A STUDY OF SCORES ON INTELLIGENCE TEST BATTERIES

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PREFACE

The Directorate of Psychological Research in the Defence Research and Development Organisation is responsible for the construction of batteries of Intelligence Tests. These are used at the Services Selection Boards for the selection of officers in the Defence Services and are periodically changed. Over a period, a mass of data accumulates. An analysis of these data is expected to throw light on the nature of the ability measured by these tests and thus aid the users. The present study was undertaken with this end in view.

The pattern of analysis depended on the availability of data and therefore could not be uniform for all the batteries of tests.

Dr. N. R. Warhadpande, Principal Scientific Officer, has carried out this study. Shri B. M. P. Khullar, Senior Scientific Officer (Statistics) in the Directorate of Psychological Research along with his associates—Shri R. S. Mehta, Senior Scientific Officer and others—has tendered statistical advice and done all the calculations. Shri Khullar has also edited the manuscript in its final form. Constructive suggestions and comments are welcome.

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CONTENTS

ABBREVIATIONS

NDA	National Defence Academy
PRW	Psychological Research Wing
ISP	Indian Selection of Personnel
UPSC	Union Public Service Commission
DPR	Directorate of Psychological Research
OLQ	Officer Like Qualities
GTO	Group Testing Officer
IMA	Indian Military Academy
SSB	Services Selection Boards.
*	Statistical significance at 5% level
**	Statistical Significance at 1% level
N	Sample size

QUALITIES ASSESSED AT THE SERVICES SELECTION BOARDS AND THE MILITARY ACADEMIES

(1) Effective Intelligence
(2) Reasoning Ability
(3) Organising Ability
(4) Power of Expression
(5) Social Adaptability
(6) Co-operation
(7) Sense of Responsibility
(8) Determination
(9) Courage
(10) Stamina
(11) Initiative
(12) Self-confidence
(13) Speed of decision
(14) Liveliness
(15) Ability to Influence the Group

I

P. R. W. I & II

1

P. R. W. I & II

(1) N. D. A. CANDIDATES

It is proposed here to study the intelligence test scores of candidates appearing for selection to the National Defence Academy Course and subsequent appointment to a commissioned rank. These candidates are from 15 to 17½ years in age. Their minimum educational qualification is Matriculation or its equivalent and they have passed the UPSC competitive examination in English, Arithmetic and General Knowledge. The pass-rate in this examination was 36.9%.

Description of the Tests

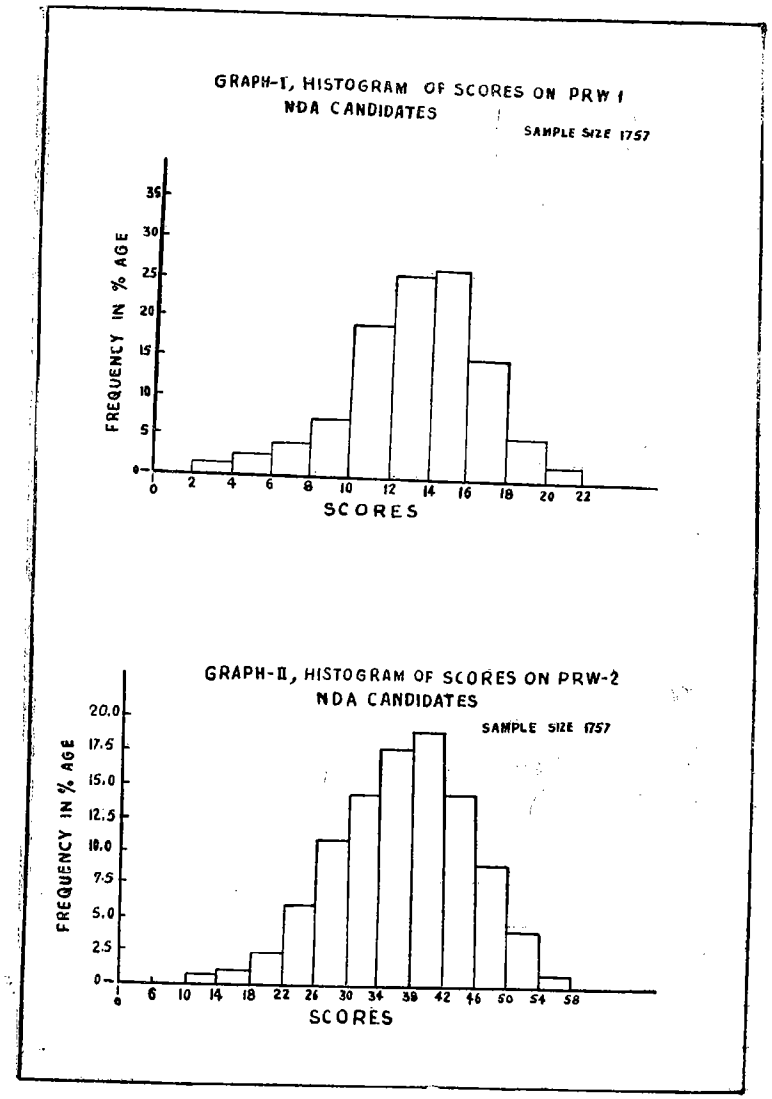
The candidates studied were tested on a battery of two test. *viz.*, P. R. W. I & II.

P. R. W. I is a non-verbal test containing items of two types. In one the testee has to choose a drawing that is different from four other drawings. In the other he has to find out which drawing will come next in a series of drawings. There are in all 24 items.

P. R. W. II is a verbal test containing 60 items of different types divided into seven parts. The item-types are, seeing similarity or difference, deciphering a code, continuing a series, finding out the rule according to which a particular numerical result is derived etc.

The following are the distributions of the test-scores:—

P.R.W. Test (See graph I)		P.R.W. Test II (See graph II)	
Score	Frequency	Score	Frequeny
1	2	3	4
2—3	17	6—9	2
4—5	33	10—13	9
6—7	60	14—17	14
8—9	115	18—21	40



1	2	3	4
10—11 . . .	300	22—25 . . .	102
12—13 . . .	440	26—29 . . .	192
14—15 . . .	444	30—33 . . .	251
16—17 . . .	260	34—37 . . .	313
18—19 . . .	76	38—41 . . .	335
20—21 . . .	11	42—45 . . .	255
22—23 . . .	1	46—49 . . .	160
		50—53 . . .	70
Total . . .	1757	54—57 . . .	13
		58—61 . . .	1
		Total . . .	1757

The distributions are negatively skewed (*vide* the following table). The following are the other statistics:

Test	*Mean*	*S.D.*	*Reliability* (Rational Equivalence)	g_1	g_2	*Remarks*
PRW I . .	12.86	3.22	0.44	—0 58**	0.61	
PRW II . .	36.49	8.28	0.81	—2.74**	—0.10	Both the distributions are negatively skewed.

Correlation between the tests=0.51

Scores on both the tests are converted into equivalent scores with a mean of 50 and a standard deviation of 10. The intelligence grade of a candidate is based on the sum of the equivalent scores. There are seven grades in all.

GROUP-DIFFERENCES

Urban/Rural

The candidates can be classified into urban and rural in various ways. One of the ways is that those whose home-town is at least a district place are treated as urban and others as rural. The following table gives data for comparing the performance of these two groups.

Classification	*N*	*Mean*	*Variance*	*Value of 'Z' (Normal variate)*
Urban	1400	106.83	231.04	
Rural	256	103.17	268.96	3.25**

The number could not be identical throughout the analysis because of incompletness of the records.

The difference in the means is significant at 1% level but it is not large enough to be of any practical value. The table also shows that most of the candidates come from the urban areas.

Income

If we divide the sample according to the income of the parents we get the following picture:—

Income group	*N*	*Mean*	*Variance*
Rs./Monthly 0—199	361	102.99	289.8
200—599	799	105.64	259.85
600—999	267	109.58	196.28
1000+	213	107.77	249.64

It will be seen that the largest number of candidates comes from the income-group 200-599.

Bertlett's test shows that the variances of the different groups cannot be regarded as equivaleant. (X^2-11.33* with 3 d. f.)

In order to ascertain whether the differences in the group means are significant, a pair of weighted mean squares was calculated and then their ratio (f^1) was tested against F distribution for n_1 and n_2 d-f where

$$F' = \frac{\sum \frac{n_i}{S_i^2} \left\{ (\overline{X}_i - \overline{X}_w^2) \right\} / a-1}{1 + \frac{2(a-2)}{a^2-1} \sum \left[\left(1 - \frac{w_i}{\sum w_i} \right)^2 / n_i - 1 \right]}$$

S_i^1 = mean square of the ith group.

$\overline{X}_i$ = mean of the ith group.

n_i = sample size of the ith group.

a = number of groups.

$w_i = n_i / s_i^2$

$n_1 = a-1$

$$n_2 = \frac{1}{\frac{3}{a^2-1} \sum \left\{ (1 - w_i / \sum w_i)^2 / n_i - 1 \right\}}$$

and $$\overline{X}_w = \frac{\sum x_i w_i}{\sum w_i}$$

The value of F′ is 10.58** for $n_1=3$, $n_2=618$. The means thus differ significantly.

The scores seem to rise with income up to the middle income-group but not after the limit of Rs. 1000 p.m. is reached.

Caste/Religion

If we divide the candidates according to caste or religion we get the following results:—

Caste/Religion	*N*	*Mean*	*Variance*
(i) Brahmin	936	106.18	266.02
(ii) Non-Brahmin	373	105.36	273.60
(iii) Sikh	286	106.95	265.04
(iv) Muslim	9	106.00	107.54
(v) Parsee	10	104.90	235.32
(vi) Christian	45	105.49	163.07

The numbers in the last three groups are very small. They were therefore pooled together. Bartlett's test revealed that the variances are homogeneous (X^2=6.87 with 3 d.f.).

Analysis of variance shows that the group means do not differ significantly (F=0.56, d.f. 3 and 1655).

Language

If we divide the sample according to the language of the candidates we get the following picture:—

Language	*N*	*Mean*	*Variance*
Punjabi	723	102.03	740.93
Hindi	596	105.24	264.39
Bengali	54	101.07	346.70
Marathi	126	106.22	416.57
South Indian (Canarese, Tamil, Telugu & Malyalam)	101	104.97	295.84

The four South Indian languages have been grouped together because individually the numbers they contribute are too small.

Bartlett's test shows that the variances in the different language groups cannot be regarded as homogeneous (X^2=178.61** with 4 d.f.)

Test for homogeneity of means when the variances are heterogeneous was applied as before F′=2.46* for n_1=4, n_2=235.

The means thus differ significantly but the maximum difference is of about 5 marks. This is negligible for all practical purposes.

Age

An agewise breakdown presents the following picture:—

Age Group	*N*	*Mean*	*Variance*
15 to 15 years 11 months	396	106.72	223.20
16 to 16 years 11 months	911	105.45	294.12
17 & above	365	105.51	271.26

Bartlett's test shows that the variances of the different age groups cannot be regarded as equivalent (x^2=23.32** with 2 d. f.).

The test for homogeneity of means when the variances are heterogeneous was applied.

F′=0.99 for n_1=2; n_2=808. This is not significant. The scores therefore cannot be said to differ with the ages studied.

Relationship with other Assessments

Besides Intelligence, qualities like initiative, confidence etc. as listed on page V are also assessed at the selection-boards. This is done by the Group Testing Officer in tests where the candidates have to execute a task in co-operation with others, by the Technical Officer, with the help of the Thematic Apperception and Word Association Tests specially adapted for the purpose, and by the Board-President in an interview.

The summed equivalent scores on the battery have the following correlations with these assessments:

Assessment	*Correlation with Intelligence Source*
Group Testing Officer	0.17**
Technical Officer	0.23**
President	0.15**

The candidates are finally discussed by all these officers in a conference and in the light of this discussion they award marks to them out of a maximum reserved for this purpose. All these marks are totalled to form the total board marks. These marks correlate to the extent of 0.21** with Intelligence Scores.

(2) PILOT-COURSE-CADETS

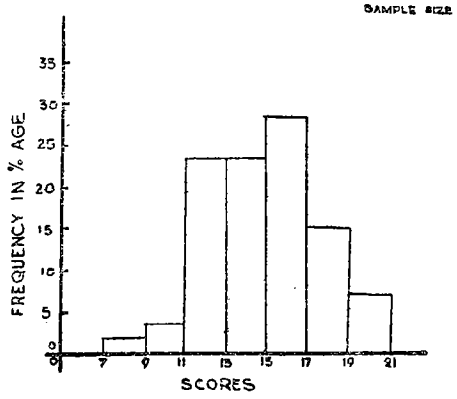
P.R.W. Tests I & II were also given to cadets under training in a Pilots' Course. In this course, the cadets are taught ground subjects like Meteorology, Navigation, etc. carrying 950 marks and also flying subjects carrying 1500 marks.

The distributions are given below:—

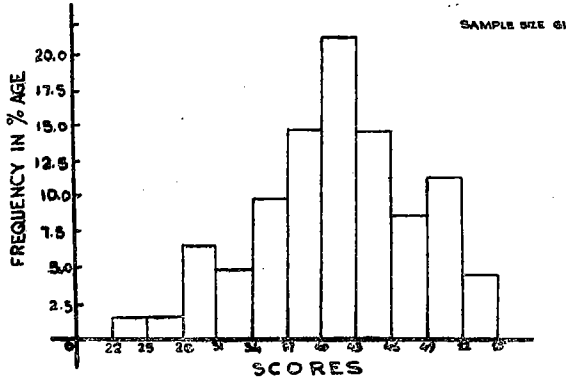
(*See* graphs III & IV).

P.R.W. I		P.R.W. II	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
7— 8	1	22—24	1
9—10	2	25—27	1
11—12	14	28—30	4
13—14	14	31—38	3
15—16	17	34—36	6
17—18	9	37—39	9
19—20	4	40—42	13
		43—45	9
Total	61	46—48	5
		49—51	7
		52—54	3
		Total	61

GRAPH III· HISTOGRAM OF SCORES ON PRW 1
PILOT COURSE CADETS



GRAPH IV· HISTOGRAM OF SCORES ON PRW 2
PILOT COURSE CADETS



The salient statistics are:—

Test	*Mean*	*S.D.*	*Reliability (Rational Equivalence)*	β_1	β_2	*Remarks*
PRW I . .	14.35	2.67	0.20	0.01	2.85	The distri-
PRW II . .	40.75	6.93	0.74	0.09	2.67	butions are normal

Correlation between the test =0·28

The β's show that the two distributions are more or less normal. The reliability of P.R.W. I is too low. One of the reasons for this may be that the assumptions involved in using the means for estimating the sum of item-variances are not fulfilled. This cannot be checked because item-analysis data are not available.

The candidates are given marks on officer-like-qualities such as initiative, co-operation etc., (page V) at the end of the course. P.R.W. I is correlated to the extent of 0.36 and P.R.W. II to the extent of 0.32 with these marks. Their combined correlation (*i.e.* Multiple correlation) is 0.43. The regression equation is OLQ=0.298 P.R.W. I+0.236 P.R.W. II.

An assessment of the overall performance of the candidates is also made at the end of the course. In this assessment a cadet is described as above average, average or below average. Average and above average were grouped together and biserial correlations of the tests with the overall assessments were calculated. They were 0.03 for PRW I and 0.12 for PRW II. Their multiple R with the assessment is 0.12 (not significant).

GROUP DIFFERENCES

Language

If the sample is divided on the basis of mother-tongue we get the following results:—

Language	*N*	*Mean*	*Variance*
Punjabi	17	57.76	71.66
Hindi	15	51.80	107.33
Tamil	5	61.00	35.52
Bengali	8	55.25	91.97
English	7	54.29	27.25
Marathi	6	55.43	17.39

Bartlett's test showed that the variances do not differ significantly from group to group (X^2=7.82 with 5 d. f.). Analysis of variance was then carried out. It showed that the means do not differ significantly from group to group (F=1.24, with d.f. 5.52).

Thus there is no evidence to show that the mean score varies significantly with language group.

Income

If the cadets are divided on the basis of their father's income we get the following table:

Income	*N*	*Mean*	*Variance*
Rs. 0—250	12	55.83	37.82
251—500	8	57.38	32.26
510 and above	13	56.62	39.30

Bartlett's test showed that the variances do not differ significantly from group to group. (x^2=3.17 with 2 d.f.). Analysis of variance was then carried out and showed that the differences between different groups are not significant.

F=0.81 for d.f. 2 and 30.

The following conclusions emerge from this investigation. In the N.D.A. sample:—

(1) The distribution of the test scores is not normal.

(2) The rational equivalence reliability of P.R.W. I is 0.44 and that of P.R.W. II is 0.81.

(3) The correlation between the two tests is 0.51.

(4) The scores of urban and rural candidates differ significantly.

(5) The scores rise with income up to the middle income group.

(6) The scores do not differ with caste or religion.

(7) The scores differ with language-group.

(8) The scores do not differ with age.

(9) Even when group differences are found they are very small.

(10) The scores are positively correlated with all other assessments.

In the Pilots' Course Sample

(1) The distribution of the test scores is more or less normal.

(2) The rational equivalence reliability of P.R.W. I is too low.

(3) The correlation between the two tests is 0.28.

(4) The mean scores on the test do not differ with language and income groups.

(5) The correlation of the tests with overall assessment in the course is not significant.

(6) The correlation of the tests with officer-like-quality marks is 0.43.

Revision of the Tests

Since the reliability of P.R.W. I was found to be low, it was revised. New items were added and the test was made omnibus. P.R.W. II was similarly made omnibus. Since, henceforward the revised tests alone are to be used, the appendices relate only to these tests.

The distribution of P.R.W. I (Revised) was found to be platykurtic (g_1=0.01 & g_2=0.86) and that of P.R. W. II (Revised) leptokurtic (g_1=0.06 & g_2=0.64). The following are the other statistics:

Sample (Miscellaneous, at Selection Board)	300
Reliability of P.R.W. I (Revised)	0.86

Reliability of P.R.W. II (Revised)	0.76
Correlation between the Revised tests	0.61
Mean of P.R.W. I (Revised)	29.5
S.D. of P.R.W. I (Revised)	9.8
Mean of P.R. W. II (Revised)	29.1
S. D of P.R.W. II (Revised)	7.8

The following table serves to assess the improvement achieved by the revision:—

RELIABILITY

P.R.W. I (N.D.A. Sample)	P.R.W. I (Pilots' Course Sample)	P.R.W. I (Revised)
0.44	0.20	0.86

P.R.W. II (N.D.A. Sample)	P.R.W. II (Pilots' Course Sample)	P.R.W. II (Revised)
0.82	0.74	0.76

P.R.W. I (Revised) marks a rise in reliability significant at 1%.P.R.W.II (Revised) marks a negligible (.06) fall in reliability, significant at 5% when compard to the reliability of P.R.W.II in the N.D.A. sample. No such fall is seen when the reliability in the Pilots' Course Sample is taken for comparison.

The correlation between the unrevised tests is 0.51 in the N.D.A. sample and 0.28 in the Pilots' Course sample. The correlation between the revised tests is 0.61. This is significantly higher than the correlation between the unrevised tests. The improvement over the larger correlation between the unrevised tests is significant at 5%.

The correlation between P. R. W. I and P. R. W. I (Revised) is 0.67.

P. R. W. Test No. I (Revised)

(Non Verbal Intelligence Test)

Instructions, illustrations and Practice

Instructions

This is a test of your ability to find out how quickly and correctly you solve problems which require keen observation.

Now look at question No. 1 in the illustration set and see how it is solved.

Question No. 1

Five drawings ABCDE are given. All the drawings in this collection excepting C are triangles. But C is a square and has already been crossed-out in your answer sheet.

When, therefore, you see five drawings ABCDE in a question you CROSS OUT—in your answer sheet—the drawing that is DIFFERENT from the other FOUR DRAWINGS.

Question No. 2.

In drawings ABCDE, two groups are formed—D is the inverted form of B & E is the enlarged form of C. A does not belong to any such group and has been crossed out in your answer sheet.

Question No. 3

In drawings ABCDE, B & E are grouped together being single closed figures, while A & D are grouped together, being single open figures. C is, therefore, different from all others. C has already been crossed out in your answer sheet.

Question No. 4

Here drawings A & C are grouped together, being ornaments while drawings B & E are used as stationery. D is therefore different from others and has already been crossed out in your answer sheet.

If a question is HARD for you, PROCEED to the NEXT question. You MAY RETURN TO THE LEFT OUT questions after FINISHING the test if you still have time.

Question No. 5

This problem is of a different type from the previous ones. Here you have to STUDY the RULE according to which the drawings in the SERIES are ARRANGED, in order to CONTINUE the series. In order to continue the series here you need a group of 4 blocks, because every alternative drawing is an increased number of blocks. D is therefore the correct answer and has been crossed out in your answer sheet.

Question No. 6

In this series of drawings the first drawing is an angle, and the second a triangle formed by closing the first drawing. The third drawing is an angle, so the fourth drawing in the series would be a closure of that angle, like A which has already been crossed out in your answer sheet.

Question No. 7

In this series there are 2 crosses, 3 circles, 4 squares, the next drawing therefore must contain 5 figures, like B which has already been crossed out in your answer sheet.

Question No. 8

In this series the first drawing shows a hand, the second drawing shows 4 fingers, the third drawing shows 3 fingers, so the fourth drawing is A since it has 2 fingers, A therefore has already been crossed out in your answer sheet.

Opposite each question number in your answer sheet a series of letters is printed. You have to put a CROSS only on ONE LETTER which in your opinion indicates the correct answer to the appropriate question number. If you give two answers, both of them will be scored as wrong.

Now wait for the testers instructions and then proceed to the Practice-Set.

Time limit: 25 minutes.

ILLUSTRATION SET

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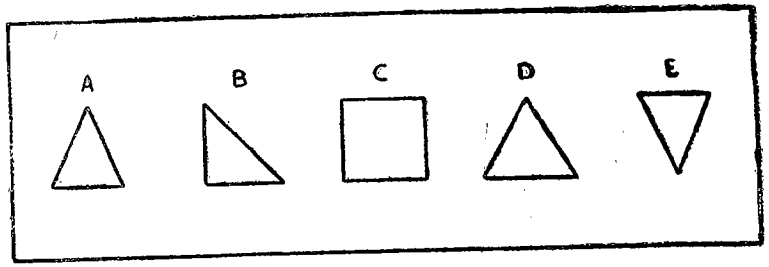

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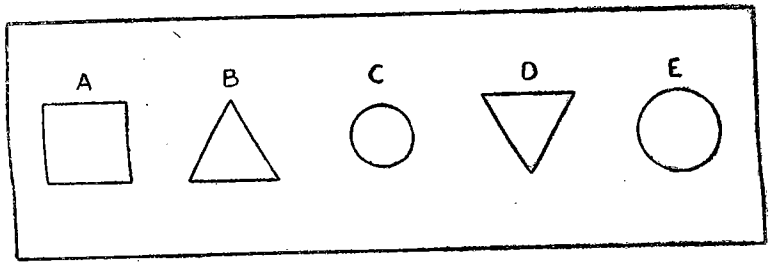

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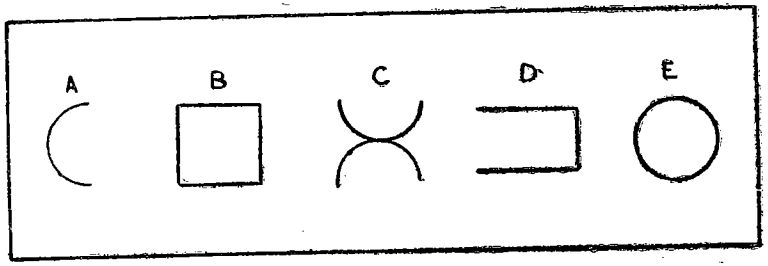

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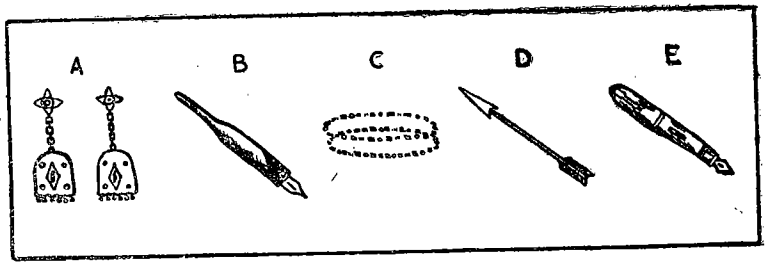

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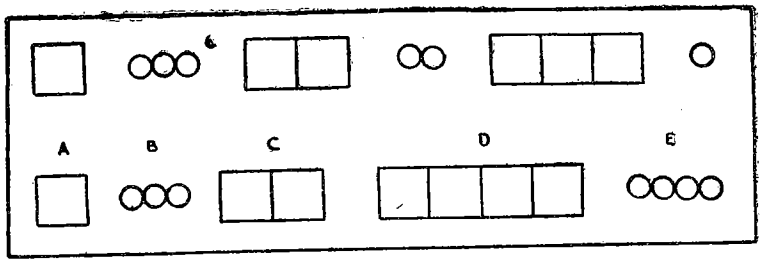

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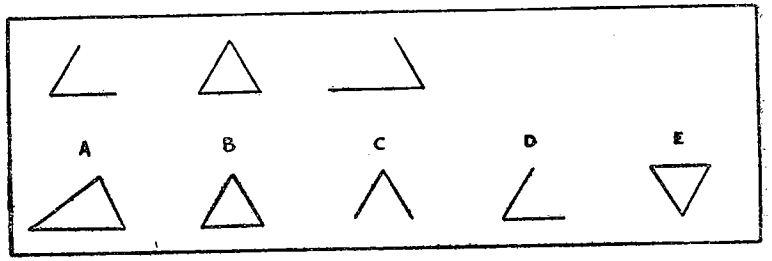

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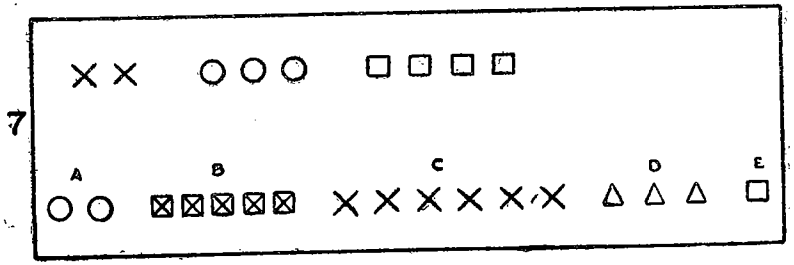

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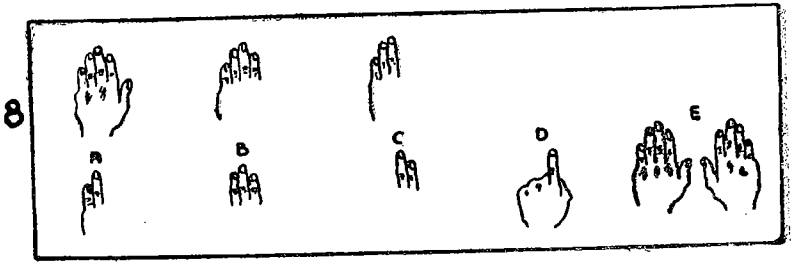

PRACTICE SET

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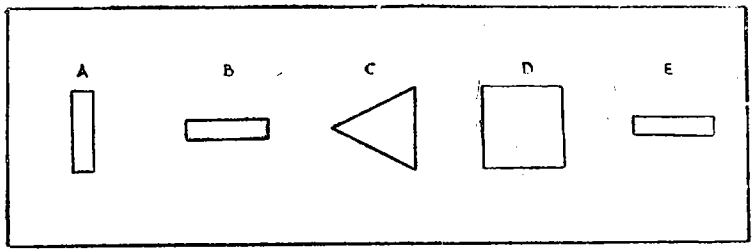

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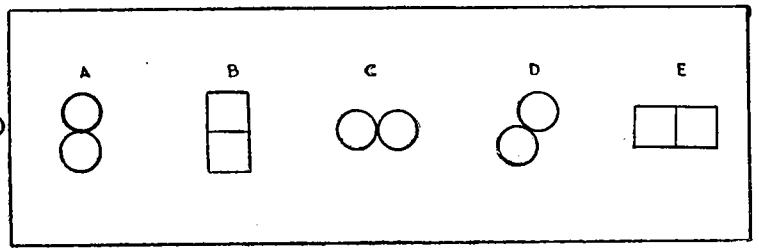

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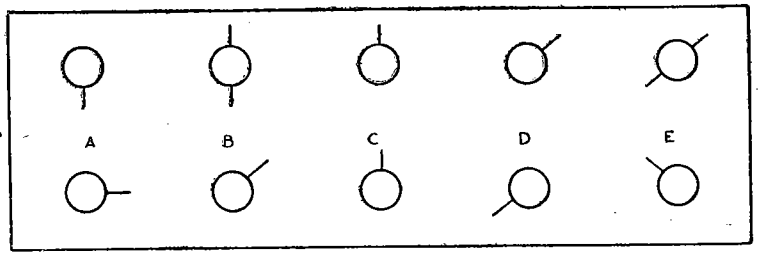

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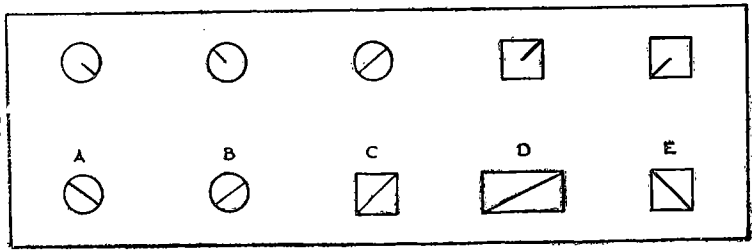

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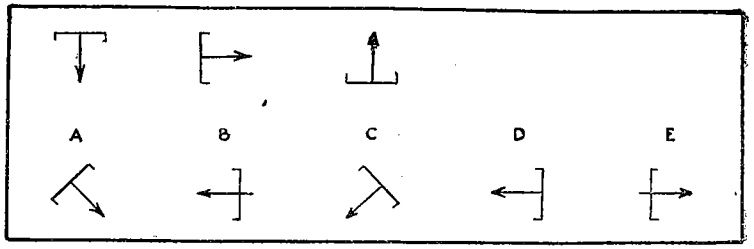

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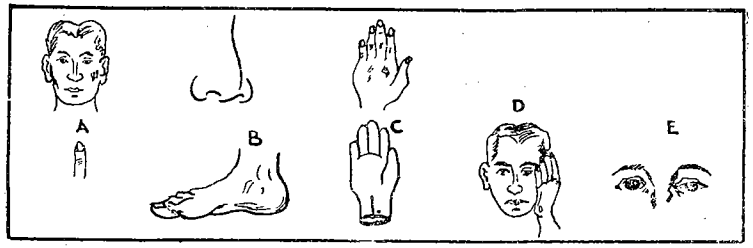

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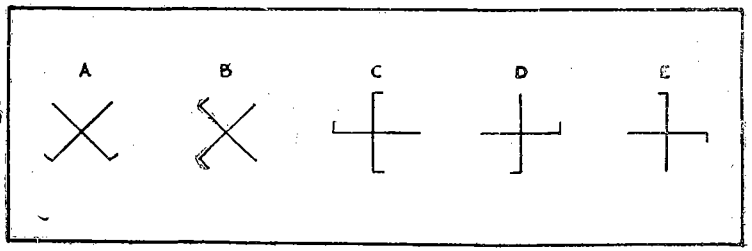
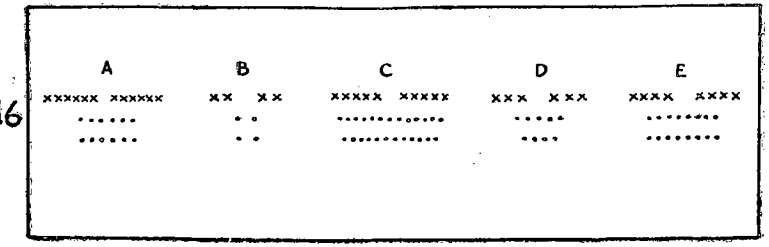


16



P R W FORM No. 60

ANSWER SHEET

P R W TEST No. 1 (REV.)

CANDIDATE'S NAME .....

BATCH No. ..... CANDIDATE'S No. .....

DATE OF TESTING.....

ILLUSTRATION SET						PRACTICE SET					
1	A	B	**X**	D	E	9	A	B	C	D	E
2	**X**	B	C	D	E	10	A	B	C	D	E
3	A	B	**X**	D	E	11	A	B	C	D	E
4	A	B	C	**X**	E	12	A	B	C	D	E
5	A	B	C	**X**	E	13	A	B	C	D	E
6	**X**	B	C	D	E	14	A	B	C	D	E
7	A	**X**	C	D	E	15	A	B	C	D	E
8	**X**	B	C	D	E	16	A	B	C	D	E

Total Score..... Marked by.....

Eq. Score..... Checked by.....

DO NOT TURN OVER UNTIL TOLD

TOTAL SCORE

THE TEST							THE TEST						
1	A	B	C	D	E		31	A	B	C	D	E	
2	A	B	C	D	E		32	A	B	C	D	E	
3	A	B	C	D	E		33	A	B	C	D	E	
4	A	B	C	D	E		34	A	B	C	D	E	
5	A	B	C	D	E		35	A	B	C	D	E	
6	A	B	C	D	E		36	A	B	C	D	E	
7	A	B	C	D	E		37	A	B	C	D	E	
8	A	B	C	D	E		38	A	B	C	D	E	
9	A	B	C	D	E		39	A	B	C	D	E	
10	A	B	C	D	E		40	A	B	C	D	E	
11	A	B	C	D	E		41	A	B	C	D	E	
12	A	B	C	D	E		42	A	B	C	D	E	
13	A	B	C	D	E		43	A	B	C	D	E	
14	A	B	C	D	E		44	A	B	C	D	E	
15	A	B	C	D	E		45	A	B	C	D	E	
16	A	B	C	D	E		46	A	B	C	D	E	
17	A	B	C	D	E		47	A	B	C	D	E	
18	A	B	C	D	E		48	A	B	C	D	E	
19	A	B	C	D	E		49	A	B	C	D	E	
20	A	B	C	D	E		50	A	B	C	D	E	
21	A	B	C	D	E		51	A	B	C	D	E	
22	A	B	C	D	E		52	A	B	C	D	E	
23	A	B	C	D	E		53	A	B	C	D	E	
24	A	B	C	D	E		54	A	B	C	D	E	
25	A	B	C	D	E		55	A	B	C	D	E	
26	A	B	C	D	E		56	A	B	C	D	E	
27	A	B	C	D	E		57	A	B	C	D	E	
28	A	B	C	D	E		58	A	B	C	D	E	
29	A	B	C	D	E		59	A	B	C	D	E	
30	A	B	C	D	E		60	A	B	C	D	E	

P. R. W. TEST NO. 2 (REVISED)

(Verbal Intelligence Test)

Instructions, Illustrations and Practice

Instructions

1. This is a test of your ability to solve problems quickly and correctly.

2. Give only ONE answer to each problem. This answer will be either a number (like 17) or numbers (like 2, 3 etc.) or a letter (like A) or a small set of letters (like s, c, etc.) or of words (like pen etc.).

3. The alphabet is printed below the answer sheet for your convenience.

EXAMPLES

Here are given a few examples of the type of questions that you will find in the test. Now read these examples carefully and see how they are solved.

1. Which choice mentions the correct answer to the following ?

Sand is to Desert as Water is to———?

Choices: (1) Tree (2) Sea (3) Table (4) House.

Here 'water' has the same relationship to one of the given words as 'Sand' has to 'Desert'. Just as 'Sand' constitutes the 'Desert', 'Water' constitutes the 'Sea'. The answer is therefore 'Sea' which is numbered (2) and is printed as the answer on the answer sheet.

2. Write the numbers of the two words which have the same relationship as 'Lead and Pencil' from

(1) Nib (2) Pen (3) Inkpot (4) Sharpner.

The two correct words here are 'Nib' and 'Pen' which are numbered 1 and 2 and are printed as the answer on the answer sheet.

3. I started cycling down a road in the morning facing the sun. After cycling for some time I turned to my right. Then I turned to my left. In which direction was I going then ? Which choice mentions the correct answer ?

Choices: (1) East (2) West (3) North (4) South.

Here I first took a turn to the right and then to the left. The two turns nullify each other. So East is the answer which is numbered 1 in the choices and is printed as the answer on the answer sheet.

4. Rearrange the jumbled letters in your mind to form a sensible word. Which choice mentions the last letter of the rearranged word ?

EALBUUIFT

Choices: (1) U (2) T (3) E (4) L

If the jumbled letters are rearranged, the word will be BEAUTIFUL. The last letter of this word is 'L' which is numbered 4 in the choices and is printed as the answer on the answer sheet.

5. Write the number of the pair which is different from other pairs in the following:—

(1) Ram and Sita (2) Krishna and Rukmini

(3) Rama and Lakshman

A number of pairs are given here. One of the pairs is in some way different from all others. In these pairs, number 3 are brothers whereas numbers 1 & 2 are husband and wife. So 3 is the correct answer and is printed as the answer on the answer sheet.

6. Which choice mentions the last letter of the required word ? If CBE means BAD, DBU means..... ?

Choices: (1) E (2) A (3) S (4) T

Here CBE means BAD because every letter in CBE stands for a letter immediately previous to it in the alphabet. Thus C stands for B, B for A and E for D. By applying the same rule to DBU, D stands for C, B for A and U for T, thus DBU means CAT. The last letter of CAT is T which is numbered (4) in the choices. (4) therefore is printed as the answer on the answer sheet.

7. Which choices mention the two letters that would come next in the following series in the correct order ?

ACEGI—

Choices: (1) K (2) L (3) H (4) M

In the above series every alternate letter of the alphabet beginning from A is taken. By following the same rule the next two letters will be K and M which are numbered (1) and (4) in the choices and are printed as the answer on the answer sheet.

8. Which choice mentions the answer ?

If 1+1=3, 2+3=6, 3+3=7 then 4+3=?

Choices: (1) 3 (2) 5 (3) 4 (4) 8

Here 1 + 1 is three and not two, 2+3 is 6 and not 5, 3+3 is 7 and not 6, *i.e.* in each case 1 is added to the correct sum. So 4+3 will be, 8 and not 7. Eight is numbered (4) in the choices and is printed as the answer on the answer sheet.

PRACTICE—SET

Try the following for practice, record your answers on the answer sheet in the column for 'Practice Set'.

9. Which choice mentions the required word?

Watch is to Time as Thermometer is to ——— ?

Choices:

(1) Mercury

(2) Glass Cylinder

(3) Centigrade

(4) Temperature

10. Write the numbers of the two words which have the same relationship—as—'World and God' from—

(1) Matter (2) Publishers (3) Author (4) Story.

11. I walked north for two miles, turned to my right and walked one mile then turned to my right again and walked two miles. Which of the choices mentions the direction in which I was going ?

Choices: (1) North (2) South (3) East (4) West.

12. I walked north for 3 miles, turned to my left and walked 8 miles, then turned to my right again and walked 3 miles. Which of the choices mentions the distance from the starting point to the place where I stopped ?

Choices: (1) 20 (2) (30) (3) 14 (4) 10

13. Which choice mentions the last letter of the word rearranged from the following jumbled spelling:

DAAECVN

Choices: (1) E (2) A (3) C (4) D.

14. Write the number of the pair which is different from the other pairs in the following:—

(1) Orange and Apple.

(2) Boy and Girl.

(3) Sugar and Sweet.

(4) Rice and Wheat.

15. Which choice mentions the last letter of the required word in the following:—

If BFDHF means CGEIG, MQISQ means———————?

Choices: (1) T (2) R (3) S (4) P.

16. Which choices mention the two letters which will come next in the series in the correct order?

GAIAKA—

Choices: (1) L (2) A (3) M (4) J.

17. Which choice mentions the answer ?

If 2+2=5, 3+2=6, 4+3=8, then 5+4=?

Choices: (1) 9 (2) 8 (3) 10 (4) 7.

Time limit: 35 minutes.

P.R.W. Form No. 37
(Revised)

ANSWER SHEET

P.R.W. TEST No. 2 (REVISED)
(V.I.T.)

Name in full.....
No. of S.S.B..... Batch No.....
Date..... Candidate No.....

EXAMPLES

Q.	ANSWER
1	2
2	1 & 2
3	1
4	4
5	3
6	4
7	1 & 4
8	4
PRACTICE SET	
9	
10	
11	
12	
13	
14	
15	
16	
17	

Q.	ANSWER	Q.	ANSWER	Q.	ANSWER
1		16		31	
2		17		32	
3		18		33	
4		19		34	
5		20		35	
6		21		36	
7		22		37	
8		23		38	
9		24		39	
10		25		40	
11		26		41	
12		27		42	
13		28		43	
14		29		44	
15		30		45	

Q.	ANSWER
46	
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

Marked by..... Total Score.....

Checked by..... Eq. Score.....

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

P. R. W. TESTS I (REV) & II (REV)—NORMS

TABLE I

SELECTION GRADES

Grades	Summed Equivalent Scores
I	137 & above
II	123—136
III	109—122
IV	91—108
V	77— 90
VI	66— 76
VII	65 & above

TABLE II

CONVERSION KEY

Raw Score	Eq. Score P.R.W. I (Rev.)	Eq. Score P.R.W. II (Rev.)	Raw Score	Eq Score P.R.W. 1 (Rev.)	Eq. Score P.R.W. II (Rev.)
0	20	13	31	52	52
1	21	14	32	53	54
2	22	15	33	54	55
3	23	16	34	55	56
4	24	18	35	56	58
5	25	19	36	57	59
6	26	20	37	58	60
7	27	22	38	59	62
8	28	23	39	60	63
9	29	24	40	61	64
10	30	25	41	62	65
11	31	27	42	63	67
12	32	28	43	64	68
13	33	29	44	65	69
14	34	31	45	66	71
15	35	32	46	67	72
16	36	33	47	68	73
17	37	34	48	69	74
18	38	36	49	70	76
19	39	37	50	71	77
20	40	38	51	72	78
21	41	40	52	73	80
22	42	41	53	74	81
23	43	42	54	75	82
24	44	43	55	76	83
25	45	45	56	77	85
26	47	46	57	78	86
27	48	47	58	79	87
28	49	49	59	80	89
29	50	50	60	81	90
0	51	51			

II

P. R. W. 24 & I. S. P. 45

II

P.R.W. 24 & I.S.P. 45

It is proposed here to study the Intelligence-Test-Stores of candidates appearing for selection to the National Defence Academy Course after passing the UPSC examination. The pass rate in this examination was 39%. Other particulars are as in page 3 para 1.

The Description of the Tests

The tests used were P.R.W. 24 and I. S. P. 45.

P.R.W. 24 is a non-verbal test of Intelligence. It contains two types of questions. In some a pattern with a blank space in it is given in the first half of the page. Below this pattern there are eight small pieces. Only one of these pieces will go to complete the pattern. The other type of questions is pictorial analogies. In each such question the first picture bears a certain relation to the second picture and the third picture bears a somewhat similar relation to one of the last four pictures. The testee has to write the number of the picture among the last four pictures, that is related to the third picture in a manner similar to that in which the second picture is related to the first. The total number of questions is 31.

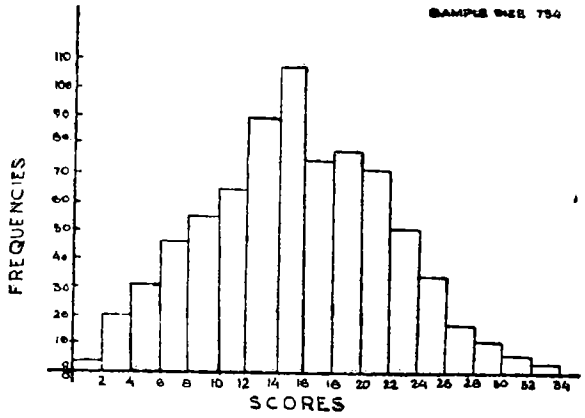
I.S.P. 45 (Modified) is a verbal test of Intelligence containing questions of a miscellaneous type, such as series completion, pointing out an odd item etc. The total number of questions, is 40.

The following are the distributions of the Test Scores:—

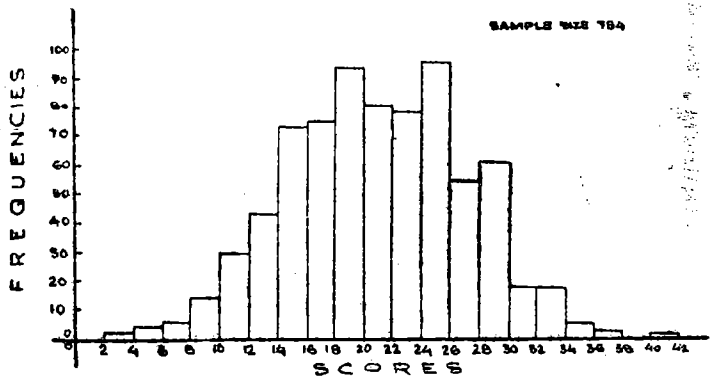
I.S.P. 45		*P.R.W.* 24	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
0—1	1	0—1	4
2—3	2	2—3	20
4—5	4	4—5	31

I. S. P.45		*P.R. W. 24*	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
6—7	5	6—7	46
8—9	14	8—9	55
10—11	30	10—11	64
12—13	43	12—13	89
14—15	73	14—15	107
16—17	75	16—17	64
18—19	94	18—19	77
20—21	80	20—21	71
22—23	78	22—23	50
24—25	96	24—25	33
26—27	54	26—27	16
28—29	61	28—29	10
30—31	18	30—31	5
32—33	18	32—33	2
34—35	5	Total .	754
36—37	2		
38—39	..		
40—41	1		
Total .	754		

GRAPH I- HISTOGRAM OF SCORES ON PRW TEST 24



GRAPH II- HISTOGRAM OF SCORES ON ISP TEST 45



Scores on I.S.P. 45 are normally distributed. The distribution for P.R.W. 24 is flat-topped (graph I & II). The following are the salient statistics:—

Test	*Mean*	*S.D.*	*Reliability (Rational Equivalence)*	*g1*	*g2*	*Remarks*
P.R.W. 24 .	20.42	6.20	0.82	0.07	—0.23	Distribution is normal
I.S.P. 45 .	14.93	6.28	0.73	0.07	—2.84**	Distribution is platykurtic.

The correlation between the tests is 0.40**

GROUP DIFFERENCES

Language Groups

The following table presents the results languagewise:

Language	*Frequency*[1]	*Mean*	*Variance*
1. Bengali	37	94.70	292.60
2. Hindi	230	95.59	437.25
3. Tamil	53	107.83	288.34
4. Marathi	48	108.85	402.27
5. Punjabi	360	99.85	411.34

Bartlett's Test shows that the variances can be regarded as equal from group to group. (X^2=5.10 with 4 d.f.) Analysis of variance was then applied. It showed that the mean scores differ significantly from group to group. (F=7.60** with 4 & 723 d.f.).

Further analysis showed that group 1 does not differ from group 2 and 3 does not differ from group 4. Group 5 differs from all the others. Likewise 1 and 2 differ from 3 and 4.

[1]The number could not be identical throughout the analysis because of incompleteness of the records.

The following table shows how the different linguistic groups are represented in the candidate population:—

S. No.	*Language Group*	*Frequency in Candidates*	*Frequency in India*	*% age of Candidates* 100 × Col 3 / No. of Candidates	*% age of the population of India* 100 × Col. 4 / Population of India
(1)	(2)	(3)	(4)	(5)	(6)
1	Hind — . . .	226	108,760966	30.50	33.57
2	Urdu — . . .	4	32,184915	0.54	9.93
3	Hindustani — . .	0	8,160683	0.00	2.52
4	Punjabi + . . .	360	837747	48.58	0.26
5	Telugu — . . .	12	32,999916	1.62	10.19
6	Marathi — . . .	48	27,049522	6.48	8.35
7	Tamil — . . .	21	26,546764	2.83	8.19
8	Bengali — . . .	37	25,121674	4.99	7.75
9	Gujarati — . . .	4	16,310771	0.54	5.03
10	Kannada — . . .	10	14,471764	1.35	4.47
11	Malayalam — . .	10	13,380109	1.35	4.13
12	Oriya — . . .	1	13,153909	0.13	4.06
13	Assamese — . . .	2	4,988226	0.27	1.55
14	Kashmiri+ . . .	6	5086	0.82	0.00
15	Sanskrit	0	555	0.00	0.00

The X^2 test shows that the linguistic distribution of candidates is different from the liguistic distribution in the population at large (X^2=182·55** with 11 d.f.)[2]. The groups appearing in numbers, larger than those expected on the basis of population are marked positive. Those appearing in smaller numbers are

[1]These figures are according to 1951 census.

[2]Serial number 3, 14 and 15 were left out.

likewise marked negative. The most marked positive tendency was displayed by serial number 4 and the most marked negative one by serial number 2.

Education

The second grouping is on the basis of education. The following table presents the results:—

Highest Examination passed	*N*	*Mean*	*Variance*
Matric	582	98.82	426.03
F.A. & F.Sc.	149	103.24	462.63
B.A. & B.Sc.	6	85.50	227.20

Bartlett's test shows that the variances do not differ significantly from group to group. (X^2=1.32 with 2 d.f.). Analysis of variance was therefore applied. It showed that the means differ significantly from group to group. (F=4.18** with 2 & 734 d.f.). Pairwise comparisons showed that the Matric and B.A. B.Sc. groups can be regarded as one with regard to the mean and differ significantly from the F.A. and F.Sc. group. The B.A. B.Sc. group has the lowest mean score. Obviously the best part of this group goes in for other avenues of employment. Another reason may be that the graduates belong to a higher age-group and this age-group is known to score less on Intelligence tests.

Age

We shall now study the agewise classification. The following table gives the results:—

Age Group	*N*	*Mean*	*Variance*
15+	66	96.74	380.35
16+	229	101.70	458.32
17+	372	98.42	423.34

Bartlett's Test shows that the variances cannot be said to differ from age to age. (X^2=1.63 with 2 d.f.). Analysis of variance was, therefore, carried out. It showed that the mean score does not differ significantly with age. (F=2.74 with 2 & 734 d.f.).

Schools

There are mainly three types of schools in India: Public, European and Ordinary. Public schools are generally residential schools with good facilities for games and other outdoor and extra-curricular activities. There is a great emphasis on the English language and western cultural moorings in general. The European schools are not necessarily residential or well equipped for games etc. The emphasis there is on the English language and the Christian religion. Ordinary schools have, generally speaking no religious teaching and are not generally well equipped for outdoor and extra-curricular activities. Academic teaching is not necessarily inferior to that in the other schools. The mother-tongue has a better place in the curriculum and there is less emphasis on western moorings.

In addition to these there is a fourth type called the Sainik Schools. These are run on public school lines with provision for military training.

The Public and European schools are preferred by most parents who can afford them. The wards of high government officials and big men in other walks of life generally go to these schools.

The following table presents the results:—

School	*N*	*Mean*	*Variance*
Ordinary	594	97.52	421.01
Public	50	108.30	343.57
European	77	108.38	394.23
Sainik	16	107.56	613.52

Bartlett's test shows that the variances do not differ from school to school. (X^2=2.28 with 3 d.f.). Analysis of variance was therefore, carried out. It showed that the schools differ in their mean score. (F=10.58** with 3 & 733 d.f.). Further analysis showed that the ordinary schools are lower than all the others and if these are left out the others do not differ among themselves.

In the 20th N. D. A. sample the selection rate was 20.95%. If we select the top 20.95% of the total distribution of Intelligence scores alone and ignore all other assessments the following will be the selection rate for different schools.

School	*Selection-rate*
Ordinary.	19.7
Public	30.5
European	35.1
Sainik	25.0

Religion

A religion-wise classification gives the following results:—

Relation	*N*	*Mean*	*Variance*
Hindu (Sanatani)	556	98.86	495.30
Sikh	171	98.39	396.52
Christian	16	105.50	331.47
Others	10	107.80	361.07

It will be noted that the number of Sikh candidates is very large. They are 22.71 per cent among candidates as against 1.74 per cent in the population. Hindus (Sanatanis) are 73.84 per cent among the candidates as against 85.00 in the population. There were only five Muslims. (.66% among the candidates as against 9.92% in the population). Christians are 2.12% among the candidates against 2.30 per cent in the population.

Bartlett's test shows that the variances do not differ from religion to religion. (X^2=4.23 with 3 d.f.).

Analysis of variance was, therefore, carried out. It showed that mean scores do not differ significantly from religion to religion. (F=1.08 with 3 & 749 d.f.).

Urban/Rural

The following table presents the results according to the urban/rural: dichotomy.

Classification	*N*	*Mean*	*Variance*	*t*
Urban	617	100.29	409.92	3.05**
Rural	135	94.46	159.51	

The mean of the urban group is thus significantly higher than the mean of the rural group.

Guardian's Income

If the candidates are classified according to their guardian's income we get the following results:—

Guardian's Income monthly	*N*	*Mean*	*Variance*
Rs.			
0— 200	231	93.08	454.30
201— 600	338	99.99	344.63
601—1000	113	104.31	456.22
1001 & above	66	111.55	297.94

The majority belongs to the income group 201-600. Bartlett's test shows that the variances within the different income groups cannot be regarded as equal. (X^2=8.88* with 3 d.f.).

Test for homogeneity of means when the variances are heterogeneous was applied. (as given in part I).

F′=19.44** for n_1=3 n_2=449.

The differences in the means are thus significant and the scores seem to rise with income.

Examination—Division

The divisions obtained by the candidates in the Matric and F.A./F.Sc. examinations are mentioned in the records. 245 candidates were in the first division as against 181 in the second

and 37 in the third in the Matric examination. The first divisioners are more numerous than the second and third divisioners put together. (245 to 218). This shows that the population that comes before the Selection Boards is high-class.

The range of Intelligence-scores was divided into three equal parts and a 3×3 scattergram of Intelligence versus Matric divisions was prepared. The contingency coefficient was found to be 0.14, significant at 1% level.

To compare group-wise, the mean score of first divisioners is 99.61 as against 98.03 of the second divisioners. The difference is not significant. The mean score of the third divisioners is 91.65. This is significantly different from that of the second divisioners (at 5%).

In the F.A./F. Sc. 11 candidates got first, 50 got second and 36 got third division. Perhaps at the intermediate level the first divisioners prefer further education to a military career.

Contingency coefficient, calculated by the same method as in the case of Matriculates, is 0.22, significant at 5% level.

To compare groupwise, the mean score of first-divisioners is 117.73 as against 101.36 of the second-divisioners. The difference is significant at 5%. The mean of third-divisioners is 102.06, not significantly different from that of the second-divisioners.

Relation with other Assessments.

The following table presents the correlation of the Intelligence-test, marks with other assessments at the SSBs:—

Assessment	*Correlation with Intelligence Scores*
Group Testing Officer	0.19**
Technical Officer	0.37**
President/Dy. President	0.27**
Total Board Marks	0.32**

The following conclusions emerge from the study:—

(1) I.S.P. 45 gives a normal distribution with a reliability of 0.73. P.R.W. 24 has a flat-topped distribution with a reliability of 0.82.

(2) Significant differences are found in the mean scores of different language groups.

(3) The mean score does not rise with the level of education.

(4) The mean score does not differ with the age group studied.

(5) Boys coming from ordinary schools score less than boys coming from public or other similar schools.

(6) The scores do not differ with religion.

(7) The urban candidates score significantly more than the rural.

(8) There is a positive but low relationship between examination division and Intelligence grade.

(9) The Intelligence test scores are positively correlated with all other assessments.

P.R.W. TEST NO. 24

(Non-Verbal Intelligence Test)

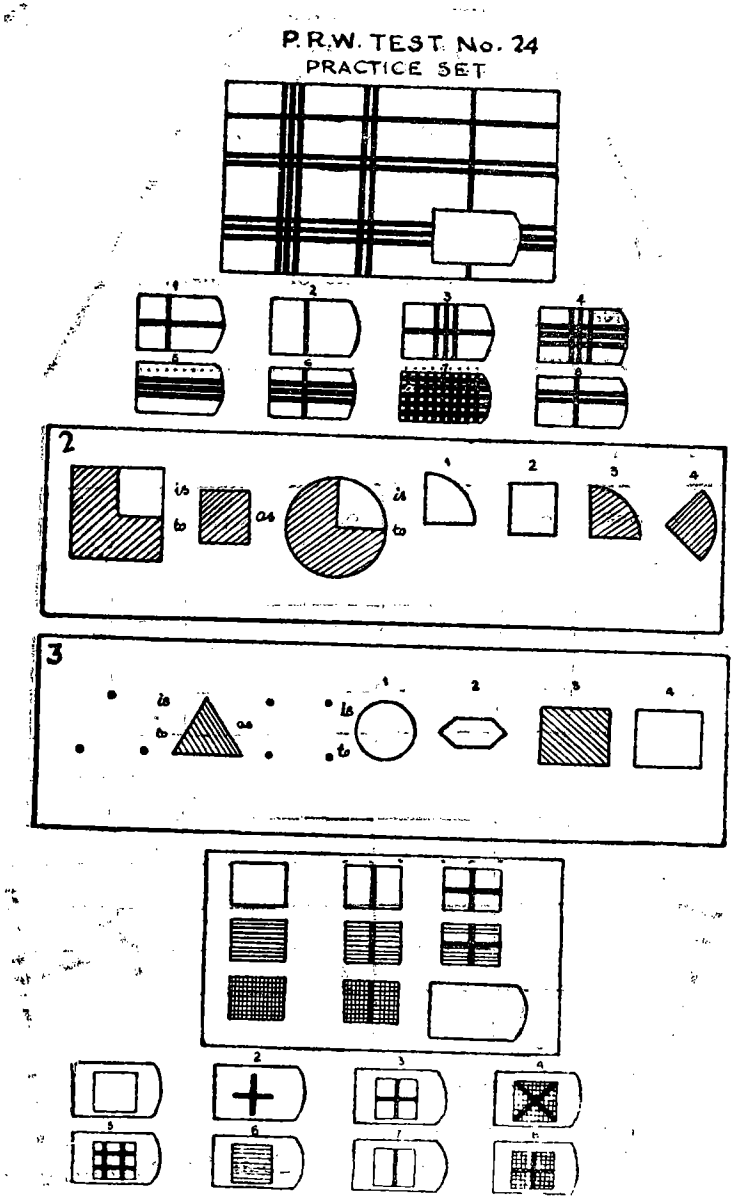
Instructions, Illustrations, Practice

Read the following instructions carefully

This is a short test mainly of observation and there is no catch in it. The test contains two types of questions. In some, a pattern with a blank space in it is given in the first half of the page. Below this pattern there will be eight small pieces numbered from 1 to 8. These will all be of the same size and shape as the missing piece in the big pattern and will therefore fit in exactly in the blank space and there is no measuring to be done. The important point is that only one of these eight pieces will go to complete the pattern. You have to write on your answer-sheets, against each question, the number of the small piece which completes the question's pattern. The other type of questions is pictorial analogies. In each such question the first picture bears a certain relation to the second picture and the third picture bears a somewhat similar relation to one of the last four pictures. The last four pictures in each such question are numbered from 1 to 4. You have to write in your answer sheet the number of the picture among the last four numbered pictures that is related to the third picture in a manner similar to that in which the second picture is related to the first.

Before the proper test, there is a practice set of four examples two of which the tester will do with you. The next two examples will be done by you. Difficulties will be explained fully after all of you have tried these examples.

Time limit: 20 minutes.



P.R.W. Form No. .....

ANSWER SHEET

P. R. W. 24 (REVISED)

(NON-V. I. T.)

No. of S. S. B. .....

Batch No. ..... Date of Testing.....

Candidate's No. .....

Name of the Candidate .....

PRACTICE SET

Q.	ANSWER	Q.	ANSWER	Q.	ANSWER	Q.	ANSWER
1	6	1		12		22	
2	3	2		13		23	
3	3	3		14		24	
4	6	4		15		25	
		5		16		26	
		6		17		27	
		7		18		28	
		8		19		29	
		9		20		30	
		10		21		31	
		11					

Marked by.....

Checked by .....

Total Score.....

Eq. Score.....

I.S.P. TEST 45 (MODIFIED)

(Verbal Intelligence Test)

Instructions, Illustrations & Practice.

This is a reasoning test. It contains questions of different kinds. Each question is incomplete ; by examining what is given you can find the missing part, which is indicated, in most cases by dots. Write one letter or number on each dot. In items where there are no dots you are required to underline certain letters, numbers or words. Here is a sample question already answered correctly. Notice how the question is answered.

Sample: A B C D E F G H

. . .

The right answer is the alphabetical order FGH, so FGH is written on the three dots. This is the way you are to answer the questions.

Try the following practice questions yourself:—

1	Short	long	down	up	black ...
2	11	9	7	5	...
3	Escape		Scape	Cape	...
4	4 1	3 8	2 7	3 1	5 49 3 7 5
5	VWX	765	XWV	..	
6	Students	University	Sailors	Navy	Soldiers...

Time limit: 20 minutes.

P.R.W. Form No. 56

ANSWER SHEET

I. S. P. TEST 45 (REVISED)

(V. I. T.)

(P. R. W. Revision)

Name in full .....

No. of S.S.B. ..... Batch No. .....

Date ..... Candidate's No. .....

EXAMPLES

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

Marked by .....

Checked by .....

Total Score.....

Eq. Score.....

P.R.W. TEST NO. 24 & I.S.P. TEST NO. 45 (mod)

TABLE I

CONVERSION KEY

Raw Scores	*Eq. Scores* PRW Test 24	*Eq. Scores* ISP Test 45 (Mod)	Raw Scores	*Eq. Scores* PRW Test 24	*Eq. Scores* ISP Test 45 (Mod)	Raw Scores	*Eq. Scores* PRW Test 24	*Eq. Scores* ISP Test 45 (Mod)
0	20	9	17	51	45	34	82	81
1	22	11	18	53	47	35	84	83
2	24	13	19	55	49	36	86	85
3	26	16	20	57	51	37	87	87
4	28	18	21	58	53	38	89	89
5	30	20	22	60	56	39	91	91
6	31	22	23	62	58	40	93	93
7	33	24	24	64	60	41	..	96
8	35	26	25	66	62	42	..	98
9	37	28	26	68	64	43	..	100
10	39	30	27	69	66	44	..	102
11	40	32	28	71	68	45	..	104
12	42	34	29	73	70			
13	44	37	30	75	72			
14	46	39	31	77	74			
15	48	41	32	78	77			
16	49	43	33	80	79			

TABLE II

SELECTION GRADES

GRADES	SUMMED EQUIVALENT SCORE ON BATTERY
I	133 & above
II	119—132
III	108—118
IV	95—107
V	77— 94
VI	66— 76
VII	65 & below

III

P. R. W. 19 & P. R. W. 20

III

PRW 19 & *PRW* 20

It is proposed here to study the scores on the intelligence test battery consisting of PRW 19 & PRW 20. The sample studied consisted of 801 U. P. S. C. passed candidates appearing for admission to the National Defence Academy Course. The pass rate in their U. P. S. C. examination was 36.1% (other details as on page 3, para 1).

The Description of the Tests

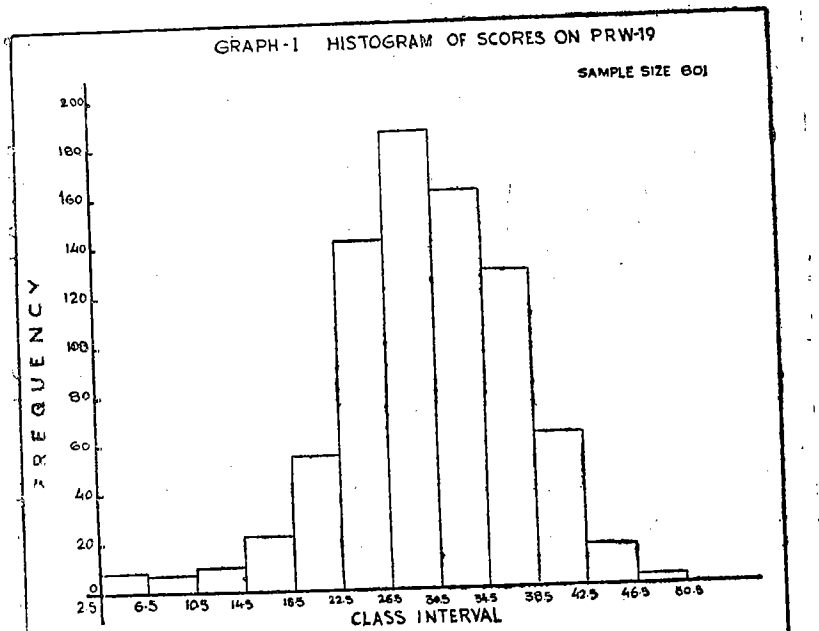
PRW 19: PRW 19 is a non-verbal test. It contains 50 questions in each of which a series of drawings has to be continued by discovering the rule according to which it is arranged.

PRW 20: PRW 20 is a verbal test containing 70 items of various types such as picking up an odd word, seeing similarity of relations, arranging words to make a meaningful statement, understanding a series, correcting a jumbled spelling etc.

Distribution of Scores on the Tests

The following are the distributions of scores on the tests:—

PRW 19		*PRW* 20	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
3— 6	8	20—23	4
7—10	7	24—27	10
11—14	10	28—31	29
15—18	22	32—35	49
19—22	55	36—39	88
23—26	142	40—43	128
27—30	186	44—47	146
31—34	162	48—51	131
35—38	129	52—55	125
39—42	62	56—59	55
43—46	15	60—63	32
47—50	3	64—67	22
		68—71	2
Total	801	Total	801



The distribution of PRW 19 is negatively skewed and the distribution of PRW 20 is positively skewed. Following are the salient statistics :—

Test	*Mean*	*S.D.*	*Reliability (Rational equi valence)*	g_1	g_2	*Remarks*
PRW 19 . .	29.70	7.29	0.79	—0.42**	—0.16—	skewed
PRW 20 . .	45.77	8.40	0.79	0.58 **	—0.25+	skewed

The correlation between the tests is 0.41.

GROUP DIFFERENCES

Age

The following table presents the mean scores of candidates grouped on the basis of age:—

Age Group	*N*	*Mean*	*Variance*
15.	97	102.16	283.92
16.	306	100.25	256.00
17.	396	98.01	306.2

As expected, the number at 15 is the smallest owing to the required minimum educational qualification viz., Matriculation.

Bartlett's test shows that the variances do not differ from age to age. (x^2=4.26 with 2 df. N. S.).

Analysis of variance shows that the means differ with age (F=3.71** with df 2 and 796). A look at the table shows that they decline with age.

A pairwise comparison shows that fifteen-years-olds score more than seventeen-year-olds. (t=2.37 d.f. 491).

Religion

Religion-wise grouping gives the following picture:—

Religion	*N*	*Mean*	*Variance*
1. Hindu (Sanatani)	601	98.30	291.30
2. Sikh	145	102.14	304.15
3. Christian	33	104.15	241.18
4. Jains	12	102.00	186.68
5. Others (Muslims, Parsi, etc.)	10	100.00	218.60

The number of Sikh candidates is impressive in view of the small numbers in the population.

Bartlett's test shows that the variances do not differ from group to group (x^2=6.23, d. f.=4).

Analysis of variance shows that the means vary between the groups (F—2.63* with d. f. 4 and 796).

Pairwise comparison shows that groups 2 and 3 score significantly more than group 1.

Difference between Groups	*Size of the difference*	*t-value*	*D.F.*
1 & 2	3.84	2.56*	744
1 & 3	5.85	2.06*	632

Medium of Instruction

The candidates study in different media for their Matriculation. A mediumwise analysis yields the following results:—

Medium	*N*	*Mean*	*Variance*
1. English	487	102.23	253.45
2. Hindi	125	95.21	329.79
3. English and Hindi	99	97.42	296.53
4. Rest	88	93.41	228.61

(Some candidates use English medium for some subjects and Hindi for others. They belong to group No. 3. The rest contain pupils studying in several different media. The number available under each of these is too small to be studied separately.)

Bartlett's test shows that the variance does not differ from medium to medium (x^2=5.94 with d. f. 3 not significant.)

Analysis of variance shows that the different medium-groups differ in their mean score. (F=6.83** with d.f. 3 and 795). A pairwise comparison shows that only the pairs including English show a significant difference. The difference of English from the combined medium English and Hindi is significant at 5% level, the other differences are significant at 1% as shown in the following table:—

Difference Between Groups	*Size of the difference*	*t-value*	*D. F.*
1 & 2	7.02	3.99**	610
1 & 3	4.81	2.17*	584
1 & 4	8.82	3.99*	573
2 & 3	2.21	0.83	222
2 & 4	1.80	0.68	211
3 & 4	4.01	1.42	185

Guardian's Occupation

The different occupational groups are known to differ in intelligence. Since the candidates themselves are all students, we can only consider the occupation of their guardians. The following table presents the results:—

Guardian's Occupaiton	*N*	*Mean*	*Variance*
1. Govt. Service (Civilian) . . .	279	99.58	301.37
2. Military Service (Non-Officer Ranks)	80	105.65	204.49
3. Military Service (Officer Ranks) .	45	104.10	198.81
4. Private Service	65	95.42	391.51
5. Teaching	55	96.04	245.24
6. Doctors	30	97.83	246.49
7. Agriculture	44	98.23	341.51
8. Business	103	96.69	284.50
9. Engineering	47	100.83	219.04
10. Law	35	102.14	265.79
11. Others	12	94.91	409.33

Bartlett's test shows that the variances do not differ from group to group (x^2=12.83, d. f.=10).

Analysis of variance shows that the means differ from group to group (F—2.76** with d. f. 10 and 784).

It should be noted that the largest number, more than half, is contributed by the Govt. servants. Candidates of the required educational qualifications are mainly found among the wards of Govt. servants. Among the rest, business contributes a good number.

Scores of candidates belonging to group 3 are higher and differ significantly from the scores of candidates belonging to 4, 5, 6, 7, 8 & 1. Scores of candidates belonging to group 2, 3, & 10 do not differ amongst themselves. Table given below gives the pairwise analysis. Only those values are shown which are significant:—

Difference between groups	*Size of the difference*	*t-value*	*D. F.*
1 & 2	6.07	2.83**	357
2 & 4	10.23	3.65**	143
2 & 5	9.61	3.43**	133
2 & 7	7.42	2.20*	108
2 & 8	8.96	2.54*	181
2 & 9	4.82	3.62**	125
2 & 11	10.74	2.10*	90
3 & 4	8.68	2.72**	108
3 & 9	3.27	2.50*	90
3 & 5	8.06	2.44*	98

Income

Closely related with occupation is income. An incomewise analysis gives the following picture :—

Income-Group	*N*	*Mean*	*Variance*
1. 0—250	245	95.24	202.40
2. 251— 700	314	99.68	374.06
3. 701—1000	114	102.19	236.84
4. 1001—1500	85	105.56	232.74
5. Over 1500	30	102.86	150.22
6. Not specified	13	95.07	185.23

The largest number comes from the 251-700 income group. The lower numbers in the higher income group are partly explicable by the small number which have such high incomes. The smaller number in the income group below 250 cannot be thus explained for this group contains a larger number.

Bartlett's test shows that variances differ from group to group (x^2=37.26** with d. f. 5). The income-group 251-700 has the highest and the income-group over 1500 has the lowest variance. Test for homogeniety of means with heterogeneous variances was applied as given in part I. It shows that mean scores differ from group to group. (F′=2.8* for d. f. 5 and 91). Further, the pairwise comparisons show that the candidates coming from 250 and above income group score more than the candidates coming from the, below 250 income group as shown in the following table:—

Difference between Groups	*Size of the difference*	*t-value*	*D.F.*
1 & 2	4.44	3.14**	557
1 & 3	6.95	4.08**	357
1 & 4	10.52	5.45**	328
1 & 5	7.62	3.12**	273
2 & 4	5.88	2.98**	397

Education

Classifying the candidates according to the level of their education gives the following results:

Education	*N*	*Mean*	*Variance*
1. Non-Matric	229	95.82	284.59
2. Matric	446	99.76	325.08
3. Higher Secondary	79	96.84	216.09
4. Intermediate	47	102.85	265.69

The largest number of candidates are Matric, the more advanced students like higher secondary and intermediate are obviously thinking of other careers.

Bartlett's test shows that the variances differ from group to group. (x^2=10.52* with d. f. 3). Test for homogeniety of means with heterogeneous variances shows that mean scores vary from group to group. (F′=4.07** with d. f. n_1=3 ; n_2=146).

Apart from the higher secondary group the means rise with education, the non-matrics have the lowest and the intermediate the highest. The difference between the matrics and the higher secondary is not significant, showing the anomaly to be apparent. Among the significant differences, the one between 3 and 4 is significant at 5% level, the others are significant at 1%. The following table shows the results:—

Difference between Groups	*Size of the difference*	*t-value*	*D.F.*
1 & 2	3.94	2.81**	673
1 & 3	1.02	0.50	306
1 & 4	7.03	2.66**	274
2 & 3	2.92	1.57	523
2 & 4	3.09	1.21	491
3 & 4	6.01	2.05*	124

Rural/Urban

The following table presents the results according to the urban/rural classification:—

	N	*Mean*	*Variance*
Urban	696	100.29	277.89
Rural	105	91.51	622.96

It is clear that candidates are drawn overwhelmingly from the urban areas, because these areas fulfil the educational and socio-economic requirements of the services.

The urban group has a higher mean score than the rural.

Difference between groups	*Size of the difference*	*t-value*	*D.F.*
Urban & Rural	8.78	3.80**	799

Type of School

The following table presents/the results schoolwise:—

Type of school	*N*	*Mean*	*Variance*
1. Public	83	103.39	201.92
2. Sainik	16	107.63	290.36
3. European	126	105.20	219.04
4. Ordinary	569	97.22	292.41

Bartlett's test shows that the variances differ from school to school. (x^2=10.24** with d. f. 3). The public-school-variance is the lowest and the ordinary-school-variance the largest. Test for homogeneity of means with heterogeneous variances, shows that mean scores vary from group to group (F′=12.91** with d. f. n_1=3, n_2=64). Pairwise analysis is given in the following table:—

Difference between Groups	*Size of the difference*	*t-value*	*D.F.*
1 & 2	4.24	0.95	97
1 & 3	2.81	1.39	206
1 & 4	6.17	3.64**	650
2 & 3	1.43	0.30	139
2 & 4	10.41	2.32*	583
3 & 4	8.98	6.11**	692

Public, Sainik and European schools form one group. The candidates from these schools do better than candidates coming from ordinary schools.

In the 26th N. D. A., the selection rate was 34.1%. If we select the top 34.1% of the total distribution of intelligence scores above and ignore all other assessments the following will be the selection rate for different schools:

Schools	*Selection%*
1. Public	51.5%
2. Sainik	37.5%
3. European	73.8%
4. Ordinary	33.0%

States

The following table presents the state-wise results:—

State	*N*	*Mean*	*Variance*
Punjab	243	98.71	296.18
Delhi	230	98.71	290.02
Jammu & Kashmir	14	104.41	189.34
Mysore	24	104.41	317.30
U.P.	118	101.71	296.87
Bihar	12	99.16	475.24
West Bengal	14	98.02	358.72
Rajasthan	12	104.91	143.52
Madhya Pradesh	14	106.42	266.67
Maharashtra	48	98.26	144.00
Kerala	30	97.28	174.50
Madras	21	99.28	234.00
Others (Andhra, Orissa, Gujarat, Assam & H. Pradesh)	18	95.55	219.34

Bartlett's test shows that the variances differ from state to state. The largest variance is that of Bihar and the smallest is that of Rajasthan (x^2=30.80** with d. f. 12).

Testing for homogeneity of means with heterogeneous variance indicates that mean scores do not vary from state to state. (F′ = 1.09 with d. f. n_1=12, n_2=93).

Language

Information about the language of the candidates is also available. A language-wise analysis gives the following table:—

Language	*N*	*Mean*	*Variance*
Punjabi	324	99.10	303.11
Hindi	287	99.26	276.23
Sindhi	16	101.68	156.25
Telugu	10	99.40	198.81
Tamil	29	99.04	218.15
Marathi	31	96.58	181.44
English	11	103.81	155.85
Bengali	18	99.35	514.83
Malayalam	27	96.51	309.41
Others	42	101.26	266.55

Bartlett's test shows that the variances differ from language group to language group. (x^2=19.33* with d. f. =9). The largest variance is shown by Bengali and the smallest by English. Testing for homogenity of means with heterogeneous variances shows that the mean score is unaffected by mothertongue (F'= 0.48 with d. f. n_1=9, n_2=75).

Migration

Data are available to show how many of the candidates are staying in their own or another linguistic area. From this it would be possible to study trends in migration. The following table presents the data:—

	Punjab		Hindi States		Andhra	
	Non. Mig.	Mig.	Non. Mig.	Mig.	Non. Mig.	Mig.
N	156	168	95	192	6	4
% migrants		(52%)		(67%)		(40%)
Mean	98.15	100.22	101.73	98.09	96.33	104.00

	Mysore		Maharashtra		Bengal		Kerala	
	Non. Mig.	Mig.	Non. Mig.	Mig.	Non. Mig.	Mig.	Non. Mig.	Mig
N	20	9	27	4	9	9	25	2
% migrants		(31%)		(13%)		(50%)		(8%).
Mean	98.90	99. 7	96.36	98.50	95.33	108.78	96.36	107.50

The largest number of migrants are found in the Hindi-speaking states. This may merely reflect the fact that many residents of these provinces declare their language to be Urdu or Hindustani etc. and are thus classified as non-Hindi though they are not migrants.

If we take the river Narmada as the boundary between the North and the South and exclude the ambiguous position of Bengal, we find that the number of migrants to the North is about 60 per cent, as against only 2 per cent to the South.

All the differences between the means for migrants and non-migrants are nonsignificant.

Only in the case of Hindi the migrants' mean in lower. This suggests that the consistent superiority of the migrants over non-migrants excepting in the case of Hindi may be significant. A sign test however reveals that even this is not significant (p.= 0.124).

The following table presents the correlation of the Intelligence Test Marks with other assessments at the boards (p. 9):—

Initial Marks of	*Intelligence Scores*
Group Testing Officer	0·24
Technical Officer	0·33
President/Dy. President	0·27
Total Board Marks	0·32

The above correlations are significant at 1% level.

Conclusions

The following conclusions emerge from the study:—

(i) Fifteen year-old boys score more than older boys.

(ii) The majority of the boys come from ordinary schools. They score less than boys coming from public or European schools.

(iii) Boys coming from schools having English as medium of instruction score better than boys taking other media.

(iv) Boys whose fathers are in military service score the highest marks. Sons of those in private service score the minimum marks.

(v) Boys coming from the income group below Rs. 250 have a lower mean score than those coming from the medium and higher groups.

(vi) The urban candidates score significantly more than the rural.

(vii) Mean score varies with religion.

(viii) Score on the battery of intelligence tests is related with the level of education.

(ix) The mean scores do not differ with State or Mother-tongue.

(x) Intelligence test marks are correlated with other assessments at the Selection-Boards.

P. R. W. TEST NO. 19

Instructions, Illustrations & Practice

Here is given a series of drawings. They are arranged in a particular way by following some rules. Below this series of drawings, there is a choice set of six drawings.

If you study the rule according to which the drawings in the series are arranged in a particular order, you will find out that one of the drawings among the choice set of drawings, should be drawn next, in order to continue the series. For example, in the first series in the illustration set, there is a group of balls after every group of blocks. Again, the blocks are arranged in an order of 1, 2, 3 while the balls are arranged in an order of 3, 2, 1. This rule makes it clear that if we want to continue the series of drawings, a group of blocks must come after every group of balls. But how many blocks should we draw? We know that the blocks are arranged in the order of 1, 2, 3, etc., that is, in an order of increasing number. A whole number greater than 3 is 4. Therefore 4 blocks must be drawn as the answer to the first item. It appears as drawing No. 4 among the 'choice set' of drawings, drawn under the series. Therefore when you are asked to mention the drawing that will have to be drawn to continue the series, you will mention drawing No. 4 as your answer, in the appropriate place in the answer-sheet. This item is already solved for you and the answer is mentioned on the answersheet as required.

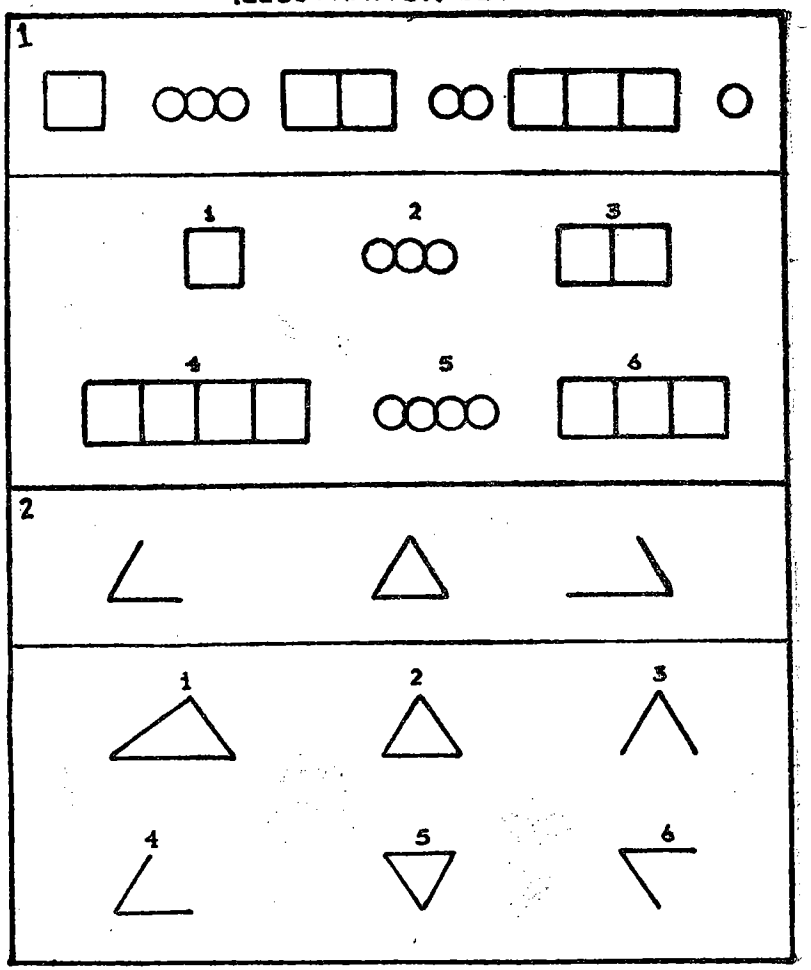
Now, look at the 2nd series of drawings in the illustration set. In the first drawing in this series two lines meet at a point to form an angle. In the second drawing the two extremities of the two lines which are not joined by straight lines in the 1st drawing are joined and a triangle is formed. The 3rd drawing is like the 1st drawing in as much as it has two lines forming an angle. But instead of the right hand side being left open as in the 1st drawing the left hand side is left open in this drawing. If we want to continue the series therefore, we have to join the two extremities in drawings No. 3 which are not joined by a straight line. This is the correct answer. The correct answer appears as drawing No. 1 among the 'choice set' of drawings drawn below the series. When you are asked to

mention the drawing that will have to be drawn if the series of the drawings is to be continued you will mention No. 1 as your answer in the appropriate place in the answer-sheet. This item is already answered for you and the answer is written on the answer-sheet as required.

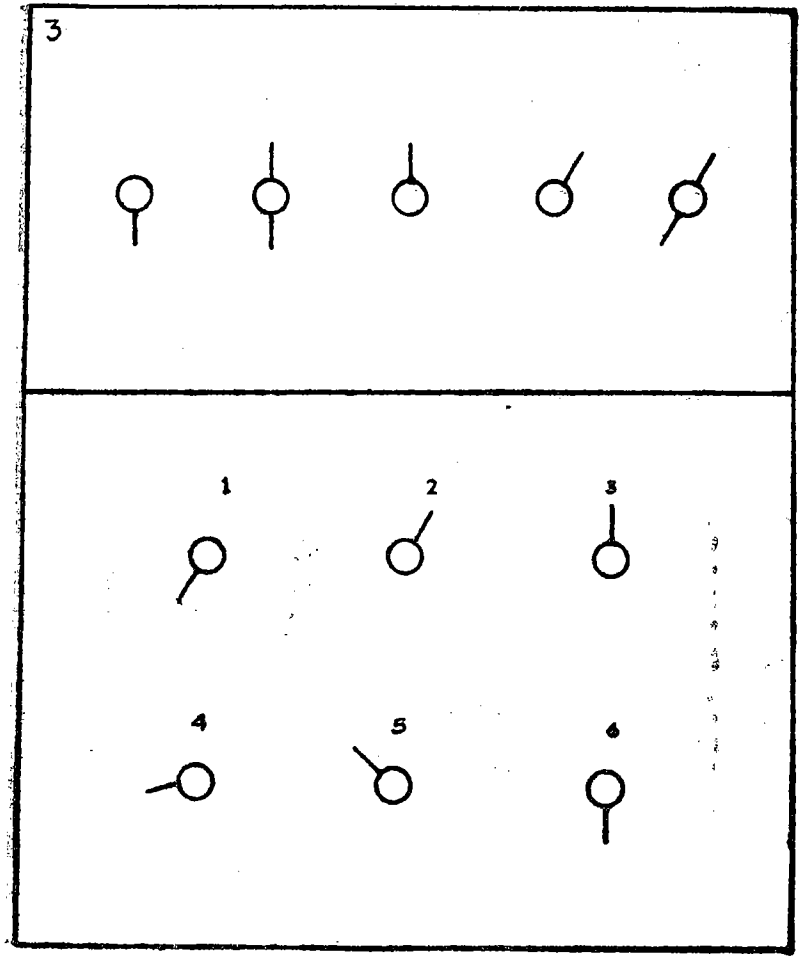
Work in the same way with other series of drawings and mention the number of one of the six drawings, from among the choice set of drawings drawn below it, which will correctly continue the series. Answer the items in the practice set first, then proceed to answer the test-items.

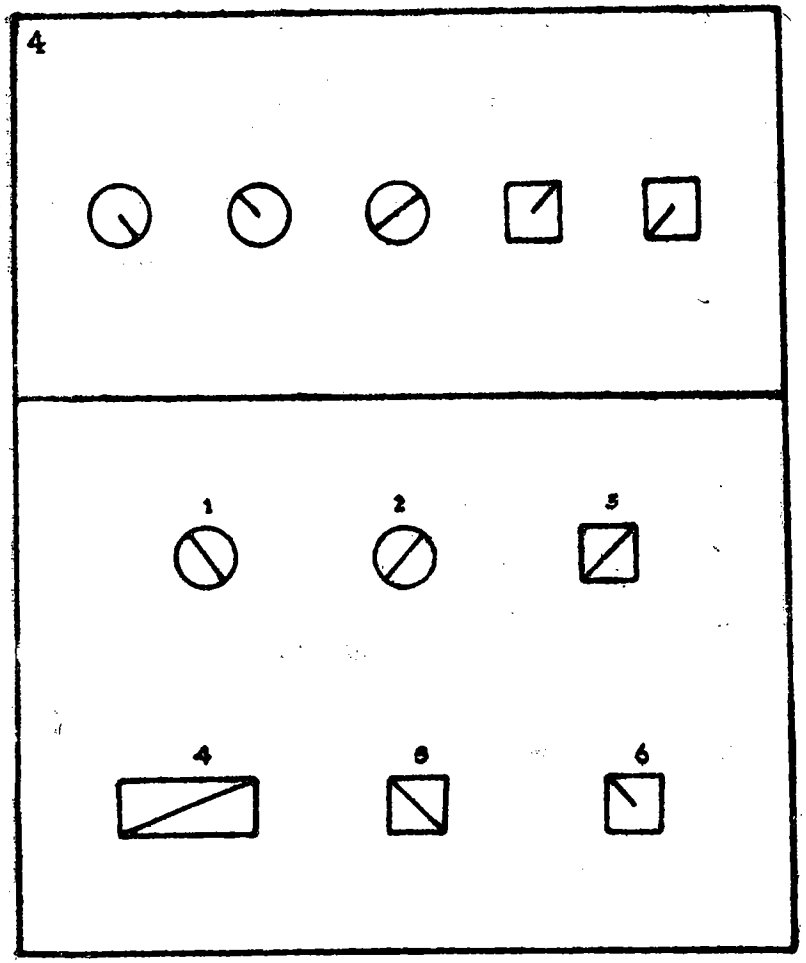
Time limit: 15 minutes.

ILLUSTRATION SET



PRACTICE SET





DO NOT TURN OVER TILL YOU ARE ASKED TO DO SO

P.R.W. Form No. 46

ANSWER SHEET

P. R. W. TEST NO. 19

(Non-V. I. T.)

No. of S. S .B..... Batch No.....

Date..... Candidate's No.....

Name in full.....

Illustration Set		Q.	Answer	Q.	Answer	Q.	Answer	Q.	Answer
Q.	Answer	1		13		25		37	
1	4	2		14		26		38	
2	1	3		15		27		39	
Practice Set		4		16		28		40	
3		5		17		29		41	
4		6		18		30		42	
		7		19		31		43	
		8		20		32		44	
		9		21		33		45	
		10		22		34		46	
		11		23		35		47	
		12		24		36		48	
								49	
								50	

Marked by..... Total Score.....

Checked by..... Eq. Score.....

P. R. W. 20

Instructions, Illustrations and Practice

EXAMPLES

Below are given a few examples of the types of questions that you will find in this test. Now look at these examples carefully and see how they are solved.

1. Which word does not belong to the same class as the others?
   (1) Rice (2) Wheat (3) Jute (4) Barley (5) Maize.

In the above problem there are five words. Rice, Wheat, Barley and Maize being cereals form a class by themselves. 'Jute' does not belong to that class because it is not a cereal. 'Jute' is therefore the answer. 'Jute' is number 3 and this number has been put as the answer in the answer sheet.

2. Bird is to Flying as Fish is to—
   (1) Water (2) Swimming (3) Pond (4) Net (5) Fisherman.

Out of the five alternatives given, 'Swimming' is the answer. The number allotted to 'Swimming' is 2. 2 is therefore recorded as the answer in the answer sheet.

3. We (1) go (2) play (3) speak (4) sleep
   to (1) hat (2) market (3) bed (4) language
   to make (1) writing (2) games (3) purchases (4) running.

In the above problem there are three lines with four numbered words in each. You have to choose only one word from each line so that these three words together with the words preceding each line will make a correct, meaningful, and a true statement.

In this example if we choose the word 'go' (No. 1) from the first line, the word 'market' (No. 2) from the second line, and the word 'purchases' (No. 3) from the third line, they together with the preceding words make a complete, true, and meaningful sentence—*i.e.* 'We go to market to make purchases'. Numbers 1, 2 and 3 are recorded as the answer in the answer sheet because they are the numbers of the words chosen respectively from the three lines.

6—2 DPR /ND/76

4. Which two numbers come next in the following series?

1, 3, 5, 7, 9,—, —.

Each succeeding number in the series is bigger than the previous number by 2. If we follow the order, 11 and 13 would be the two numbers coming next in the series. 11 and 13 is therefore the answer recorded in your answer sheet.

5. Which item would stand exactly in the middle if the following items are rearranged in proper order?

(1) Mile (2) Inch (3) Furlong (4) Yard (5) Foot.

4 has been recorded as the answer because item No. 4 *i.e.* yard will stand in the middle when all the five items are rearranged in the proper order, namely, Mile, Furlong, Yard, Foot, Inch.

6. The spelling of the word in CAPITALS in the following sentence is jumbled up. Make out the correct word and write its last letter as the answer.

KEYCHO is an outdoor game.

The correct word is HOCKEY. You have to write only its last letter as the answer. Y has been printed in your answer sheet as the answer.

PRACTICE SET

Try the following problems for practice, record your answers in the answer sheet in the column for 'practice set'.

1. Yesterday is to Tomorrow as Monday is to—

(1) Sunday (2) Tuesday (3) Wednesday (4) Friday (5) Today.

2. Which item does not belong to the same class as others?

(1) Red (2) Bright (3) Green (4) Blue (5) Yellow.

3. Choose one word from each of the three lines to make a correct, true and meaningful sentence.

All (1) birds (2) animals (3) cats (4) children.

can (1) sleep (2) walk (3) fly (4) Laughs.

because they have (1) money (2) Wings (3) tongue (4) Kittens.

4. Which item does not belong to the same class as others?

(1) Man (2) Cow (3) Woman (4) Hen (5) Cock.

5. Which two numbers would come next in the following series?

4, 7, 5, 8, 6, 9, 7,—, —.

6. Which two sets of letters would come next in the following series?

AC, BD, CE, DF,—, —.

7. Which item would stand in the middle if the following are arranged in proper order?

(1) Day (2) Year (3) Month (4) Week (5) Hour.

8. Make out the first word in the following sentence and write its last letter as the answer.

LOVNE is a popular form of literature.

Time limit: 25 minutes.

DO NOT TURN OVER TILL YOU ARE ASKED TO DO SO.

15 P.R.W. FORM NO. 47

ANSWER SHEET
P.R.W. TEST No. 20
(V.I.T.)

No. of S. S.....

Batch No.....Date of Testing.....

Candidate's No.....

Name of the Candidate.....

EXAMPLES		A B C D E F G H I J K L M N O P Q R S U V W X Y Z							
Q.	ANSWER	Q.	ANSWER	Q.	ANSWER	Q.	ANSWER	Q.	ANSWER
1	3	1		19		37		55	
2	2	2		20		38		56	
3	1,2,3	3		21		39		57	
4	11 & 13	4		22		40		58	
5	4	5		23		41		59	
6	Y	6		24		42		60	
PRACTICE SET		7		25		43		61	
1		8		26		44		62	
2		9		27		45		63	
3		10		28		46		64	
4		11		29		47		65	
5		12		30		48		66	
6		13		31		49		67	
7		14		32		50		68	
8		15		33		51		69	
		16		34		52		70	
		17		35		53			
		18		36		54			

Marked by.....

Checked by.....

Total Score.....

Sq. Score.....

P.R.W. TESTS No. 19 AND 20

TABLE I

CONVERSION KEY

EQ SCORE	RAW SCORE PRW 19	RAW SCORE PRW 20	EQ SCORE	RAW SCORE PRW 19	RAW SCORE PRW 20	EQ SCORE	RAW SCORE PRW 19	RAW SCORE PRW 20
0		6	27	13	28	54	33	50
1		7	28		29	55	34	
2		8	29	14	30	56	35	51
3		9	30	15		57		52
4		10	31	16	31	58	36	53
6		11	32		32	59	37	54
7		12	33	17	33	60	38	—
8		13	34	18	34	61	—	55
9		14	35	19	—	62	39	56
10	0	—	36	—	35	63	40	57
11	1	15	37	20	36	64	41	58
12	—	16	38	21	37	66	42	59
13	2	17	39	22	38	67	43	60
14	3	18	41	23	39	68	44	61
15	4	—	42	24	40	69	—	62
16	—	19	43	25	41	70	45	—
17	5	20	44	—	42	71	46	63
18	6	21	45	26	—	72	47	64
19	7	22	46	27	43	73	—	65
21	8	23	47	28	44	74	48	66
22	9	24	48	—	45	75	49	—
23	10	25	49	29	46	76	50	67
24	—	26	50	30	—	77	—	68
25	11	—	51	31	47	78	—	69
26	12	27	52	32	48	79	—	70
			53	—	49			

TABLE II

SELECTION GRADES

Selection Grade	Summed Eq. Scores on Battery
I	132 and above
II	120—131
III	108—119
IV	95—107
V	80—94
VI	56—79
VII	55 & below

IV

P. R. W. 26 & 27

IV

P. R. W. 26 & 27

P. R. W. 26 and 27 are Intelligence tests used for selection of officers to the Defence Services. They were given to 1042 U. P. S. C. passed candidates for a National Defence Academy course. The U. P. S. C. pass rate was 45.9% (*vide* p. 3 para 1). It is proposed to examine the results here.

Description of the tests

P. R. W. 26 is a non-verbal test in which figures are classed as A and B. Figures in each class have something in common with figures of the same class and are different in a systematic way from figures of the other class. The testee is presented with four figures two of which belong to Class A and two to Class B. He has to mention which two figures belong to class A.

There are 67 such items.

P. R. W. 27 is a verbal test containing items of various types such as jumbled spelling, education of a correlate, words to be arranged alphabetically etc. There are 100 such items.

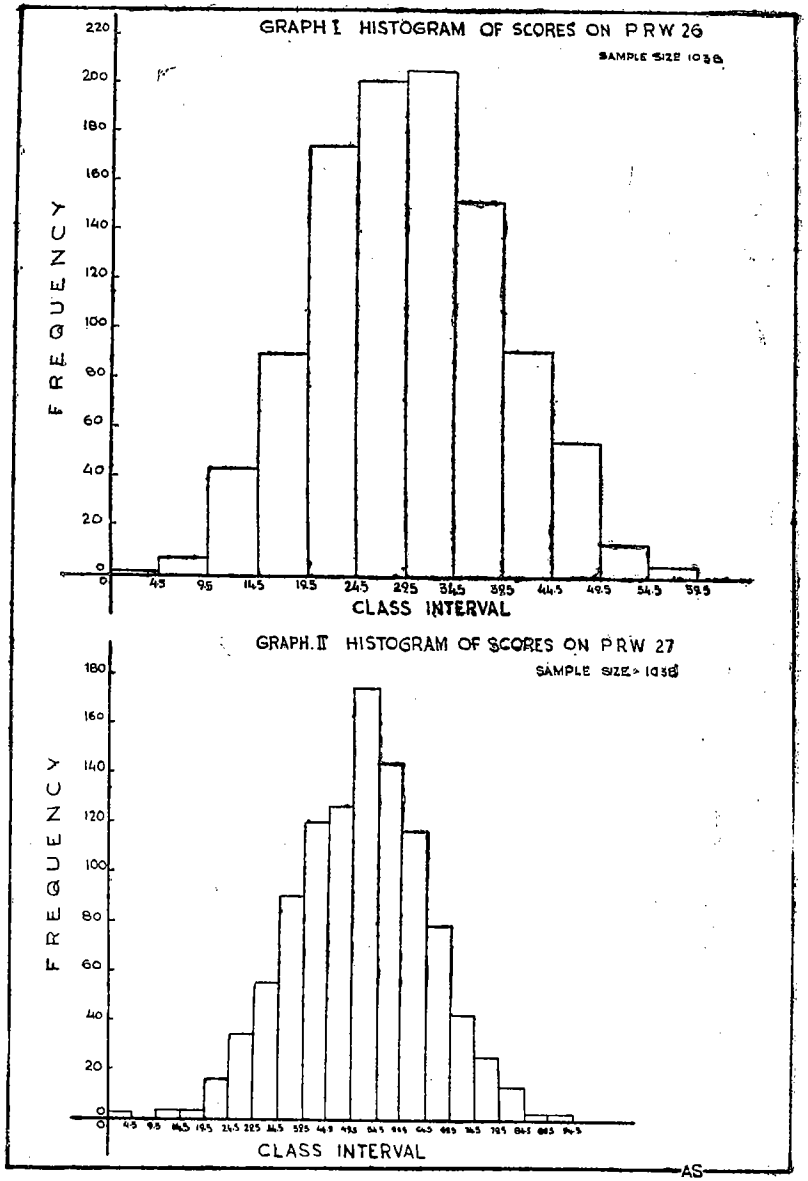
The following tables and graphs I and II show the distribution of the scores:—

P. R. W. 26

Class Interval	*Frequency*
0·0— 4·5	1
4.5— 9·5	7
9·5—14·5	43
14·5—19·5	91
19·5—24·5	175
24·5—29·5	202
29·5—24·5	206
34·5—39·5	152
39·5—44·5	91
44·5—49·5	54
49·5—54·5	13
54·5—59·5	3
	1038

P. R. W. 27

Class Interval	*Frequency*
0— 4·5	1
4·5— 9·5	0
9·5—14·5	2
14·5—19·5	2
19·5—24·5	16
24·5—29·5	34
29·5—34·5	55
34·5—39·5	90
39·5—44·5	120
44·5—49·5	126
49·5—54·5	174
54·5—59·5	143
59·5—64·5	116
64·5—69·5	78
69·5—74·5	41
74·5—79·5	25
79·5—84·5	13
84·5—89·5	1
89·5—94·5	1
	1038



AS

The following are the salient statistics:—

	Mean	*S.D.*	*Reliability (Rational Equivalence)*	g_1	g_2	*Remarks*
PRW—26 .	29·71	9·40	0·67	0·13	—0·61**	The distribution is platykurtic.
PRW—27 .	51·14	13·15	0·72	—0·07	—0·12	The distribution is normal.

The correlation between the tests is 0·43**

Thus on PRW 26 frequencies at the extremes are larger than they would be, if the distribution were normal.

GROUP DIFFERENCES

State

The following table presents the data on candidates grouped statewise:—

State	*N*	*Mean*	*Variance*
1. Uttar Pradesh, Madhya Pradesh, Rajasthan & Bihar (Hindi areas) . .	223	102·42	351·85
2. West Bengal	23	110·74	175·58
3. Madras	29	111·14	210·26
4. Andhra	23	98·35	409·01
5. Punjab, Delhi	576	100·88	287·16
6. Mysore	26	102·15	299·74
7. Maharashtra	88	104·00	316·45
8. Others, (*i.e.* Assam, Orissa, Himachal Pradesh, Jammu & Kashmir, Goa) .	27	101·67	308·07
9. Kerala	26	102·57	315·40

Bartlett's test shows that there is no evidence of any heterogeneity in the group-variances (x^2=5.51 for d. f. 8).

Analysis of variance shows that the overall differences are significant (F=2.09* for d. f. 8; 1032).

A pairwise comparison shows that the following differences are significant:—

Difference Between	*Size of difference*	*t*
1 and 2	8·32	2·10*
1 and 3	8·72	2·52*
2 and 4	12·38	2·44*
2 and 5	7·59	2·63**
3 and 4	12·79	2·62**
3 and 5	10·26	3·09**
3 and 8	9·47	2·09*

Group 2 in this investigation has a rank which is not in conformity with the rank of Bengali speaking groups in the previous investigations. In the previous investigations the classification was by mother-tongue. Here it is by state. In order to see whether this is the source of the difference, the scores of the non-Bengalis—who were found to be only two—were excluded from group 2. This changes the average score of group 2 to 109.71. This is practically the same as before.

The following table shows how far the candidate-sample reflects the statewise proportion in the country:—

State	1961 *male population* ('000)	*% of the total* $\left(\frac{100 \times \text{col.2}}{\text{Pop. India}}\right)$	*Sample*	*% of total* $\left(\frac{100 \times \text{Col.4}}{\text{Total sample}}\right)$
1	2	3	4	5
1. Uttar Pradesh, Madhya Pradesh, Rajasthan and Bihar	89148	39·76	223	21·42
2. West Bengal	18611	8·31	23	2·21
3. Madras	16915	7·54	29	2·79
4. Andhra	18175	8·10	23	2·21
5. Punjab, Delhi	12347	5·46	576	55·33
6. Mysore	12021	5·36	26	2·50
7. Maharashtra	31055	13·86	88	8·45
8. Kerala	17693	7·89	27	2·59
9. Others	8346	3·72	26	2·50
TOTAL	224,311	100·00	1041	100·00

It is clear that the candidate sample does not reflect the percentages in the population at large. A vast majority come from the Punjab and Delhi. All the other states send much fewer candidates to the boards than their population would lead us to expect.

The candidates from all the states were sifted to see how many of them do not belong to the linguistic group of the state of their domicile. These figures will serve to indicate the scale of interstate migration and the level of the intelligence of the migrating people.

The following table presents the results:—

State	*Size of sample*	*Number not belonging to language group of the state*	*Percentage*	*Mean Score*
Uttar Pradesh	165	53	32·12	103·24
Andhra Pradesh	23	8	34·78	90·50
Madras	29	3	10·34	111·67
Madhya Pradesh	14	4	28·57	102·25
Rajasthan	19	5	26·32	117·20
Maharashtra	88	18	20·45	99·44
Mysore	26	5	19·23	96·20
Assam	33	2	66·67	104·00
Bihar	25	2	8·00	90·50
Orissa	3	1	33·33	103·00
Punjab	348	1	0·26	101·00
Delhi*	228	11	4·82	107·09
West Bengal	23	2	8·70	121·50
		Weighted mean		102·70

*Punjabi speaking as well as Hindi speaking candidates have been taken as belonging the Delhi language group.

The overall mean score is 102.02. The mean of the migrants is 102.70, *i.e.* in no way different from the general mean.

The least percentage of migrants is in the Punjabi sample, the most in Assam. But since the Assam percentage is based only on three cases, we may say that the largest percentage of migrants is in the Andhra Pradesh sample.

States to the south of Narmada have 16% migrants in all as against 98% in the states to the north of Narmada excluding Assam. It is expected that the population of a country will tend to move towards areas nearer to the seat of the Government.

The following table shows the incidence of migration language-wise:—

Language Group	*Percentage of migrants*
Hindi	8·09
Telugu	6·25
Tamil	16·13
Marathi & Gujarati	2·76 (One Marathi & one Gujarat imigrant)
Punjabi	15·78
Bengali	22·22

The Marathi and Gujarati group has migrated the least and the Bengali group has migrated the most. This again is contrary to exepectation. Ordinarily, it is supposed that the Punjabis and the South Indians migrate the most.

Age

Grouping according to age yields the following results:—

Age	*N*	*Mean*	*Variance*
15+	94	104·36	244·81
16+	394	103·99	302·21
17+	542	100·26	315·20
18+	11	97·63	479·66

A vast majority belongs to ages 16 and 17.

Bartlett's test shows that the variances do not differ from group to group. (x^2=3.60, df=3).

Analysis of variance shows that the mean scores of different age groups are different. (F=4.30** df=3; 1037). But a pairwise comparison shows that only the difference between the means of 16 and 17 is significant (t=3.55**). Even the largest difference *viz.* that between 15 and 18 is not significant (t=1.20).

Guardian's Income

The income of the guardians of the candidates is classified roughly according to government pay scales. 1 is non-gazetted scale, 2 is class II, 3 and 4 are Class I, Grade I and 5 is the senior scale. The following table gives the incomewise results:—

Income Group	*N*	*Mean*	*Variance*
1. 0—250	519	99·40	304·54
2. 251—700	275	103·32	299·96
3. 701—1000	141	106·06	291·29
4. 1001—1500	69	106·58	288·84
5. 1501 and above	37	104·97	349·00

A large majority comes from the income-group below 250, 794 out of the 1041 *i.e.* about 76% candidates come from the income-group below 700. Thus it is obvious that the bulk of our candidates comes from the stratum of income below that into which they will go after selection.

Analysis of variance shows that the between-group-variance differs significantly from the within-group-variance (F=6.52** d. f. =4 and 1036). Since Bartlett's test did not show any heterogeneity in the group variances we may conclude that the mean scores differ from group to group.

A pairwise comparison shows that only the following differences are significant:—

Difference between	*Size of difference*	*t*
1 and 2	3·92	3·21**
1 and 3	6·66	4·04**
1 and 4	7·80	3·18**

In other words if group 1, where average score is the lowest, is removed, the different income groups are not seen to differ in mean intelligence score.

Medium of Instruction

The following table gives the results according to medium of instruction:—

Medium	*N*	*Mean*	*Variance*
1. English	489	106·04	300·35
2. Hindi	185	96·44	364·85
*3. English & Hindi	226	99·04	261·03
4. Others	141	100·15	230·16

(English for science subjects and Hindi for others).

The English medium students exceed all the others put together. (2+4=326). It seems that the Union Public Service Commission and the matriculation examinations are so greatly weighted in favour of English, that the non-English medium student finds it difficult to reach the selection board.

Bartlett's test shows that the group variances differ significantly. (x^2=10.98* for d. f. 3). In order to ascertain whether differences is group-means were significant, test for the case of heterogeneous variances was applied (as shown in part I).

F′ so calculated was 17.30** for n_1=3 ; n_2=412 d. f. which is significant at 1% level, indicating heterogeneity in the group means.

A pairwise comparison shows that the following differences alone are significant:

Difference between	*Size of differences*	*t*
1 and 2	9·60	6·53**
1 and 3	7·00	5·11**
1 and 4	5·89	3·57**

Thus the difference arises only from the presence of the English medium group.

Type of School

The following table presents the shool-wise results:—

Type of school	*N*	*Mean*	*Variance*
1. Public	76	104·18	357·03
2. Sainik	19	111·05	390·39
3. European	147	105·19	375·10
4. Others	799	101·01	285·76

Bartlett's test showed that the variances differ significantly from school to school (x^2=8.78* d. f.=3). In order to see whether group means differ significantly the procedure followed in the case of medium of instruction was adopted. F′=3.80*, d. f. n_1=3 ; n_2=1037, was significant at 5% level indicating differences in the group means.

A pairwise comparison shows that the following differences alone are significant:

Difference between	*Size of difference*	*t*
2 and 4	10·04	2·50*
3 and 4	4·18	2·42*

It is clear that only the differences from 4 are significant.

Religion

The following are religion-wise figures:

Religion	*N*	*Mean*	*Variance*
Hindu (Sanatani)	775	101·45	318·55
Sikh	213	102·18	276·06
Christian	42	109·83	252·04
Others	11	108·27	117·83

Bartlett's test indicated heterogeneity in the group variances (x^2=38.02**, d. f. 3). F′ statistic calculated as before was significant at 1% level (F′=4.11** d. f. n_1=3 ; n_2=42) indicating differences in the group-means. A pairwise comparison showed that the following differences are significant :—

Difference between	*Size of difference*	*t*
1 and 3	8·38	2·99**
2 and 3	7·65	2·51*

The following table shows how far the proportion of the different religions in India is reflected in the candidate sample:

Religion	*N in India (in 000)*	*N among candidates*	*% of Col. 2 in Indian Population*	*% of Col. 3 among total no. of candidates*
1	2	3	4	5
1. Hindu	199,919	775	84·87	74·45
2. Sikh	4,123	213	1·83	20·46
3. Muslims	22,417	4	9·97	0·38
4. Christians	5,025	42	2·23	4·03
5. Others	2,474	7	1·10	0·68
TOTAL	224,958	1041	100·00	100·00

Group 2 appears in large numbers as a comparison of column. 4 and 5 shows. This is an example for others to emulate.

Education

Matriculation is the minimum qualification for the candidates. But some candidates are tested by the boards before their Matric results are available. We may therefore divide the population educationwise in the following way.

Education	*N*	*Mean*	*Variance*
1. Non-Matric	178	103·44	216·39
2. Matric	695	101·18	316·32
3. Higher Secondary	77	105·99	379·60
4. Intermediate and Bachelor	91	102·22	338·99

Analysis of variance shows that the means for different education-groups do not differ (F=2.24 d. f.=3; 1037). Therefore the present data do not offer any evidence for the presence of group-differences between various education-levels.

Parental Occupation

The following table presents the means of groups based on parental occupation:—

Guardian's occupation	*N*	*Mean*	*Variance*
1. Govt. service (General)	330	102·07	287·19
2. Private service	89	100·45	349·61
3. Military service	142	105·30	292·30
4. Medical practice	45	99·27	384·66
5. Law	21	99·05	270·46
6. Teaching	65	98·48	248·00
7. Engineering	50	85·48	1,248·75
8. Agriculture	52	98·70	148·59
9. Business	146	100·57	299·18

A vast majority of the guardians are in government service. If we include military service also in this, as we should, nearly 50% of the guardians of the candidates are found to be government servants.

Bartlett's test shows that the variances of different occupations differ (x^2=95.35** d. f. =8.).

By the procedure adopted in similar situations earlier in the paper it was found that group-means also differ significantly (F′=3.18** with d. f. n_1=8 ; n^2=192).

A pairwise comparison shows that the difference between 1 and 7 which is 16.59 is alone significant (t=5.97**). This is not in the expected direction.

Relationship with other assessments

The following table mentions the correlations between Intelligence and other assessments at the selection boards:—

Assessment	*Correlation with scoreses on intelligence tests*
President	0·25**
Group Testing Officer . .	0·23**
Technical Officer	0·23**
TOTAL BOARD MARKS	0.36**

The investigation has brought to light the following:—

(i) The reliability of P. R. W. 27 is satisfactory.

(ii) The migrants do not differ from the others.

(iii) The scores differ with age, state, income, medium of instruction, religion, school and parental occupation.

(iv) Intelligence-score has a significant correlation with all the other assessments made at the Services Selection Boards.

P. R. W. TEST NO. 26

(Non Verbal Intelligence Test)

Instructions, Illustrations & Practice

This test is intended to find out how quickly and correctly you can solve certain kinds of problems which require keen observation.

All your answers will be recorded in the answer sheet provided to you along with the test booklet. DO NOT MAKE ANY MARK ON THE BOOKLET, ANYWHERE.

Now look at problem No. 1 in the illustration set.

(a) The three figures classed under A have something in common among them.

(b) The other three figures classed under B have something common to them.

(c) The common element in group A is DIFFERENT from the common element in Group B.

(d) Among the set of figures numbered as 1, 2, 3 and 4 two belong to class A, and two to class B.

(e) A question is asked "Which two of the following figures belong to class A" When in the light of the common element in class A you find out which figures belong to class A, the remaining two would automatically go under class B. There is no need to mention it separately. YOU HAVE, THEREFORE, TO FIND OUT ONLY THE TW0 FIGURES WHICH BELONG TO CLASS A.

In problem No. 1 from the illustration set:—

All the figures in class A are triangles.

All the figures in class B are quadrilaterals.

From the numbered set of four figures, figure numbers I and 3 belong to class A. The pair of numbers 1 and 3 is, therefore, crossed out as the answer among the series of pairs opposite question No. 1.

Opposite each question number in your answer sheet a series of pairs of numbers or a series of numbers is printed. You have to CROSS OUT only one pair of numbers or a number which in your opinion indicates the correct answer to the appropriate question number.

In problem No. 2, all the figures in class A are double figures, and all the figures in class B are single figures. Figure Nos. 2 and 4 belong to class A as they are double figures. 24 has therefore, been crossed out as the answer to Q. No. 2 in the answer sheet.

In question number 3 the common rule for class A is "circles are in pairs and quadrilaterals are single". The common rule for class B is "quadrilaterals are in pairs and circles are single". The common rule for class A is different from the common rule in class B. In the light of the common rule for class A figure Nos. 2 and 3 belong to class A. The pair 23 is therefore, crossed out as the answer opposite question number 3 in your answer sheet.

In question No. 4 the common rule for class A is "Triangles are shaded and circles are not shaded". The common rule for class B,—which is different from common rule in class A is: "circles shaded, triangles not shaded". 1 and 3, therefore, belong to class A—13 is crossed out as an answer to Q. No. 4 in your answer sheet.

Look at Q. No. 5. This question is of a type different from the previous ones. There is, a certain relationship between figure A and figure B. *One and only one* figure out of the five figures numbered as 1, 2, 3, 4 and 5 bears the same relationship to figure C. You have to find out that figure and cross its number as the answer in the answer sheet. Discover the relationship between A and B. If you turn the figure A through 90 degrees you get figure B. Now which one of the numbered five figures bears the same or very nearly the same relationship to figure C? If you turn the figure C through 90 degrees you will get figure 1. It is, therefore, crossed out as an answer to question No. 5.

In problem No. 6, the relationship between A and B is "figure A is enlarged and shaded in B". If C is enlarged and shaded we shall get figure 3. 3 is, therefore, crossed out as an answer to Q. No. 6 in your answer sheet.

In each problem the common rule in class A and class B is different. So is the relationship between figure A and figure B different in each question. You have to do fresh observation and thinking to discover the right answer for each question.

Remember, you will CROSS OUT ONLY ONE pair of numbers or the number, as the case may be, which, in your opinion indicates the correct answer to each question. If you give two answers, both of them will be scored as wrong.

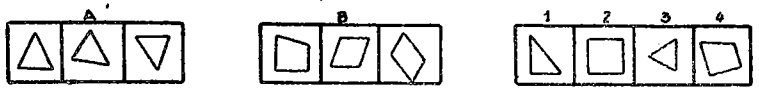
Now wait for the tester's instructions and then proceed to the practice set.

Time limit—35 minutes.

Illustrations

WHICH TWO FIGURES BELONG TO CLASS A ?

1

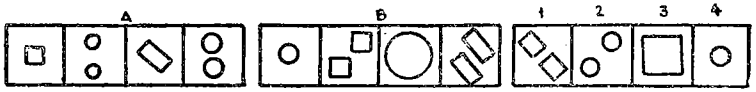


WHICH TWO FIGURES BELONG TO CLASS A ?

2

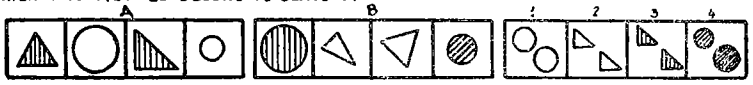
WHICH TWO FIGURES BELONG TO CLASS A ?

3

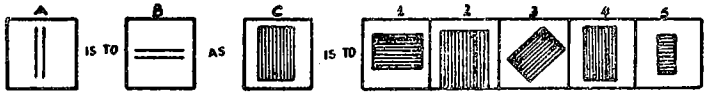


WHICH TWO FIGURES BELONG TO CLASS A ?

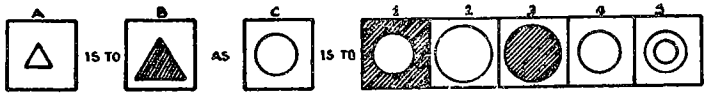
4



5

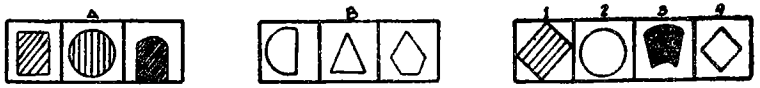


6



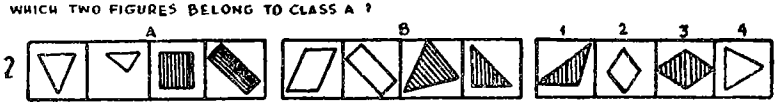
WHICH TWO FIGURES BELONG TO CLASS A ?

1

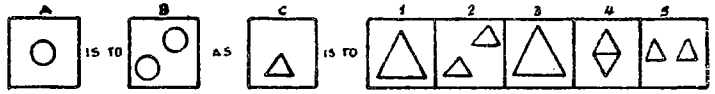


WHICH TWO FIGURES BELONG TO CLASS A ?

2

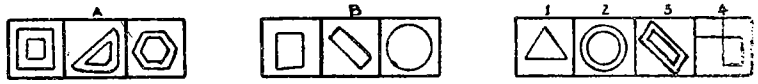


3



WHICH TWO FIGURES BELONG TO CLASS A ?

4



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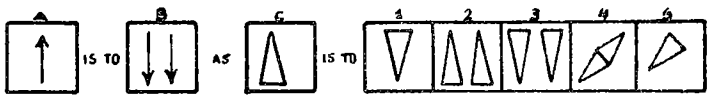
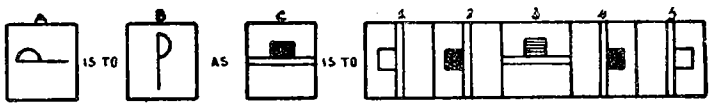


6



WHICH TWO FIGURES BELONG TO CLASS A ?

7

P R W FORM No. 55

ANSWER SHEET

P R W TEST No. 26

CANDIDATE'S NAME .....

BATCH No. ..... CANDIDATE'S No. .....

DATE OF TESTING.....

ILLUSTRATION SET

Q. No.						
1	12	~~13~~	14	23	24	34
2	12	13	14	23	~~24~~	34
3	12	13	14	~~23~~	24	34
4	12	~~13~~	14	23	24	34
5	~~1~~	2	3	4	5	
6	1	2	~~3~~	4	5	

PRACTICE SET

Q. No.						
1	12	13	14	23	24	34
2	12	13	14	23	24	34
3	1	2	3	4	5	
4	12	13	14	23	24	34
5	1	2	3	4	5	
6	1	2	3	4	5	
7	12	13	14	23	24	34

Q. No.						
1	12	13	14	23	24	34
2	12	14	13	23	24	34
3	1	3	4	5	2	
4	2	1	3	4	5	
5	12	13	14	23	24	34
6	2	3	1	4	5	
7	12	13	23	24	34	14
8		1	3	4	5	2
9	2	3	4	5	1	
10	13	12	14	23	24	34
11	24	12	13	14	23	34
12	1	2	3	5	4	
13	1	2	4	3	5	
14	2	3	1	4	5	
15	1	2	5	3	4	
16	13	12	14	23	24	34
17	12	13	23	14	24	34

Q.No.						
18	12	13	14	23	24	34
19	12	13	14	23	24	34
20	1	2	3	4	5	
21	12	13	14	23	24	34
22	12	13	14	23	24	34
23	1	2	3	4	5	
24	12	13	14	23	24	34
25	12	13	14	23	24	34
26	1	2	3	4	5	
27	1	2	3	4	5	
28	12	13	14	23	24	34
29	1	2	3	4	5	
30	12	13	14	23	24	34
31	1	2	3	4	5	
32	1	2	3	4	5	
33	12	13	14	23	24	34
34	12	13	14	23	24	34
35	12	13	14	23	24	34
36	12	13	14	23	24	34
37	1	2	3	4	5	
38	1	2	3	4	5	
39	1	2	3	4	5	
40	1	2	3	4	5	
41	1	2	3	4	5	
42	12	13	14	23	24	34

Q.No.						
43	12	13	14	23	24	34
44	12	13	14	23	24	34
45	12	13	14	23	24	34
46	12	13	14	23	23	24
47	12	13	14	23	24	34
48	12	13	14	23	24	34
49	12	13	14	23	24	34
50	1	2	3	4	5	
51	12	13	14	23	24	34
52	12	13	14	23	24	34
53	1	2	3	4	5	
54	12	13	14	23	24	34
55	12	13	14	23	24	34
56	12	13	14	23	24	34
57	12	13	14	23	24	34
58	1	2	3	4	5	
59	12	13	14	23	24	34
60	12	13	14	23	24	34
61	12	13	14	23	24	34
62	12	13	14	23	24	34
63	12	13	14	23	24	34
64	12	13	14	23	24	34
65	1	2	3	4	5	
66	12	13	14	23	24	34
67	12	13	14	24	24	34

Marked by.....

Checked by..... Total Score.....

P. R. W. TEST NO. 27

(Verbal Intelligence Test)

Instructions, Illustrations & Practice

Below are given a few samples of the type of questions that you will find in the test. Now read these sample questions carefully and see how they are solved.

1. Write the SECOND letter of the rearranged word. GTIRE is a kind of animal.

The sentence begins with a word in jumbled spelling. If you rearrange the letters (in your mind) in CAPITALS you get the word 'TIGER' which is a kind of animal. The second letter of the word 'Tiger', 'I' is therefore the answer and is printed as the answer on the answer sheet.

2. Plot is to Story as Skeleton is to—

(1) Doctor (2) Physiology (3) Bones (4) Body (5) Pupil

Here the word 'Skeleton' has the same relation to one of the five choice words, as 'Plot' has to 'Story'. Just as 'Plot' is essential to 'Story', 'Skeleton' is essential to 'Body'. The answer is therefore 'Body' which is numbered (4) and is printed as the answer on the answer sheet.

3. Which group of letters does not belong to the same class as the others ?

(1) LMNO (2) QRST (3) BCDE (4) WXYZ (5) KGTY

In this set of five items all others except 'KGTY' are arranged alphabetically and are alike and the number for the correct answer 'KGTY' is (5) which is printed as the answer on the answer sheet.

4. Write the number of the word which will come FIRST in the dictionary:—

(1) Over (2) Malt (3) Listless (4) Jolt (5) Joke

In the above sample 'Joke' is the correct answer and the number of the word 'Joke' is (5) and is printed as the answer on your answer sheet.

5. Find out from among the choice words; two correct words that can be formed by using the letters of the word in CAPITALS ONCE only. Once you have used one letter for any word it cannot be used again for the other word.

BEAUTIFUL

(1) Blue (2) Faith (3) Fault (4) Fit (5) But.

These two words 'Blue' and 'Fit' can be made by using the letters of the word in CAPITALS ONCE only. The number of the words 'Blue' and 'Fit' is (1) and (4) respectively and are printed as the answers on your answer sheet.

6. If 'BLUE' is coded as 'CMVF' the word 'PINK' should be coded as:—

(1) QJOL (2) OQLJ (3) QJMI (4) QJIM

In the code 'BLUE' the letters in the coded word are substituted by the words standing after them in the alphabet. B is substituted by C, L by M and so on. Using the same system of coding the word 'PINK' should be coded 'QJOL' and the number of 'QJOL' is (1) and is printed as the answer on your answer sheet.

7. Find two numbers which will come next in the series:—

1 3 5 7— —

In the above sample each succeeding number in the series is bigger than the previous by 2. Therefore, the number which will come next is 9 & 11.

8. Rearrange the words in your mind to form a sentence by OMITTING one word from the jumbled words and write the LAST letter of the word to be omitted.

necessity liquid water of a life is.

If the jumbled words in the sentence are rearranged, the word to be omitted will be 'liquid'. The last letter of the word 'liquid' is D'. Therefore the letter 'D' is written as an answer on your answer sheet.

9. Look at the following sample:—

ADD:

```
  4  x  6  x
  4  5  2  8
-------------
  x  0  x  0
```

In the above problem first, think of the digits which stand for each x in the top row, and then work out the digits for each x in the bottom row and enter them in the answer sheet. Here the correct digits are "99". Remember one and only one digit number stands for each x.

PRACTICE SET

Try the following for practice, record your answers on the answer sheet in the column for 'Practice Set'.

1. Write the SECOND letter of the rearranged word.
SKIAADL is the name of a poet.

2. Before is to After as cause is to—

(1) Produce (2) Effect (3) Matter (4) Due to (5) Star

3. Which word does not belong to the same class as the others ?

(1) Reward (2) Prize (3) Return (4) Punishment (5) Wages

4. Which word will come FIRST in the dictionary—

(1) Away (2) Ask (3) Again (4) Own (5) After.

5. Find out from among the choice words, the two correct words that can be formed by using the letters of the word in capitals once only. Once you have used one letter for any word it cannot be used again for the other word.

EXHIBITION

(1) Hint (2) Note (3) Nib (4) Bits (5) Exit.

6. If 'ON' is coded as 'MN' the word 'UT' should be coded as—

(1) PQ (2) ST (3) VR (4) RV

7. Find the two digits which should come in the series—

9 7 10 — 11 — 12

8. Rearrange the letters to form a sentence by OMITTING one word from the jumbled words and write the LAST letter of the word to be omitted.

precious gold metal fare is a.

9. ADD:

```
  6  7  3  x
  x  0  0  9
-------------
  9     4  2
```

DO NOT TURN OVER THE PAGE

Time limit—50 minutes.

P. R. W. FORM NO. 53

ANSWER SHEET

P. R. W. TEST NO. 27
(V. I. T.)

No. of S. S. B.....Batch No.....

Date.....Candidate's No.....

Name in full.....

ILLUSTRATION SET	
Q.	ANSWER
1	I
2	(4)
3	(5)
4	(5)
5	(1) (4)
6	(1)
7	9, 11
8	D
9	9, 9,
PRACTICE SET	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Q.	ANSWER	Q.	ANSWER	Q.	ANSWER	Q.	ANSWER
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		75		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

Marked by..... Total Score.....

Eq. Score.....

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

PRW TESTS 26 & 27—NORMS

TABLE I

Conversion Key

RAW SCORE	STANDARD SCORE P.R.W. 26	27
1	18	12
2	20	13
3	21	14
4	22	15
5	23	15
6	24	16
7	25	17
8	26	18
9	27	19
10	28	19
11	29	20
12	30	21
13	32	22
14	33	23
15	34	23
16	35	24
17	36	25
18	37	26
19	38	27
20	39	27
21	40	28
22	41	29
23	42	30
24	44	30
25	45	31

RAW SCORE	STANDARD SCORE P. 26	R.W 27
26	46	32
27	47	33
28	48	34
29	49	34
30	50	35
31	51	36
32	52	37
33	53	38
34	54	38
35	56	39
36	57	40
37	58	41
38	59	42
39	60	42
40	61	43
41	62	44
42	63	45
43	64	46
44	65	46
45	66	47
46	68	48
47	69	49
48	70	50
49	71	50
50	72	51

RAW SCORE	STANDARD SCORE P.R.W 26	27
51	73	52
52	74	53
53	75	53
54	76	54
55	77	55
56	78	56
57	80	57
58	81	57
59	82	58
60	83	59
61	84	60
62	85	61
63	86	61
64	87	62
65	88	63
66	89	64
67	90	65
68	—	65
69	—	66
70	—	67
71	—	68
72	—	69
73	—	69
74	—	70
75	—	71

RAW SCOER	STANDARD SCORE P. 26	R.W. 27
76	—	72
77	—	73
78	—	73
79	—	74
80	—	75
81	—	76
82	—	77
83	—	77
84	—	78
85	—	79
86	—	80
87	—	80
88	—	81
89	—	82
90	—	83
91	—	84
92	—	84
93	—	85
94	—	86
95	—	87
96	—	88
97	—	88
98	—	89
99	—	90
100	—	91

8—2DPR/ND/76

TABLE II
SELECTION GRADES

Selection Grade	Summed Standard Scores on the Battery.
I	139 & above
II	121—138
III	106—120
IV	93—105
V	79— 92
VI	65— 78
VII	64 & below

V
FIGURE ANALOGIES AND CANADIAN CLASSIFICATION TEST

V

Figure Analogies and Canadian Classification

It is proposed here to analyse the scores on the Intelligence battery consisting of Figure Analogies and Canadian classification.

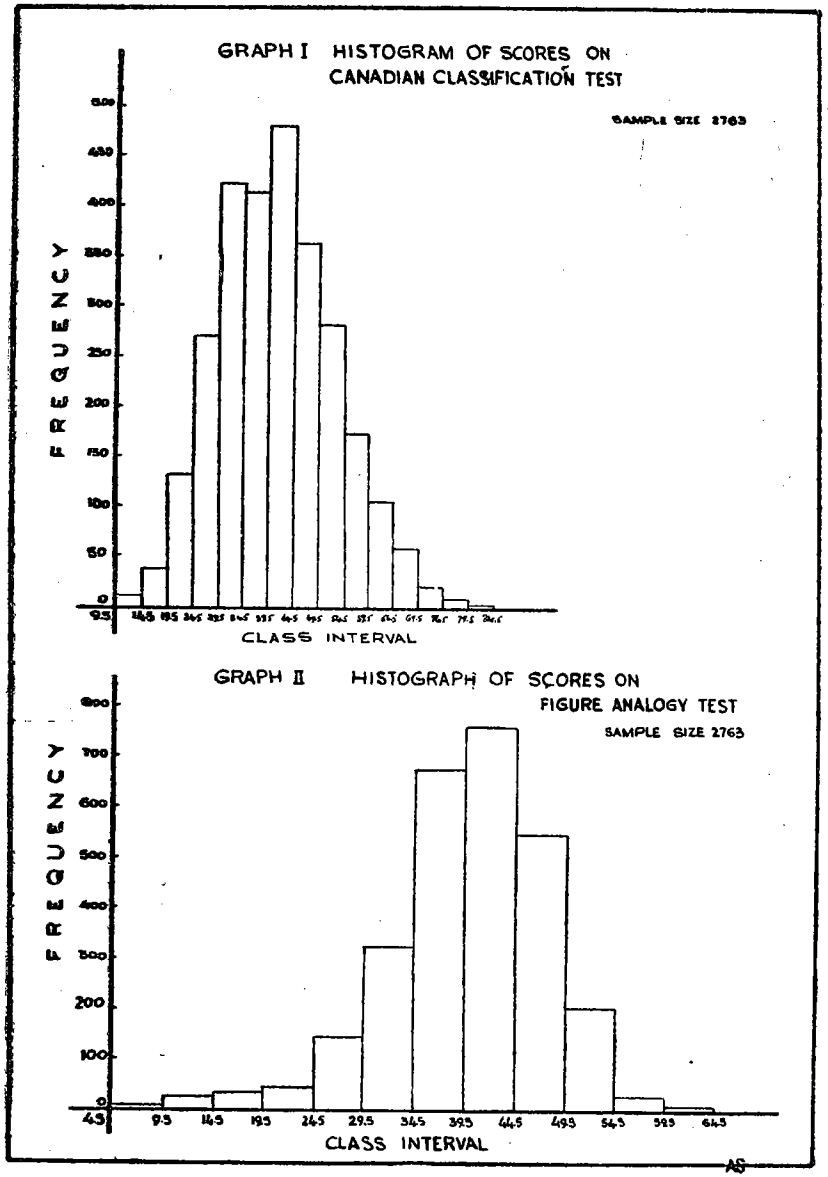
The Sample: The sample consisted of UPSC passed candidates for selection to four N. D. A. Courses and four IMA Courses. The pass percentage in the UPSC examination was 34.4 (Age limits NDA=15.5 to 17.5, IMA=18 to 21) (*vide* p. 3 para 1).

The tests: Figure Analogies is a non-verbal test in which the testee has to pick up a drawing which has the same relation to the test-drawing as there is between two given drawings. (Number of questions=60).

Canadian classification is a verbal test consisting of questions of various types like number series, best adjective, picking up an odd word etc. (Number of questions=80).

The following tables and graphs, I and II show the distribution of the scores:—

CANADIAN CLASSIFICATION TEST		FIGURE ANALOGY TEST	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
10—14	11	5—9	1
15—19	36	10—14	25
20—24	129	15—19	32
25—29	268	20—24	42
30—34	421	25—29	142
35—39	413	30—34	322
40—44	479	35—39	674
45—49	362	40—44	752
50—54	281	45—49	547
55—59	174	50—54	200
60—64	105	55—59	25
65—69	57	60—64	1
70—74	19		
75—79	7		
80—84	1		
TOTAL	2763	TOTAL	2763



The following are the salient statistics:—

	Mean	*S. D.*	β_1	β_2	*Raliability (Rationa[1] Equivalence)*	*Remarks*
Figure Analogies	39.78	7.80	—0.52**	4.15**	0.79	A negatively skewed and leptokurtic distribution.
Canadian Classification.	41.10	10.80	0:08**	2.08**	0.82	A positively skewed and platykurtic distribution.

Correlation between the tests=0.58.

Age

Group Differences

The candidates can be grouped in various ways. One of the groupings is on the basis of age. This grouping gives the following picture:—

S. N.	*Age*	*N*	*Mean*	*Variance*
1	15	226	135.52	341.09
2	16	752	134.63	401.92
3	17	964	133.97	405.76
4	18	108	138.20	544.86
5	19	250	141.33	464.91
6	20	304	139.54	385.39
7	21	137	142.16	395.39
8	22—24	22	135.36	338.45

Barlett's test shows that the variances do not differ from age to age (x^2=11.75 with d. f. 7 Not Significant).

Analysis of variance shows that the means differ with age (F=7.71** with d. f. 7 ; 2755).

A pairwise comparison shows that nineteen to twentyone year olds score more than those aged eighteen years and below, as well as twentytwo years and above. Table given below gives the analysis. Only those values of t are shown which are significant.

Difference between Groups	*Size of the difference*	*t-value*	*D. F.*
1 and 5	5.81	3.21**	474
1 and 6	4.02	3.22**	522
1 and 7	6.64	3.04**	361
2 and 5	6.70	4.75**	1000
2 and 6	4.91	3.48**	1054
2 and 7	7.53	4.16**	887
3 and 5	7.36	5.21**	1212
3 and 6	5.57	3.87**	1266
3 and 7	8.19	4.58**	1099

Education

The grouping according to education gives the following picture:—

S. No.	*Educational Standard*	*N*	*Mean*	*Variance*
1	Army Education (special) (Roughly Matric standard excepting in Mathematics)	34	131.32	382.62
2	Non-Matric or Junior Cambridge	269	132.61	327.27
3	Matric or Senior Cambridge	1883	134.21	382.05
4	Higher Secondary	100	134.59	340.50
5	Intermediate	671	138.97	364.20
6	B.A.	281	142.68	645.70
7	M.A.	25	143.84	609.73

Bartlett's test shows that the variances differ from group to group (x^2=48.96** with d. f. 6). Test for homogeneity of means with heterogeneous variances (as given in part I) shows that mean scores vary from group to group (F′=9.89** with d. f. n_1=6 ; n_2=182) Candidates of higher standards do better.

Scores not only differ but also rise systematically with higher education. The rise from the lowest to the highest level is about 12 marks.

Since age has already been shown to be unrelated to the score, this rise has to be attributed to the selective process of education itself where the less bright are weeded out in lower classes.

Vocation

Closely allied to education is vocation. This is given under the candidate's occupation. The following table presents the data :—

S. No.	*Vocation*	*N*	*Mean*	*Variance*
1	Science	1800	136.12	388.38
2	Arts	560	134.21	426.51
3	Technical	27	142.07	286.87
4	Commerce	18	135.39	409.64
5	Teaching	23	136.17	245.98
6	Law	11	138.27	405.85
7	Clerks	25	137.36	473.19
8	Military boy recruits	24	135.29	290.27
9	Medical	214	140.79	258.71
10	Others	44	141.75	588.10

The lowest mean is for Arts and the highest is for the technical. Bartlett's test shows that the variances differ from group to group (x^2=30.15** with d. f. 9). Test for homogeneity of means with heterogeneous variances shows that the mean score is not affected by different vocations (F′=1.35 with d. f. n_1=9, n_2=91).

If the data are classified religionwise, we get the following picture:

Religion	*N*	*Mean*	*Variance*
Hindus (excluding Sikhs) . . .	2287	136.16	417.05
Sikhs	415	135.46	411.46
Christians	50	141.26	384.83
Others (Muslims, Parsis, etc.) . . .	11	132.91	194.69

The variances do not differ significantly (x^2=2.57 with d. f. 3). Analysis of variance shows that the means cannot be said to differ with religion (F′=1.30 with d. f. n_1=3, n_2=2759).

S. No.	*State*	*N*	*Mean*	*Variance*
1	U.P.	893	136.25	308.21
2	Punjab	816	134.95	373.90
3	Delhi	211	136.23	337.90
4	Madras	182	143.14	387.99
5	Madhya Pradesh	150	134.45	405.44
9	Maharashtra	142	140.02	369.67
7	West Bengal	103	130.86	456.50
8	Bihar	218	135.13	570.89
9	J. & K.	29	142.59	278.67
10	Himachal Pradesh. . . .	24	131.83	617.83
11	Rajasthan	14	133.73	620.43
12	Gujarat	11	132.09	354.93
13	Kerala	11	131.95	569.94
14	Sikkim, Nepal, etc. . . .	11	132.73	596.75

The variances cannot be regarded as equal.

(x^2=31.81** with d. f.=13). Rajasthan shows the largest and J & K the lowest variance.

Test for homogeneity of means with heterogeneous variances shows that mean scores vary from group to group (F′=2.8** with d. f. n_1=13 ; n_2=139) Groups 4, 9 and 6 score more than others.

The mean for 4 is the highest and that for 7 is the lowest.

The highest number comes from U. P. This may partly be due to its large population. But the Punjab sends the second largest number of candidates though it does not have the second largest population, the single city of Delhi sends 211 candidates while the whole provinces of Gujarat and Kerala send only 11 candidates each.

Relationship with other assessments

The following are the correlations of the intelligence-score with other assessments at the Selection Boards:

Assessment	*Correlation with intelligence scores*
1. President	0.13**
2. Group Testing Officer	0.11**
3. Technical Officer	0.14**

The following are the findings of the study:—

(1) The tests are satisfactorily reliable.

(2) The score does not rise consistently with age.

(3) The scores do not vary with vocation and religion.

(4) The scores vary with the states.

(5) The States do not contribute candidates in proportion to their populations.

(6) The score has a positive relationship with other assessments at the selection boards.

FIGURE ANALOGIES TEST

(Non-verbal Intelligence Test)

Instructions, Illustrations and Practice

(To be given to groups of 50 men or less under standard test conditions).

Explaining the Examples

This is a test of pictorial analogies. In each question there are seven small figures. The first figure bears a certain relationship to the second figure and the third figure bears a somewhat similar relationship to one of the last four figures. Your job is to spot out that figure among the last four that is related to the third figure in a manner similar to that in which the second figure is related to the first, and write its number down against the question-number on the answer sheet.

Now look at the front page of the test booklet which has four examples.

Pay attention to example No. 1. You see a row of arrows pointing in different directions. Let us find out the relationship between the first and the second arrows. If you rotate the first arrow in an anti-clockwise direction through 90° you obtain the second arrow, therefore the relationship of the second arrow to the first is one of rotation through 90° in an anti-clockwise direction. To spot out the required arrow among the last four which would give the above relationship with the third arrow, you have to rotate the third arrow through 90° in an anti-clockwise direction. Thus you come to arrow No. 3 which is the correct answer to this example and this number has already been printed on the answer sheet against No. 1 in the column headed examples.

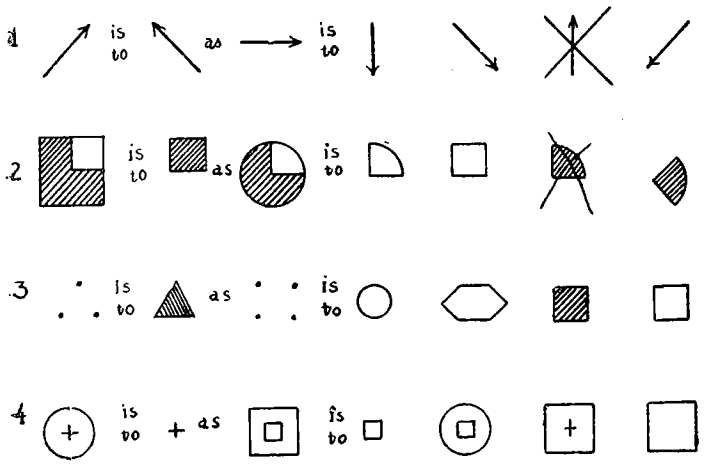
Look at Example No. 2 now. Here, obviously, the first figure is to the second as the third figure is to the sixth, which is numbered 3, the relationship being one of finding the part that will complete the whole. Thus 3 is the answer to Example No. 2 and this is already printed on the answer sheet.

Advice on method

You are to do each question in that way and put down the number of the correct figure against the relevant question-number. Give only ONE answer to each question.

The answers are to be written in the columns headed 'A' and should be inside the boxes not on the lines. Take care that the answers are in correct places. Be careful not to turn over two pages at a time otherwise you will get your answers in wrong spaces on the sheet.

Time limit 35 minutes.



P R W FORM No. 61

ANSWER SHEET
FIGURE ANALOGIST TEST
P R W REVISION

CANDIDATE'S NAME .....

BATCH No. ..... CANDIDATE'S No. .....

DATE OF TESTING.....

ILLUSTRATION SET

1	1	2	✗	4
2	1	2	✗	4

PRACTICE SET

3	1	2	3	4
4	1	2	3	4

Total Score..... Marked by.....

Eq. Score..... Checked by.....

DO NOT TURN OVER UNTIL TOLD

SELECTION OF PERSONNEL

Figure Analogies Test (*Canadian*).

Directions

This is a test of pictorial analogies. In each question there are seven small pictures. The first picture bears a certain relationship to the second picture, and the third picture bears a somewhat similar relationship to one of the last four pictures. You must mark a cross on the picture among the last four that is related to the third picture in a manner similar to that in which the second picture is related to the first. Work as rapidly as possible after the word GO is given. Stop when told to STOP. Here are a few examples to show you what you are supposed to do.

(Total No. of questions 60. Time allowed—35 minutes).

9—2 DPR (ND)/76

CLASSIFICATION TEST (CANADIAN)

(Verbal Intelligence Test)

Instructions, Illustrations and Practice

Here are some practice questions to show you what you are expected to do.

1. What number comes next in the following series ?

2, 4, 6, 8, 10, ...

These numbers increase by 2 at a time, therefore the number after 10 will be 12, and this number has been written in the answer-sheet.

Here are a few more questions.

2. Corpulent persons are

(1) brave. (2) honest (3) stout (4) clever (5) tall .....
.....

Corpulent means the same as stout ; stout is number 3, and this number has been written in the answer-sheet.

3. Which word does not belong in this list ?

(1) green (2) violet (3) red (4) net (5) yellow.....
.....

These are all colours except net, so 4 is written in the answer-sheet.

4. Bird is to air as fish is to:

(1) water (2) swim (3) bait (4) net (5) catch.....

The answer is 1, so this number has been written in the answer-sheet.

5. A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Print the letter before the sixth letter from the beginning of the alphabet .....

The sixth letter from the beginning of the alphabet is F, and the letter before it is E, so E has been written in the answer-sheet.

6. Last Tuesday was April 19th. If next Thursday is three days away, what day of the month is it today ?

Today must be Monday, April 25th, so 25th has been written in the answer-sheet.

Now go ahead and try the following questions.

7. What number comes next in the following series ?

1, 10, 2, 20, 3, 30.....

8. Which word does not belong in this list ?

1. wood, 2. iron, 3. copper, 4. lead, 5. tin.

9. A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Print the letter which comes half-way between P and X in the alphabet.....

10. Snow is to winter as rain is to

1. water 2. umbrella 3. cloud 4. shower 5. summer
.....

11. The opposite of illiterate is

1. polite 2. educated 3. considerate 4. harmonious 5. readable.....

12. One third of one half is.....

13. Private A was 22 years old in 1941. How old will he be in 1954 ?

.....

14. Are Canada snow cold in winters ?

If one word were omitted from the above the others could be rearranged to form a sentence. Print the first letter of this word.....

The questions you have just done were practice questions.

The questions in the test must be answered in the same way.

Time limit : 45 minutes.

P.R.W. FORM NO. 25

ANSWER SHEET

CANADIAN CLASSIFICATION TEST

(P. R. W. REVISION)

NO. OF S. S. B....,.....

BATCH No. .....DATE OF TESTING.....

CANDIDATE'S No. .....

NAME OF THE CANDIDATE.....

EXAMPLES

Q	ANSWER
1	12
2	3
3	4
4	1
5	E
6	25
PRACTICE SET	
7	
8	
9	
10	
11	
12	
13	
14	

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

MARKED BY..... TOTAL SCORE.....

CHECKED BY..... EQ. SCORE.....

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

FIGURE ANALOGIES AND CANADIAN CLASSIFICATION TESTS

TABLE I CONVERSION KEY

Raw Scores	Equi. Scores		Raw Scores	Equi. Scores		Raw Scores	Equi. Scores	
	Analy	Classi		Analy	Classi		Analy	Classi
1	20	40	28	57	62	55	94	85
2	21	40	29	59	63	56	96	86
3	23	41	30	50	64	57	97	87
4	24	42	31	61	65	58	98	88
5	26	43	32	83	66	59	100	88
6	27	44	33	64	67	60	101	89
7	28	45	34	65	67	61	..	90
8	30	46	35	67	68	62	..	91
9	31	46	36	68	69	63	..	92
10	32	47	37	70	70	64	..	93
11	34	48	38	71	71	65	..	93
12	35	49	39	72	72	66	..	94
13	37	50	40	74	72	67	..	95
14	38	51	41	75	73	68	..	96
15	39	51	42	76	74	69	..	97
16	41	52	43	78	75	70	..	98
17	42	53	44	79	76	71	..	99
18	43	54	45	81	77	72	..	99
19	45	55	46	82	78	73	..	100
20	46	56	47	83	78	74	..	101
21	48	56	48	85	79	75	..	102
22	49	57	49	86	80	76	..	103
23	50	58	50	87	81	77	..	104
24	52	59	51	89	82	78	..	104
25	53	60	52	90	83	79	..	105
26	54	60	53	92	83	80	..	106
27	56	61	54	93	84			

TABLE II

SELECTION GRADES

Selection Grade	Summed Equivalent Scores
I	187 and above
II	172—186
III	158—171
IV	143—157
V	128—142
VI	112—127
VII	111 and below

VI

I. S. P. 20 AND MATRIX 43

VI

I. S. P. 20 AND MATRIX 43

It is proposed here to study the Intelligence Test Scores of the UPSC passed candidates appearing for selection to the National Defence Academy Course. The pass rate in this UPSC examination was 56.6% (*Vide* page 3 para 1).

Description of the Tests

The tests used were I. S. P. 20 and Matrix 43.

I. S. P. 20 is a verbal test of Intelligence. It contains seven parts. The first part requires the testee to pick up an odd item from a group of five. The number of questions is 15. The second part consists of 14 mixed sentences which have to be correctly arranged. Part III consists of 9 questions designed to assess the capacity to follow instructions. Part IV contains 14 questions requiring the understanding of similarity of relations Part V consists of 19 words with jumbled spelling to be deciphered. Part VI contains 15 number-series to be completed. Part VII contains 14 letter codes to be deciphered. In all there are 100 items. The parts are separately timed.

The score is number right, except for part II where the score is the number of right answers minus the number of wrong answers.

Matrix 43 is a non-verbal test of Intelligence containing incomplete drawings. The testee has to indicate which of the eight choice figures can correctly complete the drawing. There are 38 items in the test.

Distribution of scores on the Tests

The following are the distributions of the scores on the tests:—

I.S.P. 20		*Matrix* 43	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
20—24	2	1—3	4
25—29	5	4—6	10
30—34	11	7—9	11

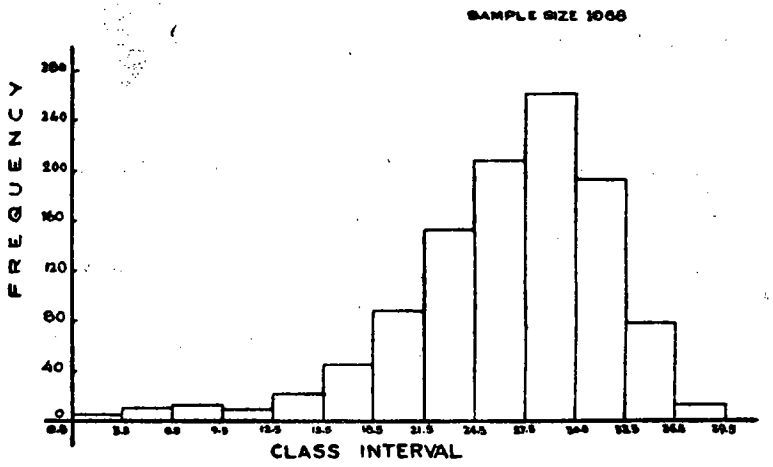
I.S.P. 20		*Matrix* 43	
Class Interval	*Frequency*	*Class Interval*	*Frequency*
35—39	37	10—12	9
40—44	54	13—15	20
45—49	103	16—18	45
50—54	112	19—21	88
55—59	138	22—24	152
60—64	153	25—27	207
65—69	160	28—30	260
70—74	143	31—33	192
75—79	83	34—36	17
80—84	52	37—39	13
85—89	22		
90—94	13		
TOTAL	1088	TOTAL	1088

Following are the salient statistics:

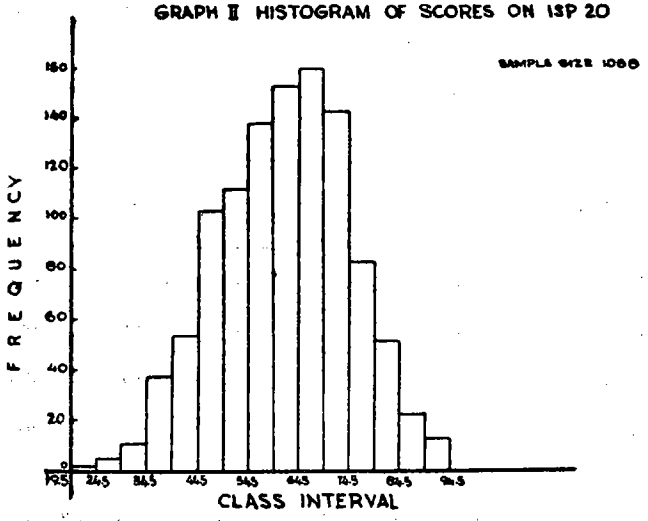
	Mean	*S.D.*	*Reliability (Rational (Equivalence)*	β1	β2	*Remarks*
I.S.P. 20	61·55	13·03	0·87	—0·13**	2·66**	Negatively skewed and platykurtic.
Matrix 43	26·47	6·10	0·81	—1·07**	4·78**	Negatively skewed and leptokurtic.

Correlation between the tests—0·52**

GRAPH I HISTOGRAM OF SCORES ON MATRIX- 43



GRAPH II HISTOGRAM OF SCORES ON ISP 20



The rational equivalence reliability of ISP 20 is 0.87 and that of Matrix 43 is 0.81. The correlation between the tests is 0.52 which is significant at 1% level.

Group Differences

Age

An age-wise breakdown of the means gives the following picture :—

Age	*N*	*Mean*	*Variance*
15+	136	96·3	408·04
16+	420	95·9	361·00
17+	529	96·1	357·21

The majority of the candidates are 17+. It is obvious that the means do not differ consistently with age. Even the inconsistent differences are not significant. (Analysis of variance shows an F=0.03 with 2 & 1082 d. f.). The following table presents the school-wise results:

Type of School	*N*	*Mean*	*Variance*
1. Public	48	106·6	374
2. Sainik	25	103·1	287
3. European	84	102·4	337
4. Rest	928	94·5	365

The vast majority comes from the last category of schools. Bartlett's test shows that the variances do not differ from school

to school. (x^2=0.86 with 3 d. f.). Analysis of variance showed that the schools differ in their mean score (F=4.49 ** with d.f. 3 & 1081). Mean scores of students coming from Public, Sainik, and European schools are homogeneous and exceed those of ordinary school students.

Medium of Instruction

Classification by medium of instruction gives the following results:—

Medium	*N*	*Mean*	*Variance*
1. English	403	96·4	445
2. Hindi	246	90·6	289
3. Punjabi	98	92·5	421
4. English + Hindi	235	93·5	434
5. Marathi	49	95·8	216

Bartlett's test shows that the variances within the media of Instruction cannot be regarded as equal (x^2=20.72** with 4 d.f.).

To test the equality of means in the case of heterogeneous variances F′ was calculated as given in part I. The value of F comes out to be 4.02** with d. f. n_1=4 ; n_2=250 which is significant at 1% level, showing that the scores of the candidates vary with Medium of Instruction. Further tests of significance show that candidates coming from schools which have English or Marathi medium score significantly higher than the candidates coming from schools having Hindi as the medium.

It should also be noted that the English-medium-group shows the largest variance.

Size of the family

It has been observed in western countries that the more Intelligent sections of society are less fertile. Presumably they practice birth-control. In order to see whether a similar tendency

obtains in the candidate population it was classified according to the number of siblings a candidate has. The following table presents the results:—

No. of siblings a candidate has	*N*	*Mean*	*Variance*
1	12	102·5	146·45
2	44	98·0	214·21
3	134	95·4	469·56
4	190	98·1	314·05
5	188	96·2	324·58
6	168	95·8	394·77
7	96	93·8	268·30
8	61	94·0	463·43
9	41	94·0	543·88
10 & above	49	89·7	418·7

Bartlett's Test of homogeneity shows that variances differ from group to group (x^2=23.24** with d. f. 9). Equality of means has been tested by using the formula used earlier in similar situations, which shows that the scores of the candidates are unaffected by the size of the family (F′=1.64 for d. f. n_1=9 and n_2=175): The correlation between the size of the family and the scores on the battery is 0.15 which is non-significant.

Parents' Occupation

Different occupations are frequently found to differ in the level of intelligence they attract. The candidates were, therefore, classified according to the occupation of their guardians. The following table presents the occupation-wise results:—

Occupation	*N*	*Mean*	*Variance*
Doctors	58	99·0	312·00
Lawyers	56	97·5	437·00
Teachers	77	94·3	350·00

Occupation	*N*	*Mean*	*Variance*
Businessmen	106	96·00	342·00
Agriculturists	54	97·00	675·00
Military	154	100·5	315·00
Private Servants	63	90·0	351·00
Govt. Servants	346	95·0	345·00
Engineers	41	93.8	362·00
Others	69	97·5	365·00

Bartlett's test shows that the variances differ from group to group (x^3=21* with d. f. 9). To test the equality of means, the formula used earlier in similar situations, has been applied. It shows that the scores of the candidates differ with the occupation of their guardians. (F′=2.16* with d. f. n_1=9, n_2=275). Scores of candidates whose fathers are in military service are higher and differ significantly from the scores of candidates whose guardians are engaged in teaching, business, private service, Government service etc. Moreover, sons of doctors, lawyers, Businessmen, Govt. servants and others form a homogenous group and score more than the private servant's sons.

Socio-religious

Castewise data are not available and, therefore, an important basis for group comparisons cannot be utilised. We have some data on other socio-religious groups. The following table presents the results:—

Group	*N*	*Mean*	*Variance*
Brahmin	158	97·8	360·00
Non-brahmin	652	95·7	367·00
Christian	26	98·6	490·00
Sikhs	215	96·00	349·00
Rest	29	91·0	652·00

Bartlett's test shows that the variances differ from group to group (x^2=25.67** with d. f. 4). Appropriate tests used earlier in similar situations show that the scores do not differ with religious groups (F′=0.75 for n_1=4 & n_2=99).

Income

An income-wise analysis gives the following picture:

	Income Group	N	Mean	Variance
1.	1— 100	96	91·2	562
2.	101— 150	90	93·2	452
3.	151— 200	106	95·0	298
4.	201— 250	102	94·5	460
5.	251— 300	101	94·0	382
6.	301— 400	108	94·0	360
7.	401— 500	107	92·5	270
8.	501— 600	71	96·0	315
9.	601— 800	74	102·0	265
10.	801—1000	100	99·0	323
11.	1001—1500	58	109·0	220
12.	1501 and above	39	100·0	285

Bartlett's test shows that the variances differ with income group (x^2=75.0** significant beyond, 1% level with d. f.=11).

Applying the test of significance of the differences between means when variance is heterogeneous we obtain an F′=5.85** with n_1=11 & n_2=384 which is again significant at 1% level.

The difference in the means of income-groups is not unidirectional. The table shows that in as many as five cases out of 12 the mean for the higher income-groups is lower. A clear-cut relationship between income and intelligence is therefore not established.

If we classify the candidates only in two income-groups we find that those belonging to the income group 600 and below have a mean significantly lower by 14.36 (Z=6.80** d. f.=1050) than those coming from the higher.

The following table gives the statistics of the two income groups:—

Income group	N	Mean	Variance
0—600	781	93·74	379·50
601 and above	271	108·10	280·25

Rural/Urban

This classification yields the following results:—

	N	Mean	Variance
Rural	150	91·7	412·00
Urban	929	96·4	371·00

The vast majority of the candidates comes from the urban group.

The urban group has a higher mean score than the rural.

States

The States have broadly become distinct linguistic groups after reorganisation. It will, therefore, be culturally meaningful to compare their performance in intelligence. The following are the results:—

State	N	Mean	Variance
Delhi	234	95·9	454
Kerala	26	98·5	407
Rajasthan	31	99·4	288
Mysore	23	92·9	195
Kashmir	10	95·9	508
Punjab	384	97·0	295
Maharashtra	97	94·1	250
Madhya Pradesh	18	93·5	203

State	N	Mean	Variance
Orissa	4	99·0	310
Andhra	12	104·6	343
Madras	21	90·9	163
Bihar	10	88·4	521
Bengal	25	93·4	416
U.P.	172	92·0	797
Assam, Himachal Pradesh	6	94·4	159

The table reveals that the largest number of candidates come from the Punjab, Delhi and U. P.

Bartlett's test of homogeneity shows that the variances differ significantly from group to group (x^2=88.78** for d. f. 14). Equality of means has been tested by the formula used earlier in similar situations. It is seen that scores do not differ from state to state (F'=0.94 for n_1=14 ; n_2=1809).

Education

Educational level is an important variable to consider in the study of intelligence. Our sample presents the following picture in this respect:

Examination	N	Mean	Variance
Non-Matric	90	102·52	326·20
Matric	737	94·16	407·98
Higher Secondary	98	101·76	269·49
F. A. & F.Sc.	139	95·88	282·39
B.A. & B.Sc.	25	94·28	754·13

Bartlett's Test shows that the variances differ from group to group (x^2=20.59** with 4 d. f.). Equality of means has been tested using the formula used in similar situations which shows that the mean score varies from group to group (F'=7.37** for m=4 and n_2=127). Non-matric candidates score the highest marks, next are Higher Secondary candidates and matriculates

score the lowest marks. Further analysis shows that Non-matric & Higher Secondary form one group and score significantly more than others.

Relationship with other Assessments

The intelligence-marks have the following correlations with other assessments at the boards:

Assessment	Correlation with Intelligence Scores
Technical Officer	0·31**
G.T.O.	0·26**
President	0·24**
Total Board Marks	0·30**

Conclusions

The following conclusions emerge from the study:—

(i) The majority (85.5%) of the boys come from ordinary schools. They score less than boys coming from public or European schools ;

(ii) Boys coming from schools having English or Marathi as medium of instruction score better than boys coming from schools in which Hindi or Punjabi is the medium of instruction ;

(iii) Boys whose fathers are in military service score the highest marks. Sons of those in private service, score the minimum marks ;

(iv) Boys coming from the income-group below Rs. 600 have a lower mean score than those coming from the higher ;

(v) The urban candidates score significantly more than the rural ;

(vi) The mean score does not differ with the age-groups studied ;

(vii) Mean score does not differ with size of family ;

(viii) The scores do not differ with religion ;

(ix) The scores do not show a definite trend with level of education.

I. S. P. TEST NO. 20

(Verbal Intelligence Test)

Instructions, illustrations and Practice

Instructions

Read the following carefully:—

1. This test consists of 7 parts, each containing a number of problems.
2. Work out the problems as carefully and as quickly as you can.
3. When the examiner says "Turn over to Part I", turn over this page: read the instructions with the examiner; and then work carefully and as quickly as you can.
4. When the examiner says "STOP" you must put down your pencils on the desk at once.
5. If you finish part of the test before the time is over, check your answers. DO NOT go to the next unless you are told to do so.

PART I

In this part you are given five words in each question. All the words, except one, indicate things which belong to the same class. You have to find the word which does not belong to the same class as the others and then write the number of this word on your answer-sheet against the number of the question.

Here is an example:

1	2	3	4	5
Anna	Pice	Dollar	Rupee	Half-rupee

In this question all the words except "dollar" are of the same class, because they are the names of Indian coins. "Dollar" is different from the rest because it is not an Indian coin. As this does not fall in the same class as the rest, you have to give this as your answer. So figure 3, printed on top of "dollar" has been written on your answer sheet against question number 1.

In the same way, in each of the questions in the next page, one of the things does not belong to the same class as the rest. You have to write the number of the different one on your answer sheet against each question.

You will get 2 minutes for this part.

(Number of questions—15)

PART II

In this part you will have a number of sentences. The words in each sentence have been mixed up. Examine each sentence and find out what it would say if the words were rearranged in the correct order. DO NOT write the sentences in their correct order. All that you have to do is to arrange the words of each sentence in correct order in your mind and then to consider whether the statement made in the sentence is true or false. If the statement is true underline the word True on your answer sheet. If you think the statement is false, underline the word False on your answer sheet.

Here are two examples:

1. give milk us cows.

If the words of this sentence are rearranged in the correct order, it would read as follows :—

Cows give us milk.

Now you have to tell whether this statement is true or false. In this example the statement is obviously true. Therefore a line has been drawn under the word True on your answer-sheet against question number 1.

2. west in rises the sun.

If this sentence is put in its proper order it will read as follows:—

Sun rises in the west.

This is obviously a false statement, so a line has been drawn under the word false on your answer sheet against question No.2.

Now do the questions on the next page. You will get 3 minutes for this part.

(Number of questions—14)

PART III

In this part you have to do what you have been asked to do in each question. Two examples are given to give you some idea of the type of questions you have been asked.

Examples :—

(1) Multiply 6 by 4 and divide the result by 3. If the answer is more than 9 write 5 on your answer sheet, otherwise put 8.

In this case the product of 6 and 4 is 24. If you divide 24 by 3, the result is 8. As 8 is NOT more than 9 you should write figure 8 on your answer-sheet against question number 1. This has already been done for you.

(2) A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Write the letter which is midway between B and F.

In this example the alphabet has been printed on top of the question to help you. As you can find from the alphabet the letter Midway between B and F is D, therefore, the letter D has been written on your answer sheet against question number 2. Similarly do the questions on the next page. You will get 3 minutes for this part

(Number of questions—9)

PART IV

Look at the examples given below :—

1. GLOVE is to HAND as SOCK is to

1	2	3	4	5
Fingers	Foot	Wool	Head	Hair

In this case GLOVE stands in the same relation to HAND as SOCK stands to one of the five answers given above. The GLOVE covers HAND in the same way as SOCK covers FOOT. Therefore the answer to this example is FOOT. On your answer sheet, 2 which is the number of FOOT has been written as the correct answer against question number 1.

2. A is to C as D is to

1	2	3	4	5
B	E	F	G	H

In this example you have to find a letter which should stand in the same relation to D as C is to A. The relation of C to A is found thus. Start from A, drop the letter B and we reach C. Similarly start from D, drop the letter E and we find F. The correct answer, therefore, is F. Therefore figure 3 which is on top of F has been written on your answer sheet against question number 2.

Similarly do the questions on the next page. You will get 4 minutes for this part.

(Number of questions—14)

PART V

In the questions below the letters of the word are mixed up. In each question some clue or indication has also been provided to indicate what the real word is. You have to rearrange the letters in your mind to form the correct word and then to write the Last letter of the word on your answer sheet against each question.

Here is an example:—

KENAL is a part of the body.

Now the real word is 'ANKLE' which is a part of the body. Its letters have been mixed up. In your mind rearrange the letter of "KENAL" to get the correct answer thus:

ANKLE

The last letter in this word is "E". So E is written against question 1 under column headed Part V on your answer sheet.

Similarly do the questions on the next page. You will get 6 minutes for this part.

REMEMBER, you have to enter the LAST letter of the correct word on your answer sheet.

(Number of questions—19)

PART VI

In this part you are given a series of numbers. You have to study each series carefully and then to find two numbers which should come next. These two numbers should be written in the first two columns under Part VI on your answer sheet. Three examples have been solved for you.

Here are the examples:—

(1) 1, 3, 5, 7, write the next two numbers on your answer sheet.

In this series 3 is obtained by adding 2 to 1 (the number before 3), 5 is obtained by adding 2 to 3 (the number before 5) and 7 is obtained by adding 2 to 5 (the number before 7). So the next two numbers should be 9 and 11. Therefore these two numbers have been written on your answer-sheet against question No. 1.

(2) 30, 29, 27, 24, write the next two numbers on your answer sheet.

In this question 29 is obtained by deducting 1 from 30, 27 is obtained by deducting 2 from 29 and 24 is obtained by deducting 3 from 27. The next number, therefore, will be obtained by deducting 4 from 24 and it will be 20 and the number after 20 will be obtained by deducting 5 from 20 and it will be 15. The two numbers which are wanted, therefore, are 20 and 15 and they have been written on your answer sheet against question No. 2.

(3) 5, 3, 6, 3, 7, 3, write the next two numbers on your answer sheet.

In this series, figure 3 is repeated after every alternate number and every alternate number increases by 1. Thus the next number should be 8 and then 3 would be repeated. Therefore 8 and 3 have been written on your answer sheet against question No. 3.

Now do the questions on the next page. You will get 7 minutes for this part.

(Number of questions—15)

PART VII

Below are given a few questions about secret writings or codes. Different codes have been used in different questions. The solution of the code is given in the first half of each question. You have to find the meaning of the code in the second half. Each question is followed by five answers. One and only one of them is correct. All you have to do is to find the correct answer and to write the number printed above it on your answer sheet.

The alphabet is printed here to help you in decoding.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Here is an example:

1. If QNA means "rob", RHS means

1	2	3	4	5
age	eye	fig	sit	mob

The word "rob" is found from "QNA" in this way. In the alphabet, letter 'r' comes after Q, letter 'O' comes after N, and letter 'b' comes after A. Thus "QNA" stands for "rob". Similarly we have to translate "RHS". In the alphabet letter 's' comes after R, letter "i" comes after H and letter "t" comes after S. Therefore "RHS" represents "sit". In other words "RHS" means "sit". The number printed on top of the correct answer (that is "sit") is 4 which is written against question 1 on your answer sheet.

Now do the questions on the next page. You will get 12 minutes for this part.

REMEMBER, the codes are not always the same.

(Number of questions—14)

Scoring

Except for items in Part II give one mark for each correct answer and zero for wrong as well as a left out answer.

In part II only give one mark for each correct answer, zero for the left-out answer and minus one for each wrong answer. The total score for part II will be calculated as right minus wrong answers. The total score for part II will, however, never go below zero.

Examples

(a) Suppose in part II a candidate has attempted only ten items, eight out of which are correct and two wrong. His score on the part will be right—wrong (*i.e.* 8—2)= Six.

(b) If a testee has solved twelve items correctly and has left out two items unattempted, then his score on part II will be ten.

(c) Six items answered correctly and eight items wrongly will render the score to be zero (and not minus two).

This procedure (Right—Wrong) is applicable *ONLY* to *part II.*

Although keys have been provided, discretion should be used while scoring.

If an answer to an item is correct in its content but is not recorded strictly in conformity with the instructions it should be marked as correct.

e. g. In parts I, IV, V and VII if a candidate puts the answer in words instead of recording it in a number or a letter and if the answer is correct in its content, it should be scored as correct.

In part VI, if the testee puts more than two next numbers in the series, the surplus number should be ignored, and the answers should be scored as right or wrong on the basis of the first two numbers only. In this part the answer will be scored as correct only if the two numbers mentioned and their order is the same as in the key.

P. R. W. FORM NO. 31

ANSWER SHEET

I. S. P. TEST 20 (P. R. W. REVISION)
(V. I. T.)

NO. OF S.S.B. .....
BATCH NO. ..... DATE OF TESTING.....
CANDIDATE'S NO. .....
NAME OF THE CANDIDATE .....

EXAMPLES	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Q.	ANSWER	Q	ANSWER	Q	ANSWER	Q	ANSWER	Q	ANSWER
1	3	1	TRUE FALSE	26		51		76	
2	TRUE FALSE	2		27		52		77	TRUE FALSE
3	2	3		28		53		78	
4	E	4		29		54	TRUE FALSE	79	
5	8,3	5		30		55	TRUE FALSE	80	
6	4	6		31		56		81	
PRACTICE SET		7	TRUE FALSE	32	TRUE FALSE	57		82	
7		8		33	TRUE FALSE	58		83	
8		9		34		59		84	
9		10		35		60		85	
10		11		36		61		86	
11		12		37		62		87	
12		13		38		63		88	
		14		39		64		89	
		15	TRUE FALSE	40	TRUE FALSE	65		90	TRUE FALSE
		16		41	TRUE FALSE	66		91	
		17		42		67		92	
		18		43		68		93	
		19		44		69		94	
		20	TRUE FALSE	45		70		95	
		21		46		71		96	
		22		47		72		97	
		23		48		73		98	
		24		49		74		99	
		25		50		75		100	

TOTAL SCORE..... EQ. SCORE .....
MARKED BY ..... CHECKED BY.....

PROGRESSIVE MATRICES 1943

(Non-Verbal Intelligence Test)

Instructions, (to the tester) Illustrations and Practice

Explaining the examples in the Practice Set

Before the test proper, there is a practice-set consisting of four examples, the first one of which we shall do together.

Turn over the cover of the book and we come to the first page where it says Practice-Set 1.

In the top half of the page you see a pattern with a blank space in it. Down below there are eight small pieces, numbered 1, 2, 3, 4, 5, 6, 7, 8, these are all of the same size and shape as the missing piece in the big pattern and fit exactly into the blank space, so there is no measuring to be done. The important point is that only ONE of these eight pieces will go to complete the pattern. Look at the pieces and find out the one which will complete the pattern. You will see that THREE horizontal lines and ONE vertical line are required in the blank space to complete the pattern and No. 6 is the only piece which satisfies the condition. So in the column headed "Practice-Set" on your answer sheet, opposite No. 1, write figure 6 not SIX, but just figure 6—as your answer.

I want you now to try the next three examples yourselves and put down the answers in the column under Practice-Set opposite Nos. 2, 3 and 4. Difficulties will be fully explained after you have tried all the three.

Right—Begin.

AFTER THE MAJORITY HAS FINISHED ALL THE EXAMPLES, Say—Stop work and listen carefully. There are many ways of arriving at the right answer, but no matter how, you tackle these questions, there is only ONE correct answer. You can work along the rows from left to right (INDICATE BY POINTING AT ONE OF THE EXAMPLES) or down the columns from top to bottom (INDICATE again) or any other way you choose, but every time the answer will be one and the same.

I will now go over each example in detail.

Turn back to Example 2. What is the answer ? ..... Yes, 1 is correct. Working along the rows, from left to right and starting from the top row, you see a set of three horizontal dotted lines running parallel and close together, crossed by sets of three

parallel and dotted vertical lines at three places. On the left the three vertical dotted lines are close together, in the middle, they are more apart and on the right they are farthest apart. Wherever the vertical dotted lines cross the horizontal ones, the lines have been printed thick and black. This holds good in the middle row with the difference that the horizontal dotted lines are more apart than in the top row. This is true of the bottom row too, where the only change is that the horizontal lines are farthest apart. So, in the blank space there should be three horizontal dotted lines farthest apart crossed by three vertical dotted lines farthest apart, with the lines printed thick at the places where they intersect. This is the case with piece No. 1 only, therefore, 1 is the answer to example No. 2. If you have put down any other answer, cross it out and write 1 in the same space.

Look at Example No. 3 now. What is the answer ? ..... Yes 2 is correct. Here in the top row, there is one small horizontal line at three places which is intersected by one, two and three small vertical lines respectively, working from left to right. In the remaining two rows the condition is the same with the difference that the No. of horizontal lines has increased to two in the middle row and three in the bottom one. So, in the blank space there should be three horizontal lines crossed by three vertical lines, and this is what you get in piece No. 2 ; therefore, 2 is the answer to this example. Correct your answer if you have put down some other figure.

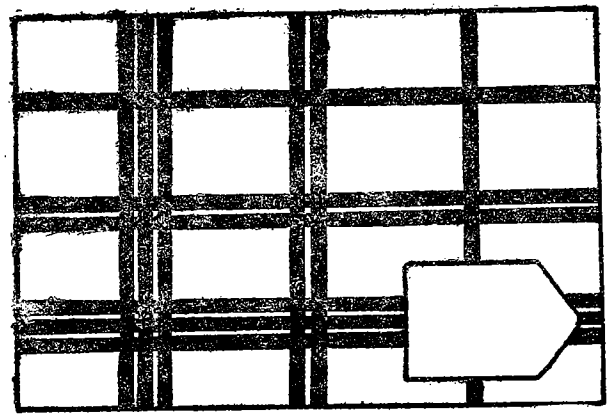
Finally, come to Example No. 4. What is the answer?..... Yes, 8 is correct. Here, in the top row there are three squares with a white background, and going from left to right, the first one is blank, the next one has a thick black vertical line in the centre, while the third one has a cross formed by thick black vertical and horizontal lines. This condition remains unchanged in the other two rows but the background in the squares changes to thin horizontal lines in the middle row and to check in the last row. The missing piece, therefore, must have a square with check background and a cross of two thick black vertical and horizontal lines, and it is No. 8. Correct your answer if you had not put down 8 on your sheet against No. 4.

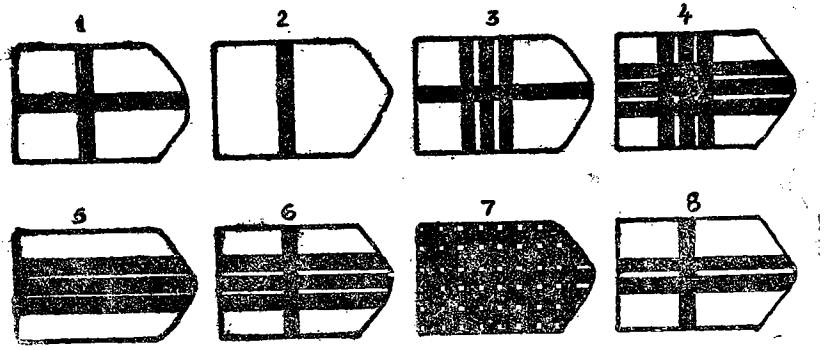
Now put down your pens and pencils.

Time limit: 20 minutes.

PROGRESSIVE MATRICES
1943

Practice Set

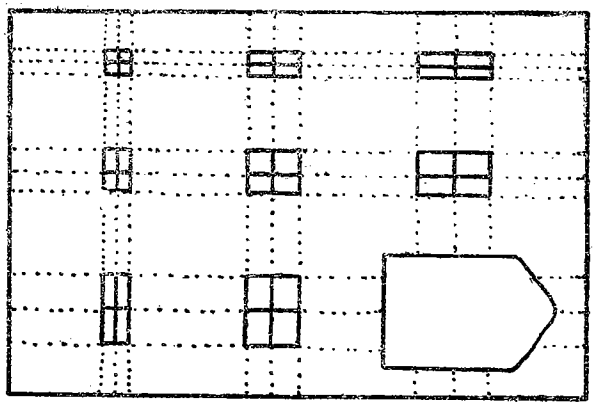


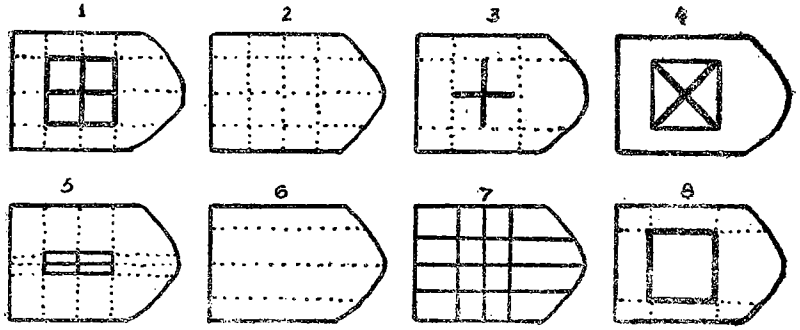


Progressive Matrices

1947

PRACTICE SET.

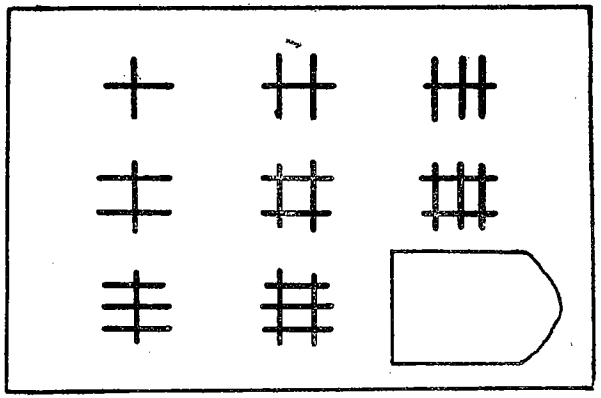


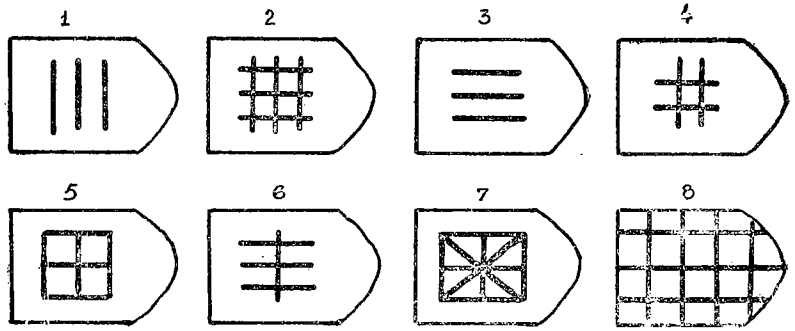


PROGRESSIVE MATRICES
1943

Practice Set

3.

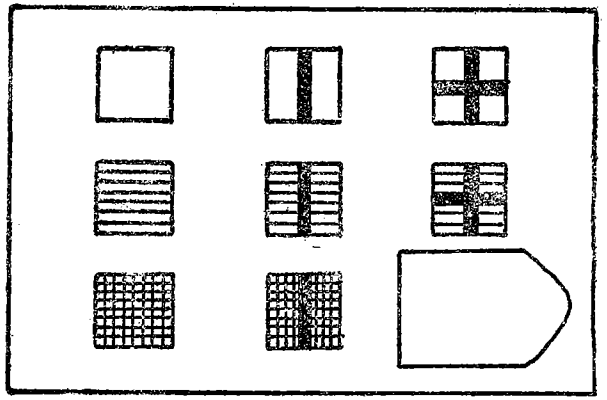


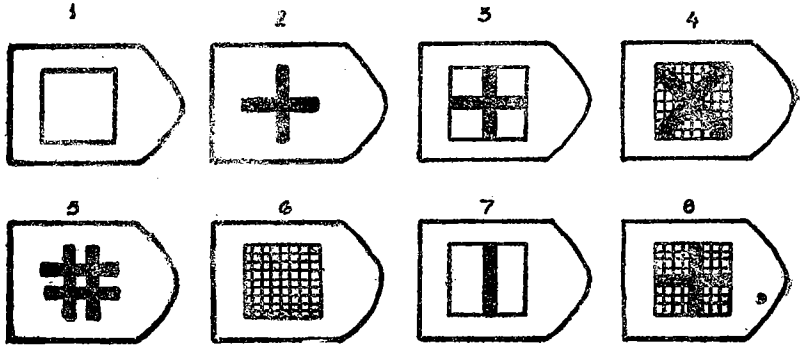


PROGRESSIVE MATRICES
1943

Practice Set.

4.





I. S. P. Form 1602

ANSWER FORM-PROGRESSIVE MATRICES (1943)

NO. OF S.S.B. .....

DATE..... NAME IN FULL.....

BATCH NO. ....

CANDIDATE NO. .....

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

MARKED BY..... TOTAL SCORE.....

CHECKED BY..... EQ SCORE.....

ISP 20 and Matrix 45

TABLE I—CONVERSION KEY

Raw Scores	Equivalent Scores I.S.P. 20	Mat 43	Raw Scores	Equivalent Scores I.S.P. 20	Mat 43	Raw Scores	Equivalent Scores I.S.P. 20	Raw Scores	Equivalent Scores I.S.P. 20
0	—4	5	31	22	58	61	48	91	73
1	—3	7	32	23	60	62	49	92	74
2	—2	8	33	24	62	63	49	93	75
3	—1	10	34	25	63	64	50	94	76
4	—0	12	35	26	65	65	51	95	76
5	0	14	36	27	67	66	52	96	77
6	1	15	37	27	68	67	53	97	78
7	2	17	38	28	70	68	54	98	79
8	3	19	39	29		69	54	99	80
9	4	20	40	30		70	55	100	81
10	5	22	41	31		71	56		
11	6	24	42	32		72	57		
12	6	26	43	33		73	58		
13	7	27	44	33		74	59		
14	8	29	45	34		75	60		
15	9	31	46	35		76	60		
16	10	32	47	36		77	61		
17	11	34	48	37		78	62		
18	11	36	49	38		79	63		
19	12	38	50	38		80	64		
20	13	39	51	39		81	65		
21	14	41	52	40		82	65		
22	15	43	53	41		83	66		
23	16	44	54	42		84	67		
24	16	46	55	43		85	68		
25	17	48	56	43		86	69		
26	18	50	57	44		87	70		
27	19	51	58	45		88	70		
28	20	53	59	46		89	71		
29	21	55	60	47		90	72		
30	22	56							

TABLE II—SELECTION GRADES

Selection Grades	Summed Equivalent Score
I	132 & above
II	121—131
III	108—120
IV	94—107
V	79—93
VI	59—78
VII	58 and below.

VII

THE ALLEGED COMPROMISE OF INTELLIGENCE TESTS

CHAPTER VII

THE ALLEGED COMPROMISE OF INTELLIGENCE TESTS

Introduction

Complaints are repeatedly received from the Services Selection Boards that the Intelligence Tests in use become known to the candidates in a very short time and therefore the tests fail to reveal their true ability. The *modus operandi* of this leakage is described as follows:

Some candidates try to remember the questions and pass them on to the institutes which coach candidates for the SSB tests. Even if one candidate remembers 10 questions, five such candidates can succeed in remembering all the questions in a 50 item test. These are passed on to other candidates. Another way in which compromise can take place is that a copy of the test is in possession of a candidate or candidates. If this is what is happening it is obvious that Intelligence Testing is vitiated. It is, therefore, necessary to investigate the matter.

Possible effects of test compromise

If test-compromise is occurring as described above, the following will be the effects on the test score distribution: If test items are passed on through memory or actual possession of a copy of the test by some candidate, a large number of candidates will score more than what they would have otherwise scored. Consequently, the mean score on the test would rise. Again, the number of candidates who remember the test item will go on increasing as time passes, because the business of passing on knowledge of items will go on continuously. Every new batch will contain some repeaters, they will already be knowing some items through compromise. In addition, they will try to pick up information about other items which they do not already know. The fresh candidates in that new batch will also come to know more items than the fresh candidates in the older batches and as time passes the test compromisers will come to know more and more items. Thus the mean on the test will rise continuously without exception. It will never go down to the level of the mean obtained on the population when the test was newly

introduced because from previous studies of population on which the test was standardized it is known that real fluctuation of ability in different batches of candidates does not, on the average, exceed 8 marks. A compromise of test-items can easily more than compensate for this much deficiency in ability.

The second effect of compromise will be that the variance of the score distribution will go on becoming smaller. Suppose 30 items in a test have become known, this fact will help the candidates who could have solved, say 10 items without previous knowledge, to the extent of 20 marks, whereas the candidate who could have solved 25 items without previous knowledge could be helped only to the extent of 5 marks, since he can solve only 5 extra items as a result of test-compromise. Thus test-compromise will help the candidates at the lower end of the distribution much more than those at the upper end. Thus the lower scores will rise to a large extent whereas the higher scores will have no room for rising appreciably. The scores will tend to cluster together and their variance will be reduced.

The third effect of compromise will be to reduce the reliability of Intelligence-testing. When the same candidates appear again it is not likely that compromise will have benefited every candidate in the same way, as it did at first appearance. Those who knew a few items at first appearance may gain more whereas those who knew a large number of items have less room to gain by compromise. Thus the compromise-effect will introduce an error in assessment which will reduce the reliability of intelligence testing as measured by correlation between the two scores of the repeaters.

In a nut-shell, compromise is expected to have the three following effects:

(1) The mean score will rise continuously, so that any subsequent mean will be higher than any previous mean.

(2) The standard deviation will fall continuously.

(3) Test-reliability will become lower.

Search for Compromise effects

It is now obvious that all the possible effects of compromise can be easily detected by examining the test score distribution. Four tests of intelligence which are now in use for the Short Service Commission were studied from this point of view.

The sixth SSC sample on which the cut off scores were obtained was treated as the sample whose scores are unaffected by compromise. After this the mean of the sample when the test was first introduced was taken. Subsequently, means for samples appearing after at least three monthly intervals were taken. Larger intervals had to be allowed when the same test was not given after three months.

The size of each sample was 175. The samples were formed in the following way: (1) The boards at which the candidates appeared were selected at random (2) From the selected boards the candidates who appeared in the earliest portion of the month were selected.

This method will show whether the means rise and the S.D.s and reliabilities decrease with time. The only objection to this method would come from the absurd supposition that the effects of compromise are visible only on the samples between the periods considered. This objection can be levelled against any method of choosing successive samples because the possible successive samples are legion and it can always be argued that the effects of compromise would have been visible if the samples had been chosen in some other way.

If compromise is occurring as described before, it is clear that any selection of successive samples should show a trend in the means to rise and the variability to fall.

The following table presents the data on D.P.R. 52.

TABLE I

Particulars of Score distribution at Successive Periods

DPR TEST No. 52

Period	Mean	SD	Sign for runs test	
			Mean	S.D.
6th SSC(before screening)	24.29	7.68	—	—
Nov.68	24.88	6.80	—	—
May 69	28.30	6.73	+	—
Dec.69	25.17	7.76	—	+
Mar.70	24.06	7.88	—	+
Jul.70	25.51	6.97	+	—
Feb.71	28.34	7.74	+	+
Jul.71	25.91	7.95	+	+
Dec.71	25.20	7.59	+	—
Apr.72	22.77	8.53	—	—

Runs test

Median	=	25.18	Median	=	7.71
N1	=	5	N1	=	5
N2	=	5	N2	=	5
N	=	10	N	=	10
r	=	5NS	r	=	6 Ns

Table Value (2,10) Means are distributed randomly.

Table Value (2,10) SD's are distributed randomly.

It will be seen that the initial mean was 24.29 and the mean obtained in the last period was 22.77. The mean, instead of rising has fallen. The maximum mean is obtained in Feb '71. It is higher only by four marks. The runs test shows that there is no trend in the means to rise. The same is true of standard deviations.

The following table presents the data on DPR-53.

TABLE II

Particulars of Scores distribution at successive periods

DPR Test No. 53

Period	Mean	SD	Sign for runs test	
			Mean	S.D.
6th SSC (before screening)	25.69	7.81	—	—
May 69	24.23	8.40	—	—
Aug. 69	23.46	7.62	—	—
Jul. 70	25.43	8.40	—	+
Dec. 70	25.44	7.85	+	—
Mar. 71	28.23	6.85	+	—
Jul. 71	26.54	8.25	+	+
Nov. 71	25.74	8.15	+	+
Feb. 72	27.69	7.20	+	—
May. 72	25.03	8.30	—	+

Runs test

Median	=	25.72	Median	=	8.00
N1	=	5	N1	=	5
N2	=	5	N2	=	5
N	=	10	N	=	10
r	=	3NS	r	=	3 NS

Table value (2,10) Means are distributed randomly.

Table value (2,10) SD's are distributed randomly.

The initial mean is 25.69 whereas the final mean is 25.03. The two means are almost identical. Maximum mean is 28.23 in March, 1971. It is higher only by 3 marks. The column of sign for runs test shows that there is no trend in the means to rise. The same is true of standard deviations.

The following table presents the data on DPR Test No. 54.

TABLE III

Particulars of score-distributions at successive periods

DPR Test No 54

Period	Mean	SD	Sign for runs test	
			Mean	SD
6th SSC (before screening)	19.55	6.63	—	+
Jan. 69	19.74	6.12	—	—
May 69	23.63	6.29	+	+
Jan. 70	19.49	6.81	—	+
Jun. 70	20.11	6.81	—	+
Dec. 70	21.72	6.18	+	+
Jun. 71	20.62	5.82	+	—
Dec. 71	21.42	5.30	+	—
Apr. 72	20.39	5.16	+	—

Runs test

Median	=	20.39	Median	=	6.18
N1	=	5	N1	=	5
N2	=	4	N2	=	4
N	=	9	N	=	..
r	=	4NS	r	=	4NS

Table value (2,9) Means are distributed randomly.

Table value (2,9) SD's are distributed randomly.

The initial mean is 19.55 whereas the final mean is 20.39. This is higher than the initial mean by only one mark. The maximum mean is 23.63 in May 1969. This is higher by only four marks. The column of sign for runs test shows that there is no trend in the means to rise. The same is true of standard deviations.

The following table presents the data on DPR. Test No. 55.

TABLE IV

Particulars of Score distribution at Successive Periods

DPR Test No. 55

Period	Mean	SD	Sign for runs test	
			Mean	SD
6th SSC (before screening) .	25.08	7.83	—	—
July 70	24.49	7.60	—	+
Feb. 71	25.69	7.60	+	+
Jul. 71	27.55	8.08	+	+
Nov. 71	23.75	7.40	—	—
Feb. 72	28.03	6.58	+	—
May 72	25.83	8.15	+	+

Runs test

Median =	25.69	Median =	7.60
N1 =	4	N1 =	5
N2 =	3	N2 =	2
N =	7	N =	7
r =	4	r =	3
†Test not applicable		Test not applicable	

†r values for N1 & N2 are not available in the Table of critical values of r in the Runs Test in Nonparametric Statistics for the Behavioral Sciences by Sidney Siegual.

The initial mean is 25.08 and the final mean is 25.83. The maximum mean is 28.03 in Feb. '72. This is higher only by three marks. The column of runs test seems to show no trend in the means to rise, though the test is inapplicable. The same is true of standard deviations.

Thus on the whole none of the effects of compromise are visible in the data. The mean score instead of rising with time, frequently falls, the SDs are more or less the same throughout the period, and the sign test does not show any trend.

Even if we assume that whenever the means rise, the rise is due to compromise alone, it can be shown that its effect on selection rate is negligible. The following table presents the data showing how much the rejection rate has been reduced on each test over the period under consideration.

TABLE V

Reduction in rejection rate on 4 intelligence tests over the period studied

S. No.		DPR-52	DPR-53	DPR-54	DPR-55
1	Weighted Mean Marks in SSC Courses after introducing Intelligence Test as Screening (Mean of all the samples)	25.44	25.82	20.63	27.77
2	Mean Marks in SSC courses (6th SSC) before introducing Intelligence Tests for screening in SSC courses.	24.29	25.69	19.55	25.08
3	Difference .	1.15	0.13	1.08	0.69
4	Cut off score (40% rejection)	23& above	24& above	18& above	24& above
5	Score after deducting difference marks given in S. No. 3	21.85	23.87	16.92	23.31
6	New rejection rate .	36.82%	39.75%	35.56%	40.00%
7	Reduction in rejection rate due to deduction.	3.18%	0.25%	4.44%	0.00%

It will be seen that the maximum reduction in rejection rate is 4.44%. On DPR-55 there has been no reduction whereas on DPR-53 it is only .25%.

Repeaters

It is very often said that those who appear for the second time before the SSBs having failed once, score unreasonably high marks on our intelligence tests. In order to verify this scores of candidates for 15th SSC who appeared again because they failed on the OLQ tests were compiled. The following table shows the results:

TABLE VI

Two performances of Repeaters

(N=140)

	Means	
	Ist time	IInd time
Intelligence	27.21	29.41
OLQ Marks	243.25	257.15

It will be seen that the intelligence mean has risen only by 2.23 marks. This rise is negligible. A similar rise has occurred in OLQ marks also.

The data on repeaters can be used for ascertaining how the reliability of the test is affected by compromise. The correlation between the two scores of repeaters is .61, whereas the correlation obtained in the course of test-standardization was of the order of .5. This means that reliability of intelligence testing has not been affected adversely.

Conclusions

1. The mean scores on the Intelligence Tests do not rise with time.
2. The variance of the test scores remains more or less the same at successive periods.
3. The reliability of intelligence testing has not been affected adversely.

From the above it can be said that the prevalent notion that intelligence-test scores have been compromised has no basis.

VIII

VALIDITY FOR MILITARY SELECTION

VIII

VALIDITY FOR MILITARY SELECTION

The main purpose of selection is to ensure that only such candidates are selected who can imbibe training well and do their job efficiently when posted to the units. Performance in training as well as on the job is thus the criterion on the basis of which the validity of each test at the Selection Boards can be decided.

Training as Criterion

Recently, some studies were conducted about the validities of different tests at the Selection Boards with training performance as the criterion. The courses chosen were 43rd NDA and 51st IMA. These studies showed that the intelligence-test-marks correlated to the extent of .213* whereas the total Board marks to the extent of .223* with overall performance in training. In this way, the validity of Intelligence-Tests alone is more or less equal to the validity of the whole selection Board procedure.

Job Performance Criterion

In order to estimate the validities, of different selection assessments at the Selection Boards with Job Performance as the Criterion, a follow up study was undertaken. The Officers Commanding different units were asked to assess the Officers' working under them, on the basis of their performance on the job. Their number in all was 1196. The officers were assessed into 5 categories.

(i) Above Average

(ii) High Average

(iii) Average

(iv) Low Average

(v) Below Average

These assessments were correlated with their grades on the Intelligence-Tests administered at the time of selection. The overall correlation was .221. The maximum correlation obtained was .548 for the 39th IMA. If we allow for the effect of selectivity and the unreliability of unit assessments which have to have a large subjective assessment, it will not be unsafe to assume that the validity of intelligence tests for military selection is in the neighbourhood of .4, the validity generally obtained for good selection tests.

IX

THE OVERALL RESULTS

IX

THE OVERALL RESULTS

It is now time to outline the overall picture as it emerges from the six studies. In doing this the first consideration that needs to be emphasised is that no inference about the parent Indian population is possible from the samples that we have studied, because these samples are not random samples. Our samples are the outcomes of a continuous process of educational selection, first up to the matriculation and then in the U. P. S. C. competitive examination. It is well known that different regions, classes and castes etc., are not equally attracted to education. Even among those who go in for education, the pass rate widely differs in different groups. Military service also is not equally popular among all the groups. Preference for military service is an important factor in the selection of our samples. No attempt shall therefore be made to draw any conclusions about the Indian population from our samples. For our purpose therefore the population means the population of candidates coming before the selection boards.

Even in this population the results are not consistent. Groups which are higher in one study are lower in another. Theoretically, this may be ascribed to several causes. For example, some test-batteries may be favourable to some groups and others to other groups. Though this is possible, it is not very likely. Items in various batteries are more or less of the same type and it is impossible to say how one battery could be more favourable than another to a particular group. A more likely explanation is that the intelligence level of the groups in different samples is different. This can very well happen. The quality of goods in the employment market can fluctuate as in any other market.

Urban/Rural

In all the studies the urban candidates score more than the rural. This is in line with the usual phenomenon of flight of ability from the rural to the urban areas.

Medium of instruction

In the mediumwise grouping the English-medium-group consistently scores higher than others. This is expected because English-medium schools are in hot demand and therefore they can restrict admission to the brighter boys. In those schools

which provide both media, only the brighter boys are admitted to the English medium class. Even when admission to English medium is obtainable, it is obvious that only the brighter boys will think of going in for it because not everybody can feel confident to acquire knowledge and to express it in a foreign medium. The higher mean of the English medium group reflects this preliminary selection of brighter boys for the English medium. It should not be taken as evidence of the absurd claim that studying through English improves intelligence.

School-type

The schoolwise results are consistent only in as much as the ordinary schools have the lowest mean. The public schools rank third out of the four types of schools in two studies, first in one study and second in another. The Sainik schools rank second in one study, third in another and first in two studies. The European schools are first in two, second in one and third in another. The maximum superiority over ordinary schools is equal to .61 S. D. and the minimum equal to .21 S. D.

While constructing intelligence tests care is taken to exclude all the items which are likely to call upon acquired ability, because intelligence, by definition is an innate ability. It is therefore wrong to attribute the inferiority of ordinary school-boys to their schooling.

The true explanation is quite obvious. The public school products have a high market value. Admission to public schools has a first preference but since the public schools are very costly, only those parents who can afford them can send their wards to these schools and they are necessarily those who have succeeded in life and are well placed. Success in life depends partly on intelligence. The parents of public school boys therefore belong to the high intelligence group. Since intelligence is largely hereditary, the children of such parents are expected to do better on intelligence tests, and in all those activities where inherited abilities are called into play.

The same considerations apply to some extent to European schools.

The Sainik school boys are found to be superior perhaps because admission to Sainik schools is on the basis of intelligence tests.

The following is the percentage of candidates from the different types of schools:

School type	*Percentage*
Public	7·03
Sainik	2·08
European	11·87
Others	79·02

Thus the overwhelming majority of candidates comes from the ordinary schools and however high the selection rate in other schools may be the Armed Forces will have to depend on ordinary schools for the bulk of their requirements.

Level of Education

Level of education does not yield any consistent results. This may be due to two complicating factors which work in opposite directions. Education is a continuous process of screening and therefore the higher education groups are expected to be more intelligent. On the contrary, it is also possible that some among the higher education group had thought in the earlier stages of their education that they have better prospects in higher education and therefore did not think of military service. They changed their mind later on in view of their below-expectation performance in higher education. This would tend to make our higher education group consist of candidates of lower ability. The inconsistency in the results may be due to the influence of these opposing tendencies.

Guardian's Occupation

Those whose guardians are in military service, have the topmost mean score. It may be that the wards of those who are in the military profession are keener on military service than others and therefore try to get coaching in doing intelligence tests. But this will result in a very marginal improvement. The results as they stand are not completely explicable.

Caste/Religion

The results under this head are not consistent, but the Christian candidates have the highest mean in four out of the six studies. In the remaining studies they rank second in one and

third in the other. It is likely that military service is more popular among the intelligent classes of Christians than among the intelligent classes of other communities. Since religion is not a genetic group there is no reason to expect any relationship between religion and intelligence.

Language

The language-wise results are too inconsistent to yield any conclusion. One group is first in two studies and last in one whereas another is first in one study and last in two others. No conclusion can be drawn from this erratic result.

Age

The age-group 15 to 16 has the highest score in four out of the six investigations. In the remaining two it has the second and the third highest. Results for other ages are even less consistent. The age groups studied are mostly adult age groups and therefore we cannot expect age to make much different to the score.

Income

There is a slight tendency for boys coming from higher income groups to score higher, though the score does not rise consistently with the guardian's income. The lowest income group has the lowest mean in all the studies. But the highest income group *i.e.* of over 1500 has a second position in one study and third in two others. In two other studies this income group was included in the category over 1,000 which ranks first in one and second in another.

State

The state-wise results do not show consistency as will be seen in the following table:

Fluctuation in the ranks of the states:

	Rank in Study Number			
	III	IV	V	VI
M. P.	1	5	8	1
R. S.	2	2	9	1
W. B.	10	1	13	7
T. N.	5	3	1	10

The state ranking first in one study ranks as low as 8th 9th, 10th or even 13th in another study.

From 48% to 50% of the candidates come from the Punjab alone. This is about 10 to 18 times more than what one could expect from the population of the province. All other provinces send much fewer candidates than their population would lead us to expect. In one study there is only one Oriya candidate and two Assamese candidates. It is time that other provinces emulate the example of the Punjab and compete in large numbers for joining the Armed Forces.

There is no significant difference in the scores of migrants and non-migrants.

Other Assessments

The correlations of the different batteries with the other assessments at the boards differ significantly from each other. The following table shows the range of these differences:

1	2	3
G.T.O. . .	Interview	Projective Tests (Technical officer.).
·11 to ·26 . .	·13 to .27	·14 to ·37.

Correlation with the projective tests is higher than that with other assessments in all the studies without exception. This may be so because those who assess on the basis of projective tests have knowledge of the intelligence grade of the candidate. This knowledge may be influencing their assessment.

X

ABILITIES ASSESSED BY THE TESTS

14—2 DPR (ND)/76.

X

ABILITIES ASSESSED BY THE TESTS

Factorial Analysis

In addition to the tests described so far, an additional pair of tests (ISP15 & Matrix 38) was also used. Only a pair of tests is used on one sample at the time of selection. It is very difficult to administer all the 14 tests to the same sample. But this is necessary if we want to find out which particular abilities are tested by the tests and what is the minimum number of factors required to explain their inter-correlations. The tests were therefore administered to 68 cadets of the IMA and intercorrelations between the scores on the tests were calculated. They are as follows:

TABLE I

The Intercorrelations between Intelligence Tests

	PRW 1	PRW 2	PRW 26	PRW 27	Matrices 38	SP 15	PRW 24	ISP 45	PRW 19	PRW 20	Matri-ces 43	ISP 20	CFA Test	CC Test
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRW1 . .		·47	·65	·43	·24	·37	·54	·39	·44	·29	·29	·54	·13	·31
PRW2 . .			·55	·49	·41	·50	·59	·41	·59	·52	·35	·50	·29	·43
PRW26 . .				·69	·47	·54	·61	·38	·47	·35	·39	·58	·27	·43
PRW27 . .					·23	·50	·51	·49	·54	·56	·29	·65	·30	·50

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Matrices 38	.					.41	.54	.29	.30	.32	.42	.19	.40	.32
SP 15	.						.35	.47	.44	.55	.31	.61	.12	.44
PRW 24	.							.61	.48	.53	.55	.48	.55	.52
ISP 45	.								.42	.61	.38	.51	.41	.56
PRW 19	.									.57	.32	.58	.09	.33
PRW 20	.										.19	.56	.24	.58
Matrices 43	.											.28	.32	.37
ISP 20	.												.15	.52
CFA Test	.													.51
CC Test.	.													

It may be urged that a sample of 68 is too small for the purpose. On the other hand it was not found practicable to give 14 tests to a much larger sample as this involves detaining a larger number of persons for about two hours every day for 14 days when they are already exhausted by their normal duties. The smallness of the sample, however, may not be a very grave defect in view of the fact that the sample for factor analysis is required to be as homogeneous as possible. Pooling different courses together will give a larger sample but it will also introduce more heterogeneity.

On the basis of these correlations, we may estimate the validities of the tests by obtaining their loadings on a factor common to all the test. Since all the tests are meant to be tests of intelligence the loading on the common factor may be taken to be the general intelligence component in each test, representing its validity. The first centroid factor loadings of the tests may be taken as indications of the validities of the tests.

TABLE II

The first centroid Factor loadings on the Intelligence Tests

Tests	Factor Loading
PRW 1 (NVIT)	0·62
PRW 2 (VIT)	0·72
PRW 26 (NVIT)	0·76
PRW 27 (VIT)	0·74
MATRICES 38 (NVIT)	0·54
S. P. 15 (VIT)	0·67
PRW 24 (NVIT)	0·80
ISP 45 (VIT)	0·70
PRW 19 (NVIT)	0·66
PRW 20 (VIT)	0·70
MATRICES 43 (NVIT)	0·54
ISP 20 (VIT)	0·73
CFA Test (NVIT)	0·46
C.C. Test (VIT)	0·69

Another index of the validity of the tests can be the correlation of each test with the total score on all the tests taken together. The following table presents the results :—

TABLE III

Correlations of the Intelligence Tests with the Total Score on All the Tests taken together

Sl. No.	TEST	r	Sl. No.	TEST	r
1	PRW 1 (NVIT)	0·65	8	ISP 45 (VIT)	0·70
2	PRW 2 (VIT)	0·72	9	PRW 19 (NVIT)	0·67
3	PRW-26 (NVIT)	0·79	10	PRW 20 (VIT)	0·72
4	PRW 27 (VIT)	0·80	11	MATRICES 43 (NVIT)	0·50
5	MATRICES 38 (NVIT)	0·51	12	ISP 20 (VIT)	0·78
6	SP 15 (VIT)	0·69	13	CFA Test (NVIT)	0·46
7	PRW 24 (NVIT)	0·77	14	14 CC Test (VIT)	0·74

PRW-2,26,27,24, 20 and ISP-45,20 and CC have validities above 0.7.
PRW-24 & 27 have the highest and CFA the lowest validity.

The following table presents the residuals left after extracting the first factor :—

TABLE IV

First Factor Residuals

	PRW 1	PRW 2	PRW 26	PRW 27	Matrices (38)	SP 15	PRW 24	ISP 45	PRW 19	PRW 20	Matrices 43	ISP 20	CFA Test	CC Test
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRW 1		.02	·18	—·03	—·09	—0·0	5·04	—·04	·03	—·14	—·04	·09	—·16	—·12
PRW 2			·00	—·04	·02	·02	·01	—·09	·11	·02	—·04	—·03	—·04	—·07
PRW 26				·13	·06	·03	·00	—·15	—·03	—·18	—·02	·03	—·08	—·09
PRW 27					—·17	·00	—·08	—·03	·05	·04	—·11	·11	—·04	—·01
Matrices 38						0·5	·11	—·09	—·06	—·06	·13	—·20	·15	—·05
SP 15							—·19	·00	·00	·08	—·05	·12	—·19	—·02
PRW 24								·03	—·05	·03	.12	—·10	·18	—·03
ISP 45									—·04	·12	·00	·00	·09	·08

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
											·11	—·04	·10	—·21	—·13
PRW 19 .	:											—·19	·05	—·08	·10
PRW 20 .	:												—·11	·07	·00
Matrices 43	:													—·19	·02
ISP 20 .	:														·19
CFA Test .	:														
CC Test .	:														

Quinn McNamar's Test was applied to test the significance of the residuals. It showed that the residuals were large enough to require the extraction of another factor.

σ_1 was greater than $\frac{1}{\sqrt{N}} = 12$

$\sigma_1 = \frac{\sigma_s}{1-M_{h2}} = \cdot 17$ where

σ_s = Standard Deviation of the residuals.

M_h^2 = Mean of the Squares of communalities.

N = Sample size.

A second factor was therefore extracted. Table V gives the residuals after the extraction of the second factor as well as the second factor loadings :—

TABLE V

Second Factor Residuals

	2nd factor Loading	PRW 1	PRW 2	PRW 26	PRW 27	Matrices 38	SP 15	PRW 24	ISP 45	PRW 19	PRW 20	Matrices 43	ISP 20	CFA Test	CC Test
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PRW 1 .	—·20		·00	·14	—·08	—·04	·10	—·10	—·01	—·03	—·16	·02	·02	—·05	—·08
PRW 2 . .	—·12			—·02	—·07	·05	·01	—·04	—·07	—·07	·01	·00	—·07	+·02	—·05
PRW 26 .	—·18				·09	·11	·01	—·05	—·12	—·09	—·20	·04	—·03	·02	—·05
PRW 27 .	—·25					—·11	—·06	—·01	·01	—·03	·02	—·03	·02	·10	·04
Matrices 38 .	·26						·11	·03	—·13	·02	—·04	·05	—·11	·01	—·10
SP 15 . .	—·23							—·12	·03	—·07	·06	·02	—·04	—·07	·03
PRW 24 . .	·29								·01	·04	·00	·03	·00	·02	—·09
ISP 45 . . .	·15									·01	·13	—·05	·05	·01	·05
PRW 19 .	—·32										·08	·06	—·02	—·04	—·07

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
PRW 20 . .	—·09											—·16	·02	—·03	·12
Matrices 43 . .	·32												·01	—·10	—·06
ISP 20 . . .	—·36													·00	·09
CFA Test . .	·54														·08
CC Test . . .	·20														

Application of McNemar's test showed that another factor could be extracted. Table VI gives the third factor loading as well as the residuals after the extraction of the third factor.

$$\sigma_1 = 0.15; \frac{1}{\sqrt{N}} = 0.12; \text{ Therefore } \sigma_1 > \frac{1}{\sqrt{N}}$$

TABLE VI

Third Factor Loadings and Residuals

1	3rd Factor Loading 2	PRW 1 3	PRW 2 4	PRW 26 5	PRW 27 6	Matrices (38) 7	S.P 15 8	PRW 24 9	ISP 45 10	PRW 19 11	PRW 20 12	Matrices 43 13	ISP 20 14	CFA test 15	CC Test 16
PRW 1 . . .	—·21		—·03	·09	—·05	—·09	—·08	·06	·04	—·05	—·09	—·03	·06	—·03	—·01
PRW 2 . . .	—·15			—·06	—·05	·01	·01	·01	—·03	·05	·06	—·04	—·04	·04	·00
PRW 26 . . .	—·25				·13	·05	·02	·00	—·06	—·11	—·12	—·02	·01	·05	·04
PRW 27 . . .	·16					—·07	—·08	·02	—·03	—·01	—·03	·01	—·01	·08	—·02
Matrices 38 . .	—·25						·14	—·02	—·07	·00	·04	—·01	—·07	·04	—·01
SP 15 . . .	·11							—·10	·00	—·06	·02	·05	·02	—·08	—·01
PRW 24 . . .	—·20								·06	·02	·07	—·02	·04	·04	—·02
ISP 45 . . .	·26									·04	·04	·01	·00	—·02	—·04
PRW 19 . . .	—·10										·11	·04	·00	—·03	—·03

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PRW 20 . .	.34											—.08	—.04	—.07	—.00
Matrices 43 . .	—.25											.05	—.07	.03	
ISP 20 . . .	.18												—.02	.03	
CFA test . .	.11													.04	
CC Test . . .	.35														

McNemar's test showed that the residuals were not significant enough to require the extraction of another factor. $\left[\sigma_1 = 0.12; \frac{1}{\sqrt{N}} = 0.12, \text{ therefore } \sigma_1 = \frac{1}{\sqrt{N}} \right]$

Table VII gives the centroid factor loadings of the tests on their actors as well as their communalities and uniqueness.

To obtain a meaningful picture of the factors involved in the battery the centroid factors were rotated in an attempt to obtain a simple structure which requires elimination of negative loadings, presence of at least one zero loading in each row of the factor matrix and of at least as many zeros in each column as the number of factors.

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TABLE VII

Centroid Factor Matrix (F)

S.No.	TESTS	FACTORS I	II	III	Communality	Uniqueness
1	2	3	4	5	6	7
1	PRW 1 (NVIT)	0.62	—.20	—.21	.4685	.5315
2	PRW 2 (VIT)	0.72	—.12	—.15	.5553	.4447
3	PRW 26 (NVIT)	0.76	—.18	—.25	.6725	.3275
4	PRW 27 (VIT)	0.74	—.25	.16	.6101	.3899
5	MATRICES (38) (NVIT)	0.54	.26	—.25	.4217	.5783
6	S. P. 15 (VIT)	0.67	—.23	.11	.5139	.4861
7	PRW 24 (NVIT)	0.80	.29	—.20	.7641	.2359
8	ISP 45 (VIT)	0.70	.15	.26	.5801	.4199
9	PRW 19 (NVIT)	0.66	—.32	—.10	.5480	.4520
10	PRW 20 (VIT)	0.70	—.09	.34	.6137	.3863
11	MATRICES (43) (NVIT)	0.54	.32	—.25	.4565	.5435
12	ISP 20 (VIT)	0.74	—.36	.18	.6949	.3051
13	CFA test (NVIT)	0.46	.54	.11	.5153	.4847
14	CC test (VIT)	0.69	.20	.35	.6386	.3614

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Table VIII gives the simple structure on reference vectors as well as the rotation matrix used in obtaining the same.

TABLE VIII

Simple structure on rotated reference vectors

Sl. No.	TESTS	X	Y	Z
1	PRW 1 (NVIT)	.37	·48	—·02
2	PRW 2 (VIT)	·41	·46	·10
3	PRW 26 (NVIT)	·42	·57	·03
4	PRW 27 (VIT)	·67	·21	·10
5	MATRICES 38 (NVIT)	·02	·40	·34
6	SP 15 (VIT)	·59	·22	·08
7	PRW 24 (NVIT)	·18	·47	·47
8	ISP 45 (VIT)	·46	·04	·47
9	PRW 19 (NVIT)	·53	·42	·08
10	PRW 20 (VIT)	·65	·01	·29
11	MATRICES 43 (NVIT)	—·01	·40	·39
12	ISP 20 (VIT)	·74	·21	·01
13	CFA test (NVIT)	—·00	·00	·67
14	CC Test (VIT)	·47	—·06	·54

ROTATION MATRIX

Direction Cosine of reference vectors

S.No.	X	Y	Z
I	·59	·42	·36
II	—·61	—·17	·87
III	·54	—·89	·33

The structure is a matrix of correlations of the tests with the reference vectors. Table IX gives the pattern on primary factors which represents the matrix of loadings of coefficients for predicting test scores from a knowledge of factor scores. Matrix T which is the rotation matrix for obtaining this pattern is also given.

TABLE IX

Pattern on primary Factors (ft)

Sl.No.	TESTS	X	Y	Z
1	PRW 1 (NVIT)	·47	·57	·21
2	PRW 2 (VIT)	·54	·60	·35
3	PRW 26 (NVIT)	·55	·70	·31
4	PRW 27 (VIT)	·75	·38	·31
5	MATRICES 38 (NVIT)	·17	·55	·50
6	SP 15 (NVIT)	·67	·37	·27
7	PRW 24 (NVIT)	·38	·69	·70
8	ISP 45 (VIT)	·57	·28	·60
9	PRW 19 (NVIT)	·61	·52	·17
10	PRW 20 (VIT)	·72	·22	·43
11	MATRICES (43) (NVIT)	·14	·55	·55
12	ISP 20 (VIT)	·81	·36	·22
13	CFA Test (NVIT)	·14	·23	·72
14	CC test (VIT)	·58	·21	·65

MATRIX T

Direction Cosine of the primary Factors T

	X	Y	Z
I	·76	·68	·64
II	—·48	·00	·75
III	·45	—·74	·16

MATRIX T 'T'

Angle between primary Factors

	Xp	Yp	Zp
XP	1·00		
YP	·18	1·00	
ZP	·19	·32	1·00

In order to identify the primary factors thus obtained, the factor loadings of the various tests were arranged according to their magnitude separately for each factor. Table X gives the primary factor loadings so arranged.

TABLE X

Primary factor loadings arranged according to Magnitude

TESTS	I	TESTS	II	TESTS	III
ISP 20 (VIT)	.81	PRW 26 (NVIT)	.70	CFA Test (NVIT)	.72
PRW 27 (VIT)	.75	PRW 24 (NVIT)	.69	PRW 24 (NVIT)	.70
PRW 20 (VIT)	.72	PRW 2 (VIT)	.06	CC test (VIT)	.65
SP 15 (VIT)	.67	PRW 1 (NVIT)	.57	ISP 45 (VIT)	.60
PRW 19 (NVIT)	.61	MATRICES 43 (NVIT)	.55	MATRICES 43 (NVIT)	.55
CC test (VIT)	.58	MATRICES (NVIT) 38.	.55	MATRICES 38 (NVIT)	.50
ISP 45 (VIT)	.57	PRW 19 (NVIT)	.52	PRW 20 (VIT)	.43
PRW 26 (NVIT)	.55	PRW 27 (VIT)	.38	PRW 2 (VIT)	.35
PRW 2 (VIT)	.54	SP 15 (VIT)	.37	PRW 26 (NVIT)	.31
PRW 1 (NVIT)	.47	ISP 20 (VIT)	.36	PRW 27 (VIT)	.31
PRW 24 (NVIT)	.38	ISP 45 (VIT)	.28	SP 15 (VIT)	.27
MATRICES 38 (NVIT)	.17	CFA test (NVIT)	.23	ISP 20 (VIT)	.22
MATRICES 43 (NVIT)	.14	PRW 20 (VIT)	.22	PRW 1 (NVIT)	.21
CFA test (NVIT)	.14	CC test (VIT)	.21	PRW 19 (NVIT)	.17

It will be seen that in the 1st factor the verbal tests have the higher loadings. The only exceptions are PRW-19 and PRW-26. The lowest loadings are in the non-verbal tests. This is obviously a verbal factor. In the second factor, the non-verbal tests have higher loadings; the only exception is PRW-2. The verbal tests have comparatively lower loadings, one exception being the (C.F.A.) Canadian Figure Analogies. In the third factor, the order does not seem to be determined by the verbal or non-verbal nature of the test. But the tests constructed in foreign countries have the higher loadings. The fact that even non-verbal tests have a foreign factor shows that cultural or ethnological difference influencing test performance cannot be detected merely by inspecting the test. They can be found out only after experimentation.

Thus the battery under examination has three factors viz. Verbal, & Non-Verbal factors (depending on the nature of items used) and foreign/indigenous factor, depending on the country where the tests were originally constructed.

APPENDIX I

General Instructions for Test Administration

Tester says "this is a simple test which does not require any previous preparation. You may find some problems easy while some others might be difficult. Try to solve as many as you can, as quickly as possible. Do your best."

'All your answers must be recorded on the answer-sheet. Do not mark the booklet in any way. The answers must be put in their appropriate column for answers, opposite the relevant question number on the answer sheet. If you wish to amend your answer after you have put it on the answer-sheet, cross it out and write the new answer. Do not use erasers. If you find any problem hard for you proceed with the succeeding problems without wasting time on it. You may return to the left out problem after finishing the test if there is any time left.'

'Start only when the examiner asks you to start and put down your pencils after he says stop'.

"Read the instructions carefully." So saying the tester waits for a reasonable time required for reading the instructions. After the instructions have been read by the candidates, he asks them whether they have not followed any of the instructions and explains the difficulties. After that he asks the candidates to do the items in the practice-set themselves. After a large number of candidates have finished the practice set he himself explains how the items have to be solved. He also tries to convince the candidates who have given wrong answers by showing why the answer is to be regarded as wrong. After ensuring that everyone has understood the instructions, he gives the signal to start. He announces half time and then ensures that everybody stops when the time is over and collects all the answer-sheets.

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Appendix II

AGE AND INTELLIGENCE

ONE of the discoveries in the sphere of Intelligence Testing that has shocked some people is that ageing is not restricted, merely to physical powers, and does not spare the mental abilities like intelligence. Unwelcome though this fact is, more extensive research has only confirmed it. The only saving feature of the situation is that some intellectual abilities are affected less and at a later age than others. For a proper use of intelligence tests it is therefore necessary to have age-wise norms for all ages and not merely for ages below adulthood. The present investigation was carried out to obtain norms for ages from 14 to 44.

Sample Used

The investigation was carried out on candidates who appeared before the Services Selection Boards for the 1st to the 8th Military Wing, the 1st to the 3rd JSW, the University Graduates' and the 1st and the 2nd Technical Graduates' courses at the National Defence Academy, Dehra Dun, and for Temporary Commission courses at the OTS, Poona. Their ages varied from 14 to 44.

Tests Used

The tests used for this purpose were Matrices 38 and 43, SP Test 15 (Modified) and ISP Test 20.

Description of the Tests

(1) *Matrix* 38.—This is one of the progressive matrices devised by Penrose and Raven and provides a non-verbal series suitable for measuring intelligence. Each problem in the test consists of a design from which a small part has been removed; this is printed in the upper half of the page. In the lower half of the page there are 6 or 8 small pieces of the same size and shape as the missing piece in the design above. The candidate has to examine the design and decide which of the pieces given below is the right one to complete the pattern above.

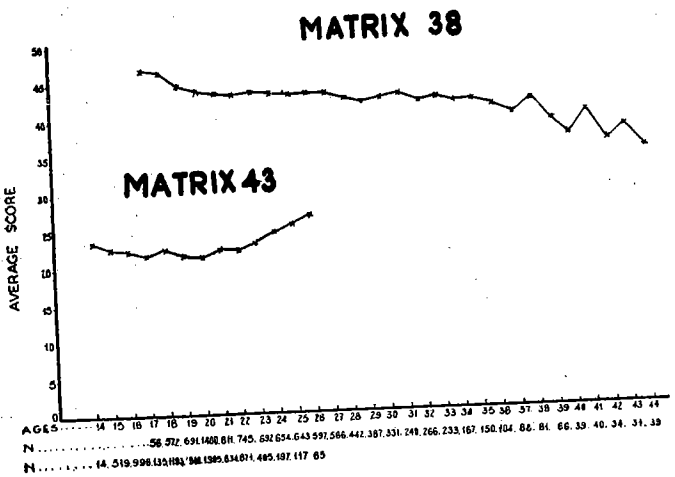
There are five sets of 12 problems each.

Forty-five minutes are allowed for this test and each correct solution carries one mark, bringing the possible total score to 60.

*Thanks are due to Mrs. Irene Jain, Junior Psychologist, for assistance in obtaining some of the data and to the Statistical Assistants for computational work. The basic data and figures mentioned in appendices I to IV are taken from P.R.W. Note No. 13, June 1950.

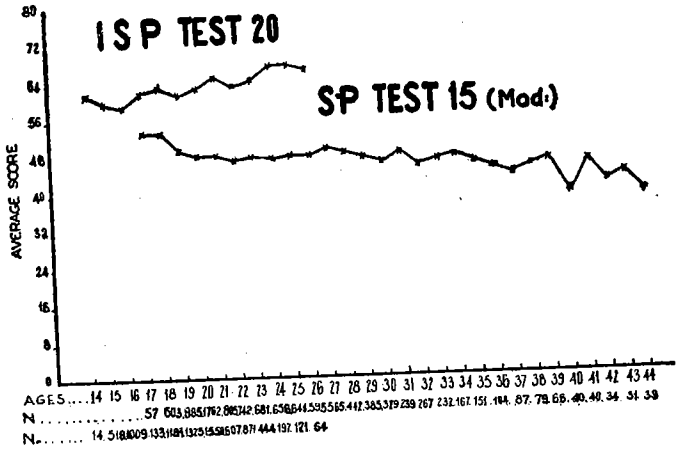
GRAPH–1

GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES



GRAPH–2

GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES



(2) *Matrix* 43.—In this version there are only 38 problems preceded by a practice set of four which the tester explains before starting the test. Each problem carries one mark for its correct solution, bringing the total possible score to 38. Twenty minutes are allowed for this test.

(3) *SP Test* 15 (*Modified*).—This is a verbal test, more or less self-administering, for testing intelligence. It is of the omnibus type in which questions based on reasoning, analogy, number series and the like have been included. There are 113 questions. Twenty minutes are allowed for the whole test. One mark is allowed for each question bringing the total possible score to 113.

(4) *ISP Test* 20.—This is another verbal intelligence test where the questions are under seven separate headings, namely, Classifications, True and False Statements in disarranged sentences. Following Instructions, Analogy, Mixed letters of words, Number Series and Coding. Each part is preceded by its own specific instructions and one or two examples and is timed separately. The timings for the various parts vary from 2 to 12 minutes. The maximum possible score is 100.

Reliability

The reliability of the Tests was calculated by the "split-half" method. The Coefficients of Reliability are as follows:—

	Coefficient of Reliability
Matrix 38	·72
Matrix 43	·78
SP Test 15 (Mod)	·73
ISP Test 20	·85

Procedure

The scores of the sample under study were taken from the Services Selection Boards as the candidates appeared for selection.

The number of candidates who took the tests differed from age to age. It was anything from 14 to 1905. Full results are given in the appendices.

Statistical Analysis

The data were separately analysed for each test. Means and standard deviations were first of all calculated for each age-group separately. (Shown in the last two columns of the appendices I to IV. Average scores at different ages are shown in graphs 1 and 2.)

To determine whether the variation in scores of a test remains constant for different ges, Bartlett's test of significance was used. It states that, if $S_i 2i = 1; 2, \ldots\ldots K$ are ıdependent estimates of the same true variance based on n_i degrees of freedom, the uantity

$$\frac{2{\cdot}3026}{1+\frac{1}{3(k-1)}\left(k1-1\right)}\left\{n\log_e\left(\frac{\sum_{i=1}^{k} ni\ si^2}{10}\right)-\sum_{i=1}^{k} ni\log_{10} si\right\}$$

$$\text{where } n=\sum_{i=1}^{k} x_i$$

s distributed approximately as X^2 with (K-1) degrees of freedom.

In the case of the test S.P. 15(Mod), the value of the above X^2 came out to be 39.83 with 27 d.f. and was not significant at 5% point. Thus we can assume that in the case of this particular verbal intelligence test, there was no evidence to show that the variation in scores differed with age.

But in the case of the other tests like I.S.P. 20, Matrix 38 and Matrix 43, the values of x^2s were 34·76 with 12 d.f., 66·82 with 27 d.f. and 66·91 with 12 d.f. respectively. All of them were significant at 1% point, which indicates that variances for the different ages cannot be assumed to be equal.

In the case of the S.P. 15 (Mod), the usual analysis of variance was then carried out to see if the mean scores obtained by candidates of various ages differed significantly among themselves. The result is given below.

TABLE 1

SP 15 (MOD)

Variation	Degrees of freedom	Sum of Squares	Mean Square	F
1	2	3	4	5
Between age-groups	27	45036·35	1668·01	8·15
Within age-groups	10792	2207625·40	204·56	
TOTAL	10819	2252661·75		

The value of F in column (5) came out to be very highly significant, proving that the observed differences in the means for various ages, are not due to chance alone.

Linear, quadratic and cubic equations were then fitted successively taking age as the independent variate, and average score as the dependent one. The usual least square technique with varying number of observations in each age group was applied to get the best fit in the case of the SP 15 (Mod) test. In this case the second degree parabola did not improve the fit significantly better than the linear one. The third degree curve, however, showed quite a good fit, as may be seen in graph 3.

GRAPH–3

GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES

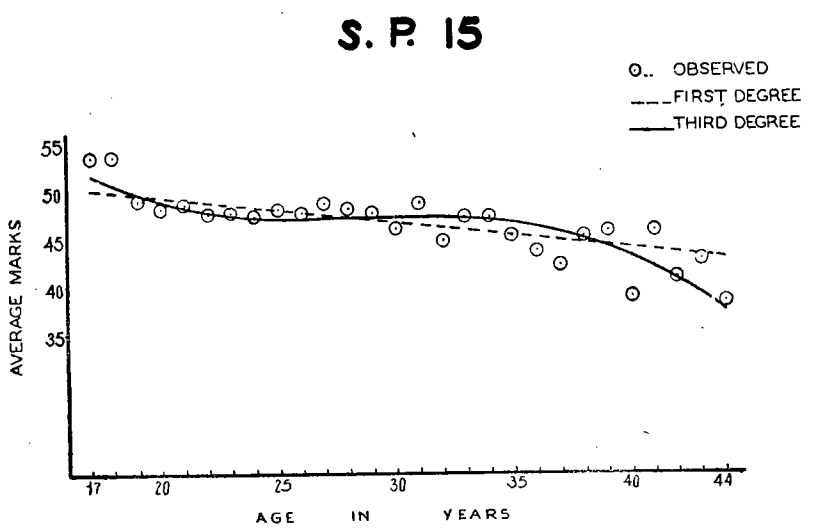


Table 2 below gives the observed mean scores and those expected from the linear and the cubic fits for various age groups. Since a very large number of candidates has been tested in each age group, it is obvious from the shape of the graph that the deviation from regression will remain significant until we fit a curve employing a large number of parameters. But for all practical purposes, the cubic curve gives quite a good fit.

TABLE 2

SP 15 (MOD) AVERAGE SCORE

Age	Observed mean score	Expected value from the linear fit	Expected value from the cubic fit	Difference (2)—(4)
(1)	(2)	(3)	(4)	(5)
17	53·56	49·91	51·79	1·77
18	53·56	49·64	50·70	2·86
19	48·94	49·36	49·79	—0·85
20	48·10	49·09	49·04	—0·94
21	48·40	48·82	48·44	—0·04
22	47.38	48·54	47·98	—0·60
23	47·86	48·27	47·62	+0·24
24	47.20	48.00	47.37	—0·17
25	47·50	47·73	47·19	0·31
26	47·50	47·45	47·08	0·42
27	48·70	47·18	47·01	1·69
28	47·92	46.91	46·98	0·94
29	47·14	46·64	46·96	0·18
30	45·88	46·36	46·94	—1·06
31	48·58	46·09	46·89	1·69
32	44·80	45·82	46·82	—2·02
33	46·66	45.54	46·69	—0·03
34	47·14	45·27	46·49	0·65
35	45·16	45·00	46·21	—1·05
36	43·78	44·73	45·82	—2·04
37	42·28	44·45	45·32	—3·04
38	44·80	44·18	44·67	0·13
39	45·58	43·91	43·88	1·70
40	38·32	43·64	42·91	—4·59
41	45·52	43·36	41·76	3·76
42	40·24	43·09	40·41	—0·17
43	42·58	42·82	38·84	3·74
44	37·96	42·55	37·03	0·93

Linear fit :— $y = 54{\cdot}544 - 0{\cdot}273x$.

Cubic fit :— $y = 114{\cdot}153 - 6{\cdot}952x + 0{\cdot}2404x^2 - 0{\cdot}00278x^3$.

For obtaining the relationship between age and average score in the other three tests, the least square method was modified to allow for the heterogeneity in the variances for different ages. Only the data for those age groups, where the number of candidates was large (*i.e.* more than 300) were considered and others were excluded. The estimated variances within each age-group were then taken to represent the corresponding parametric values. Instead of minimising the quantity $\sum_{i=1}^{k} {}_{n}i\,(yi - a - bxi - cx^2 - \ldots\ldots)^2$ to determine the constants a, b, c, etc., the expression $\sum_{i=1}^{k} \frac{ni}{\sigma i^2} \left\{ y_i - a - bx - cx^2 \ldots\ldots \right\}^2$

was minimized. The estimated variance for the i^{th} age-group was substituted for σ^2_i in the above expression, when n_i i.e. the number of candidates in that age-group was more than 300 "$\bar{y}_i$" here denotes the observed average score corresponding to the age x_i, there being k such age-groups.

Before proceeding to obtain the relationship between age and intelligence test score, it was, however, necessary to test the significance of the differences between the mean scores of candidates of various ages. This was done by calculating the quantity $\sum_{i=1}^{k} xi \frac{(\bar{y}i - \bar{\bar{y}})^2}{\sigma i^2}$ where $\bar{y}i$=average score of n candidates of the i_{th} age group and $\bar{\bar{y}} = \frac{\sum_{i=1}^{k} ni\,\bar{y}i / \sigma i^2}{\sum_{i=1}^{k} ni / \sigma i^2}$ which is distributed as x^2 with (k—1) degrees of freedom.

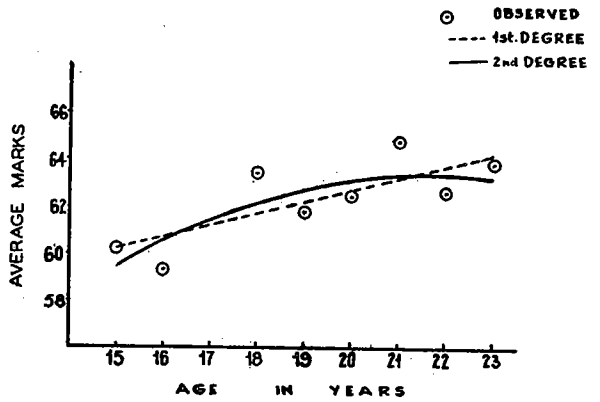
The above X^2 came out to be 91·38 for 7d.f. in case of the test I.S.P. 20, 117·20 for 12 d.f. in case of Matrix 38, and 81·55 for 7 d.f. in case of Matrix 43. All of them were highly significant proving that the differences between the average scores of candidates of various age groups are not due to chance alone.

First, second and third degree equations were successively fitted by the method outlined above, taking age as the independent variable. In the case of I.S.P. 20, the second degree equation gave the best fit (*vide* graph 4) there being no further improvement with the cubic. But in the case of Matrix-38 and 43, significant improvements were found after successive fittings, the cubic giving the best fit in both the cases, as may be seen in graphs

GRAPH—4

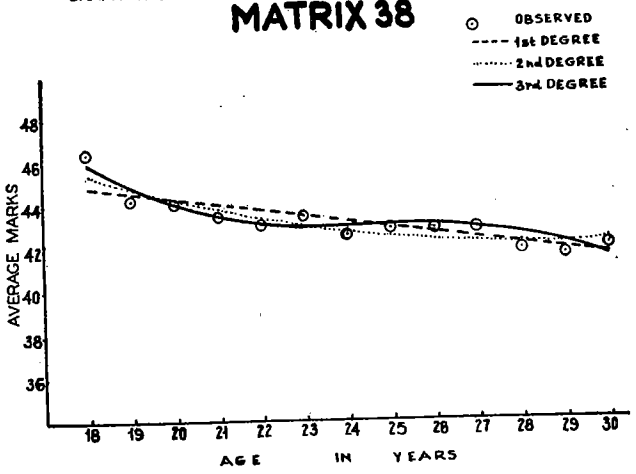
GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES

I. S. P. 20



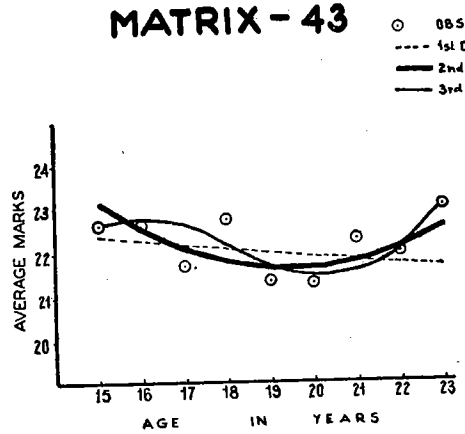
GRAPH—5

GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES



GRAPH—6

GRAPH SHOWING AVERAGE SCORES AT DIFFERENT AGES



Tables 3, 4 and 5 give the observed and expected values of the average scores for various age groups for I.S.P.-20, Matrix-38 and Matrix-43 respectively.

TABLE—3 I.S.P.—20 AVERAGE SCORE

Age	Observed mean score	Expected value from the linear fit.	Expected value from the quadratic fit.	Difference (2)—(4)
(1)	(2)	(3)	(4)	(5)
15 . .	60·20	60·21	59·39	0·81
16 . .	59·25	60·69	60·42	—1·17
18 . .	63·30	61·67	62·01	1·29
19 . .	61·85	62·16	62·56	—0·71
20 . .	62·45	62·64	62·96	—0·51
21 . .	64·80	63·13	63·20	1·60
22 . .	62·60	63·62	63·28	—0·68
23 . .	63·70	64·11	63·20	0·50

Linear fit :— $y=52\cdot892+0\cdot4876x$
Quadratic fit :— $y=24\cdot952+3\cdot4825x-0\cdot07911x^2$.

TABLE—4 MATRIX—38 AVERAGE SCORE

Age	Observed mean score	Expected value from the			
		Linear fit.	Quadratic fit	Cubic fit	Difference (2)—(5)
(1)	(2)	(3)	(4)	(5)	(6)
18 . .	46·50	44·80	45·40	46·04	0·46
19 . .	44·18	44·52	44·81	44·86	—0·68
20 . .	43·98	44·25	44·28	44·01	—0·03
21 . .	43·38	43·97	43·81	43·44	—0·06
22 . .	43·02	43·70	43·40	43·09	—0·07
23 . .	43·42	43·42	43·05	42·91	0·51
24 . .	42·74	43·15	42·76	42·83	—0·09
25 . .	42·90	42·87	42·53	42·81	0·09
26 . .	42·90	42·60	42·36	42·78	0·12
27 . .	42·78	42·32	42·25	42·69	0·09
28 . .	41·94	42·05	42·20	42·48	—0·54
29 . .	41·66	41·77	42·20	42·09	—0·43
30 . .	42·06	41·50	42·27	41·48	0·58

Linear fit :— $y=49\cdot757-0\cdot2754x$.
Quadratic fit:—$y=66\cdot159-1\cdot6893x+0\cdot02977x^2$.
Cubic fit :— $y=188\cdot871-17\cdot5568x+0\cdot70415x^2-0\cdot009423x^3$.

MATRIX—43

Age	Observed mean score	Expected value from the			Difference (2)—(5)
		Linear fit.	Quadratic fit.	cubic fit.	
(1)	(2)	(3)	(4)	(5)	(6)
15 . .	22·66	22·41	23·12	22·63	0·03
16 . .	22·64	22·32	22·56	22·77	—0·13
18 . .	22·66	22·15	21·86	22·18	0·48
19 . .	21·36	22·06	21·73	21·77	—0·41
20 . .	21·30	21·98	21·73	21·50	—0·20
21 . .	22·36	21·89	21·87	21·54	0·82
22 . .	22·02	21·80	22·15	22·04	—0·02
23 . .	22·98	21·71	22·57	23·17	—0·19

Linear fit : $Y=23\cdot723-0\cdot08735x$.

Quadratic fit : $Y=48\cdot306-2\cdot7290x+0\cdot0700x^2$.

Cubic fit : $Y=-130\cdot604+26\cdot1225x-1464^3+0\cdot02692x^3$.

The following table gives some salient facts about the age-wise differences in scores.

Test	Minimum Average score	Age at which the average score is minimum	Maximum Average Score	Age at which the average score is maximum	Difference (4)—(2)	Pooled Average of all ages.	Pooled S. D. for all ages
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Matrix-38 . .	34·70	44	46·78	17	12·08	42·99	9·98
Matrix-43 . .	21·30	20	26·48	26	5·18	22·13	6·30
S.P. 15 (Mod) .	37·96	44	55·56	17	17·60	47·87	14·43
ISP-20 . . .	59·25	16	66·70	25	7·45	62·38	13·90

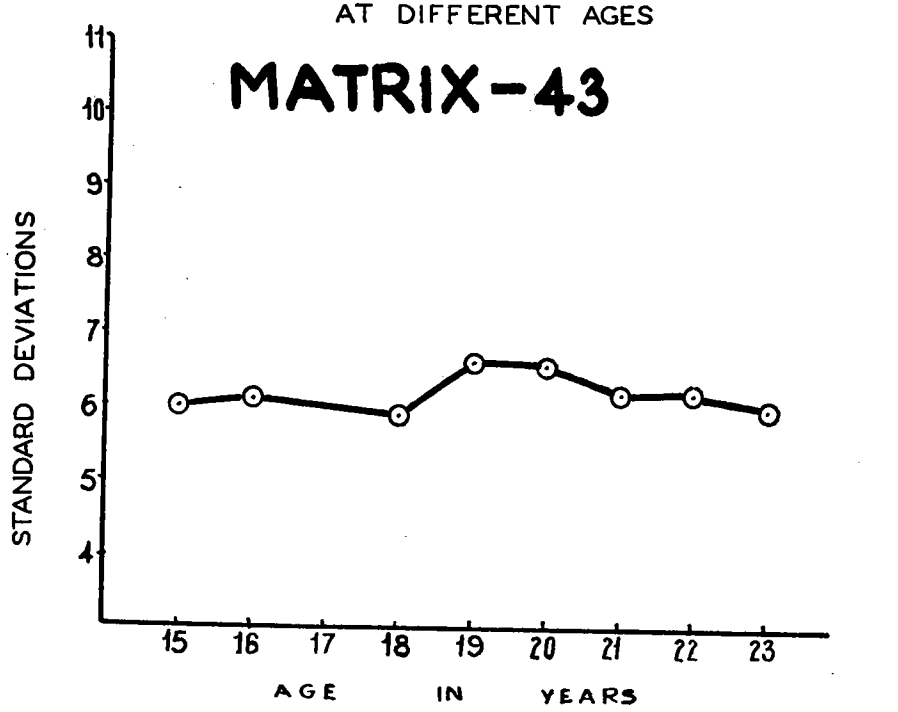
The present results do not encourage the hope of finding a peak in intelligence test scores after the age of 26. On some of the tests used, the peak is reached as early as 17. Again the rise or fall in scores, with age, as shown in the graphs is not regular.

Since the variances in scores were found to be significantly different for various age-groups in the case of I.S.P.-20, Matrix-38 and Matrix-43, one would wish to find out if there are any particular trends in their variations at different ages.

But a study of the values of standard deviations given in the last column of the appendices reveals the irregular manner in which the standard deviations vary with age. This is also obvious from the Graphs 7, 8 and 9.

GRAPH—7

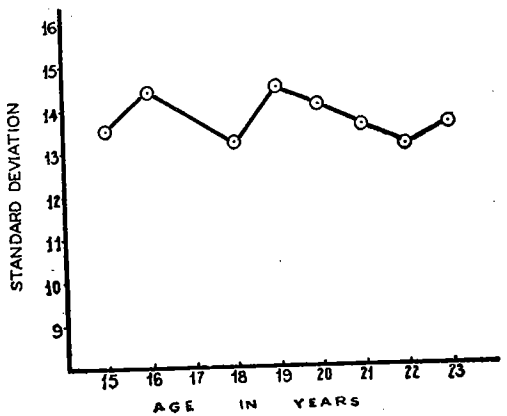
GRAPH SHOWING STANDARD DEVIATIONS OF SCORES AT DIFFERENT AGES



GRAPH–8

GRAPH SHOWING STANDARD DEVIATIONS OF SCORES AT DIFFERENT AGES

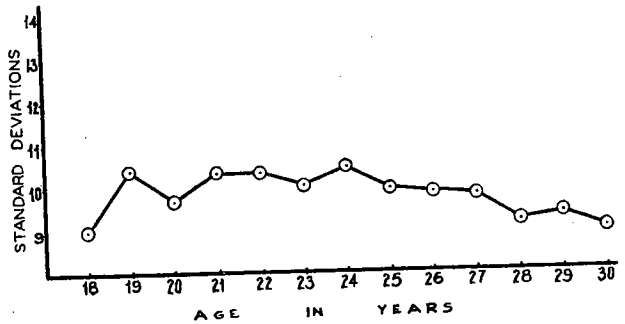
I. S. P. 20



GRAPH–9

GRAPH SHOWING STANDARD DEVIATIONS OF SCORES AT DIFFERENT AGES

MATRIX – 38



Comparison of Findings

We can now compare our findings with those of other studies. In such comparisons the non-comparability of the different scales is always the greatest hurdle. Nevertheless we can assume that the sign of the difference between scores at different ages is independent of the scale. We can therefore compare the difference between scores at adjacent ages. The following table will help to compare our data with Wechsler (grouping of age is after Wechsler).

Increase (+) or decrease (—) in test scores with age

Age	Matrix	Matrix	SP-15	ISP 20	Verbal tests as reported by Wechsler	Performance tests as reported by Wechsler
15		—		—	+	+
16		—		—	+	+
17—19		—		+	—	+
20—24	—	+	—	+	+	—
25—29	—	+0	—	+0	—	—
30—34	—		—		—	—
35—39	—		—		—	—
40—44	—		—		+	—
45—49					—	—

1. The Measurement of Adult Intelligence.

The signs marked O are based on age-groups at or below 26.

The sign at 40-44 under Wechsler verbal tests is based on a very small difference. One might therefore say that all the findings agree in showing that, on the whole, the scores begin to decline after the age of 26.

The same conclusion is reinforced by Raven's data[1] on Matrix 38. The signs of the difference from scores at the previous age are negative at 30, 35 and 40 (Appendix V).

This uniformity in findings disappears if we consider scores not by grouped ages, but at all ages. Scores for ages above 26 are available only on Matrix 38 and SP 15. Here we get positive signs right up to the age of 43, though the negative signs predominate. (Appendix VI).

The following conclusions emerge from this study.

(1) The differences in average scores at different ages cannot be attributed to chance alone.

(2) On the whole it seems a safe generalization that the scores begin to decline after the age of 26.

(3) Variability of scores does not show any regular relationship with age.

N.B.—It should be borne in mind while interpreting these conclusions that they might not have been applicable if the same sample had been followed up

1. Guide to using Progressive Matrices (1938)

from age 14 to age 44. The samples at different ages are different and some of the results may be due to the peculiarities of the samples and not to age.

APPENDIX I

Table showing Means and Standard Deviations of Tests-Scales in different Age-Groups

MATRIX—38

Age	Number	Mean	Standard Deviation
17	56	46·78	6·98
18	572	46·50	9·04
19	691	44·18	10·40
20	1400	43·98	9·72
21	811	43·38	10·36
22	745	43·02	10·28
23	692	43·42	10·00
24	654	42·74	10·40
25	643	42·90	9·88
26	597	42·90	9·84
27	566	42·78	9·76
28	442	41·94	9·16
29	387	41·66	9·36
30	331	42·06	8·96
31	240	42·70	9·84
32	266	41·50	9·20
33	233	41·70	9·56
34	167	41·26	10·12
35	150	41·26	9·40
36	104	40·66	8·48
37	88	39·46	10·28
38	81	41·42	9·56
39	66	38·42	11·84
40	39	36·74	11·76
41	40	39·58	11·08
42	34	35·78	10·72
43	31	37·46	10·88
44	39	34·70	11·52

APPENDIX II

MATRIX—43

Age	Number	Mean	Standard Deviation
14	14	23·43	3·74
15	519	22·66	6·00
16	996	22·64	6·10
17	135	21·68	6·58
18	1193	22·66	5·88
19	1616	21·36	6·56
20	1905	21·30	6·56
21	634	22·36	6·22
22	871	22·02	6·22
23	405	22·98	6·02
24	197	24·12	5·52
25	117	25·36	4·52
26	65	26·48	4·92

APPENDIX III

SP 15 (MOD)

Age	Number	Mean	Standard Deviation
17	57	55·56	14·76
18	603	53·56	13·86
19	985	48·94	14·94
20	1762	48·10	14·76
21	805	48·40	14·22

Appendix III—SP 15 (Mod) contd.—

Age	Number	Mean	Standard Deviation
22	742	47·38	14·04
23	681	47·86	14·52
24	658	47·20	13·92
25	641	47·50	13·80
26	595	47·50	13·56
27	565	48·70	13·14
28	442	47·92	14·34
29	385	47·14	14·28
30	329	45·88	13·98
31	239	48·58	14·70
32	267	44·80	14·34
33	232	46·66	14·16
34	167	47·14	13·98
35	151	45·16	15·30
36	104	43·78	15·12
37	87	42·28	14·40
38	79	44·80	14·16
39	66	45·58	13·80
40	40	38·32	10·38
41	40	45·52	16·14
42	34	40·24	14·70
43	31	42·58	16·74
44	33	37·96	18·06

APPENDIX IV

I.S.P. 20

Age	Number	Mean	Standard Deviation
14	14	61·20	8·75
15	518	60·20	13·50
16	1009	50·25	14·45
17	133	62·00	12·30
18	1181	63·30	13·20
19	1325	61·85	14·55
20	1550	62·45	14·05
21	607	64·80	13·55
22	871	62·60	13·10
23	444	63·70	13·60
24	197	66·70	13·60
25	121	66·70	13·00
26	64	65·60	11·55

APPENDIX V

Comparison of Matrix 38 results with Raven's data

Serial No.	Age	Medians from Reven's data	Means for Matrix 38 (present data)	Differences in medians (Rown-Rown—1)	Difference in means (Rown-Rown—1)
1	20	44	43·98	0	—1·08
2	25	44	42·90	—2	—0·84
3	30	42	42·06	—2	—0 80
4	35	40	41·26	—2	—4·52
5	40	38	36·74		

APPENDIX VI

Signs of differences from means of previous age groups

Age	Matrix 38	Matrix 43	SP—15	ISP—20
14				
15		—		
16		—		—
17		—		+
18	—	+	—	+
19	—	—	—	+
20	—	—	—	+
21	—	+	+	+
22	—	—	—	+
23	+	+	+	+
24	—	+	—	+
25	+	+	+	Nil
26	Nil	+	Nil	—
27	—		+	
28	—		—	
29	—		—	
30	+		—	
31	+		+	
32	—		—	
33	+		+	
34	—		+	
35	Nil		—	
36	—		—	
37	—		—	
38	+		+	
39	—		+	
40	—		—	
41	+		+	
42	—		—	
43	+		+	
44	—		—	