 60,000 pounds and the coal is 2% sulphur, how many pounds of sulphur are in the coal? .....
10. If Cedar Rapids is 28 miles from Iowa City, and one kilometer equals 2/3 of a mile, what is the distance between these towns? .....
11. A sample of flour weighing 6 grams, on drying loses 2 grams of water. What per cent water was the original sample? .....
12. If 10 gallons of ice cream are needed for a party of 75 persons, how many gallons are needed for a party of 250 persons? .....
13. If coal contains 3% sulphur, how many tons of coal will be needed to get one ton of sulphur? .....
14. Solve for x: $\frac{18.3}{12.2} = \frac{21.9}{x}$ .....
15. Solve for T_1: $(Q_1 - Q_2) = \frac{(T_1 - T_2)Q_1}{T_1}$ .....

PART 2

Directions: Below are three paragraphs taken from a chemistry text-book. Beneath each paragraph are six statements. Read paragraph I, then examine the statements beneath it. *Every statement is to be compared with the material in the paragraph.* If the statement is *true,* place a T after it on the dotted line; if the statement is *false,* place an F after it on the dotted line.

Then proceed in a similar manner wih the other two paragraphs, placing a T or an F after each statement under the paragraphs.

Under each paragraph, statement No. 1 is already properly marked.

Paragraph I

The density of iridium is 22.4; it is more dense than platinum. The melting point of platinum is 1755°; it is more easily melted than iridium. Iridium is silver-white, hard, brittle, acid-resisting. Platinum is grayish-white, harder than gold, a good conductor of electricity.

1. Iridium is more dense than platinum. ....T....
2. The melting point of iridium is higher than 1550°. .....
3. Platinum is whiter than iridium. .....
4. Platinum is a hard metal. .....
5. Platinum is a better conductor of electricity than iridium. .....
6. Acids do not easily attack iridium. .....

Paragraph II

Thorium has an atomic weight of 232.15 and a density over 20; it occurs in monazite sand, is heavy, grayish-white. It is rarely found as pure metal. It is used in gas mantles. Tungsten is found in rather large quantities in the ore called scheelite. Its density is 18.72 and melting point 3400°. It is used to temper steel, and in electric light filaments.

1. The density of thorium is 18.72. ....F....
2. The atomic weight of tungsten is higher than that of thorium. .....
3. Tungsten is fairly common. .....
4. Thorium and tungsten are very useful commercially. .....
5. Small particles of metallic thorium are mixed with a sand called monazite. .....
6. Thorium is probably very brittle. .....

Paragraph III

Radium shoots off the following three types of rays: (1) Alpha rays—these are atoms of helium shot off at velocity of 30,000 kilometers per second, but they cannot penetrate even thin paper; (2) Beta rays—these are electrons, and more penetrating than Alpha rays; (3) Gamma rays—these are X-rays and can penetrate thick layers of metal. Radium is found only in the ores of uranium. Pure radium would be worth about $125,000 per gram.

1. Radium shoots off three types of rays. ....T....
2. It would be possible to stop some of the rays with a metallic plate. .....
3. On rare occasions radium is extracted from vanadium. .....
4. It is extremely difficult to stop waves traveling 30,000 kilometers per second. .....
5. Radium-lighted watch dials that can be seen in the dark must contain an extremely small amount of radium. .....
6. Gamma rays penetrate more readily than alpha rays. .....

PART 3

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

Read the passage as often as necessary.

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

The Daniell Cell serves as an illustration of the most familiar [1] types of cells. In this combination [2] two plates, one of [3] copper and the other of [4] zinc, each fashioned so as to have a large surface, are arranged in a glass jar. [5] The electrolyte in contact with [6] the zinc plate, is [7] zinc sulphate, while that in contact with the [8] copper plate is [9] copper sulfate.

[10] The action of the Daniell cell can be explained as follows: [11] The zinc atoms have a tendency to give up to [12] the zinc plate A [13] two electrons each, and to pass into solution as [14] zinc ions, the force urging this change being designated as [15] solution tension. But since the [16] zinc ions are positively charged, and their formation leaves [17] the zinc plate [18] negatively charged, [19] the accumulation of these charges soon produces [20] an equilibrium by the attraction of the zinc plate for [21] the positive ions. Copper ions, on the other hand, [22] tend to leave the solution because of their [23] osmotic pressure, and to deposit as [24] metallic atoms upon the copper plate B, [25] each copper ion recovering [26] two electrons from [27] the copper plate. Since this process results in [28] charging the copper plate positively, the accumulated charge soon produces [29] an equilibrium by repelling [30] the positive copper ions. [31] If now the two plates are joined by a wire, the excess electrons on the [32] zinc plate flow through the wire to make up the deficiency upon [33] the copper plate. This prevents [34] an accumulated charge on either plate and results [35] in a current through the wire. [36] The chemical action taking place is represented by the equation:

(zinc)	(copper sulfate)	(copper)	(zinc sulfate)
[37] Zn	+ [38] $CuSO_4$	= [39] Cu	+ [40] $ZnSO_4$ + 50,100 cal.

in which nearly all the heat is transformed into [41] electrical energy. [42] The reaction ceases when the wire connection is broken.

The order of the metals in the electro-chemical series is the [43] order of intensity with which the metals tend to pass into ionic form. [44] Any two metals in a suitable electrolyte will constitute [45] a cell in which [46] the metal highest in the series is the negative pole and [47] the lower one the positive. As a rule, only a part of the [48] chemical energy is converted into [49] electrical energy, [50] the remainder being transformed into heat.

Answers

.10. 1. What does this passage explain?

..4.. 2. One of the two metallic plates is copper. What is the other?

.... 3. What electrolyte is in contact with the zinc plate?

.... 4. What force makes the copper ions leave the solution?

.... 5. What force causes zinc to go into solution?

.... 6. What becomes of the chemical energy which is not converted into electrical energy?

.... 7. Is the zinc plate positively or negatively charged?

.... 8. What metals can be used in making an electrolytic cell?

.... 9. Do zinc ions carry electric charges?

.... 10. What is deposited on the copper plate?

.... 11. Does the formation of zinc ions continue indefinitely?

.... 12. Under what circumstances do the excess electrons leave the zinc plate?

.... 13. What does each copper ion receive from the copper plate?

.... 14. What is the formula for for copper sulfate?

.... 15 .What do the copper ions tend to do?

.... 16. What is the final form of the zinc?

.... 17. In an electrolytic cell, which metal will be the negative pole?

PART 4

Directions: Examine each statement below and decide whether it is true or false. If the statement is *true*, place a T after it on the dotted line; if the statement is *false*, place an F after it on the dotted line.

Samples: Gold is heavier than iron ....T....

Stone will float on water. ....F....

1. Lead is difficult to melt. .....
2. Most metals conduct electricity. .....
3. Matter cannot be destroyed. .....
4. An atom is about the size of a pin-point. .....
5. Plants breathe in oxygen. .....
6. Concrete will dissolve in water. .....
7. Common salt is a chemical compound. .....
8. Ice melts at 32° Fahrenheit. .....
9. Some coins are made of pure gold. .....
10. Gasoline is very inflammable. .....
11. Matches contain phosphorus. .....
12. Snowflakes often form crystals. .....
13. All gases must have weight. .....
14. Steel will not rust. .....
15. Heat can pass through a vacuum. .....
16. An acid usually has a sweet taste. .....
17. Electricity never travels through the air. .....
18. Heat may be generated through friction. .....
19. Burning really means combining with oxygen. .....
20. Heat is a form of matter. .....
21. Radium was discovered by Thomas A. Edison. .....
22. Solid iron is, in a sense, "frozen" iron. .....
23. Water boils at 100° Fahrenheit. .....
24. Water is composed of hydrogen and chlorine. .....
25. A man associated with radio is DeForest. .....
26. Wrist-watches are visible at night because of radium. .....
27. Incandescent means capable of conducting electricity. .....
28. Electric light filaments are made of tungsten. .....
29. Charcoal is a good example of the chemical element carbon. .....
30. A liquid tends to take the shape of the vessel which contains it. .....
31. A molecule is the smallest drop of water that can be seen. .....
32. Mercury contracts when heated. .....
33. A block of aluminum will float on water. .....
34. The warmer air tends to rise to the top of the room. .....
35. Zinc can be drawn into a fine wire. .....
36. Photographic films are covered with a silver salt. .....
37. One of the best conductors of electricity is lead. .....
38. Vinegar should be kept in tin cans. .....
39. The ordinary household thermometer gives degrees Centigrade. .....
40. Dissolving means breaking up into extremely fine particles. .....
41. There is a close connection between burning and rusting. .....
42. The modern electric light gives light without heat. .....
43. Rubber is a poor insulator against electricity. .....
44. Platinum costs five times as much as gold. .....
45. A motor is used to generate electricity. .....
46. Radium rays affect photographic plates. .....
47. The like poles of two magnets attract each other. .....
48. All living matter contains carbon. .....
49. An alloy is a solution of metals. .....
50. Gold leaf can be made that is much thinner than tissue paper. .....

Name..... Age..... Sex..... Date.....
(print)

High school attended..... City..... College.....

IOWA FRESHMEN PLACEMENT EXAMINATIONS, Series CT1

(Tentative Edition)

CHEMISTRY—TRAINING

DIRECTIONS

Do not write anything until told to do so.

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

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

PART 1

Directions: Examine each statement below and decide whether it is true or false. If the statement is *true*, place a T after it on the dotted line; if the statement is *false*, place an F after it on the dotted line.

Samples: Water is a chemical compound. ....T....
Nitrogen burns readily. ....F....

1. Burning is always a chemical change. .....
2. Absolute zero is —273° C. .....
3. The calorie is a unit of electricity. .....
4. Gunpowder is a good example of a chemical compound. .....
5. A meter is approximately 6 ft. .....
6. Brine is a chemical compound. .....
7. The discoverer of oxygen was Ramsay. .....
8. Nitrogen is a very active element. .....
9. All living matter contains carbon. .....
10. A kilogram is equivalent to about 10 pounds. .....
11. Bronze is a useful chemical element. .....
12. The molecules remain unchanged during chemical action. .....
13. Electrons are much smaller than atoms. .....
14. Ozone is an odorless gas. .....
15. Examples of rare elements are Mn, Ni, and Sn. .....
16. The souring of milk is a purely physical change. .....
17. The energy of moving bodies is called kinetic energy. .....
18. The symbol for antimony is Sb; for arsenic, As; for Bismuth, Bi. .....
19. Iodine is easily sublimated. .....
20. The atmospheric pressure is about 15 pounds to the square inch. .....
21. Carbon monoxide is a very poisonous gas. .....
22. The measure of the earth's attraction for a body is called weight. .....
23. A chemical reaction always involves combination or decomposition. .....
24. Chemical action is usually lessened by an increase in temperature. .....
25. A gram is equal to the weight of a cubic centimeter of water at 100° Centigrade. .....
26. The same chemical element may exist as a gas, a liquid, or a solid. .....
27. There are known to be at least several hundred chemical elements. .....
28. Two of the rare gases in the atmosphere are argon and neon. .....
29. A liter contains a hundred cubic centimeters. .....
30. More than one element is required to produce chemical change. .....
31. The symbol for copper is Cu; for gold, Au; for silver, Ag. .....
32. Calcium is one of the most abundant elements in the world. .....
33. Chlorates always contain oxygen. .....
34. Removing oxygen from a compound is said to reduce it. .....
35. An electric current will pass through salt water. .....
36. Sodium colors a flame red. .....
37. Decomposition always accompanies electrolysis. .....
38. It is correct to speak of an atom of water. .....
39. Standard pressure is the pressure exerted by a column of mercury one meter in height. .....
40. Bromides never contain 0. .....
41. A catalytic agent enters readily into the chemical reaction. .....
42. Gelatine is an example of a colloidal substance. .....
43. Surface tension acts perpendicular to the surface. .....
44. Barium sulfate is easily soluble in most acids. .....
45. Under equal conditions of temperature and pressure the number of molecules in a volume of gas depends upon its density. .....

PART 2

Section A

Directions: Write the *valence* after each of the following elements.

Sample: Hydrogen .....1.....

1. Chlorine .....
2. Iodine .....
3. Barium .....
4. Aluminum .....
5. Nickel .....
6. Silver .....
7. Silicon .....
8. Mercury (mercuric) .....
9. Tin (stannous) .....
10. Carbon .....

Section B

Directions: Write the *formula* for each of the following compounds.

Sample: Water .....H_2O.....

1. hydrogen chloride .....
2. potassium chlorate .....
3. carbon dioxide .....
4. copper sulfate .....
5. potassium hydroxide .....
6. nitrous oxide .....
7. calcium carbonate .....
8. lime (unslacked) .....

Section C

Directions: Write the *names* for the following compounds.

Sample: NaI .....sodium iodide.....

1. H_2SO_4 .....
2. MnO_2 .....
3. N_2O .....
4. $C_6H_{12}O_6$ .....
5. NaOCl .....
6. $Ca_3(PO_4)_2$ .....

Section D

Directions: *Complete and balance* the following equations.

Sample: $Na_2CO_3+2C \rightarrow 2Na+3CO$

1. $KOH+HCl \rightarrow$ ..... + ...
2. $2NaOH+H_2SO_4 \rightarrow$ ..... + ...
3. $Ca(OH)_2+H_2SO_4 \rightarrow$ ..... + ...

PART 3

Directions: Examine each statement below and decide whether it is true or false. If the statement is *true*, place a T after it on the dotted line; if the statement is *false*, place an F after it on the dotted line.

Samples: Gold is heavier than copper. ....T....
Great copper deposits are found in Pennsylvania. ....F....

1. An immense amount of sodium carbonate is produced by the Solvay Process. .....
2. Free iron in nature is rare. .....
3. Iron pyrites is mined chiefly for its sulfur. .....
4. Pig iron is soft and pliable. .....
5. The Bessemer process is used to burn out the impurities contained in pig iron. .....
6. Tungsten steel melts too easily to be used in lathe tools. .....
7. Pittsburgh is a great steel city because it lies in the center of great iron ore deposits. .....
8. Passive iron rusts rapidly. .....
9. Wrought iron is soft, malleable, and ductile. .....
10. The first commercially successful sodium carbonate process was developed by LeBlanc. .....
11. Ordinary baking powder contains an atom of hydrogn. .....
12. Aluminum ore is found in only a few localities. .....
13. The two most abundant elements are oxygen and silicon. .....
14. Borax is the popular name for sodium tetraborate. .....
15. A colloidal condition is a state between suspension and true solution. .....
16. Small drops of liquid scattered through a second liquid constitute a foam. .....
17. A by-product of the Solvay process is calcium chloride. .....
18. Diamond is a form of amorphous carbon. .....
19. Free carbon is often found in nature.
20. Carbon fuses at about 500° C. .....
21. Carbon dioxide is effective in smothering fire. .....
22. Carbon dioxide is harmful to plants. .....
23. Elements are inactive during the nascent stage. .....
24. Compounds are marked "C. P." to show they are commercially pure. .....
25. A base is a compound containing a metal and one or more hydroxyl groups. .....
26. Nitrides are solids and react with water to form ammonia. .....
27. Nitric acid is prepared by the action of sulfuric acid upon sodium nitrate. .....
28. Alkalies change litmus from blue to red. .....
29. Sulfurous acid is a good bleaching agent. .....
30. In the contact process for manufacturing sulfuric acid an intermediary product is sodium sulfate. .....
31. In beginning the lead-chamber process for making sulfuric acid sulfur dioxide is reduced to sulfur. .....
32. Chamber sulfuric acid is practically chemically pure. .....
33. Cyanogen is a poisonous gas. .....
34. Commercially iodine is often obtained from seaweeds. .....
35. During the World War phosgene was used as an antiseptic. .....
36. Some of the naphthas make excellent fuels. .....
37. The chief supply of carborundum is produced in Utah. .....
38. Beautiful dyes can be made from coal tar. .....
39. The principal explosive used during the World War was trinitrotoluene. .....
40. Fire damp is the same as laughing gas. .....

PART 4

Directions: Solve the following problems, and place the answer to each problem on the dotted line at the right.

Do not spend much time on any one problem.

Use the margins of this page for figuring.

Answers

1. 7 gm. of iron unite with 4 gm. of sulfur. How many gm. of iron sulfide will be produced? .....

2. What volume would 100 cc. of oxygen, measured at 546° C. occupy at 0° C? .....

3. What volume will 10 cc. of hydrogen occupy when its pressure changes from 770 mm. to 700 mm? .....

4. A gas under pressure of 60 cm. has a volume of 440 cc. What will be its volume under a pressure of 80 cm? .....

5. Potassium chlorate is 39% oxygen. If 100 gm. potassium chlorate and 3 gm. manganese dioxide are used to produce oxygen, how many gm. potassium chloride remains in the flask? .....

6. Given 600 cc. of hydrogen at 27° C. The gas is heated to 77° C. How many cc. does it then occupy? .....

7. The atomic weight of K is 39; of Cl, 35.5; of O, 16. What is the molecular weight of $KClO_3$? .....

8. The atomic weight of a certain metal is 52. If 26 gm. of this metal replace 1 gm. of hydrogen from hydrochloric acid, what is the *valence* of the metal? .....

9. The atomic weight of Hg is 200; of O, 16. How many gm. HgO must be used to generate 2 gm. of O? .....

10. The atomic weight of H is 1; of Cl, 35.5; of Zn, 65. What weight of Zn will be needed to generate 10 gm. of H, using dilute HCl? .....

Name Fred Wise (Print) Age 19 Sex male Date Sept 17 1925

High School attended Highland Springs College Physics course and section D

IOWA PLACEMENT EXAMINATIONS, Series PA1

(Tentative Edition)

PHYSICS—APTITUDE

60

DIRECTIONS

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

PART 1

Directions: Place the answer to each question on the dotted line at the right. Use the margins this page for figuring. You have 15 minutes for Part 1.

Sample: $3x=15$; what does x equal? ....5....

1. $\frac{s}{t}=v$; what does s equal? ....vt....
2. $\frac{a}{b}=y$; what does b equal? ....$b = \frac{a}{y}$....
3. $m+n=a-b$; what does n equal? ....$n = a-b-m$....
4. $v^2=2gs$; what does v equal? ....$v = \sqrt{2gs}$....
5. $a^2=b^2+c^2$; what does b equal? ....$b = c-a$....
6. $ax=8$; what does x equal? ....$x = \frac{8}{a}$....
7. Solve for y: $\frac{y}{2}=3x^2$. ....
8. What is the mean of 4, 12, 2, 0, and 2? ....
9. What is the reciprocal of $\frac{x}{y}$? ....
10. What is the square root of 529? ....23....
11. Add: $\frac{1}{x}+\frac{1}{y}$. ....
12. Solve: $100x\frac{273}{300}x\frac{740}{760}$. ....
13. Solve for x: $\frac{18.3}{12.2}=\frac{21.9}{x}$. ....
14. Express verbally: .008. ....six thousandths....
15. Multiply 53.6 by 0. ....0....
16. Write with an exponent $\sqrt{a-b}$. ....
17. $k^2=1-q^2$; if q is ½, what is k^2? ....$k^2 = 1-\frac{1}{4}$....
18. Write as a decimal fraction 361 millionths. ....0.000361....
19. If $\frac{W}{W_2}=\frac{W_1}{W}$, what is the value of W? ....
20. What is 12% of .02? ....$a = \frac{12}{100}$....
21. $\frac{x}{y}=\frac{2a}{b}$; what does a equal? ....
22. If $c=p+q$, how much greater than q is c? ....
23. What is the cube of 9x? ....
24. What kind of proportion is represented by the statement "the more the pressure the less the volume?" ....
25. A man judged a distance of 50 yards to be 65 yards. What was his per cent of error? ....

End of Part 1.

83

PART 2

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

Proceed similarly with the other two paragraphs.

You have 15 minutes for Part 2.

PARAGRAPH I

Plastic bodies may be beaten into various forms, rolled into sheets, or drawn into wire. This is exemplified in the case of copper and platinum and in still higher degree in the case of gold. Substances which may be beaten into thin sheets are called malleable; those which may be drawn into wires are said to be ductile. Certain substances which are plastic at high temperatures are brittle at ordinary temperatures. Thus glass and quartz are extremely brittle at ordinary temperatures, yet when fused they may be drawn into threads of exceeding fineness. Quartz, especially, when fused, may be drawn into fibers so fine as to be invisible to the naked eye, yet capable of supporting relatively large masses, and possessing almost entire freedom from elastic after-effect. Plastic substances under great pressure behave as liquids.

1. Gold is malleable. ....T....
2. Most quartzes are ductile when cold. ....T....
3. Since watch-springs are fine wire, the metal of which they are composed must be very malleable. ....F....
4. Gold can be drawn so fine that the wire is invisible to the naked eye. ....F....
5. The material of a spider's web must be very ductile. ....F....
6. Substances are more likely to be plastic when hot. ....T....
7. Celluloid is an example of a plastic substance. ....T....
8. Under great pressure copper would flow through a pipe. ....F....
9. Some plastic bodies are not ductile. ....F....
10. Platinum can be rolled into thinner sheets than can gold. ....F....

Go on to paragraph II.

PARAGRAPH II

When an insulated neutral conductor is brought into contact with a charged conductor, some of the electricity will pass over to it, and it becomes charged by conduction. If two small spherical conductors be charged, they exert a definite mechanical force upon each other, which may be measured in terms of any unit of force. While investigating the attraction or repulsion between such spheres, Coulomb found the law that the force between two charged spheres is inversely proportional to the square of the distance between the centers of the spheres and directly proportional to the product of the charges, measured in some arbitrary unit.

1. A neutral conductor may be charged by conduction. ....T....
2. Spherical bodies exert electrical influence upon each other. ....T....
3. The greater the distance between the two charged spheres, the less the force between them. ....T....
4. The force between two charged spheres depends upon the diameter of the spheres. ....F....
5. The amount of electricity is measured by the ordinary units of force. ....T....
6. If you double the charge on each of two small equally charged spheres, the force between them is quadrupled. ....T....
7. An insulated neutral conductor cannot be charged by conduction. ....F....
8. Reducing the charge on one sphere reduces the force between the spheres. ....T....
9. Conduction will act across great distances if the charge be great. ....F....
10. Coulomb found that the neutral conductor received electricity from the charged one. ....F....

Go on to Paragraph III

PARAGRAPH III

A result of the rectilinear propagation of light is the formation of dark spaces in the rear of opaque objects of any size when exposed to a source of light. The dark outline of an opaque body projected upon a screen by a luminous point is called its shadow. Such an outline may be found by drawing straight lines from the luminous point to the screen past every point of the exposed surface of the body. The figure obtained is termed the geometrical shadow. If the source of light be very nearly a point, then all the light is cut off from the screen, over a certain space, which is called the umbra. If the luminous body have any dimensions, there will always be a ring of partial shadow surrounding the umbra. This is called the penumbra.

1. The dark spaces result from the small size of the illuminated object. ....F....
2. Transparent bodies would have no shadow. ....T....
3. The earth has a penumbra. ....T....
4. The penumbra is smaller than the umbra for most bodies. ....F....
5. Light is propagated along a straight line. ....T....
6. The shadow is deepest in the penumbra. ....F....
7. Outside the penumbra is a region of partial shadow. ....T....
8. The umbra is between the source of light and the illuminated object. ....F....
9. Geometrically the umbra is contained in the penumbra. ....T....
10. The size of the penumbra depends partly upon the size of the luminous body. ....T....

End of Part 2.

PART 3-A

Directions: Each of the following number series is made up according to a rule. Discover the rule for each example and write the next *two* terms on the dotted line.

Sample: x, 2x, 4x, 8x, ...16x..... .....32x.....

(You will have 10 minutes for Part 3-A and Part 3-B together.)

1.	128, 64, 32,	16	4
2.	$\frac{7}{30}$ $\frac{14}{23}$ $\frac{21}{16}$	$\frac{28}{9}$	$\frac{35}{2}$
3.	16, 31, 16, 30, 16,		
4.	3n, n^2, 4n, n^2,		
5.	$\frac{1}{4}$ $\frac{1}{3}$ $\frac{5}{12}$ $\frac{1}{2}$		

65

Go on to 3-B

PART 3-B

Directions: Below are 15 examples, each consisting of two statements. You are to assume that the statement beginning with the word "given" is true. Read the first statement in each example, and then examine the "conclusion." Decide whether the conclusion is true or false. If the conclusion is true, place a T after it on the dotted line; if the conclusion is false, place an F after it on the dotted line. *Do not guess.*

1.	Given:	A piece of cloth was cut into a number of squares, and no cloth was left over.	T X
	Conclusion:	Therefore the piece of cloth was square.	
2.	Given:	All platinum is white. Mary's watch is platinum.	T
	Conclusion:	Therefore Mary's watch is white.	
3.	Given:	A side of a square is equal to the longer side of a rectangle.	F
	Conclusion:	Therefore the area of the rectangle equals the area of the square.	
4.	Given:	A loan of one hundred dollars earns k dollars interest in one year.	T
	Conclusion:	Therefore the rate of interest is k.	
5.	Given:	A telephone pole casts a shadow longer than a lamp-post, and a tree casts a shadow four times as long as the lamp-post.	
	Conclusion:	Therefore the tree is taller than the telephone pole.	F
6.	Given:	A divided by B equals 10; A divided by C equals 5.	F
	Conclusion:	Therefore B is greater than C.	
7.	Given:	A is greater than B, B is greater than C.	T
	Conclusion:	Therefore A is greater than C.	
8.	Given:	A is greater than C, B is less than C.	T
	Conclusion:	Therefore B is less than A.	
9.	Given:	A times B equals C times D.	T X
	Conclusion:	Therefore A plus B equals C plus D.	
10.	Given:	a is greater than b.	T
	Conclusion:	Therefore the average of a and b is less than a.	
11.	Given:	a^2 equals b.	T
	Conclusion:	Therefore a is less than b.	
12.	Given:	Square A is circumscribed about circle O, and Square A′ is circumscribed about Circle O′. A is greater than A′.	T
	Conclusion:	Therefore O is greater than O′.	
13.	Given:	A divided by B equals 10, A divided by C equals 5.	T X
	Conclusion:	Therefore B is greater than C.	
14.	Given:	M is greater than N, N equals O, P equals M.	T
	Conclusion:	Therefore P is greater than N.	
15.	Given:	X equals Y; M equals 2Y.	F
	Conclusion:	Therefore M equals one-half X.	

End of Part 3.

PART 4

Directions: Examine each statement below and decide whether it is true or false. If the statement is true, place a T after it on the dotted line; if the statement is false, place an F after it on the dotted line.

Do not guess.

You have five minutes for Part 4.

1. Lead is difficult to melt. .....
2. All metals conduct electricity. .....
3. Yellow linen is whitened by rinsing in water tinged with blue. .....
4. Water contracts on freezing. .....
5. An atom is about the size of a pinpoint. .....
6. All gases must have weight. .....
7. Cast steel will rust. .....
8. Heat is a form of matter. .....
9. A man associated with radio is DeForest. .....
10. A molecule is the smallest drop of water that can be seen. .....
11. Rubber is a poor insulator against electricity. .....
12. The modern electric light gives light without heat. .....
13. Electric light filaments are usually made of tungsten. .....
14. A liquid tends to take the shape of the vessel which contains it. .....
15. Mercury contracts when heated. .....
16. A meter is about 3 yards. .....
17. Alcohol has a lower freezing point than water. .....
18. A barometer is a special form of thermometer. .....
19. Incandescent means capable of conducting electricity. .....
20. A motor is used to generate electricity. .....
21. Radio waves differ from light waves in length only. .....
22. Helium is inflammable. .....
23. An object is "top-heavy" if its center of gravity is too low. .....
24. In rounding a curve the inner railway track is slightly elevated. .....
25. A transparent prism will bend a ray of light. .....
26. On entering a river from the ocean, a ship sinks deeper in the water. .....
27. Water boils more readily on a mountain. .....
28. All sounding bodies are in vibration. .....
29. Gold leaf can be made that is much thinner than tissue paper. .....
30. Ice melts at 32° F. .....
31. Water sticks to a spoon because of molecular attraction. .....
32. If thunder follows lightning at an interval of 5 seconds the flash must have been about 10 miles distant. .....
33. Energy is the capacity to do work. .....
34. The pressure of the atmosphere is about 15 pounds to the square inch. .....
35. The image in an ordinary mirror is reversed. .....
36. A kilowatt is 100 watts. .....
37. Water rises in a pump because of atmospheric pressure. .....
38. An ordinary dry cell produces about 10 volts. .....
39. The earth magnetically affects a compass. .....
40. A transformer is used on a direct-current circuit. .....
41. The greatest source of heat is the sun. .....
42. A locomotive whistle apparently lowers its pitch on passing an observer. .....
43. Efficiency equals input divided by output. .....
44. Fuses are put in electrical circuits as a safety device. .....
45. Sound travels about 10 miles per second. .....
46. Pitch depends upon vibration frequency. .....
47. White light may be broken up into all colors of the rainbow. .....
48. If a clock loses time its pendulum should be shortened. .....
49. A kilogram is about half a ton. .....
50. The water pressure at any point on a dam depends upon the length of the dam. .....

Psychological Examination

For High School Graduates and College Freshmen

Prepared by L. L. THURSTONE, University of Chicago
Chairman of Committee on Personnel Research
National Research Council

SCORES	
Completion	
Arithmetic	
Art. Language	
Proverbs	
Reading	
Opposites	
Grammar	
Estimating	
Reasoning	
TOTAL:	
PERCENTILE:	

Name_____
(Last Name) (Given names or initials)

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For official use in accredited colleges
and universities
26 Jackson Place, Washington, D. C.

Completion

(Prepared by Prof. H. T. Moore, Dartmouth College)

You will have ten minutes in which to fill in as many of the missing words as you can. Think of the most appropriate word to complete each of the sentences. The number in each space indicates the number of letters in the most appropriate word for that space. Do not waste too much time on any one sentence, as you will be credited with one point for every word correctly supplied.

1. A (8) bachelor is an unmarried (3) man
2. An (6) adverb may be used to qualify a (4) verb or an adjective.
3. A (6) planet is any body, except a comet, that (8) revolves around the sun.
4. The word (8) latitude means distance measured in degrees (5) north or south of the equator.
5. An (4) oath may be either a mere expression of profanity or a solemn appeal to God as part of a judicial proceeding.
6. An (5) axiom is a truth so plain that no demonstration can make it plainer.
7. An (9) incubator is an apparatus by which eggs are (7) hatched artificially.
8. (11) bimetallism is the government policy of employing both (4) gold and silver as the standard of value.
9. A (12) somnambulist is a person who walks in his sleep.
10. An (6) albino is a person having a congenital lack of pigment in the skin, the hair, and the eyes.
11. A (8) serenade is music sung or played in the open air at night, especially under the windows of ladies.
12. A (6) magnet is any body having the characteristic properties of loadstone.
13. A (6) funnel is a hollow cone with a tube at the point, through which liquids may be poured from one vessel into another.
14. A prophylactic is a medicine which serves as a (12) preventative against disease.
15. By (5) orbit is meant the path described by a heavenly (4) body in its revolution around another body.
16. (8) currency is that which is in circulation as a medium of (8) exchange including coin, government notes, and bank notes.
17. Homeopathy differs from (9) allopathy in that its remedies produce results which are similar to those produced by the disease itself.
18. By (7) anarchy is meant the complete absence of government.
19. An (8) alluvial deposit is one that has been washed from one place to another by flowing water.
20. The interior of a curved surface is (7) concave

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

21. A (10) dispensary is a place where medicines can be bought at a nominal (5) fees.

22. (7) alchemy was the medieval chemical science, the great object of which was to transmute the baser (6) metals into gold.

23. A (5) crime is a gross violation of law, as distinct from a misdemeanor, or slight offense.

24. An (5) agent is one who acts for, or in place of another, having been entrusted with the business of another.

25. A (6) legend is a story popularly taken as historical, though not verifiable by historical record.

26. (10) Aesthetics is the science of the beautiful in nature and art.

27. An (8) antidote is a remedy to counteract the effects of a poison.

28. (11) environment is second only to heredity in its effects on character.

29. An (8) allegory is a representation by means of a figurative story of something metaphorically suggested, but not expressly stated.

30. An (11) anachronism is an error in the order of time, especially one by which an event is placed too early.

Stop here. Wait for further instructions.

Arithmetical Reasoning

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

1. A rectangular bin holds 300 cubic feet of lime. If the bin is 10 feet long and 5 feet wide, how deep is it?

   Answer: 6 ft.

2. A firm builds a warehouse four stories high. The interior dimensions of the building are 50 by 200 feet. How many square feet of floor space have they provided for themselves?

   Answer: 40 000 sq. ft.

3. If 4 three-ton trucks require 3 trips apiece to remove a pile of scrap, how many similar trucks making only one trip each would be required to remove half the pile?

   Answer: 12 trucks.

4 A invests $5,000 and B $3,000. They buy three houses of equal value. Each one takes a house for himself, and they sell the remaining house for $8,000. How should the money be divided?

   Answer: $1000 to A and $7000 to B.

5. How long would you keep 4 electric lights going on the amount of current required to keep 3 similar lights going 2 hours?

   Answer: 1½ hrs.

6. The following rule is given for computing a railroad fare in cents. "Multiply the number of miles by 4 and subtract from the product one-tenth of the number of miles." If it is 180 miles to New York, how much does a ticket cost?

   Answer: $7.02

7. If 144 cubic feet of water are drawn from a tank which is 12 feet long, 6 feet wide, and 10 feet deep, how much is the surface of the water in the tank lowered?

   Answer: 2 ft.

8. An aeroplane flew three miles in seventy-two seconds. How many miles an hour is that?

   Answer: 2½ mi. per hr.

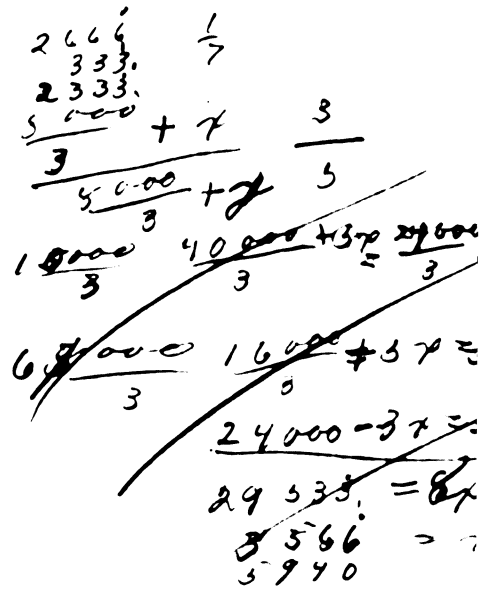
9. A commission house which had already supplied 1,987 barrels of apples to a hotel delivered the remainder of its stock to 28 restaurants. Of this remainder each restaurant received 47 barrels. What was the total number of barrels supplied?

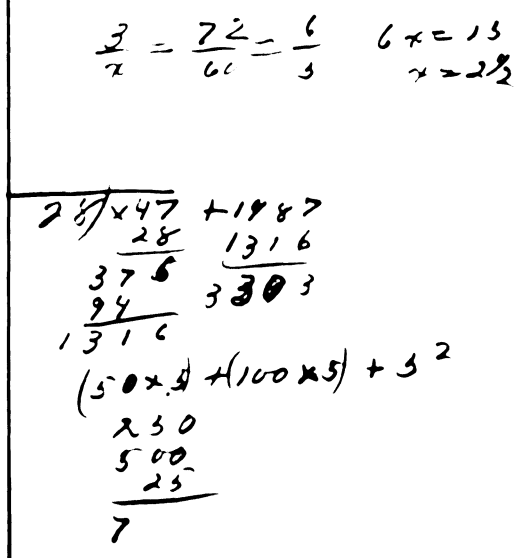
   Answer: 3303 barrels.

10. What will be the expense for a cement sidewalk on the two sides of a corner lot 50 ft. by 100 ft. if the walk is 5 ft. wide and costs 10 cts. per square foot?

    Answer: $77.50

You may use this space for figuring.





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11. A case which measures on the inside 3 feet by 3 feet by 2 feet is filled with cardboard boxes, each 9 inches by 4 inches by 3 inches. Find the number of boxes that can be put into the case.

Answer: 528 boxes.

12. At 8 P. M. the barometric pressure was 30.6 and at 9 P. M. the pressure was 31.2. Assuming a constant rate of increase in barometric pressure, at what time was the pressure 31.0?

Answer: 8:40 o'clock.

13. A certain division contains 2,000 artillery, 15,000 infantry, and 1,000 cavalry. If each branch is expanded proportionately until there are in all 19,800 men, how many will be *added* to the artillery?

Answer: 200 men.

14. In six separate races over a given course the times of the winning horses were 1 min. 16⅕ sec.; 1 min. 15⅘ sec.; 1 min. 13⅗ sec.; 1 min. 12⅘ sec.; 1 min. 11⅘ sec.; 1 min. 10⅘ sec. Find the average time for the six races.

Answer: 1 min. 13.5 sec.

15. Mr. Smith owns a one-fourth interest in a taxi line and Mr. Jones owns the rest. Mr. Jones received $980 more a year than does Mr. Smith. How much does each receive?

Answer: $490 for Smith and $1470 for Jones.

16. If a quarterly dividend on bonds worth $13,000 is $195, what is the annual rate of interest?

Answer: 6% per cent.

17. A freight train left Albany for New York at 6 o'clock. An express left on the same track at 8 o'clock. It went at the rate of 40 miles an hour. At what time of day will it overtake the freight train if the freight train stops after it has gone 56 miles?

Answer: 9:24 o'clock.

18. How many hours is it from 8 A. M. May 27 to 10 P. M. July 3? May has 31 days and June has 30.

Answer: 902 hrs.

19. A contractor offers to lay asphalt pavement at $3.60 per square yard. The street is 50 feet wide. How much must the lot owners on both sides of the street be assessed for each foot in the width of their lots?

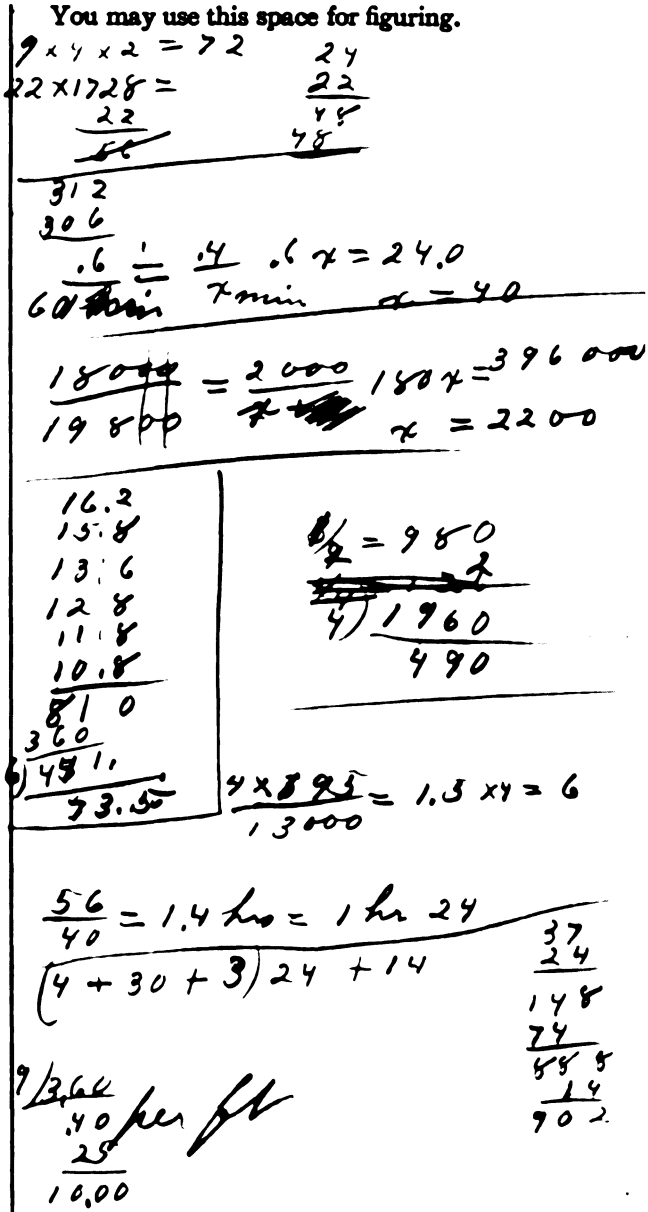
Answer: $10.00 per ft.

20. A boy bought a pair of shoes for $4.00 and gave a $10.00 bill in payment. The shoemaker had a neighbor change the bill, and gave the boy his change. The neighbor returned the bill, saying it was counterfeit, and the shoemaker gave him good money for it. What was the shoemaker's loss?

Answer: 10.00

Stop here. Wait for further instructions.

You may use this space for figuring.



Artificial Language

(Devised by Mr. Stuart C. Dodd, and submitted by Prof. Carl C. Brigham, Princeton University)

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

VOCABULARY

I—em
me—emon
he—ek
him—ekon
that—tar
is—tob
please—planto
satisfy—sauto
live—logo
forever—vern

RULES

1. Plurals are formed by adding "e". Only nouns and pronouns have plurals.
   Example:
   we—eme
   them—ekone

2. Past time is expressed by placing "ath" before the verb.
   Example:
   pleased—athplanto

3. Future time is expressed by placing "bol" before the verb.
   Example:
   will please—bolplanto

4. Nouns are formed by substituting the ending "ur" for the "o" ending of the verb.
   Example:
   pleasure—plantur

5. Adjectives are formed by substituting the ending "al" for the "o" ending of the verb.
   Example:
   pleasant—plantal

6. Adverbs are formed by substituting the ending "ob" for the "o" ending of the verb.
   Example:
   pleasantly—plantob

SAMPLES

(*a*)	He	pleases	me.	(*c*)	He	is	living.	
	Ek	planto	emon.		Ek	tob	logal.	
(*b*)	Eme	logo	plantob.	(*d*)	Logur	athplanto	ekone.	
	We	live	pleasantly.		Life	pleased	them.	

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

20 ± min.

Translate as many of these sentences as you can in the time allowed. Translate the sentences in order 1, 2, 3, etc. Do not skip any sentence. If a complete sentence is omitted, no credit will be given for any work done beyond that point, but if a particular word bothers you, go on to the next word.

1. Life is satisfactory.
logur tob sautal

2. Ek athlogo sautob.
he lived satisfactorily

3. I will satisfy them.
em bolsauto ekone

4. Logur tob plantal.
life is pleased

5. That satisfied them.
tar athsauto ekone

6. Eme bollogo vern.
we will live forever

7. Satisfactory lives pleased.
sautal logure athplanto

8. Planture logo vern.
Pleasure live forever

9. That will please them.
Tar bolplanto ekone

10. Sautal logure athplanto emon.
satisfied lives ~~pleased~~ pleased me

11. He lived pleasantly.
Ek athplanto plantob

12. Tar logur athsauto ekon.
That life satisfied them

13. Satisfactions live forever.
sautur logo vern

14. Plantur tob logal sautur.
Pleasure is lively satisfaction

15. Pleasant lives satisfy forever.
alplanto logure sauto vern

16. Tar plantur athsauto ekon.
That pleasure satisfied him

17. Life that satisfies is pleasant.
logur tar sauto tob alplanto

18. Logur tar planto tob sautal.
life that places is satisfactory

19. That pleasant life satisfied me.
Tar plantal logurathsauto emon

20. Ek athlogo sautob: tar athplanto ekon.
He lived satisfactorily; that pleased him

Stop here. Wait for further instructions.

~~First~~

7 min

Proverbs

(Prepared by Thelma Gwinn Thurstone, University of Chicago)

Example: Which one of the twenty proverbs below has the same meaning as the following?
"Sail when the wind blows." Proverb number 3

TWENTY PROVERBS

1. Ashes fly in the face of him that throws them.
2. Half a loaf is better than no bread.
3. Strike while the iron is hot.
4. Not heaven itself upon the past has power.
5. A beaten dog is afraid of the stick's shadow.
6. The same knife cuts both the bread and the finger.
7. Where there isn't any water one can't sail ships.
8. She who is the wife of one man cannot eat the rice of two.
9. Even a mountain may be worn away by the tread of many feet.
10. He that hath no children doth bring them up well.
11. We are all Adam's children but silk makes the difference.
12. Many captains and the ship goes to the rocks.
13. He who comes from the kitchen smells of its smoke.
14. The heaviest rains fall on the leaky roof.
15. Marble is not less hard or less cold for being polished.
16. Might is right.
17. The honey is sweet but the bee has a sting.
18. The losing horse blames the saddle.
19. One coin in the money box makes more noise than when it is full.
20. The shoemaker's wife and the smith's mare often go barefooted.

Which one of the twenty proverbs above has the same meaning as the following?
"Spilt water cannot be gathered up again." Proverb number 4

Which one of the twenty proverbs has the same meaning as the following?
"Justice is ever on the victor's side." Proverb number 16

Which proverb has the same meaning as the following?
"A good horse cannot wear two saddles." Proverb number 8

Which proverb has the same meaning as the following?
"He who cannot sleep finds his bed badly made." Proverb number 16

Which proverb has the same meaning as the following?
"If you always live with those who are lame you will yourself learn to limp." Proverb number 13

Which proverb has the same meaning as the following?
"Great boast, small roast." Proverb number 19

Which proverb has the same meaning as the following?
"There is always a bee to sting a weeping face." Proverb number 14

Which proverb has the same meaning as the following?
"Fine feathers make fine birds." Proverb number 11

Which proverb has the same meaning as the following?
"We may change our skins without changing our vices." Proverb number 15

Which proverb has the same meaning as the following?
"A good horseman is the man on the ground." Proverb number 10

Which proverb has the same meaning as the following?
"The stone may hurt the dog but not as much as the hand that threw it." Proverb number 1

Which proverb has the same meaning as the following?
"The water that bears the ship is the same that engulfs it." Proverb number 17

Which proverb has the same meaning as the following?
"Little and often fills the purse." Proverb number 9

Which proverb has the same meaning as the following?
"Too many cooks spoil the broth." Proverb number 12

Which proverb has the same meaning as the following?
"She went to sleep hungry altho her husband is a baker." Proverb number 20

Stop here. Wait for further instructions.

8 min (3/4)

Reading

(Prepared by Mr. A. W. Kornhauser, University of Chicago)

Read paragraph No. 1 and the five sentences below it. Then place a check mark (√) on the dotted line in front of each sentence which contains an idea that is in the paragraph or can be derived from it.

When you have finished with the sentences below paragraph 1 go to paragraph 2 and so on.

The paragraphs and sentences may be reread as often as is necessary.

You may check any number of sentences under each paragraph.

Paragraph 1. It is easy to imagine an economic order wherein each person produces the very things which he consumes—bakes the bread he eats from the flour he has ground from wheat he has raised. Such an order might be called an autonomous economic order. But the actual system is far different. Most of the goods which each of us consumes are, speaking literally, produced by others, while most of those which each produces are consumed by others. In short, the present order is not autonomous, but cooperative. Herein is the most important single characteristic of that order.

..... 1. An outstanding feature of the present industrial organization of society is the almost complete independence of each unit in the system.

..... 2. An autonomous economic order in which each consumer produces those things which satisfy his own wants, is the goal toward which we are rapidly moving.

✓..... 3. Few, indeed, of the articles which we use in our daily lives are the product of our own individual labor.

✓..... 4. The fact that many individuals cooperate in supplying economic goods, far from being an incidental feature of the existing industrial order, lies at the very root of the system.

..... 5. In those countries where the industrial system is most highly developed, the system is ordinarily least cooperative and most autonomous.

Paragraph 2. The interplay of human motives and the interaction of human beings is the fundamental fact of social life, and the permanent results which this interaction achieves and the influence which it exercises upon the individuals who take part in it constitute the fundamental fact of social evolution. These results are embodied in what may be called, generically, tradition. Tradition is, in the development of society, what heredity is in the physical growth of the stock. It is the link between past and future, it is that in which the effects of the past are consolidated and on the basis of which subsequent modifications are built up.

..... 1. It is unjustifiable to speak of a social inheritance whereby tradition is passed from generation to generation, in the same way as we speak of physical inheritance from father to son.

..... 2. Each new age, as each new individual, must build anew, from the ground up, uninfluenced by the restraining ties of the past.

✓..... 3. An understanding of the process of social evolution involves at least some knowledge of the interaction of individuals and the products of their reciprocal relations.

..... 4. Tradition perpetuates the finer and more sentimental contributions of the past and has little to do with the permanently valuable products of preceding generations.

✓..... 5. The influences of individuals on each other and the results of their activities constitute the permanent heritage upon which all new advances are based.

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

Paragraph 3. The employer is in business for profits. Industrial profits come from the work of the hired hand. The smaller the wages the larger the profits. The employee works for wages. Wages represent the product of his labor after deduction of the employer's profit. The smaller the profit the larger the wages. The employer must strive to maintain or increase his profits under penalty of industrial extermination. His personal views and feelings cannot alter the situation. The employee must strive to maintain or increase his wages under pain of physical destruction. His personal inclinations do not count. Sometimes this antagonism of interests expresses itself in petty bargaining and commonplace haggling, and at other times it assumes the form of violent conflicts: strikes, boycotts, and occasional dynamite explosions and, on the other hand, lock-outs, blacklists, injunctions, and jails.

..... 1. The interests of capital and labor are essentially one and it is only an overreadiness to fight that occasions the larger part of our deplorable industrial strife.

..... 2. Almost too obvious to require demonstration is the simple fact that the more productive an industry becomes the greater is the reward for both employer and employee, and hence that there can be no natural conflict between the two.

..... 3. After all, the antagonism of interests between workers and employers is dependent upon the attitudes of the men concerned; a kind and well meaning employer has it within his power to give his employees any reasonable wage they may desire.

..✓..... 4. In a real sense the interests of employer and employee are fundamentally opposed. Since the product of industry is divided between employer and employed it is evident that the larger the share the employer takes, the smaller is labor's portion.

..✓..... 5. The individual employer on the one hand and the individual workingman on the other, are forced by the very nature of the situation to strive for profits and wages respectively, and the problem is little influenced by personal inclinations.

Paragraph 4. Man is the tool-using animal, and the machine, that is, the power-driven tool, is his peculiar achievement. It is purely a creation of the human mind. The wheel, its essential feature, does not exist in nature. The lever with its to-and-fro motion, we find in the limbs of all animals, but the continuous and revolving lever, the wheel, cannot be formed of bone and flesh. Man as a motive power is a poor thing. He can only convert three or four thousand calories of energy a day and he does that very inefficiently. But he can make an engine that will handle a hundred thousand times that, twice as efficiently and three times as long. In this way only can he get rid of pain and toil and gain the wealth he wants.

..✓..... 1. All animals below the human being differ from man in the relatively unimportant place that tools play in their lives.

..... 2. The main characteristics of all the tools used by man are to be found in nature.

..✓..... 3. Man has learned how to supplement his own relatively feeble strength with engines that operate with vastly greater efficiency and power.

..... 4. With all his creation of tools and of immense energy-converting machines, man has not succeeded in lightening noticeably his burden of pain and toil.

..... 5. Even when we view man simply as a machine it is fair to say that the human body constitutes about the most nearly perfect mechanism in existence.

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

Paragraph 5. The classification of facts and the formation of absolute judgments upon the basis of this classification—judgments independent of the idiosyncracies of the individual mind—essentially sum up the aim and method of modern science. The scientific man has above all things to strive at self-elimination in his judgments, to provide an argument which is as true for each individual mind as for his own. The classification of facts, the recognition of their sequence and relative significance is the function of science, and the habit of forming a judgment upon these facts unbiassed by personal feeling is characteristic of what may be termed the scientific frame of mind. The scientific method of examining facts is not peculiar to one class of phenomena and to one class of workers; it is applicable to social as well as to physical problems, and we must carefully guard ourselves against supposing that the scientific frame of mind is a peculiarity of the professional scientist.

..... 1. It is a fact of considerable significance that only the specially trained mind of the true scientist is capable of assuming a sound scientific attitude toward the world.

..✓.. 2. The scientific frame of mind leads not merely to the collection and classification of facts but it involves, to some extent, at least, the interpretation of the facts and the basing of the judgments upon them.

..✓.. 3. Scientific investigation is objective—in the sense, that is, that its interpretations and judgments are relatively uninfluenced by the subjective or personal prejudices and inclinations of the scientist.

..✓.. 4. There is no reason why a thoroughly scientific attitude may not be taken by competent minds toward even our vital social and political problems.

..... 5. Scientific judgments in actual practice never stand as true or false upon their own merits, but are always influenced by the character or authoritativeness of their originator.

Paragraph 6. Science in general, however defined in its abstract phases, is in its practical aspects simply the organized technic of human knowledge by which the community and the individual alike sustain themselves in the face of natural forces. Scientific research is the germinating vital principle by which this technic is constantly developed to meet more fully the shifting conditions of life, and to master more perfectly the forces of the environment. To eliminate it would be tantamount to the final stagnation of human progress and the production of a condition of substantial equilibrium, a withdrawal of the fruitful operations of intelligence, and a reduction of human behavior to purely stereotyped and habitual forms. Scientific research is, accordingly, in no sense an extrinsic luxury of the mind, nor does it merely reflect the play of intellectual curiosities; it is of the very life-blood of human progress, the embodiment of the inner principle of intelligence itself. The maintenance of appropriate and fruitful conditions for its growth is therefore in the final analysis a matter of absolutely fundamental significance for humanity, and in a democratic order of society, it requires peculiar nurture because it appeals to the full appreciation of only the highly intelligent, and consequently stands in constant danger of being underestimated, with resulting loss of adequate financial and social support.

..... 1. The primary value of scientific research is the same as that of the creation of works of art; both add first of all to the finer and higher intangible values of life.

..✓.. 2. The masses of men have little understanding of, and regard for, the importance of scientific research. Consequently, in a democratic country the growth of scientific work is likely to be retarded.

..... 3. The real responsibility for the healthy advancement of science rests with the research workers themselves, for it is their science; society is only secondarily concerned.

..... 4. The crying need at present is not for the furtherance of scientific research but for the making available to the popular mind the results already achieved by science.

..✓.. 5. Science is not a mere theoretical interest remote from daily life; on the contrary, it enters into, or in fact constitutes, the very essence of our ability to meet the complexities of life.

Stop here. Wait for further instructions.

6 min

Opposites

(Prepared by Prof. Carl C. Brigham, Princeton University)

Each group ot four words in the thirty lines below contains two words which are either (*a*) the same or nearly the same in meaning, or (*b*) the opposite or nearly the opposite in meaning.

Find the two words in each group that are either same or opposite, and write the numbers of these two words in the column at the right, headed "Same," or the column headed "Opposite," as the case may be.

The first group of words, "1 bent, 2 cold, 3 hot, 4 sad" contains two words ("cold" and "hot") that are opposite in meaning, so that the figures 2 and 3 are entered in the column headed "Opposite." The second and third groups have also been marked correctly.

				SAME	OPPOSITE
1 bent	2 cold	3 hot	4 sad	...&...	2 & 3
1 white	2 safe	3 black	4 raw	...&...	1 & 3
1 rapid	2 hard	3 large	4 great	3 & 4	...&...
1 wet	2 dry	3 thin	4 easy	...&...	1 & 2
1 flat	2 tired	3 smart	4 level	1 & 4	...&...
1 corpulent	2 opulent	3 torpid	4 affluent	2 & 4	...&...
1 lavish	2 jaunty	3 gradual	4 demure	...&...	2 & 4
1 partial	2 careful	3 jubilant	4 exultant	3 & 4	...&...
1 animated	2 vivacious	3 tarnished	4 caustic	1 & 2	...&...
1 formidable	2 tangible	3 preferable	4 alarming	1 & 4	...&...
1 captivating	2 belligerent	3 pacific	4 universal	... & ...	2 & 3
1 capacious	2 petrified	3 obligatory	4 restricted	...&...	1 & 4
1 agile	2 lithe	3 hirsute	4 previous	1 & 2	...&...
1 bombastic	2 obnoxious	3 astute	4 modest	...&...	1 & 4
1 maudlin	2 obvious	3 mawkish	4 oblique	1 & 3	...&...
1 lingual	2 raucous	3 overt	4 manifest	...&...	3 & 4
1 delectable	2 mutable	3 reflexive	4 permanent	...&...	2 & 4
1 literate	2 choleric	3 irascible	4 ambidextrous	2 & 3	...&...
1 illegible	2 agnostic	3 amenable	4 refractory	...&...	3 & 4
1 punctilious	2 brusque	3 translucent	4 insensitive	...&...	2 & 4
1 legitimate	2 disparate	3 unequal	4 metric	2 & 3	...&...
1 enigmatic	2 extraneous	3 loquacious	4 intrinsic	...&...	2 & 4
1 laconic	2 dulcet	3 epigrammatic	4 titanic	1 & 3	...&...
1 gratuitous	2 sanctimonious	3 rhythmic	4 obligatory	...&...	1 & 4
1 anomalous	2 efficacious	3 jugular	4 usual	...&...	1 & 4
1 jovial	2 nascent	3 incipient	4 nauseous	2 & 3	...&...
1 capricious	2 spectral	3 speculative	4 corporal	...&...	1 & 4
1 pertinent	2 prismatic	3 congruous	4 juridical	2 & 3	...&...
1 infantile	2 infinitesimal	3 amorphous	4 shapeless	3 & 4	...&...
1 nugatory	2 efficacious	3 gregarious	4 transcendental	...&...	1 & 2

Stop here. Wait for further instructions.

H138
23 min.

Grammar

(Prepared by Thelma Gwinn Thurstone, University of Chicago)

Some of the sentences in the following list contain mistakes in grammar, punctuation, spelling or rhetoric. Some of them are correct.

Make a plus sign (+) before each sentence that is correct.

Make a minus sign (−) before each sentence that is incorrect.

The first two sentences are already marked as they should be.

−. I seen him when he done it.

+. John and James are coming.

−. She sat the plant in the window.

+. Ought we not to start?

+. Who do you think will go?

−. He does that work equally as well as I.

+. It is hard always to be on time.

−. I am returning the book to you like you directed.

−. The bluff raises very steeply from the edge of the river.

−. He has no doubt but what you told the truth.

−. The youngest of the two daughters is still at home.

+. My wife and I shall go.

−. How much further on this road shall we go?

−. The train had already gone when we arrived.

+. The dress looks beautiful on you.

−. The number of books in the library are very large.

+. The man whom I expected to meet did not come.

+. I don't know that I can finish it.

+. I saw him go into the house.

−. I remember of his saying that.

−. "Will you help" he asked?

−. I wish I was in Dixie.

−. He hasn't scarcely time to finish the job.

+. The law goes into affect January 1.

−. Please take this here package to the desk.

+. Whom do you mean?

+. This is the place whence we started.

+. Take the fan from the desk.

−. I saw her at church some months since.

. She let the papers lie where they were.

+. That evidence is altogether unconvincing.

+. There is a sale of womens' shoes to-day.

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

..... Write the names of those whom you think should go.

..... The club meets regular the first day of the month.

..... We use only the best materials.

..... She told it to no one except Mary and me.

..... Don't never forget to put the date on these slips.

..... He is somewhat better today than he was yesterday.

..... Will you loan me your eraser?

..... Men like you and him have a good influence.

..... The king favors her rival more than her.

..... It is superior in every way than the old edition.

..... The balance of the crowd is coming later.

..... He has an independent income beside his salary.

..... I have forgotten it's name.

..... This room is only open to those who hold tickets.

..... Employees cannot leave their desks open..

..... Her brother is a better student than she.

..... It is just as it should be.

..... Would you rather let Mary go than me?

..... I certainly would have liked to hear her.

..... You will never succeed without you study.

..... Each of the boys was ready to start.

..... It may be true although it doesn't sound true.

..... Except for you and me the company remained silent.

..... It will pass providing all vote.

..... We stored eight tons of coal in the basement.

..... The covers of the book is worn.

..... I don't believe I shall be able to go.

..... A new order of ideas and principles have been instituted.

..... The fire was built and the potatoes baked.

..... He had no love or confidence in his employer.

..... I took you to be her.

..... The offices were closed in respect of the president.

..... Each of the boys were ready to start.

..... Will you send this memoranda to Mr. Jones?

..... Whoever tries hard enough will get what he tries for.

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

We should have expected to find him.

Several pair of shoes were among the things stolen.

We are all ready to go.

If anybody in the audience has a question, will they please raise their hand?

I think that, after you have read it, that you will agree with me.

I don't know but what you are right.

The cause of his failure was his imprudence.

I had to wait on him for nearly an hour before he arrived.

It is very late to begin now.

The play is over with.

He would have come, but he was not well.

The book deals with points of general interest.

She does not type very well.

Then everybody but you and he agrees to the plan.

These two books are both alike.

We haven't anything like that.

I have drank two glasses of water.

I heard that you were not expecting us.

A new shipment of sweaters and blouses have come in.

It is good enough for me.

I cannot go unless he sends me the money.

He lay still to make us think he was asleep.

Between you and I and the gatepost, I expect he will lose his job.

You have less letters to answer today.

How much each one of you manage to accomplish!

Whom are you trying to call?

The reason I am late is I was detained by business.

A new order of ideas and principles have been instituted.

The cows were milked, and the horse fed.

When I was six years old, my grandfather died.

I did not anticipate his coming.

There is an access of moisture in the air to-day.

The telegraph pole is fifty feet long.

He came near being run over.

That is one of the physical factors that is extremely difficult to control.

Stop here. Wait for further instructions.

Estimating

(Devised by Prof. L. L. Thurstone, University of Chicago)

You will be asked to give twenty estimates about facts that you probably do not know. Try to make your estimates as reasonable as possible. Try to find something in your experience, in your reading of newspapers, or in your general knowledge, that enables you to give an intelligent estimate or guess.

For example: If you are asked to estimate the number of children in the United States who were under five years of age in 1920 you would recall that the entire population is about 100,000,000. You might guess the average length of life to be, let us say, 50 years roughly. The first five years of life would therefore include very roughly one-tenth of the population, and you would consequently give about 10,000,000 as an intelligent guess of the number of children who are under five years of age. This answer is nearly right.

If you are asked to estimate the number of automobiles in the United States you might recall the approximate range of the highest automobile license numbers that you have seen in your state; you would recall roughly the population of your state, make any reasonable corrections to the ratio, and estimate the total number of automobiles for the entire country on that basis. Or you might simply say that, according to your general observation, there seems to be one automobile for every ten persons in the population, and you would guess, accordingly, about ten million machines. That would be nearly right.

Proceed in the same manner for all the questions, making your estimates as reasonable as you can with whatever information you may be able to recall.

If you cannot reason out a question, make some guess anyway. Make it look as reasonable as possible even though you may not be able to substantiate it. Do not use statistical tables.

1. Estimate the number of men in the police force of New York City in 1921.

   10 000 Men

2. Estimate the number of new books published in the United States in 1921. (This means number of new titles, not number of books printed).

   30 000 Books

3. Estimate the number of firms manufacturing furniture in the United States in 1919.

   12 000 Firms

4. Estimate the altitude of Mount McKinley, the highest mountain in the United States.

   20 000 Feet

5. Estimate the number of prisoners in all prisons of the United States in 1920.

   5 [illegible] Prisoners

6. Estimate the number of persons who died of pulmonary tuberculosis in New York City in 1921.

   5 [illegible] Persons

7. Estimate the number of foreign born men of voting age in the United States in 1920.

   [illegible] Men

8. Estimate the number of Bell Telephones in the United States in 1922.

   10 000 000 Telephones

You may use this space for figuring.

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

9. Estimate the number of marriages in the United States in 1916.

2000 000 Marriages

10. Estimate the number of divorces in the United States in 1916.

200 000 Divorces

11. Estimate the cost of the Brooklyn Bridge. Ignore cost of the land.

$ 12 000 000

12. Estimate the number of persons engaged in farming in the United States in 1922. Include farmers' families in your estimate.

40 000 000 Persons

13. Estimate the amount of sugar consumed in the United States in 1921.

10 000 000 000 Pounds

14. Estimate the number of wage earners in the printing and publishing of newspapers and periodicals in the United States in 1919.

250 000 Persons

15. Estimate the total railroad mileage in the United States.

200 000 Miles

16. Estimate the total of the personal incomes in the United States in 1920 as determined by the income tax returns.

$ 10 000 000 000

17. Estimate the number of persons in the United States with incomes over $5,000 in 1920.

100 000 Persons

18. Estimate the number of persons in the United States with incomes over $500,000 in 1920.

5 Persons

19. Estimate the number of persons killed in railroad accidents in the United States in 1921.

2300 Persons

20. Estimate the number of incorporated manufacturing concerns in the United States in 1920.

10 000 Firms

Stop here. Wait for further instructions.

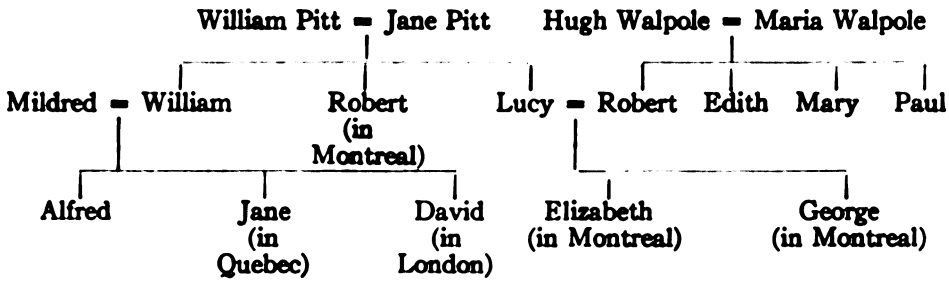
You may use this space for figuring.

21

Reasoning

(1–3) In the following problems, underline the word or words indicating the correct answers. Nothing is to be written.

The following chart gives the complete pedigree of the families concerned:



What relation was Elizabeth to Mildred?

Answer: Cousin Step-daughter Step-niece Niece

What relation was Robert Pitt to Robert Walpole?

Answer: Cousin Uncle Step-brother Brother-in-law

How many grand-daughters in Canada had Maria Walpole?

Answer: One Two Three Four

All of the above persons lived in England unless otherwise stated.

(4–7) Each of the following sentences is absurd but could be made reasonable by the change of a single word. Find such a word and underline it.

Sample: I have three brothers—Paul, Ernest, and myself.

He trudged through the pouring rain until he reached the house, stopped on the porch to wipe the dust from his shoes, and then entered quickly.

Mary started from the house and George from the gate simultaneously, but Mary walked so much less rapidly than George, that she had nearly reached the gate before she met him.

A band of savages wearing nothing but smudges of war paint overpowered him, filled their pockets with plunder and disappeared in the forest.

The one-armed, one-eyed man fell upon the dusty road, but rose, brushed off his knees and his elbow with the slender fingers of his hand, and walked gaily off.

In the very cold climates north of the Arctic Circle the oranges do not blossom until late in July.

The small child was much lighter than the man, but since her end of the see-saw was shorter, she kept him balanced in the air.

The legs of the chair were so uneven in length that only two of them rested upon the floor.

With his ear against the keyhole of the closed door between them, he distinctly saw the blush come over her face when the words were spoken.

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

(8–9) In the following problem, underline the word or words indicating the correct answer. Nothing is to be written.

In a certain territory 80 per cent of the inhabitants were against German rule, and 60 per cent were against French rule.

Were there any who were against both French rule and German rule?

Answer: Yes No One cannot say without further details.

Were there any who were not against either?

Answer: Yes No One cannot say without further details

(10) In the following problem, underline the word or words indicating the correct answer. Nothing is to be written.

My nephew writes: "I have just walked here from Milford Forest, where I had the misfortune yesterday to break a limb. I was thrown from my horse into the hedge; and the stirrup caught my right ankle."

Can you guess from this which he probably broke?

Answer: His right arm His left arm His right leg
His left leg It is impossible to guess without further details.

(11–12) In the following problem underline the word or words indicating the correct answer. Nothing is to be written.

All the trains from this platform stop first at Ayton; but after that some go to Beaton and Seaton; and others branch off to Deaton and Eaton. There are no other stations. The fare to Eaton and Seaton is fifty cents; elsewhere, twenty-five cents.

Brown had a twenty-five cent ticket; and, although in a hurry, did not get in the first train, which was going towards Eaton.

Where do you think he is traveling to?

Answer: Ayton Beaton Seaton Deaton Eaton
Either Ayton or Beaton Either Beaton or Deaton
It is impossible to say without further information.

(13–14) In the following problem, underline the word or words indicating the correct answer. Nothing is to be written.

The witness said: "I heard my bedroom clock strike three-quarters of an hour after the first drop of rain came down on the roof. I was too sleepy to count the strokes of the clock, but I am sure it struck an even number." The sky was clear until at least two hours after midnight; and the witness' clock stopped at a quarter to six that morning.

When did the first drop of rain fall?

Answer: 8.15 A.M. Quarter to four Quarter past four
3.15 A.M. 5.45 A.M. 3.45 A.M.
Impossible to say without further details

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

(15–18) Fill in the blank spaces with conclusions which can be correctly drawn from the given facts. Write only one word in each space.

Given facts	*Conclusions*
A is higher than G	Therefore A is higher than D
B is equal to E	
D is lower than G	Therefore F is lower than B
C is higher than G	
G is lower than B	Therefore H is lower than E
B is higher than H	
A is lower than H	Therefore D is lower than C
F is equal to H	
E is higher than G	

(19–20) A man went to a farmer to buy 3 pints of milk. The farmer had nothing but a 5 pint pail and a 7 pint pail with which to measure. Without guessing at the amount he succeeded in measuring out exactly 3 pints of milk with these two pails. Below are listed the different things he did. Mark them from 1 to 5 in the order in which he did them

.....4..... Poured from the 5 pint pail into the 7 pint pail until it was filled.

.....1..... Filled the 5 pint pail

.....5..... Emptied the 7 pint pail

.....3..... Filled the 5 pint pail

.....2..... Emptied the 5 pint pail into the 7 pint pail