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A TEST OF PERCEPTUAL ABILITY
FOR LEBANESE SCHOOLBOYS
BETWEEN AGES TEN AND EIGHTEEN

By

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PERCEPTUAL TEST

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ABSTRACT

Introduction

The educator is now fully aware of the importance of valid and reliable psychological tests. A test constructed and standardized in one culture cannot be used in another culture without necessary adaptations. The need for a test of intelligence, constructed and standardized in Lebanon is being keenly felt. Before a test of intelligence for use in Lebanon can be constructed, studies must be conducted in each of the major areas of an intelligence test. The present research has been conducted in one of the areas: perceptual ability.

A Definition of Intelligence

For the purpose of the present study, intelligence has been defined as a composite of abilities, enabling the individual to perform acts of different levels of complexity, characteristic of his stage of development, and characterized by an adaptation of means to end. Intelligence is thus manifested in a large number of activities of different levels of complexity. The abilities that make up intelligence are many, for example, verbal ability, numerical ability, deductive ability, perceptual ability, etc.

The Problem For the Present Research

The present study has been conducted to ascertain whether certain tests used in other cultures for the measurement of perceptual ability, could be used in Lebanon, and to select, if possible, items suitable for use at the ages between ten and eighteen.

Behavioural Functions to be Measured

The test devised for the present study, was to measure the following functions of perceptual ability:

✓ (a) The ability to discriminate between similar, though not identical, visual perceptual materials. This function was sampled by the "matching of design" test.

(b) The ability to perceptually rotate a visual form and to compare it with a similar reference form. This ability is tested by the "inversion" test.

(c) The ability to imaginally select a form that would complete, both in size and shape, a given incomplete form. This function is measured by the "figure completion" test.

(d) The ability to imaginally split a given figure into four parts and to compare each with reference blocks, so as to arrive at an arrangement of these blocks that would result in the given figure. This ability is sampled by the "block-making by design" test.

The Try-Out of Instructions

As the purpose of the test was to measure perceptual ability, it was necessary to ascertain that the instructions for the test were understood by all, so that the verbal factor does not enter into the performance. The instructions were, therefore, tried out with a few very simple items. The result of the try-out suggested that the instructions for all the sub-tests were understandable to children of ten and eleven years of age, to whom the try-out test was administered.

The Sample ✓

The test was administered to forty schoolboys of each age level from ten to eighteen. These subjects were drawn from three cities of Lebanon: Beirut, Zahle and Souk-el-Gharb. About seventy-five per cent of the subjects were drawn from Beirut, and out of these eighty per cent were from one institution: the International College. The sample was thus small and not representative of all the socio-economic groups of Lebanon.

The Analysis of Test Results

Increase in performance with age

The analysis of test results showed that on most of the items the performance of subjects showed an increase with increase in age.

After rejecting those items that did not show an increase of performance with age, the score of all the subjects on the remaining items was calculated. The mean and standard deviation of the scores of each age group was then determined. A study of these showed that:

(a) The "matching of design" test discriminated between subjects of ages ten, eleven and twelve only. For ages beyond twelve this sub-test had little practical value.

(b) The "inversion" test was suitable for ages above eleven years. The subjects of ages ten and eleven passed less than half of the items. For subjects of ages twelve to eighteen this sub-test had high discriminative power.

(c) The "figure completion" test discriminated well between subjects of ages twelve to sixteen. For ages below twelve, the test was too difficult and for ages above sixteen, too easy.

(d) The "design-making" test was rather easy for ages beyond fourteen. The test, however, discriminated between subjects of ages ten to fourteen.

Internal consistency of the test

The correlation between scores on the sub-tests ranges between .28 to .39. The correlation between scores on the sub-tests and the scores on the total test ranges between .50 and .78. It, therefore, seems that all the sub-tests measure the same variable.

Predictive value of the test

The test situations were generally "culture-free", and the verbal ability does not enter into the performance on this test, while school achievement is affected by both. The correlation between the score on this test and the school grade cannot, therefore, be expected to be high. The coefficients of correlation between test scores and schoolgrades range from .12 to .27. These coefficients were, however, derived from very scanty data, as school grades of all the subjects could not be obtained, and are not statistically significant.

The Allocation of Items to Various Age Levels

On the basis of the statistical analysis of test results, eight items were assigned to each of the age levels between ten and fifteen. These items were assigned only from the sub-tests found suitable for these age levels. Other factors that went into item allocation were:

- (a) that an item allotted to an age level must be passed by fifty to eighty per cent of the subjects of that age group; and
- (b) that the difference between the number of top twenty-five and bottom twenty-five per cent of subjects passing that item should be significant.

Reliability of the Instrument

In all forty eight items were selected for allocation to appropriate

age levels. The reliability of these test items was determined by the split-half method. For this purpose, the score of subjects on the odd-numbered and the even-numbered items was calculated separately for each age level. The coefficient of correlation between these scores was later corrected by the Spearman-Brown method for the double length. The coefficients of reliability for various age levels ranged between .87 and .95.

Conclusions

The present research has succeeded in the construction of items that register and increase in performance with an increase in age. These items have also been found to give reliable measures, as inferred from the high reliability coefficients. However, before a final selection of items for inclusion into a test of intelligence can be made, these items should be administered again to a representative sample. Nevertheless, the results of the present research provide a starting point for future intelligence testing in Lebanon, and raise the hope that it is possible to obtain test items that would discriminate between subjects of different ages.

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CHAPTER ONE

I N T R O D U C T I O N

The educator is constantly making decisions about children under his care. These decisions concern the grade placement, the method of presenting school subjects, special programme for the deviates, and the various aspects of counselling and guidance. These decisions profoundly affect the character of youth, by determining the type of educational experiences to which they are to be exposed. It is therefore necessary that these everyday decisions should be based on objective and reliable information about the potentialities of the children. One of the ways of obtaining such information is through the use of psychological tests.

The lack of such devices for use in Lebanon is being keenly felt, for tests devised and standardized in countries other than Lebanon cannot be used with much confidence. Sociologists and cultural anthropologists have shown how children from different socio-economic backgrounds differ in their experiential background and motivational system. The test situations that motivate one group may not motivate the other.

The attempt to construct a test of intelligence for use in Lebanon must be preceded by experimental studies designed to ascertain the suitability of the various test tasks for measuring the intelligence of Lebanese subjects. Separate studies are needed in each of the areas

generally covered by intelligence tests. The present study has concerned itself with only one of these areas, namely the perceptual ability, whose existence as a factor in intelligence has been established by the studies of El-Koussy, Thurstone, and others. It is hoped that the present study shall be a part of a larger project, to be undertaken at the Department of Education of the American University of Beirut, aimed at the construction of an intelligence scale for use in Lebanon. The present study aims at ascertaining the suitability of certain tasks of perceptual nature for inclusion in a test of intelligence for Lebanese subjects between the ages of ten and eighteen. X T +

TOWARDS A DEFINITION OF INTELLIGENCE

Although Terman feels that it is unreasonable "to demand that one who would measure intelligence shall first present a complete definition",¹ one cannot evade the task of properly defining intelligence. Of course, it is possible to construct a test of intelligence without first defining intelligence, if one takes the stand that intelligence is that mental characteristic which is measured by the test. However, whether one formally defines intelligence or not, the nature of test items included in the test, indicates an implicit commitment as to what the items should measure.

¹The Measurement of Intelligence, as quoted by Rex Knight, Intelligence and Intelligence Tests, (2nd Edition, London, Methuen, 1956), p. 4.

Some of the Views on IntelligenceBinet's approach

Binet regards intelligence as a general inborn capacity that enables human beings to undertake the various activities of life. It is intelligence that accounts for the differences in the quality of performance of various people. The performance of the same individual in a variety of tasks shows differences in the degree of excellence, yet there seems to be a common level which all his performances tend to approximate. This is because success in the varied activities of life depends on one fundamental faculty--the faculty of judgment, or practical sense, defined as the capacity to adapt one's self to novel circumstances.

Binet thus regards intelligence as a general capacity that enables the individual to meet the varied situations of life. Intelligence functions, according to him, at four main levels. Firstly, intelligence enables us to comprehend a situation, to understand the problem and to analyze it. Once the problem has been comprehended, the individual engages himself in resolving it. At this level the function of intelligence is to enable the individual to "invent" a solution ideationally, with a minimum of trial and error. At the third level, the individual should translate his solution into practice. At this level, intelligence enables the individual to act upon his solution and to maintain a definite direction in the execution of his plan. And last, but not least, intelligence enables the individual to simultaneously evaluate his actions

and to modify them whenever necessary. The solution of the problem is first worked out mentally and then put into action. It is, therefore, necessary that the role of each step in the solution of the problem be evaluated, thus enabling the adaptation of the plan of action to new situations, if and when they arise. The four levels at which intelligence functions are therefore: comprehension, invention, direction, and censorship. Binet would thus describe intelligence as a capacity:

- (i) to make adaptations for the purpose of attaining desired goals;
- (ii) to take and maintain a definite direction;
- and (iii) to apply self-criticism.

It may be pointed out that Binet lists here all factors, intellectual as well as temperamental, that may make for success in a given situation. It is true that in actual practice both intellectual as well as temperamental factors contribute to success in life. However, the inclusion of temperamental factors in intelligence tests can not but complicate the measurement of intelligence.

Binet devised his test of intelligence on the basis of his concept of intelligence as a general capacity guaranteeing for an individual a more or less uniform level of achievement in a variety of tasks. He constructed a measuring scale of intelligence composed of a series of tests of increasing difficulty. Each group of tasks in the series corresponded to a different mental level. The level to which the performances of an individual reached on these tasks of graded difficulty was taken as an index of his intelligence. This index of intelligence

was not to be taken as an absolute measure of intelligence, it was rather to be used to classify a group of persons in a hierarchy. For practical purposes, this classification was as good as an absolute measure. What Binet intended, therefore, was to arrange a group of persons in a hierarchy on the basis of their level of performance on a number of different tasks. This he did on the assumption that the level of difficulty to which an individual's performance could reach was due to the level of his intellectual capacities, or intelligence. This was specially so because the level at which a particular task was placed in his scale was determined by the performance of a large number of subjects of that age.

However, the general level of an individual's performance does not tell the whole story about his ability, for in certain areas his performance may be well above others, while in other areas it may be well below others. For purposes of vocational and educational guidance, a knowledge of the areas of weakness and strength of an individual is very necessary. Binet's scale does not give such a profile of the individual. McNemar's factor analysis of the standardization data of the Stanford-Binet test, shows that the general intelligence factor accounts for almost half of what the items measure, the other half is accounted for by various abilities. The Binet scale is, therefore, "unsuitable for diagnosing separately the various aspects of ability."²

²Lee J. Cronbach, Essentials of Psychological Testing (new York, Harper, 1949), pp. 117.

Piaget's approach

For Piaget, intelligence manifests itself not only in higher mental processes, but at all levels of human activity. Every human action is an adaptation of the organism to an experienced need. Every action has two aspects, the affective and the cognitive. The affective aspect of the action is concerned with the release of physical energy within the organism. The cognitive aspect is concerned with the structuring of the possible relations between the subject and his environment. This structuring of the relation between the subject and his environment takes place at different behavioural levels. Intelligence, according to Piaget, does not begin to function suddenly at a certain level of human development; its manifestation continues from inborn processes to the higher mental functions. Piaget thus takes a developmental view of intelligence.

The essence of an intelligent action consists in the adaptation of means to ends. The behavioural patterns that bring about adaptation at the earlier stage of human development are much simpler than those at later stages. The behavioural structure thus develops from simple to complex; however, Piaget affirms that the function performed by that behaviour remains unchanged. The functional invariants of intelligence are assimilation, accommodation, and organization. By assimilation is meant the incorporation of all given data of experience. The adaptation of the organism to the environment is brought about by an assimilation of objects to the subject. The assimilation of new elements modifies the earlier structure and thus leads to accommodation. While the organism

is thus adapting itself to its environment, an internal mechanism of organization takes place. The growth in the behavioural structure is brought about by these processes of assimilation, accommodation, and organization.

The development of intelligence proceeds through six well-differentiated stages. √ First is the stage of reflex actions, which are capable of gradual accommodation and adaptation through experience. The behaviour pattern typical of this stage is the sucking reflex. Accommodation exists even at this stage because the reflex mechanism needs the environment. Assimilation is also found, because the subject incorporates every object which is capable of supplying it with its needs.

√ At the second level reached by the integration of cortical processes with the reflexes, the behaviour patterns acquired are the sucking habit, vision, phonation and hearing, and prehension. This stage is called the stage of "acquired associations", habits, or conditioned reflexes. At this stage the search for means begins to appear, yet the element of intention is missing.

√ The third stage is that of "intentional sensorimotor adaptations", which begins as soon as the child passes the stage of simple corporal activities and begins to act upon things and use their interrelationships for the satisfaction of his needs. The behaviour pattern that characterizes this stage consists in rediscovering the gestures which in the first instance gave some advantage over things by mere chance. This behaviour is an advance over the previous stage in so far as there

is an intentional search to reproduce or repeat the movements that incidentally led to the fulfillment of some need. These behaviour patterns are termed by Piaget as "secondary schemata".

✓ The fourth stage is that of "coordination of the secondary schemata and their application to new situations." At this stage a clear distinction is made between means and ends. The behaviour patterns at this stage result from an intercoordination of the responses of the previous stage. The subject tries to realize an end by working out a new scheme on the basis of earlier schemata. The child no longer repeats or prolongs an effect which he has discovered by chance, but pursues an end by a combination of earlier behaviour patterns. These new behaviour patterns constitute the first acts of intelligence, properly so called.

↓ The fifth stage is characterized by a "discovery of new means through active experimentation". At this stage new behaviour patterns are worked out, which are not the result of simple reproduction or combination of chance results, but are the result of active experimentation or search for novelty.

↓ At the sixth or the last stage, the behaviour patterns that emerge are characterized by an "invention of new means through mental combinations". This new type of behaviour patterns are typical of systematic intelligence. The behaviour at this stage is governed by an awareness of relationships which permit a reasoned prevision of the solution of the problem. An important structure that makes the invention of new means possible is the mental representation. Behaviour at this stage

is characterized by a sudden insight into the problem and the working out of the solution without actual experimentation.

Piaget's developmental approach to the problem of intelligence seems to be fruitful from the point of view of psychometry. If intelligence is regarded as synonymous with reasoning, the measurement of intelligence in young children becomes a hopeless task. Any attempt to measure intelligence in young children implies the view that intelligence is manifested in activities of all degrees of complexity. When Binet included very simple tasks for measuring intelligence in children between two and four years, he implied that successful performance of these tasks is as much an evidence of intelligence as the solution of a mathematical or a logical problem. Piaget's approach may prove useful in measuring intelligence of children below two years. However, no attempt has been made to work out such a test on the basis of his approach.

The factorial approach

The purpose and method of factor analysis. If a large number of subjects is given a battery of tests designed to measure distinct abilities, it will be found that their scores on these tests are positively correlated. The existence of high correlation on such tests shows that:

- (a) the performance on these tests does not depend upon distinct abilities, several abilities rather enter in varying degrees in the performance on these tests;

- (b) the scores on different tests do not give any new information about the abilities of the subject, the various tests merely duplicate the information.

The method of factor analysis consists in statistically analyzing the correlations between the scores on a number of tests with a view to separating the factors that would explain these correlations. A 'factor' is thus a theoretical construct which accounts for the objectively obtained correlations between tests. These factors do not enter equally into all tests. A factor may thus explain only a part of the correlation between two tests, the remainder of the correlation is explained by other factors. The method of factor analysis aims at providing a description of the factor patterns and their loadings for the tests under analysis. Once the factors and their loadings have been ascertained for each test, a study of the items of all tests showing a loading for a factor reveals the nature of that factor.

The factor analysts believe that once the nature of all the factors that enter into a large number of tests is determined, it will be possible to construct a few 'pure' tests to measure the abilities represented by these factors. Each test would then give a distinct information about the ability of a subject, and the duplication now involved in current testing methods will be avoided. It would also be possible to obtain a profile of the individual's abilities with a fewer tests than is now possible. The purpose of factor analysis has been stated by Jane Loevinger in the following words:

... first we will construct an objective map of mental organization by analyzing the correlations of such tests as we have; then we will construct pure³ tests of abilities defined in our factor analyses.

The two-factor theory of intelligence. There are at present two main methods of factor analysis, the bi-factor method of Spearman and Holzinger, and the multiple factor method of Thurstone. In the bi-factor method the test correlations are accounted for by two factors, the general factor and the specific factors. The general or 'g' factor is common to all tests, while the specific or 's' factors are different from test to test. An individual's performance in any activity depends upon the amounts of general and specific abilities possessed by him. The amount of general ability that an individual has is fixed, while the amount of specific ability varies from ability to ability. Although both factors enter into every cognitive activity, the relative influence is not always the same. The performance of an individual in any intellectual activity shall thus depend upon the level of his 'g' and 's' abilities, as well as on the extent to which the two factors enter into that activity.

On the basis of the results obtained by his bi-factor analysis of tests, Spearman propounded his two-factor theory of intelligence. According to him, every intellectual activity involves a general factor or function, which is common to all intellectual activities, and a specific factor, which it shares with no other activity. This general function has been identified by many as intelligence, though Spearman

³"Intelligence", Theoretical Foundations of Psychology, ed. Harry Helson (Toronto, Van Nostrand, 1951), pp. 590.

has not specifically mentioned so. Different cognitive tasks involve this general factor in different proportions. According to Spearman, a task involves more or less of this general factor according as it involves more or less of the three following operations:

- (a) apprehension of one's own experience, or to observe and comprehend one's mental processes;
- (b) eduction of relations, or to discover the essential relations between different items of experience. For example, if two objects, one black and the other white, are presented simultaneously, one should apprehend the relation of opposition between them.
- (c) eduction of correlates, or given the relationship between two items, to discover the second item when the first is given. For example, if a task involves the discovery of the opposite of black, it involves this process of education of correlates.

To sum up, Spearman regards intelligence as that general ability which enters into all cognitive tasks and which enables the individual to apprehend his experiences, to educe relations, and to educe the correlates.⁴

The multiple-factor theory of intelligence. Thurstone has devised another method of factor-analysis wherein the factor pattern reveals no common factor. Instead of a common factor entering into all tests, he

⁴C. Spearman, The Nature of Intelligence and the Principles of Cognition, as quoted by A. W. Heim, The Appraisal of Intelligence (London, Methuen, 1954), pp. 14.

found a few factors, each entering into only a few tests. The group factors that he found to be present in a large number of tests were:

Verbal factor; word-fluency factor; numerical factor;
 perceptual factor; spatial factor; memorizing factor;
 inductive factor; and deductive factor.

Thurstone believes that each of these factors corresponds to a primary mental ability. There is thus a primary mental ability called the verbal ability, in virtue of which the individual is able to perform tasks of a verbal nature. The extent to which these group factors enter into a particular task varies from factor to factor, and the degree to which an individual has these primary abilities also varies from ability to ability. The efficiency of an individual in a particular task is thus determined, firstly, by the degree to which these factors enter into the test, and secondly, by the amount of those abilities possessed by the individual.

Thurstone separated the nine factors enumerated above by his multiple-factor analysis, and found that the performance on these abilities showed a small positive correlation. The existence of positive correlation among these abilities suggests that there is a common general factor underlying these abilities. Thurstone thus came to believe in the possibility of a second-order general factor. This second-order general factor comes very close to Spearman's 'g', except that Thurstone does not identify it with intelligence proper.

To sum up, intelligence is a composite of a number of primary
 V / mental abilities. Each of these abilities enables an individual to

perform a group of allied tasks. Intelligence is thus the sum total of all the primary mental abilities possessed by an individual.

A critique of factor analysis. One of the criticisms against the factor analysts is that they have brought back the 'faculties' in the guise of 'factors'. Two factors, however, point to the shallowness of this criticism. √ Firstly, the 'factors' have not been postulated to explain human performances, as the 'faculties' were. The factors have been empirically established to explain the fact of correlation between the scores on a group of tests. √ Secondly, these factors do not work separately in separate spheres, as the faculties were said to work.

√ Another criticism springs from the fact that what factors are reported depends upon the battery of tests used, the group of subjects tested, and the method of analysis applied. That is, the same set of data can yield different factors on different methods of analysis. It is argued that it is not justifiable to regard such 'factors' as forming part of the 'mental organization'. However, the justification for the acceptance of the primary mental abilities is the practical usefulness of the concept. Such a concept of human abilities makes possible the construction of 'pure' tests permitting to obtain a profile of human abilities. Such a profile has immense practical value in the field of counselling and guidance as well as in the diagnosis of mental deficiency.

A comprehensive theory of intelligence

The problem of the nature of intelligence has three main aspects, and a comprehensive theory of intelligence must tackle each of these.

✓ The questions that it must seek to answer are as follows:

- (i) Whether or not inheritance is responsible for individual differences in intelligence?
- (ii) What are the degrees of complexity of human activity at which intelligence is manifested?
- (iii) Whether intelligence is one single ability or a composite of more or less separate abilities?

To begin with, let it be pointed out that the problem of intelligence is a part of the bigger problem of individual differences. It is now an accepted fact that individual differences, in general, have both a hereditary as well as an environmental basis. So have individual differences in intelligence. However, it is difficult to bifurcate the effects of heredity and environment at any stage of human development. Moreover, while the differences in the genetic constitution are still too obscure, it is generally believed that environment begins its effect early in life. At the same time, the only way in which the differences in intelligence manifest themselves is in the quality of the performances of different individuals. It therefore seems reasonable to set aside the question of the role of heredity in intelligence and to concentrate on how the individual learns from his experiences. This is the only way in which we can tackle the problem of the nature of intelligence in a scientific way. Moreover, if the measurement of intelligence is to be undertaken, it is to be done by determining the differences in the capacity to learn. Whether differences in this capacity are due to differences in the genetic constitution

of the individual, no one can at present say. It, therefore, seems more profitable to concentrate on the differences in performances as they result from environmental effects. The measurement of intelligence shall thus have to concern itself, not with genetic constitution, but with the effect of environment or training. The measurement of intelligence would thus be the measurement of achievement.

Intelligence serves a biological purpose in the life of man. It makes for his survival by helping him in adjusting himself to his environment. An action is intelligent in so far as it is marked by a selection of means to the ends. As such every adjustive behaviour, whether simple or complex, is an expression of intelligence. Intelligence is thus manifested, not only in higher mental processes, like education of relations and correlates, but also in simplest adjustive action. Such an approach is particularly useful from the point of view of psychometry. The measurement of intelligence in children is only possible through simpler tasks.

Intelligence is not only manifest in activities at all levels of complexity, it is also manifest in all kinds of activities. An individual's performance in different kinds of activities does not reach the same level of excellence. In some spheres his performance excels that in others. None of these performances is his characteristic performance, all contribute to determine the over-all level of his intelligence. Intelligence is thus a composite or an organization of all human abilities, each ability being different though not completely unrelated, to other abilities.

To sum up, intelligence is a concept used in psychology to explain the observed fact of individual differences in performances. These differences are caused partly by heredity and partly by environment. Intelligence is manifested in activities of all degrees of complexity and at all levels of human development. Intelligence is an organization of all human abilities, each determining the individual's level of performance in a different area of task. In practice, such a view of intelligence would imply that the measurement of intelligence is possible through all types of activities and of all degrees of complexity. The index of intelligence shall be obtained by combining the indices obtained for the various abilities, as determined by factor analysis. As such, while the indices of the various abilities shall be used in vocational and educational guidance, the over-all index of intelligence shall be used for all general purposes in education.

THE PROBLEM FOR THIS RESEARCH

The Purpose of the Research

The factorial studies of El-Koussy, Thurstone, and others have established that perceptual ability is one of the factors in intelligence. This finding forms one of the bases of this research. In the present study an attempt has been made to ascertain whether some of the test tasks used in other countries to measure perceptual ability could be

used in Lebanon also. This was done with the objective that these test tasks may later on be included in a test of intelligence for Lebanon.

The purpose of the present research is therefore to ascertain which of the test items could be used as a measure of perceptual ability in Lebanon for schoolboys between the ages of ten to eighteen years. Another purpose was to ascertain whether a scale of perceptual ability for the specified age groups could be arrived at.

The choice of perceptual ability for the purpose of this study has been made on theoretical as well as practical considerations. Theoretically, the study of perceptual ability has special claims upon the attention of those interested in the educational use of mental tests. Tests of perceptual ability can be used to diagnose poor readers and "to determine whether pupils entering school have adequate ability to learn to read."⁵ Practically, the construction of a test of perceptual ability could be undertaken with only a minimum use of the Arabic language, in which the researcher had only a little background.

Rationale for the Adoption of a Group Scale

The scale of perceptual ability that the present study aims to arrive at is to be a group scale. This was done because a group test is more useful where the aim is a broad general classification of a large

⁵Lee J. Cronbach, Essentials of Psychological Testing (New York, Harper, 1949), p. 215.

number of subjects. | The group test can be standardized in much shorter a time, is much easier to administer and score, and does not require as much training in its administration as does an individual test. A group test takes much less time than an individual test when a large number subjects are to be tested. ✓ Of course, the individual test is much more useful for clinical purposes and will continue to be used inspite of the fact that it takes much more time in administration and standardization. However, the present research was planned to yield a group scale because it was felt that what is more urgently needed in Lebanon is a group test of intelligence for broad classification of schoolboys.

Rationale for the Adoption of a Non-Verbal Scale

✓ The scale worked out in the present research is a non-verbal scale. This is done partly because of the handicap of the experimenter in the use of the Arabic language, and partly because a non-verbal scale has certain advantages over a verbal scale. A verbal scale, though very useful for general purposes, gives an advantage to children from higher socio-economic levels and those with better academic performance. It can be easily assumed that all school boys have more or less equal experiential background with such figures and designs as are used in a non-verbal test. No advantage is given to any socio-cultural level.

Last, but not the least, the sampling of perceptual ability can only be undertaken in real tasks of a perceptual nature with non-verbal

items. The perceptual ability is involved in tasks of perception, and the use of non-verbal items alone can give a measure of that ability through actual functions involved in that ability.

Limitations of the Study

For the purpose of the present study four components of perceptual ability were chosen, and a test for each of these components was constructed. These components do not, by any means, completely determine the individual's perceptual ability. The present study is consequently limited to a study of these four functions or levels of perceptual ability. Moreover, the analysis of perceptual ability made for the purpose of the present research was done on a rational analysis of the perceptual functions involved in solving perceptual tasks. No attempt was made either to confirm or to determine the nature of these components by factor analysis.

Another limitation arises from the fact that the test devised for this study was a power test, as opposed to a speed test. Most studies of perception stress speed as an important aspect of perceptual ability. As this study was primarily concerned with the selection of items that could be used to measure perceptual ability of Lebanese schoolboys, the test was made a power test. This was done to ensure that each item would be attempted by all the subjects taking the test. This research is therefore limited to a study of the power in perceptual

organization and discrimination of visual forms to the exclusion of speed.

Another limitation of the study is that it is limited to the measurement of the perceptual ability of the schoolgoing male population of Lebanon. The schoolgirls between the ages of ten and eighteen were not included in the sample due to purely administrative reasons. This exclusion seriously affects the nature of the sample and places a limitation on the use of the test.

A last limitation arises from the difficulty of obtaining a fairly large and representative sample of the population for which the test is designed. It was initially planned to draw the sample from different parts of Lebanon, but this plan could not be fully executed due to the outbreak of political disturbances in the country. The sample to which the test is administered is both small and biased.

CHAPTER TWO

METHOD OF STUDY

Introduction

The construction of a test must proceed through certain well-defined steps. The first step involves the formulation of the purpose of the test. Every test is constructed for a specific purpose, and it can only be used for that purpose. The plan of the test and the nature of the items shall depend upon the purpose for which the test is to be used. It is therefore necessary that from the very beginning the purpose of the test should be clearly formulated. The second step consists in specifying in behavioural terms what the test proposes to measure. In other words, a detailed statement of the specific behaviours to be tested should precede the construction of the test items. Third, for each of the behaviours to be tested, a few situations should be structured in which that behaviour shall be displayed. This is the stage of item construction and selection. The fourth step involves the presentation of these situations to a fairly representative sample of subjects for whom the test is designed. The subjects who are exposed to the test situations should be carefully chosen so as to make the sample as representative as possible of the population for whom the test is intended. Lastly, studies of reliability and validity of the test are made in the light of the results obtained by the test. When necessary, this entire

procedure should be repeated in order that we may improve the reliability and the validity of the test.

This standard procedure in test construction is followed in the present study. However, only the purpose and the objectives of the test, together with results pertaining to try-out studies on the suitability of the instructions of the test, shall appear in this chapter. Data pertaining to the reliability and the validity of the test shall be presented in the next chapter.

The Purpose of the Test

Various studies in the field of factor analysis have pointed to the existence of perceptual ability as a component of intelligence. The purpose of the test is to obtain a measure of the perceptual ability of Lebanese schoolboys between the ages of ten and eighteen. Some factorial studies of perception have pointed out the complex nature of perceptual ability and have shown that diverse operations are involved in perceptual tasks. For this reason the test is made up of four sub-tests, each designed to measure a different operation. However, the purpose of the test is not to obtain a profile of the perceptual ability, it is rather to obtain an over-all measure of visual perceptual ability.

Definition of Objectives in Behavioural Terms

For the purpose of the present study perceptual ability has been analyzed into four components. This analysis has been made through a rational analysis of the processes involved in tasks of a perceptual nature. Though this has been done in a purely a priori fashion, the existence of the components of perceptual ability detailed below, has been confirmed by the studies of El-Koussy, Thurstone, and Abdel-Salam Ahmed.

Perceptual ability has been variously defined by different workers. Thurstone defines it as "the facility to perceive detail even when it is buried among perceptual distractors."¹ In the American Air Force study the perceptual factor has been found to "involve the rapid comparison of visual forms, and the notation of similarities and differences in form and details."² For the purpose of the present study, perceptual ability has been described as the ability to properly organize visual stimulus material. This organization would involve attention to 'similarities and differences in form and detail', the facility to perceive details among 'perceptual distractors', and other perceptual operations detailed below.

¹"The Perceptual Factor", Psychometrika 3, 1, 1938 as quoted by Mohamed Abdel-Salam Ahmed, "Mental Manipulation", The Egyptian Yearbook of Psychology, Vol.I, 1954, 66.

²J. P. Guilford (ed), "Printed Classification Tests", AAF Aviation Report, No. 5, p. 838 as quoted by Mohamed Abdel-Salam Ahmed, op.cit., 66.

At the simplest level, perceptual ability is involved in perceiving the similarities and differences in the details of a number of given figures. That is, the perceiver should be able to determine which, of a number of similar but not identical figures, is exactly like a given sample figure. The operation involved can be called perceptual comparison. Here the subject is to perceive the details of a figure and to compare them with the details of another. This component or function of perceptual ability is sampled by the "matching of design" test.

√ Another aspect of perceptual ability is involved when the perceiver imaginably manipulates a given figure before comparing it with another given figure. Here the subject should be able to spatially rotate a figure, perceive it as it would then look, and to compare it with another given figure, in order to determine their similarity or difference. This operation is measured through items in the "inversion" test, where the subject has to identify which of the five given figures would be identical to the reference figure if it were imaginably rotated clock-wise.

√ A third level is reached when the subject has to combine imaginably two visual stimuli and to perceive them as a whole, in order to compare this total figure with the reference figure. Here the perception is not limited to form alone, but involves the perception of size also. That is, the subject should be able to perceive the figure that would result by combining two figures and should be able to compare this resulting figure to the reference figure. This component of perceptual ability is sampled by the "figure completion" test, where the subject is

required to choose a figure, from among other five given figures, that would complete a given incomplete figure.

✓ A fourth level is reached when the subject is to determine what combination of four given blocks would result in a form similar to the reference design. In these tasks the subject should be able to imaginably split the reference design into four parts, and taking each part separately, to be able to compare it with the four given blocks, in order to determine the order in which these blocks should be combined so as to make the reference design. This component of perceptual ability is sampled by the "design-making by blocks" test.

Rationale for the choice of these components

The above functions do not exhaust the operations that one is able to perform in virtue of his perceptual ability. Other aspects of perceptual ability are sampled by tasks such as block-counting, identification of a hidden figure, pattern perception, etc. The reason for the choice of the above-mentioned aspects of perceptual ability for inclusion in the present study are theoretical as well as practical. Theoretically, these four processes appear to be more elemental and primary than those involved in other types of perceptual tasks. Moreover, this classification is systematic and logical, in so far as it begins with direct visual comparison, proceeding to more complex comparisons requiring first imaginal manipulation; to the imaginal combination of two elements so as to make a whole; and finally to the imaginal combination of four blocks so as to make a design.

On purely practical considerations, a selection had to be made. A test sampling all possible functions of perceptual ability could only include a few items for each component. The choice was thus between sampling a few functions by a large number of items for each, or sampling a large number of functions by only a few items for each. The former was preferred because it appeared to be more promising in yielding definite results on the suitability of these tests.

Construction and Selection of Test Items

The construction of test items for each of the four selected components of perceptual ability proceeded through the following three stages. First, the existing tests making use of perceptual test items were studied and the processes involved in their solution were analyzed. Those that involved the same functions (as were selected for the present study) were used as models. The following tests include items designed to sample the ability for perceptual comparison, perceptual manipulation, and perceptual combination of two or more items:

✓ | Chicago Non-Verbal Examination
 | Chicago Test of Primary Mental Abilities
 | Detroit Advanced Intelligence Test
 | Cattell Culture-Free Test

The items designed for the present test were either increased or decreased in complexity in comparison to the items in the above tests, according as

these were designed for younger or older subjects. Most of the items for the present test are therefore different from those in the above tests.

√ Second, about fifty items were initially constructed for each of the four functions chosen for measurement in the present study. These items ranged from the simple to the complex. This was specially necessary for this study, because the subjects were to be taken from the ages of ten to eighteen. An important consideration in the construction and selection of test items was to end up with a more or less equal number of test items suitable for each age group. It was aimed that for each age group, there should be some items that most of the subjects could do, and some that very few could do. Still, it was intended that the difficulty level of the items should be within the ability of all. It was necessary that all items should be attempted by each subject, so that the items could later be allocated to the appropriate age level.

√ Third, a selection of the items to be included in the test was made. For each sub-test thirty items were selected. Apart from the considerations discussed above, the effectiveness of the alternative responses of an item was a criterion of selection. Only those items that appeared to have really effective alternative responses were kept in the final draft. This was done on the basis of a purely rational judgment.

The complete test⁵ of one hundred and twenty items would have been too long to administer at one sitting, and the testing period would have exceeded the normal duration of a school session. The test was therefore split into two parts, the first consisting of the "matching of design"

⁵A copy of the complete test is given in Appendix B.

and "inversion" tests, and the second consisting of the "figure completion" and "design-making by blocks" tests.

Administration of the Test

Try-out of instructions

Before the differences in performance on the test can be regarded as indicative of differences in perceptual ability, it must be ascertained that the instructions are understood by all subjects. In order to make sure that the test instructions are expressed in a language that is simple for subjects at the lowest age level, these instructions were tried out with a number of very easy items. In Appendix A, a copy of the try-out test has been included. The items included in the test are simple enough so that if the subject knows what he is expected to do, he would easily find the solution of the item. This pilot-study was conducted at the elementary sections of the International College and the National Protestant College. The results are presented in the tables that follow.

Over eighty-five percent of the ten-eleven-year olds scored the maximum on the "matching of design" test. Only eight per cent of the subjects scored below five. From the results given in Table I it seems justified to conclude that the instructions were clear to most of the subjects.

The low performance on the "inversion" test, as given in Table II, is explained as follows. In the previous test, there was only one possible correct response to each item, and this fact was specified in the instructions. In the "inversion test"

TABLE I
DISTRIBUTION OF SCORES ON THE 'MATCHING OF DESIGN' TEST IN THE TRY-OUT

Score	PROTESTANT COLLEGE		INTERNATIONAL COLLEGE		TOTAL SAMPLE	
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency
7	66.6	14	83.9	26	76.9	40
6	9.5	2	9.7	3	9.6	5
5	9.5	2	3.2	1	5.8	3
4	4.8	1	0.0	0	1.9	1
1	4.8	1	3.2	1	3.9	2
0	4.8	1	0.0	0	1.9	1
	100.0	21	100.0	31	100.0	52

there were two correct responses for each item, and this fact was not clearly mentioned in the instructions. The instructions merely stated that 'some' of the given alternatives are correct. Most of the subjects identified only one of the correct responses and did not look for the other. When each item is scored as if it had only one possible correct response, the distribution of scores acquires a different shape. This distribution is given in Table III.

From Table III, it can be seen that over eighty per cent of the subjects solved between five to seven out of the seven items. This shows that the instructions were clear as to what operations the subjects were required to perform. However, the instructions left some ambiguity as to

TABLE II
 DISTRIBUTION OF SCORES ON THE 'INVERSION' TEST IN THE TRY-OUT

Score	PROTESTANT COLLEGE		INTERNATIONAL COLLEGE		TOTAL SAMPLE	
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency
14	4.8	1	6.5	2	5.8	3
13	14.3	3	9.7	3	11.5	6
12	9.5	2	0.0	0	3.9	2
11	4.8	1	6.5	2	5.8	3
10	9.5	2	3.2	1	5.8	3
9	0.0	0	3.2	1	1.9	1
8	9.5	2	9.7	3	9.6	5
7	14.3	3	19.3	6	17.3	9
6	23.7	5	16.1	5	19.2	10
5	0.0	0	12.9	4	7.6	4
3	4.8	1	6.5	2	5.8	3
2	0.0	0	3.2	1	1.9	1
0	4.8	1	3.2	1	3.9	2
	100.0	21	100.0	31	100.0	52

the number of possible correct responses. Consequently, the items for the final test were so designed as to have only one possible correct answer, and this was clearly specified in the instructions.

TABLE III

MODIFIED DISTRIBUTION OF SCORES ON THE 'INVERSION' TEST OF THE TRY-OUT

Score	PROTESTANT COLLEGE		INTERNATIONAL COLLEGE		TOTAL SAMPLE	
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency
7	28.5	6	32.3	10	30.8	16
6	33.3	7	19.3	6	25.0	13
5	23.8	5	25.8	8	25.0	13
4	4.8	1	9.7	3	7.8	4
3	0.0	0	9.7	3	5.7	3
2	4.8	1	0.0	0	1.9	1
1	0.0	0	3.2	1	1.9	1
0	4.8	1	0.0	0	1.9	1
	100.0	21	100.0	31	100.0	52

TABLE IV

DISTRIBUTION OF SCORES ON THE 'FIGURE COMPLETION' TEST OF THE TRY-OUT

Score	PROTESTANT COLLEGE		INTERNATIONAL COLLEGE		TOTAL SAMPLE	
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency
7	52.4	11	48.4	15	50.0	26
6	42.8	9	38.8	12	40.4	21
5	4.8	1	6.4	2	5.8	3
4	0.0	0	6.4	2	3.8	2
	100.0	21	100.0	31	100.0	5.2

On the "figure completion" test, over ninety per cent of the subjects obtained maximum or near maximum scores, as given in Table IV. This seems to suggest that the instructions for this test were understood by most of the subjects.

TABLE V
DISTRIBUTION OF SCORES ON THE 'DESIGN MAKING BY BLOCKS' TEST

Score	PROTESTANT COLLEGE		INTERNATIONAL COLLEGE		TOTAL SAMPLE	
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency
7	38.1	8	54.8	17	48.1	25
6	23.8	5	12.9	4	17.3	9
5	0.0	0	6.5	2	3.9	2
4	19.0	4	16.1	5	17.3	9
3	4.8	1	0.0	0	1.9	1
2	14.3	3	6.5	2	9.6	5
1	0.0	0	3.2	1	1.9	1
	100.0	21	100.0	31	100.0	52

On the "design-making" test forty-eight per cent of the subjects scored the maximum, and twenty-one per cent obtained the two scores below that. The results on this test are given in Table V. It thus seems reasonable to conclude that the instructions were clearly understood by a great majority of the subjects.

The observation of the behaviour of the subjects during the administration of the try-out test indicated that they did not want to read long instructions. The instructions for the final test for all the sub-tests were so revised therefore as to reduce their length. Strict scientific procedure demanded the try-out of the revised instructions, but the shortage of time did not permit this undertaking.

Subjects

The subjects to whom the final test was administered were drawn from the elementary and secondary schools of Lebanon. The subjects were drawn from the ages of ten to eighteen years. The schools participating in this research were situated at three different towns of Lebanon-- Beirut, Zahle, and Souk-El-Gharb. Table VI shows the number of subjects drawn from the various schools. It shall be seen that over seventy-five per cent of the subjects were drawn from Beirut. This became inevitable in view of the disturbed condition of Lebanon at the time of the administration of the test. Many of the schools outside Beirut could not be included in the project as it became difficult to reach them.

Each of the school grades included subjects differing in age by at least three years. In some grades the age difference between subjects was as great as seven years. However, the majority of subjects in each grade had an age equal to grade plus six, as shown in Table VII. This table gives the age-grade distribution of subjects.

TABLE VI
SCHOOL-GRADE DISTRIBUTION OF SUBJECTS

S C H O O L S	G R A D E S								T O T A L
	Elementary		Secondary						
	5	6	1	2	3	4	5	6	
International College, Beirut	36	40	22	46	-	25	27	27	223
National Protestant College, Ras Beirut	25	-	-	-	-	-	-	-	25
Maqasid School, Beirut	-	-	-	-	24	-	-	-	24
Protestant College, Zahle	37	-	-	-	-	-	-	-	37
Lebanon College, Souk-El-Gharb	-	-	-	23	-	28	-	-	51
TOTAL	98	40	22	69	24	53	27	27	360

✓ Three factors affect the nature of the sample used for the test.

✓ Firstly, the sample is largely drawn from the student population of Beirut. Moreover, about eighty per cent of the subjects drawn from Beirut come from a single institution--the International College. This became inevitable due to the outbreak of disturbances in Lebanon. For the same reason, the total sample remained smaller than initially planned. ✓ Secondly, the sample is drawn exclusively from the male student population of Lebanon. ✓ The exclusion of girls may effect the distribution of scores. ✓ Thirdly, the socio-economic background of the subjects is unknown. No effort was made to classify subjects on the basis of their socio-economic status. This

TABLE VII
AGE-GRADE DISTRIBUTION OF SUBJECTS

A G E S

		10	11	12	13	14	15	16	17	18	Total
S E C O N D A R Y	VI							2	8	17	27
	V						2	8	9	8	27
	IV					2	15	16	12	8	53
	III						4	5	9	6	24
	II			2	14	24	19	7	2	1	69
	I		2	7	10	3					22
E L E M E N T A R Y	VI	10	14	10	4						38
	V	30	24	21	12	11		2			100
	Total	40	40	40	40	40	40	40	40	40	360

factor was not controlled because the socio-economic status of a subject does not seem to effect his experiential background in the tasks included in the test. All social classes seem to have equal opportunity to deal with the types of figures and designs used in the test, especially because all the subjects were drawn from schools. Moreover, no known study has pointed the effect of social class upon perceptual ability.

Conditions of test administration

For the sake of uniformity in test administration the two parts of the test were administered on the same day. The test was usually administered in the classroom, in the presence of the teacher. Before the administration of the test, the students were orally briefed on the purpose of the test. They were advised to read the instructions carefully and to show the solution of the practice exercises to the proctor before attempting the test. They were told that no questions shall be answered once they completed their practice exercises. No coaching was done after the subject showed the correct solution of the practice exercises. The students were instructed to leave the classroom on completing the test.

Scoring

For scoring the test forms a stencil for each of the test pages was prepared. This scoring key was made by removing the answer-squares of the correct response to each item. The holes on the scoring key thus corresponded to the exact location of correct responses on the answer sheet. The scoring of the test forms was done by superimposing each answer key on the appropriate page, and counting the number of x's, showing through the holes in the scoring key.

In order to ascertain the reliability of scoring, a randomly selected set of thirty test forms was given to another person for scoring. The rescoring was alone done with the scoring keys. No discrepancy was found between the two scores.

CHAPTER THREE

ANALYSIS OF THE DATA

The Purpose of the Analysis

The main purpose of the present study being the selection of items likely to discriminate among schoolboys as regards their perceptual ability, the statistical analysis of the test results was undertaken to secure answers to the following questions:

- ✓ (a) What characteristics are possessed by the test?
- (b) Which of the sub-tests could be used at the various age levels?
- (c) Which of the items could be placed at the various age levels, so as to obtain an age scale of perceptual ability for use in Lebanon?
- (d) How reliable is the proposed scale at the various age levels?

Before a detailed analysis was undertaken, it was thought desirable to exclude items which were obviously unsuited for the purpose for which they were designed. For this purpose, the percentage of subjects of various ages passing each item was determined. The percentage of subjects at each age level passing the items of the four sub-tests is given in Tables VIII to XI. From an inspection of these tables, the following types of items were excluded from further statistical analysis:

- (a) Items that were passed by almost all the subjects at most

- of the age levels tested,
- (b) items that were passed by a greater per cent of subjects at the lower than at the higher age level, and
 - (c) items that were passed by very few subjects at most of the age levels tested. The items that were excluded from further statistical analysis on account of the above are marked with an asterisk in the tables.

Characteristics of the Test

In order to have practical utility a test of mental function should possess certain characteristics. For example, it should be able to discriminate between subjects of different ages, that it should give reliable measures of the variable tested, and so on. The test constructed for the purpose of the present study possesses the characteristics discussed in the following sections.

Face validity of the test

The present test was constructed to sample some of the functions of perceptual ability. These functions were: visual comparison of similar but not identical designs, perception of imaginably manipulated figures; perceptual completion of figures; and perceptual combination of four blocks to make a given design. The test situations were deliberately designed to call forth these functions of perceptual ability. A rational analysis of the processes involved in the solution of the items of the sub-test shows that the test items really sample the selected function.

TABLE VIII

PERCENTAGE OF SUBJECTS AT EACH AGE LEVEL PASSING ITEMS ON
"MATCHING OF DESIGN" TEST

Item No	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18
1*	95	77	72	82	92	92	95	90	87
2*	100	95	100	100	100	100	100	100	95
3*	100	92	95	97	100	100	100	100	97
4	80	87	72	82	82	97	95	100	95
5	75	87	90	92	90	92	92	92	100
6	77	70	72	85	90	80	92	97	95
7*	100	85	90	95	100	95	95	97	100
8*	100	92	100	100	97	100	97	100	97
9*	100	90	87	100	97	100	95	100	100
10*	100	92	97	100	95	97	95	100	100
11*	97	85	90	87	85	97	92	97	95
12	82	90	85	87	92	90	97	95	97
13	75	82	87	100	90	100	97	97	100
14*	100	90	95	100	100	100	100	97	100
15	72	72	82	85	82	80	95	95	90
16	77	82	87	97	97	90	97	97	95
17*	82	87	100	100	100	97	100	97	100
18*	82	92	90	100	100	100	100	97	100
19	65	77	87	92	95	95	100	95	97
20	75	75	80	87	92	97	92	95	100
21*	100	72	87	95	90	90	95	85	95
22*	100	68	97	92	100	97	97	100	100
23	53	85	72	87	87	100	97	85	97
24	68	82	90	90	77	82	95	87	92
25	72	95	92	97	95	100	100	100	97
26*	100	90	90	100	95	95	97	97	100
27*	85	90	95	97	97	100	95	97	97
28	62	85	90	97	92	97	100	100	100
29*	85	92	85	100	92	97	100	97	100
30	62	77	77	90	92	92	97	95	97

Note: The items marked with an asterisk are excluded from further statistical analysis.

TABLE IX
 PERCENTAGE OF SUBJECTS AT EACH AGE LEVEL PASSING ITEMS ON
 "INVERSION" TEST

Item No	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18
31*	82	85	87	90	80	97	92	92	97
32	40	35	60	67	62	55	82	82	95
33*	82	85	80	80	77	87	92	95	100
34*	72	62	87	77	70	87	87	92	95
35*	67	62	72	70	72	82	87	90	100
36*	72	45	65	62	70	75	85	85	95
37*	75	62	72	72	77	80	87	82	95
38*	55	60	85	87	72	75	92	85	90
39*	77	70	80	80	80	87	87	92	95
40	40	37	45	67	57	42	77	77	90
41	40	50	46	62	60	70	82	75	92
42*	70	72	77	80	82	82	87	90	95
43	45	55	62	65	55	70	90	85	92
44	46	45	62	57	62	65	71	71	85
45	50	60	67	85	70	62	87	85	97
46	45	55	65	65	65	75	87	87	97
47	50	62	75	67	67	65	90	92	90
48	42	57	70	72	70	72	90	92	97
49	52	57	60	70	52	75	80	80	90
50	60	52	80	75	62	75	77	87	87
51	30	40	60	67	50	57	80	77	92
52	37	57	70	70	67	55	77	80	90
53	52	55	60	70	65	72	90	97	90
54*	65	55	75	85	75	75	90	90	97
55	57	42	57	55	50	62	80	87	92
56	30	45	47	47	65	70	75	80	82
57	47	55	72	80	57	72	87	92	97
58	50	55	90	72	67	85	85	90	97
59	27	27	46	46	50	70	77	80	72
60	17	25	40	57	60	50	62	75	87

Note: The items marked with an asterisk are excluded from further statistical analysis.

TABLE X

PERCENTAGE OF SUBJECTS AT EACH AGE LEVEL PASSING ITEMS ON
"FIGURE COMPLETION" TEST

Item No	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18
1*	62	80	72	80	87	77	85	90	85
2*	77	85	65	70	77	75	90	90	90
3*	77	77	87	90	92	92	92	92	100
4	62	60	70	72	82	80	8-	87	100
5	65	57	67	62	55	67	77	60	85
6	57	42	55	52	67	80	95	90	72
7	57	75	67	82	82	95	92	95	90
8	50	62	45	72	75	72	85	87	87
9	50	65	57	67	72	80	95	95	92
10	35	42	42	72	75	77	90	90	95
11	52	62	65	65	60	60	77	77	80
12	42	30	52	75	77	75	85	82	82
13	50	62	80	70	85	90	90	85	77
14	62	37	50	47	37	42	62	47	47
15	35	27	25	40	40	25	52	55	42
16	27	57	40	29	45	70	62	62	67
17*	85	60	60	70	55	72	85	82	82
18	52	52	65	70	60	57	92	72	67
19*	40	30	27	30	42	52	65	52	47
20*	22	20	17	27	25	60	60	80	60
21	57	42	55	37	42	52	55	40	60
22*	70	57	70	65	90	82	90	95	87
23*	52	67	65	82	77	82	92	90	90
24*	52	65	62	65	65	70	77	77	77
25	42	35	50	30	40	55	67	60	55
26	35	50	47	47	55	55	95	80	77
27	45	46	32	60	46	70	87	85	87
28	30	37	20	47	55	42	60	62	42
29	32	35	22	32	42	55	67	52	65
30	17	40	37	42	55	50	80	72	70

Note: The items marked with an asterisk are excluded from further statistical analysis.

TABLE XI
 PERCENTAGE OF SUBJECTS AT EACH AGE LEVEL PASSING ITEMS ON
 "DESIGN-MAKING" TEST

Item No	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18
31*	80	82	82	90	92	90	97	97	97
32	60	77	70	77	82	92	92	90	100
33*	97	82	92	97	90	92	100	95	97
34	42	62	40	65	77	75	95	87	87
35	27	45	57	57	80	85	92	80	95
36	70	72	65	67	80	85	97	95	95
37	52	55	52	77	67	90	85	87	80
38	65	75	67	85	70	90	97	95	87
39*	82	82	77	70	77	90	92	95	100
40	65	85	77	92	82	92	100	100	100
41	57	82	82	87	80	92	92	90	100
42	75	72	75	80	80	95	97	92	100
43*	85	70	75	92	85	95	97	95	95
44*	75	75	80	87	85	92	97	92	100
45	30	60	55	62	77	80	95	87	95
46	75	67	80	80	82	97	97	95	97
47	70	67	67	75	77	92	92	95	95
48	46	75	72	75	87	92	97	95	95
49	57	72	80	80	87	95	100	95	97
50	65	60	67	62	77	90	97	97	95
51	70	70	75	90	90	90	100	97	97
52	62	55	75	75	80	92	97	100	95
53*	80	70	82	90	92	97	100	100	100
54	55	67	80	87	87	95	97	90	97
55	52	62	60	72	90	90	100	95	95
56*	80	67	87	77	80	90	95	82	95
57*	82	65	70	85	80	90	100	92	100
58*	80	67	60	90	80	97	95	87	90
59*	80	60	50	72	77	90	100	100	90
60	62	65	50	65	80	92	97	95	97

Note: The items marked with an asterisk are excluded from further statistical analysis.

Increase in performance with age

A test that seeks to classify subjects in a hierarchy on the basis of some mental function should be able to differentiate between subjects of different ages. In other words, subjects of higher ages should obtain a higher score on the test than subjects of lower ages. In the present test, only a few items from each of the four sub-tests do not show increase in performance with increase in age. Most of the items however succeed in this task of differentiating subjects on the basis of their ages, as the percentage of subjects passing these items increases as we proceed from lower to higher age groups. When undifferentiating items are excluded, and the remaining items are scored, the mean performance shows a definite increase from age to age. This is expected in view of the increase with age in the percentage of subjects passing the items and the exclusion of such items as do not show an increase with age.

From a study of Table XII many conclusions can be drawn about the suitability of the sub-tests for use at the various age levels. For this purpose, a study of the results given in Table XII is undertaken separately for each sub-test.

(a) "Matching of design" test. The performance on this sub-test shows an increase with age, except for ages twelve and fourteen, where no statistically significant change is found. The mean for age thirteen almost reaches the maximum possible on this sub-test and the standard

deviation decreases from 2.84 for age twelve to 1.48 for age thirteen, signifying that the test has very little discriminative power within the age groups beyond age twelve. This sub-test can, therefore, be used for ages ten, eleven and twelve only.

TABLE XII
MEAN AND S.D. OF SCORES ON EACH SUB-TEST
AT THE VARIOUS AGE LEVELS

TEST	No. of Items	Statistic	10 YEAR	11 YEAR	12 YEAR	13 YEAR	14 YEAR	15 YEAR	16 YEAR	17 YEAR	18 YEAR	TOTAL SAMPLE
Matching of Design	14	M	10.05	11.55	11.45	12.60	12.45	12.85	13.25	13.20	13.26	12.28
		S.D.	2.68	2.42	2.84	1.48	1.95	1.32	.80	1.05	.66	2.12
Inversion	20	M	8.57	9.70	12.33	13.00	12.18	13.38	16.07	16.45	17.80	13.30
		S.D.	6.06	5.88	5.37	6.69	6.64	6.06	4.86	3.93	2.80	6.18
Figure Completion	21	M	9.57	10.18	10.55	11.53	12.58	13.48	16.55	15.35	15.43	13.80
		S.D.	3.90	3.84	3.10	3.70	3.48	3.48	2.73	3.12	3.42	4.20
Design-Making	20	M	11.42	13.30	13.38	15.03	15.93	17.65	18.85	18.33	18.63	15.26
		S.D.	5.52	6.36	5.90	5.13	5.00	3.66	.65	2.55	1.36	5.70

(b) "Inversion" test. This sub-test also shows an increase in performance with an increase in age, except for age fourteen, where no statistically significant change occurs. On this sub-test the mean for ages ten and eleven is very small, that is, subjects at this age level are able to pass only nine or ten of the twenty items. The subjects at

the ages seventeen and eighteen are able to pass sixteen or seventeen out of the twenty items. This sub-test can be used for all ages, except ten and eleven, for which the test tasks are rather difficult.

(c) "Figure completion" test. The performance on this test shows an increase with increase in age, except for ages seventeen and eighteen. At ages ten and eleven the subjects are able to pass less than half of the items. The test seems to be suitable for use at ages between twelve and sixteen.

(d) "Design-making" test. The performance on this test increases with increase in age till the age of sixteen, beyond which no statistically significant difference is shown. The mean almost reaches the maximum possible on this sub-test at the age of sixteen, thus signifying that the test does not discriminate among subjects at this and next age levels. This sub-test, thus, seems to be more suitable for use at lower age groups, that is, for ages ten to fifteen.

Internal consistency of the test

The purpose of the test was to obtain a measure of the perceptual ability of schoolboys. Though perceptual ability works as a functional unity, it has been found to involve various functions.¹ The four sub-tests were designed to sample four rationally selected functions of perceptual ability based on items used in tests in other cultures. In order to ascertain the extent to which the sub-tests measure the same

¹L.L. Thurstone, A Factorial Study of Perception, Psychometric Monograph No. 4 (Chicago, Psychometric Society, 1949).

TABLE XIII
COEFFICIENTS OF CORRELATION BETWEEN SCORES ON THE SUB-TESTS

CORRELATION BETWEEN	COEFFICIENT
Matching of design and Inversion	.32
Matching of design and Figure Completion	.33**
Matching of design and Design-making	.28
Inversion and Figure Completion	.36**
Inversion and Design making	.34**
Design-making and Figure Completion	.39**
Matching of Design and Total Test	.50*
Inversion and Total Test	.78*
Figure Completion and Total Test	.76*
Design-making and Total Test	.74*

Note: The coefficients marked with an asterisk are not significant at the .01 level. The coefficients marked with two asterisks are significant at .05 level.

All other coefficients are statistically insignificant.

variable, the coefficients of correlation between the scores on the sub-tests were obtained. These coefficients of correlation are given in Table XIII. From this table it will be seen that while the intercorrelations

between the sub-tests range between .28 to .39 they are all positive and that the correlations between the sub-tests and the total tests are between .50 and .78. It, therefore, seems reasonable to conclude that each of the sub-test measures a different function of the same variable.

Discriminative power of the items

✓ The practical usefulness of a test depends upon the discriminative power of the test. In the process of item analysis, the discriminative power of the items is ascertained. Only those items that discriminate among individuals with respect to their level of excellence in the variable under examination, are retained in the test. An item that so discriminates among individuals must be passed by a larger number of above-average subjects than below-average subjects. To test the discriminative power of the items two reference groups of subjects were taken. One group consisted of the top twenty-five per cent subjects of an age-level as determined by their score on the total test. The second group consisted of the bottom twenty-five per cent of subjects. The decision to have top twenty-five and bottom twenty-five per cent of subjects, instead of twenty-seven per cent as suggested by J.C. Flanagan,² was taken on purely practical considerations. The number of subjects at each level was forty and twenty-seven per cent of forty comes out to be a

²"General Considerations in the Selection of Test Items and a Short Method of Estimating the Product-Moment Coefficient from the Data at the Tails of the Distribution", J. Educ. Psychol., 30, 674-680 (1939), as quoted by Albert L. Thorndike, Personnel Selection (New York, John Wiley, 1949).

function, while twenty-five per cent gives a convenient whole number.

For each item, the number of subjects of each of these two reference groups passing the item was determined. It was found that all the items were discriminative, in so far as a larger number of the subjects from the upper quartile passed the items than the subjects from the lower quartile. This was to be expected because of the high correlation coefficients obtained between the scores on the sub-tests and the total test.

This process of item selection includes a test of the effectiveness of the alternative responses of the items. Those items that were made up of alternative responses, each of which attract some of the subjects who fail on that item, are more effective. For the purpose of the present study this analysis of items could not be undertaken.

Predictive value of the test

It is now generally accepted that academic achievement depends upon many factors besides so-called "general intelligence". However, the correlation between some kinds of intelligence tests and school achievement has been found to be relatively high and positive. In school, greater emphasis is placed upon verbal ability, and school achievement is largely influenced by that ability. Moreover, academic learning is influenced by cultural factors. In the present test, the verbal factor was, as far as possible, eliminated, and the test situations were more or less "culture-free".⁴

⁴E. Terry Prothro in "An Alternative Approach in Cross-Cultural Intelligence Testing", The Journal of Psychology, 1955, 39, 247-251, suggests that the so-called "culture-free" tests are "criterion-bound" rather than culture-free.

The correlation between school achievement and performance on this test cannot, therefore, be expected to be high. The coefficients of correlation between the scores on this test and school grades in languages, mathematics and social studies are given in Table XIV.

TABLE XIV
COEFFICIENTS OF CORRELATION BETWEEN THE TEST SCORES
AND SCHOOL GRADES

CORRELATION BETWEEN TEST SCORES AND	YEAR 13	YEAR 14	YEAR 15
LANGUAGES	.15	.22	.24
MATHEMATICS	.20	.18	.16
SOCIAL STUDIES	.18	.12	.27
N =	24	29	34

These coefficients were obtained on data pertaining to a limited number of subjects only. The school grades could only be obtained for subjects drawn from the secondary section of the International College and the Lebanon College of Souk-el-Gharb. From these coefficients of correlations it is evident that the test has a very low predictive power. However, as the items selected from this test are ultimately to form only a part of a larger test, these coefficients are quite useful for practical purposes.

ALLOCATION OF ITEMS TO VARIOUS AGE LEVELS

Criteria

The statistical analysis of the data showed that the test was not very discriminative at ages above fifteen. For this reason, the allocation of items to various age levels was attempted only for the ages between ten and fifteen. The decision about the age placement of an item was based on many factors. Firstly, items assigned to an age group were selected only from the sub-tests found suitable for that age group. The decision about the suitability of a sub-test for use at the various age levels was taken on the basis of the size of the means at those age levels. Where the mean of an age group on a sub-test was very small, or where it almost reached the maximum possible on that sub-test, that sub-test was considered to be unsuitable for use at that age level.

Secondly, an item was allotted at that age level at which the percentage of subjects passing that item was between fifty and eighty. A third consideration was the discriminative power of the item. The discriminative power of the item was determined by the difference between the number of the top twenty-five per cent of the subjects and the number of the bottom twenty-five per cent of the subjects passing that item. An item was assigned at that age level for which the difference between the top and the bottom twenty-five per cent of the subjects passing the item, was greatest.

Items Assigned at Various Age Levels

The statistical analysis of test results showed that all four sub-tests were not equally discriminative at all age levels. Some were discriminative at the lower age levels, but were too easy for higher age levels, while others were too difficult for the lower age levels and were discriminative at the upper age levels. As such, at some age levels items from only two of the sub-tests were used, while at other ages items from three or four sub-tests were used.

Items from the "matching of design" test were assigned at the ages of ten, eleven and twelve only. ✓

Items from the "inversion" test were assigned at the age of twelve, thirteen, fourteen and fifteen. This test appears to be rather difficult for ages ten and eleven.

Items from the "figure completion" test were allotted to age levels twelve, thirteen, fourteen, and fifteen years only.

Items from the "design-making" test were assigned at all ages except fifteen.

Eight items were placed at each age level.³ The number of the items of the various sub-tests placed at each age level is given in Table XV.

The Reliability of the Instrument ✓

Reliability is one of the essential characteristics of any measuring instrument, because if the repeated measures obtained through it differ

³A copy of the items selected for each age level is given in Appendix C.

TABLE XV
ITEMS OF THE SUB-TESTS PLACED AT DIFFERENT AGE LEVELS

SUB-TEST	Item Nos: Placed At 10 YEAR Level	Item Nos: Placed At 11 YEAR Level	Item Nos: Placed At 12 YEAR Level	Item Nos: Placed At 13 YEAR Level	Item Nos: Placed At 14 YEAR Level	Item Nos: Placed At 15 YEAR Level
Matching of Designs	5, 13, 16 24, 25, 28	19	4, 6, 20, 30			
Inversion				46, 47, 48, 60	44, 45, 49	32, 41, 43, 53, 59
Figure Completion			4, 9	6, 7	10, 12	8, 11, 27
Design Making	32, 40	34, 35, 36, 37, 45, 54, 60	47, 48	52, 55	38, 46 50	

significantly, the instrument is of little theoretical or practical value.

✓ A test is said to be highly reliable when the scores obtained by a group of subjects on repeated application of the test are highly correlated. In other words, if a test is administered twice to a set of subjects, and the two scores obtained by each subject on the average are not significantly different, the test is reliable.

The reliability of the scale drawn up above was determined separately for each age group. This was done by the application of the split-half method, as it was not possible to administer the test twice to the same sample. The odd-numbered items were taken as one half, and the even-numbered items were taken as the other half. Where the odd-

numbered and the even-numbered items belonging to a sub-test were not equal, a few odd-numbered items were taken with the even-numbered items, or vice versa, so as to keep an equal number of items in the two halves. The coefficient of correlation between the scores on the two halves of the scale was then obtained. This coefficient was adjusted for double length by the use of the Spearman-Brown formula.⁵

$r_{tt} = \frac{2r_{12}}{1 + r_{12}}$, where r_{tt} is the coefficient of reliability for the total test, and r_{12} is the coefficient of correlation between the scores on the two halves of the test. The reliability of the suggested scale for each of the age levels is given in Table XVI. These reliability coefficients are higher than those reported in most studies of this kind.

TABLE XVI

COEFFICIENTS OF RELIABILITY OF THE SCALE FOR EACH AGE LEVEL

YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	Total Sample of Ages 10-15
.91	.93	.95	.92	.87	.94	.92

√ These reliability coefficients are specially significant because they are obtained for what is to be a sub-test, with only forty-eight items.

⁵Harold Gulliksen, Theory of Mental Tests (New York, John Wiley, 1950), p. 63.

CONCLUSIONS

The statistical analysis of test results was undertaken to ascertain what operational characteristics the test possessed, that is what the test could actually do in practice. The analysis was also undertaken with a view to arriving at a judgment as to the suitability of the various sub-tests for use in a test of intelligence for Lebanon, and to select, if possible, a few items for each of the age levels studied.

In the absence of an outside criterion of validity, no index of validity could be obtained. Instead an attempt was made to ascertain what the test could do in practice. It was found that the test discriminates among subjects of different ages, as well as among subjects of the same age. This was concluded from the increase in the performance of successive age groups, and the range of distribution of scores within each age group. However, the test does not discriminate much among subjects of ages sixteen and above. The performance of subjects beyond sixteen years does not show much increase on some of the sub-tests, and the range of the distribution of scores becomes too narrow for higher age levels. It thus seems reasonable to conclude that the test can only be used for ages between ten and fifteen. ✓

✓ An examination of individual items showed that a large number of them register progressive increase in performance with increase in age. The items that did not show this characteristic were rejected. Also, those items were kept that were found to discriminate among the

subjects belonging to the upper and the lower quartiles of the distribution for a certain age group.

The homogeneity of the test was determined by the inter-correlations of scores on the sub-tests. It was found that the coefficients of correlation between scores of the sub-tests ranged between .28 and .39. The coefficients of correlation between the scores on the sub-test and the scores on the total test varied from .50 to .78. It, therefore, seems fair to conclude that the various sub-tests, while measuring different functions of perceptual ability, measure essentially the same variable.

The items were assigned to the various age levels with these considerations: (1) the items should belong to a sub-test that is more suitable for that age; (2) the item should be passed by an appropriate percentage of subjects; and (3) the item should be of a satisfactory discriminative power. The allocation of items was successful only for ages between ten and fifteen. Eight items were assigned at each age level, because these were the only items that were found to be suitable for each of those age groups. Moreover, these items are to form merely a part of a battery of tests, the number of items selected is sufficient for this purpose.

The reliability of these selected items was determined by the split-half method. Score for each age group were obtained on all items finally selected. The coefficient of correlation was then computed between the scores on the two halves into which these items were divided. The reliability coefficients, when adjusted for full length by the

Spearman-Brown formula, ranged between .87 and .95. These coefficients are significantly high for items that are designed to form only a sub-test.

To sum up, the present study has succeeded in devising items for measuring perceptual ability, that show a progressive increase in performance with age, and that have a high reliability. However, the items finally chosen for the various age groups need to be administered again to a representative group of subjects in Lebanon, before a satisfactory set of items, to be included in a future test of intelligence, can be arrived at.

APPENDIX A

اختبار في العلاقات البصرية

اعده : س * م اعجاز - تلميذ متخرج من دائرة التربية - الجامعة الاميركية
في بيروت *

تحت مراقبة الاساتذة : عطية - كين - مليكيان - من الجامعة الاميركية
في بيروت *

الاسم : العمر : سنوات اشهر
الصف : المدرسة : التاريخ :

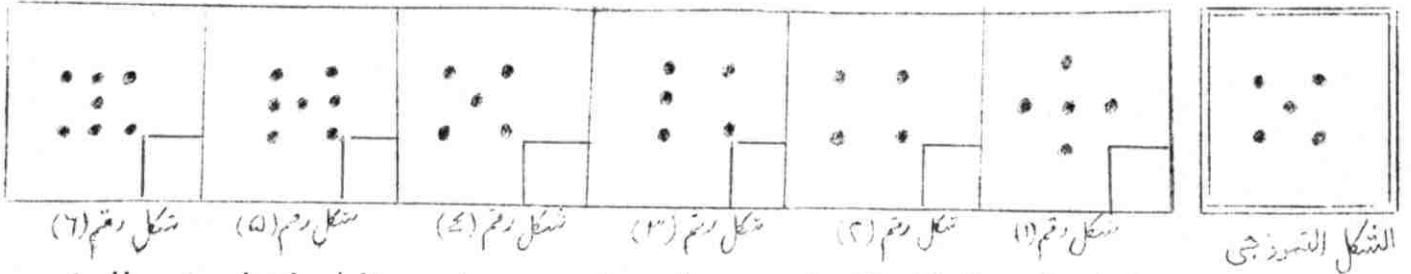
تعليمات عامة

- ٠١ ستأخذ سلسلة من اربعة امتحانات - يتألف كل منها من سبعة اسئلة -
- ٠٢ كل امتحان له تعليماته الخاصة - اقرأها بانتباه وضع خطا تحت كل كلمة صعبة لا تفهم معناها * - كل امتحان يعدوى على تمرين -
تأكد انك تفهم هذا التمرين قبل المباشرة بالامتحان *
- ٠٣ ليس هناك وقت محدد لهذا الامتحان - بإمكانك ان تأخذ من الوقت ما تحتاج اليه - ولكن ليس من الضروري ان تأخذ وقتا طويلا بلا فائدة
انه الامتحان بأسرع ما يمكن * قف ! لا تفتح ورقة الامتحان حتى يطلب منك ذلك *

(١) اقرأ التعليقات والتعريف قبل البدء في الاجابة

(٢) يشمل كل سؤال سبعة اشكال، الشكل الاول الموجود على حده، هو شكل نمودجي • والمطلوب هو ان تجد من بين الاشكال الستة الباقية الشكل الذي يشابه تماما الشكل النمودجي •

(٣) انظر الى الشكل النمودجي بدقة تامة • ثم انظر الى الاشكال الاخرى، واحدا بعد الآخر • كل واحد من هذه الاشكال يشابه نوعا ما الشكل النمودجي ولكن هناك شكلا واحدا فقط يشابهه تماما • جد هذا الشكل وضع علامة (x) في المربع الصغير المجاور له • فيما يلي مثل على ما هو مطلوب منك



الشكل رقم (١) الشكل رقم (٢) الشكل رقم (٣) الشكل رقم (٤) الشكل رقم (٥) الشكل رقم (٦)

الشكل النمودجي

انظر الى الشكل النمودجي • انه يتكون من خمس نقاط، اثنتان في الصف

الاعلى، واحده في المنتصف، واثنتان في الصف الاسفل •

لننظر الآن الى الاشكال الاخرى، واحدا بعد الآخر •

الشكل رقم (١) يتكون كذلك من خمس نقاط ولكن ترتيب هذه النقاط يختلف •

ولهذا فهو لا يشبه الشكل النمودجي •

لنأخذ الشكل رقم (٢) • انه يتكون من اربع نقاط فقط • ولهذا فهو ايضا لا

يشبه الشكل النمودجي • لنأخذ الآن الشكل رقم (٣) انه يتكون من خمس نقاط فقط •

ولكن مكان النقطة في الصف الاوسط يختلف عن مكانها في الشكل النمودجي • لهذا

فهو ايضا يختلف عن الشكل المطلوب • الآن لنأخذ الشكل رقم (٤) •

انه يشبه تماما الشكل النمودجي • ولهذا فهو الشكل الصحيح الذي نبحث عنه

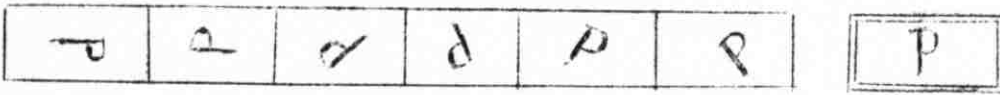
فضع علامة (x) في المربع الصغير ضمن الشكل الرابع وبما انه ليس هناك الا شكل

واحد فقط مطابق للشكل النمودجي • فلا حاجة بنا للنظر الى الشكل الخامس •

ولنجرب الآن الاسئلة التي تلي :

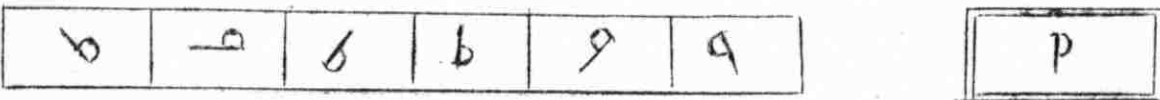
التعليقات

- انظر الى الاشكال السبعة التالية • الشكل النموذجي يمثل الحرف " P "
- باللغة الانكليزية • كل الاشكال الاخرى هي مشابهة للحرف النموذجي ولكنها قد قلبت بطرق مختلفة ، وبأماكنك اذا امكن ايا من هذه الاحرف نحو اليمين او الشمال ان تجعله مشابها تماما للحرف النموذجي • جرب ذلك ليتأكد لك •



الشكل النموذجي

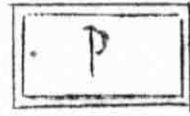
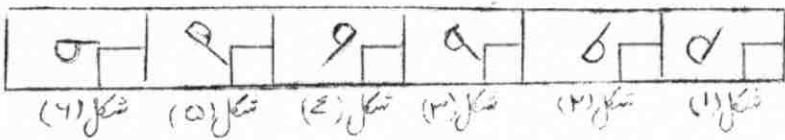
- انظر الآن الى الاشكال السبعة التالية • الشكل النموذجي يمثل الحرف " P "
- باللغة الانكليزية • ولكن ليس هناك اي حرف من الاحرف الستة الباقية يشبهه • اذا ادركت هذه الاحرف يمينا او شمالا لكي تجعلها مشابهة تماما للحرف النموذجي فلن تقدر ان تجعل ايا منها مشابها تماما له • جرب ذلك ليتأكد لك •



الشكل النموذجي

- وانظر الآن الى الاشكال التالية : الشكل النموذجي يمثل الحرف " P " باللغة الانكليزية • ولكي تصبح الاشكال الاخرى بشكل الحرف " P " تماما ، ينبغي ان تديرها الى اليمين او الشمال • حاول ان تدير هذه الاشكال فتجد ان بعضها منها يصبح مشابها تماما للحرف النموذجي (P) ، والبعض الآخر بهذا الشكل (q) ، اى انه يختلف عن الشكل النموذجي •

- المطلوب هو ان تشير الى الاشكال التي تصبح تماما ، حين تديرها الى اليمين او الشمال ، مثل الحرف النموذجي " P " ، فتضع علامة (x) في المربع الصغير الموجود ضمن كل من الاشكال الملائمة للمطلوب



الشكل النموذجي

ولنأخذ الآن هذه الاشكال ، واحدا بعد الآخر .

اذا ادرت الشكل رقم (1) الى اليمين او الشمال بطريقة تجعل اعلاه الى فوق

تجد انه يظهر هكذا (P) ، وانه يشبه تماما الشكل النموذجي (P) . فلذلك نضع

علامة (x) في المربع الصغير ، كما يظهر في الصورة ، للدلالة على ان الشكل رقم (1)

يشبه الشكل النموذجي وانا ادرت الشكل رقم (2) يمينا او شمالا بطريقة تجعل اعلاه

الى فوق ، تجد انه يظهر هكذا (9) وانه يختلف عن الشكل النموذجي (P) .

فلذلك لا نضع اى علامة في المربع الصغير ، للدلالة على ان الشكلين لا يتشابهان .

لنأخذ الشكل رقم (3) . عندما تديره ليصبح اعلاه الى فوق ترى انه يشابه

تماما الشكل (9P) .

لذا نضع الاشارة (x) في المربع المخصص لذلك .

لنأخذ الآن الشكل رقم (4) فنديره الى اليمين ونجد انه يختلف عن الحرف

(P) .

وانا اخذنا الشكل رقم (5) نجد انه يشبه الحرف " P " تماما . بعد ان نديره

فنضع اشارة (x) في المربع المخصص . وعندما ندير الشكل رقم (6) نجد انه يختلف

عن الشكل النموذجي ، فنترك المربع الصغير فارقا .

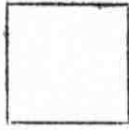
والآن ، اقلب الصفحة واجب الى الاسئلة التالية : -

٢ - مقابلة الاشكال (العكس)

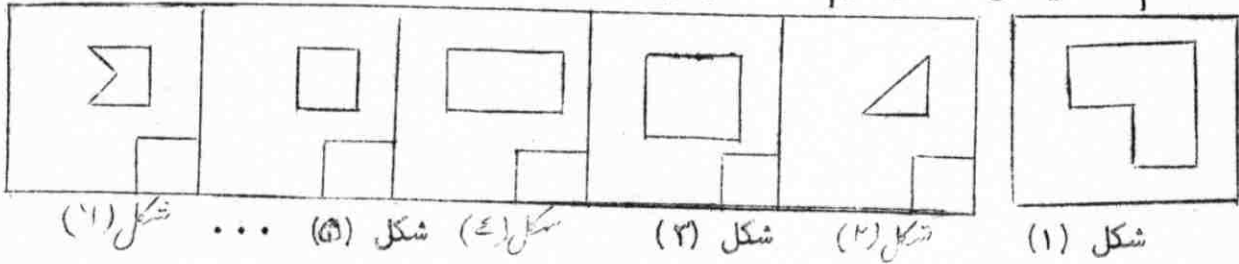
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ح	ح	ح	ح	ح	ح	ح
ط	ط	ط	ط	ط	ط	ط
ق	ق	ق	ق	ق	ق	ق
ك	ك	ك	ك	ك	ك	ك

٣- اختبار في اكمال الاشكال الناقصة .

- هنا نوع آخر من الاختبارات • واليك تمرينا منه على سبيل المثال •
انظر الى المربع المرسوم امامك :



ثم انظر الى الشكل رقم (١) الموجود ادناه .

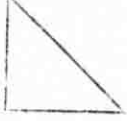



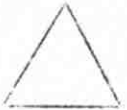

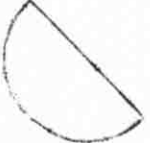

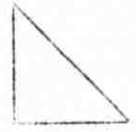


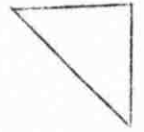




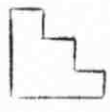







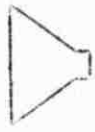




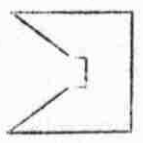





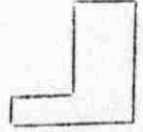


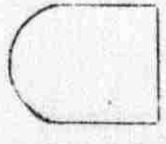





فترى انه يشبه المربع المرسوم اعلاه ، الا ان جزءا منه ناقص .

- ٢- انظر الى الاشكال الخمسة التي تلي الشكل رقم (١) وفتش عن الرسم الذي
حالما تتجمع الى الشكل رقم (١) ، يؤول معه مريعا مثل المربع المرسوم اعلاه .
- ٣- رسم واحد من بين الاشكال الخمسة هو الجواب الصحيح المطلوب .
- ٤- ضع علامة (x) في المربع الصغير الموجود ضمن الرسم المطلوب ليكمل الشكل
رقم (١)





٣- اختبار في المجال الأشكال الناتجة

٣- اختيار في المجال الاشكال الناقصة

٤- اختبار في تنظيم الرسوم بواسطة جمع القطع

١- هنا عدد آخر من الاسئلة .

لدينا اربعة انواع من القطع ، هي رقم (١)  ، رقم (٢)  ، رقم (٣)  ، رقم (٤) 

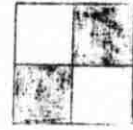
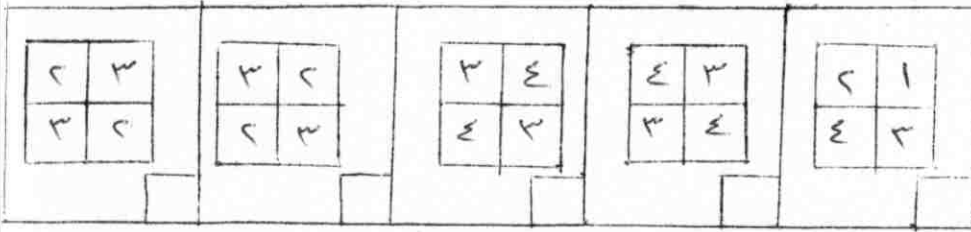
ولدينا من كل نوع عدد كبير من القطع .

٢- اذا جمعت هذه القطع بعضها الى بعض في ترتيب ما ، يكون لدينا رسمة من

نوع ما ، وانما جمعت في ترتيب آخر ، يكون لدينا رسمة من نوع آخر .

٣- في السؤال المعطى ادناه ، الصورة الموجودة الى اليمين على حده ، هي نموذجي .

والاشكال التي تلي الصورة النموذجية هي ترتيبات مختلفة للقطع الموجودة اعلاه حسب ارقام

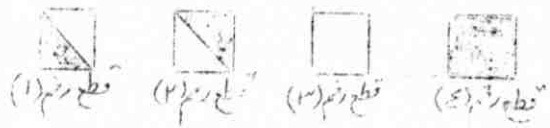


رسم نموذجي

٤- هناك شكل واحد من الاشكال الخمسة فيه القطع مرتبة بطريقة تشبه تماما الرسم النموذجي .

٥- فتش عن هذا الشكل ، وضع علامة (x) في المربع الصغير المخصص للجواب

٤- اختبار في تنظيم الرسوم بواسطة جغ القطع



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APPENDIX B

اختبار في العلاقات البصرية

اعده : س . م اعجاز - تلميذ متخرج من دائرة التربية - الجامعة الايرانية في بيروت .
تحت مراقبة الاساتذة : عطية - كين - مليكيان - من الجامعة الاميرتية في بيروت .

الاسم :
العمر : سنوات اشهر
الصف : المدرسة : التاريخ

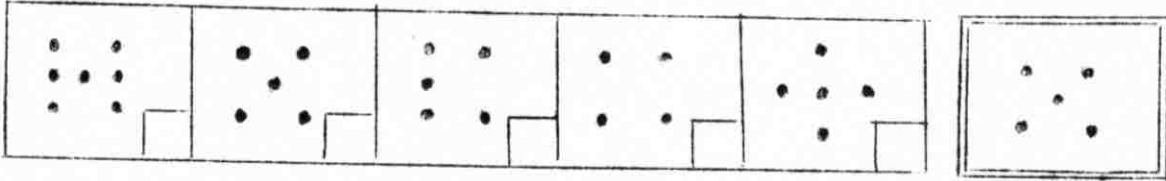
تعليمات عامة

- ٠١ ستأخذ سلسلة من الامتحانات
- ٠٢ كل امتحان له تعليماته الخاصة - اقرأها بانتباه قبل ان تباشر بالعمل .
كل امتحان يحتوى على تمرين ، تأكد انك تفهم هذا التمرين .
- ٠٣ ليس هناك وقت محدد لهذا الامتحان ، بإمكانك ان تأخذ من الوقت ما تحتاج اليه . ولكن ليس من الضروري ان تأخذ وقتا طويلا بلا فائدة فحاول ان تنتهي بأسرع ما يمكن . لا تفتح ورقة الامتحان حتى يطلب منك ذلك .

٠١ اختبار في مقارنة الاشكال (التشابه)

التعليمات

- (١) يشمل كل سؤال ستة اشكال ، الشكل الاول الموجود على انفراد ، هو شكل نمودجي . والمطلوب هو ان تجد من بين الاشكال الخمسة الباقية الشكل الذي يشابه تماما الشكل النمودجي ، مع العلم ان هناك شكلا واحدا فقط يشابهه .



شكل نمودجي شكل (١) شكل (٢) شكل (٣) شكل (٤) شكل (٥)

- (٢) انظر الى الشكل النمودجي المرسم اعلاه . انه يتكون من خمس نقاط ، اثنتان في الصف الاعلى ، واحدة في المنتصف واثنتان في الصف الاسفل .
لننظر الآن الى الاشكال الاخرى ، واحدا بعد الآخر .
الشكل رقم (١) يتكون كذلك من خمس نقاط ، ولكن ترتيب هذه النقاط يختلف . ولذلك ، فهو لا يشبه الشكل النمودجي .
لنأخذ الشكل رقم (٢) . انه يتكون من اربع نقاط فقط . ولهذا فهو ايضا لا يشبه الشكل النمودجي .

- (٣) تابع البعث عن الشكل الذي يشابه الشكل النمودجي ، وعندما تجده ضع علامة (x) في المربع الصغير الموجود في زاوية الشكل المطلوب .

(٤) لا تقلب الصفحة حتى يشار اليك بذلك .

- (٥) عندما يشير اليك المراقب ، اقلب الصفحة واجب على كل ما يمكنك من الاسئلة .
بوسمك ان تأخذ كل ما تحتاج اليه من وقت . حاول ان تجيب على كل الاسئلة

ولو لم تكن واثقا من الجواب .

شکل نمونہ جی

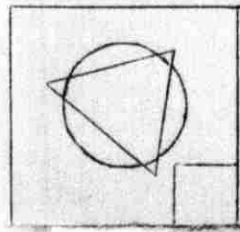
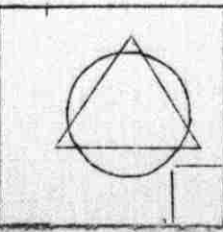
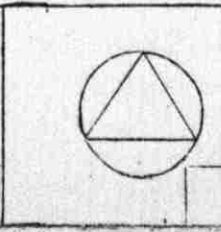
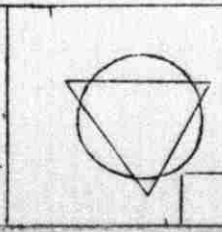
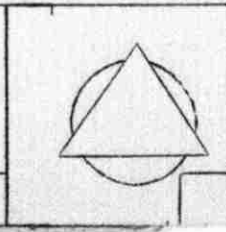
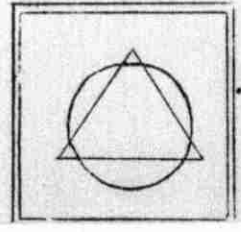
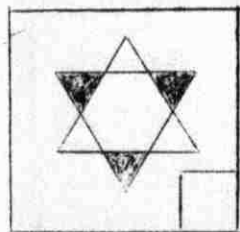
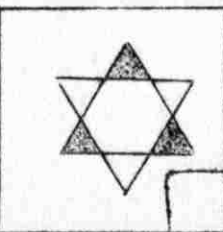
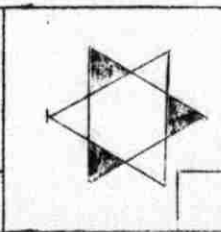
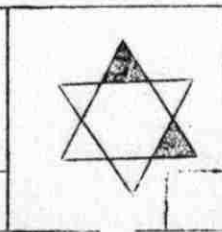
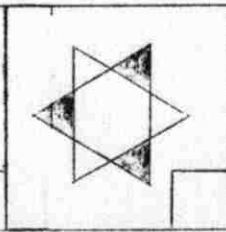
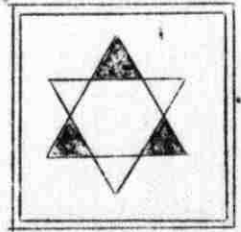
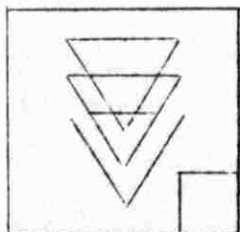
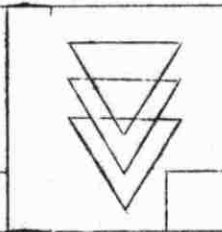
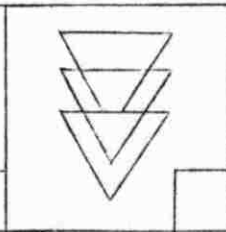
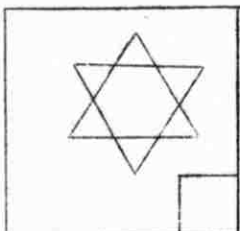
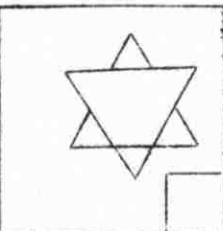
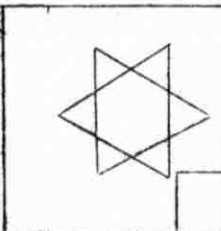
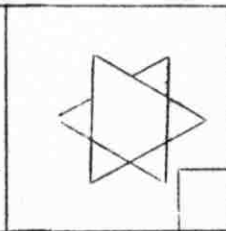
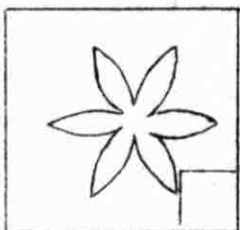
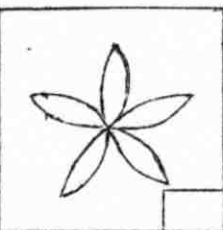
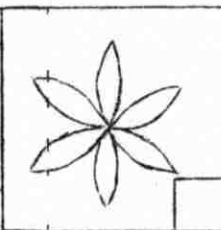
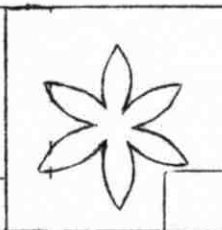
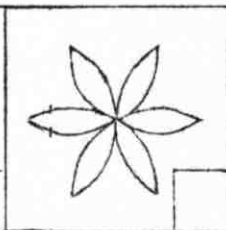
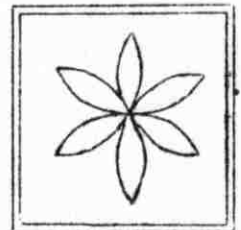
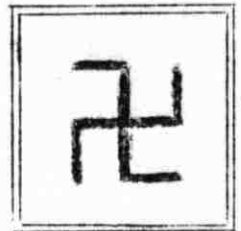
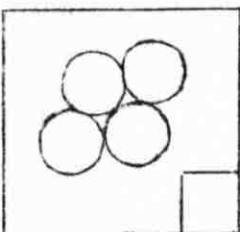
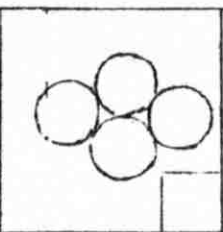
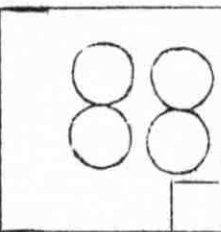
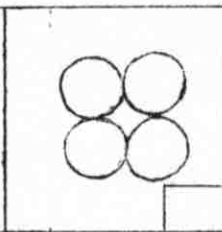
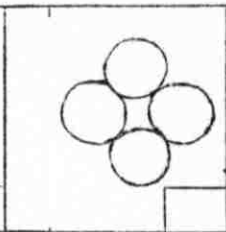
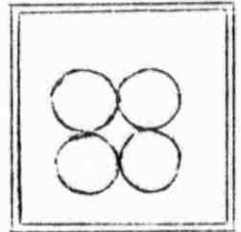
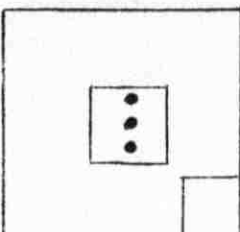
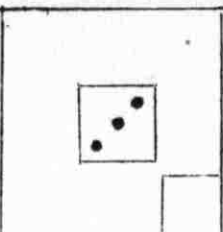
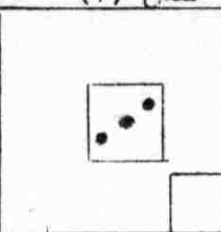
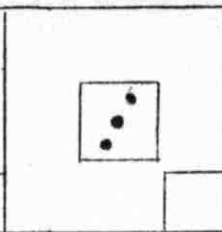
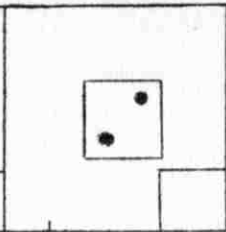
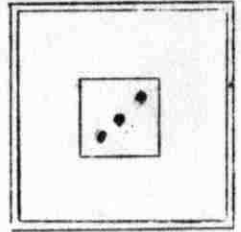
شکل (۱)

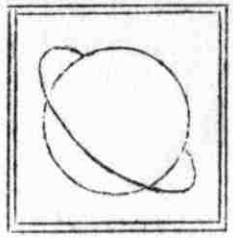
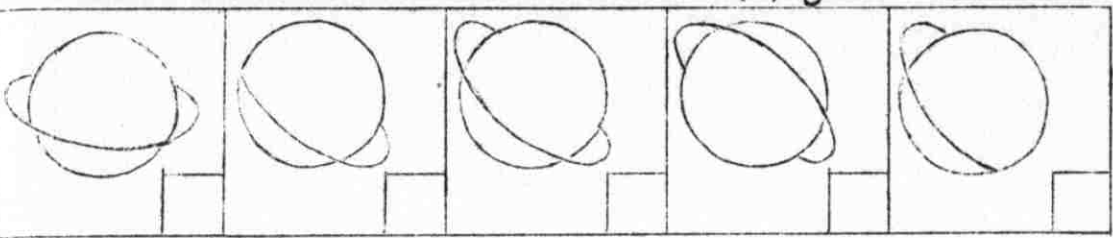
شکل (۲)

شکل (۳)

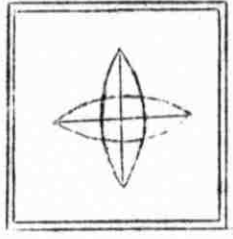
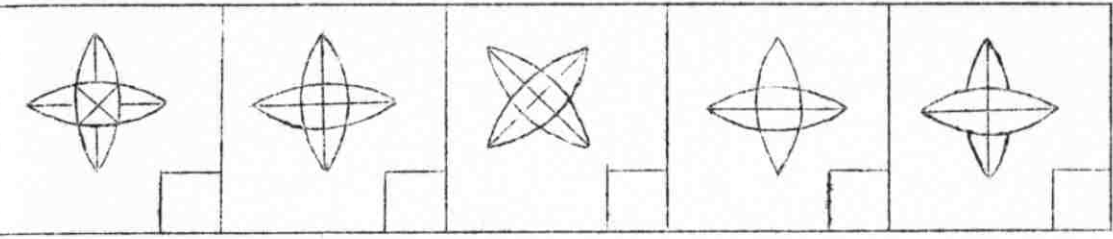
شکل (۴)

شکل (۵)

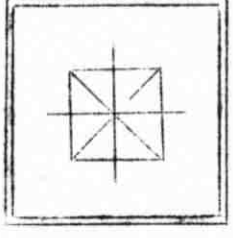
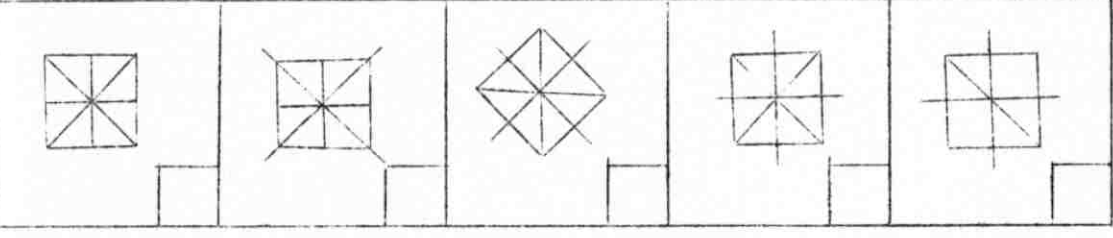




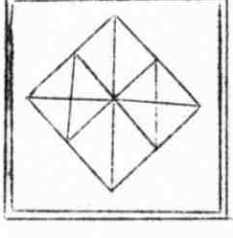
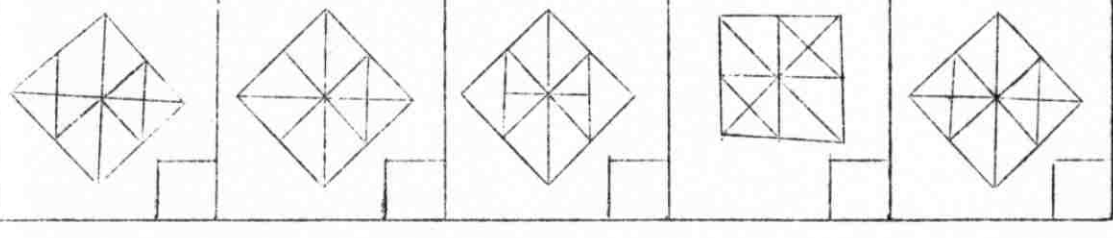
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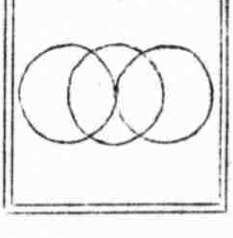
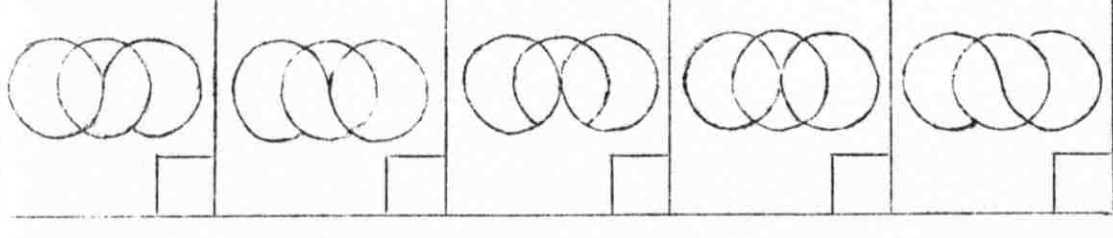
۱۰



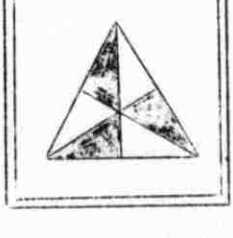
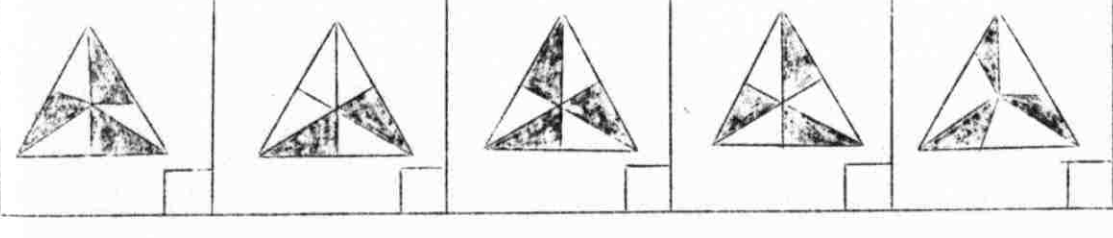
۱۱



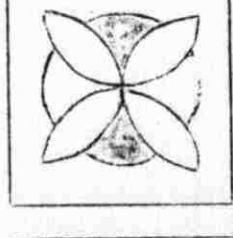
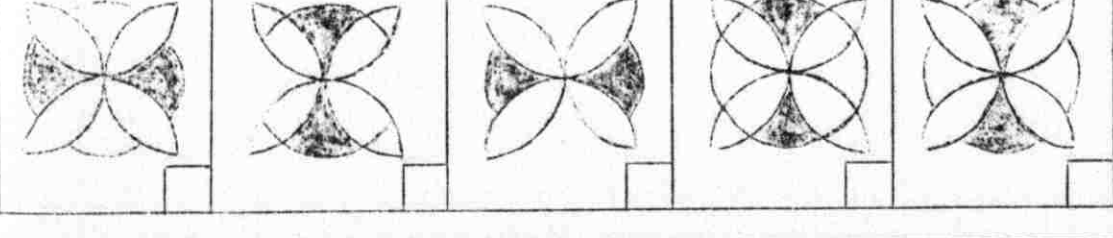
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RPB BPR BRR RPR BRP

BPR

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CQO QOC COQ COC QOQ

COQ

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EEE EEF EFF EFE FEE

EFE

۱۸

شکل (۵)

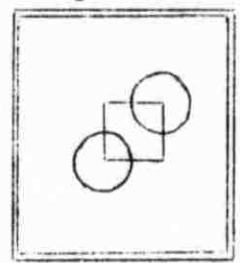
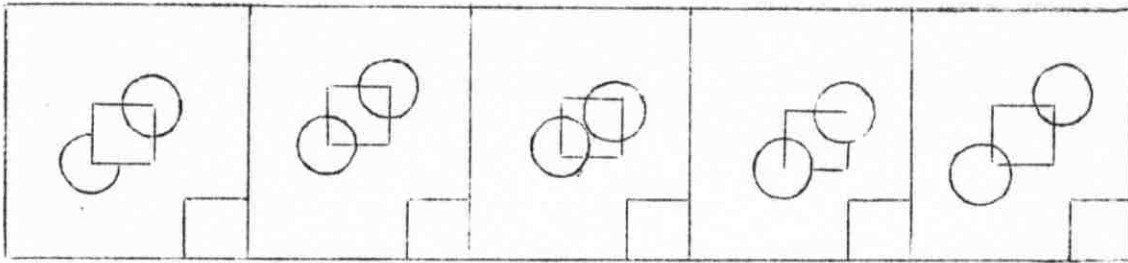
شکل (۴)

شکل (۳)

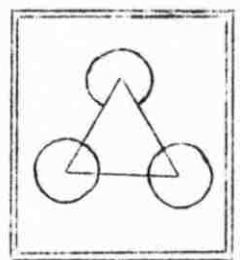
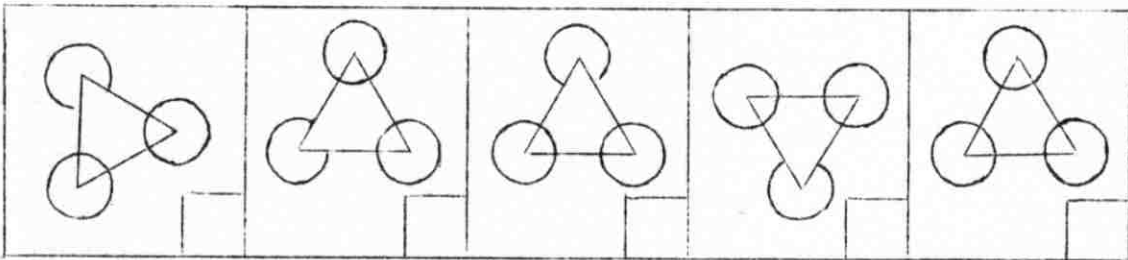
شکل (۲)

شکل (۱)

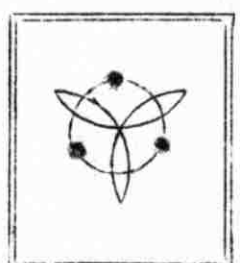
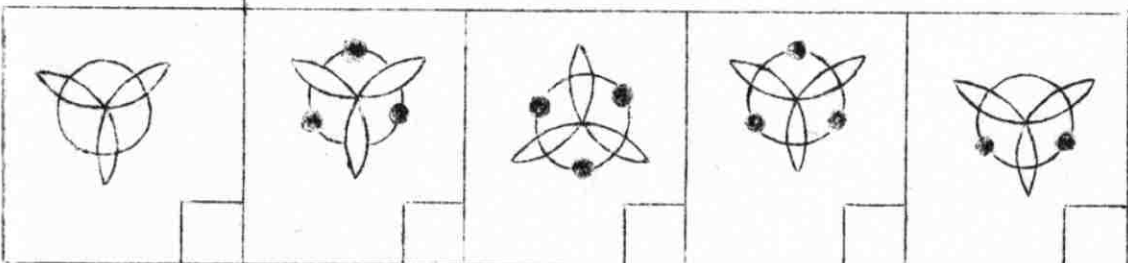
شکل نمونہ جي



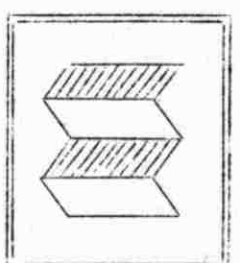
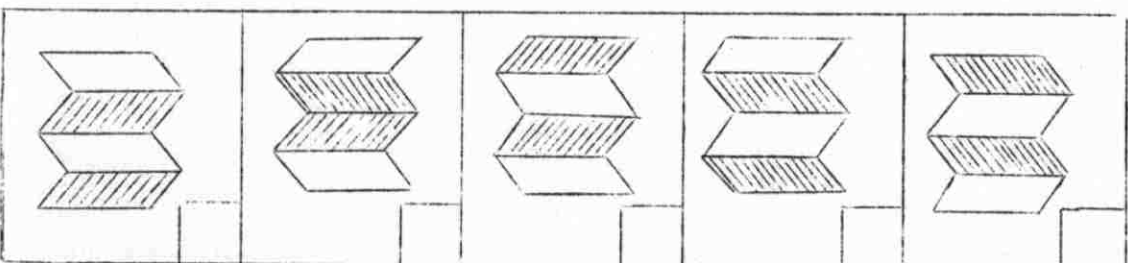
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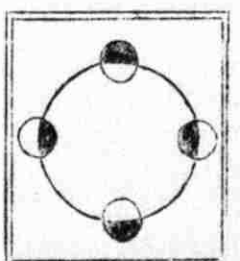
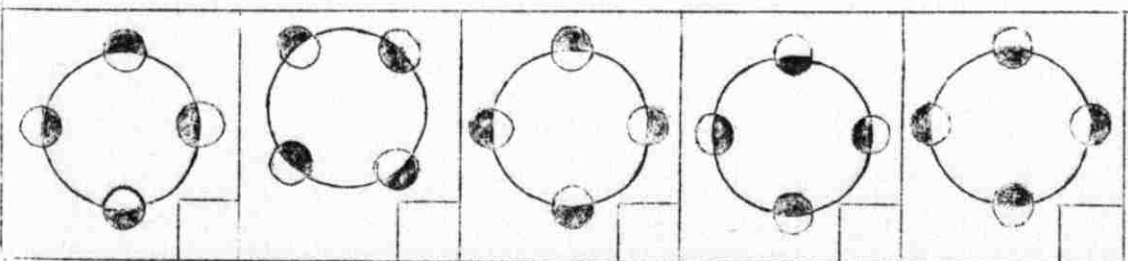
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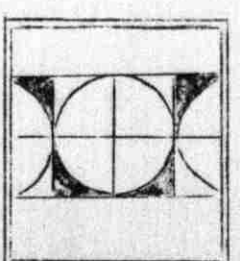
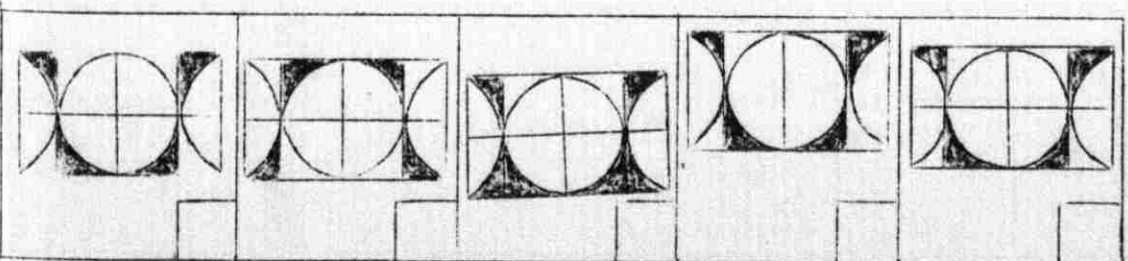
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شکل (٥)

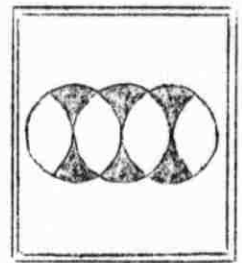
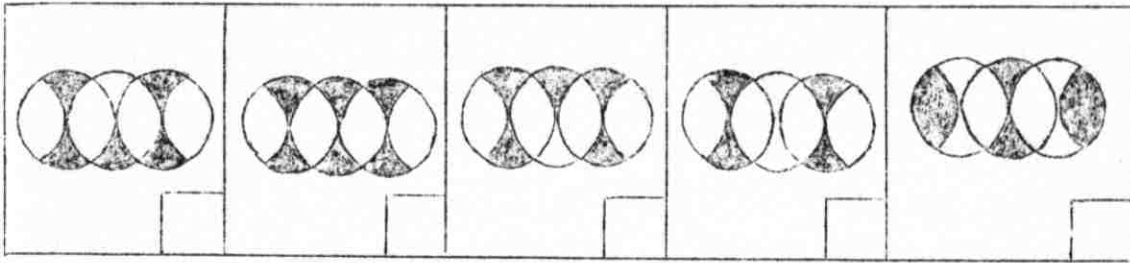
شکل (٤)

شکل (٣)

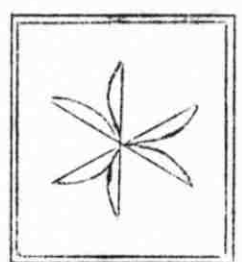
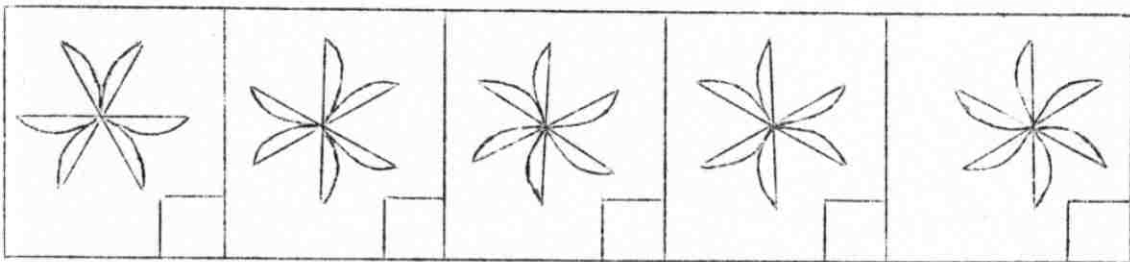
شکل (٢)

شکل (١)

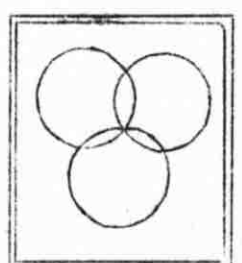
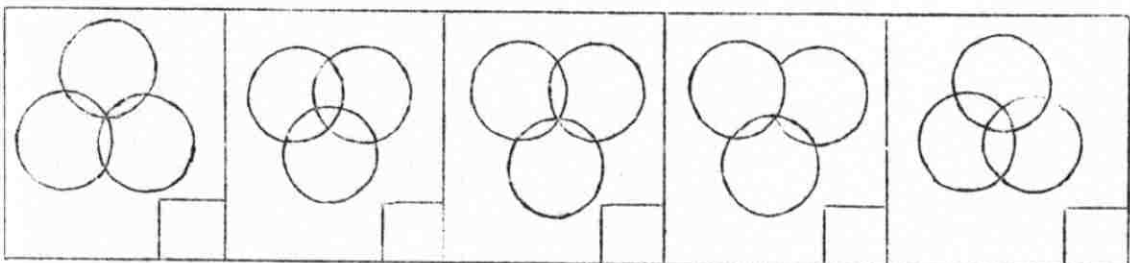
شکل نمونہ جی



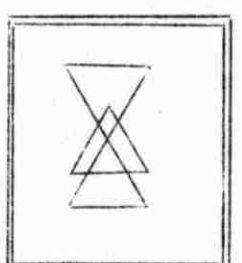
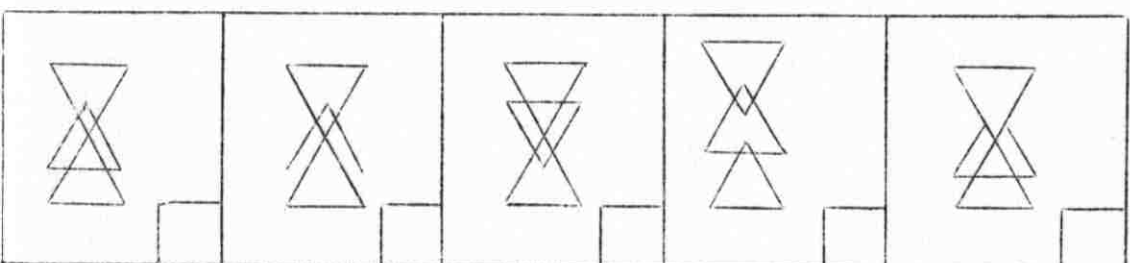
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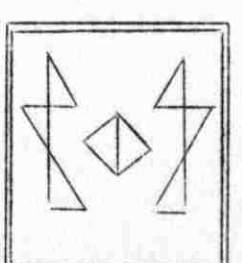
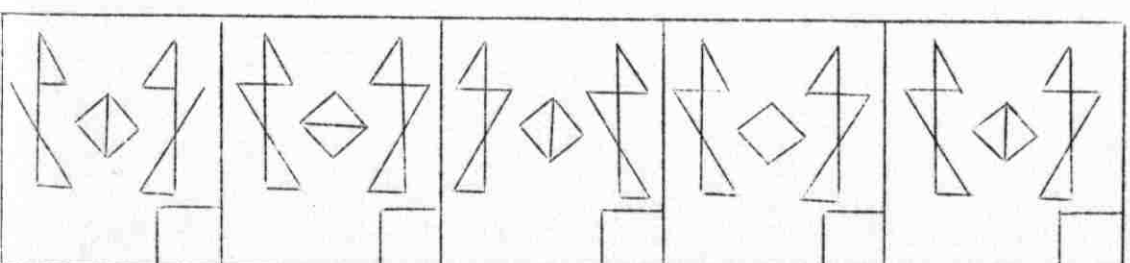
٢٦



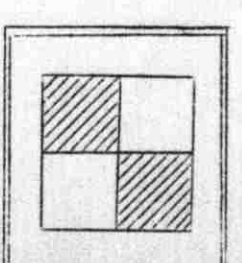
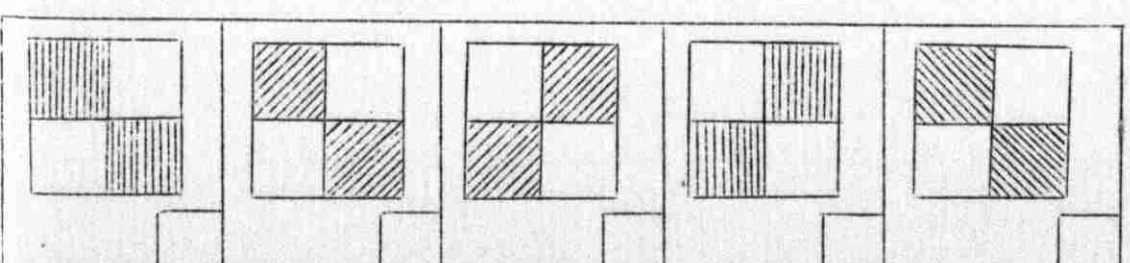
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التعليمات

(١) انظر الى الاشكال الستة التالية :

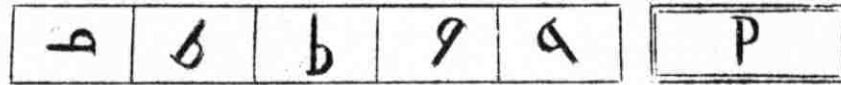


الشكل النموذجي

الشكل النموذجي يمثل الحرف " P " باللغة الافرنيةية . كل الاشكال الاخرى

مشابهة للحرف النموذجي ، ولكننا قلبت بطرق مختلفة ، وبأماكنك اذا اذرت ايا من هذه الاحرف نحو اليمين او الشمال ان تجعله مشابها تماما للحرف النموذجي . جرب ذلك ليتأكد لك .

(٢) انظر الآن الى الاشكال الستة التالية :

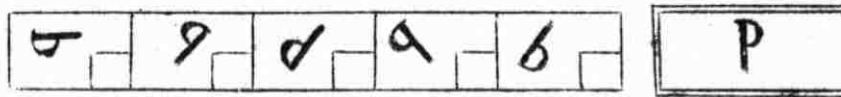


الشكل النموذجي

الشكل النموذجي يمثل الحرف " P " باللغة الافرنيةية . اذا اذرت الاحرف الباقية

يمينا او شمالا لكي تجعلها مشابهة تماما للحرف النموذجي فلن تقدر ان تجعل ايا منها مشابها تماما له . جرب ذلك ليتأكد لك .

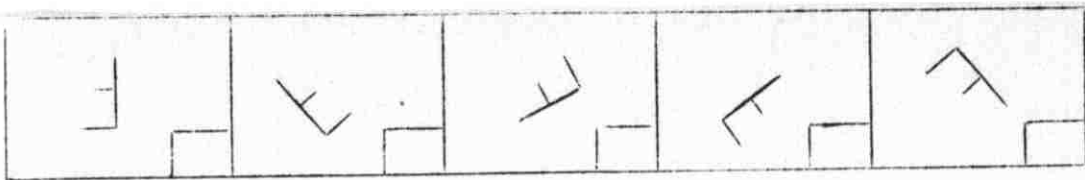
(٣) وانظر الآن الى الاشكال التالية :



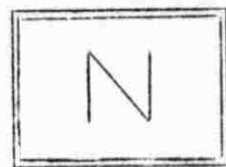
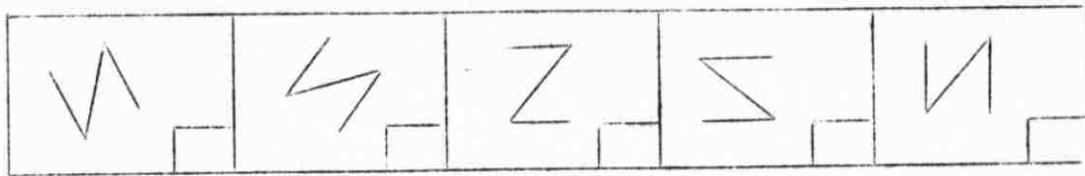
الشكل النموذجي

الشكل النموذجي يمثل الحرف " P " باللغة الافرنيةية . ولكي تصبح الاشكال

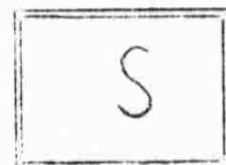
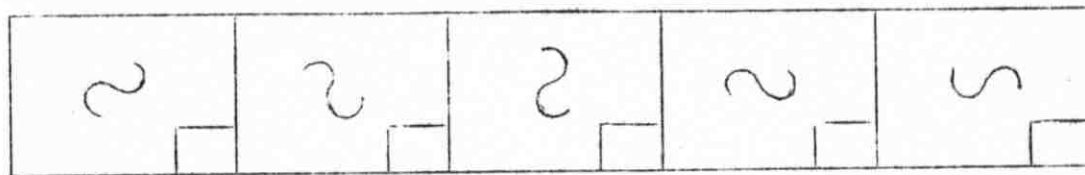
الاخرى بشكل الحرف " P " تماما ، ينبغي ان تديرها الى اليمين او الشمال . حاول ان تدير هذه الاشكال ، يمينا او شمالا ، ^{فتجد} ان بعضها منها يصبح بهذا الشكل (٩) ، اى انه يختلف عن الشكل النموذجي . ولكن واحدا منها يصبح مشابها تماما للحرف النموذجي . المطلوب هو ان تشير الى هذا الشكل الذي يصبح ، بعد ان تديره يمينا او شمالا ، تماما مثل ، مثل الحرف النموذجي " P " ، فتضع علامة (x) في المربع الصغير المخصص للجواب .
(٤) عندما يشار اليك ، اقلب الصفحة وحاول ان تجيب على كل الاسئلة ، وان لم تكن واثقا من الجواب .



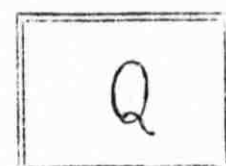
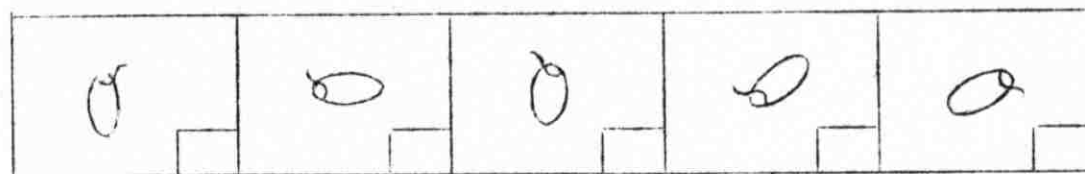
२१



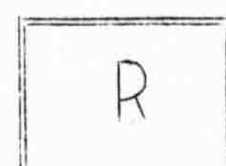
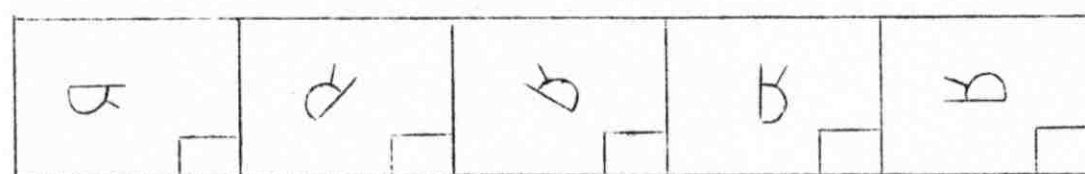
२२



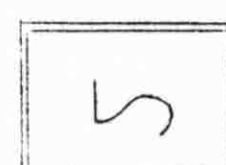
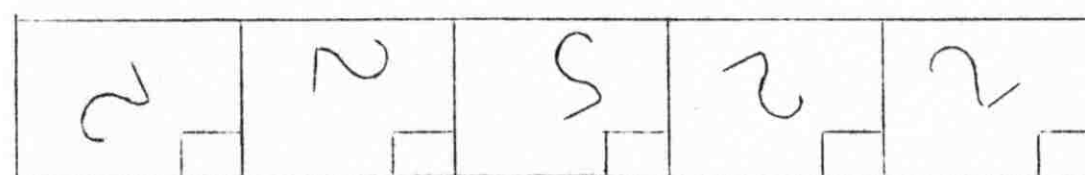
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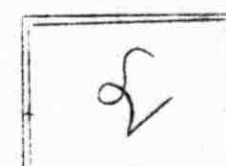
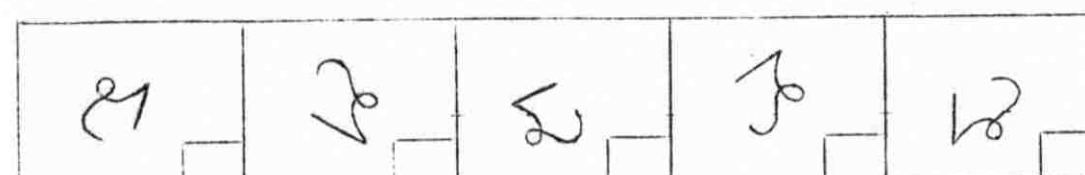
२४



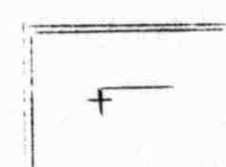
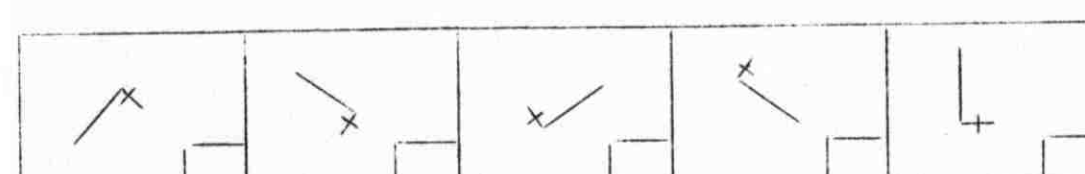
२५



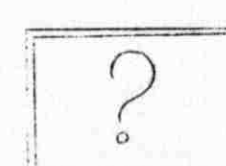
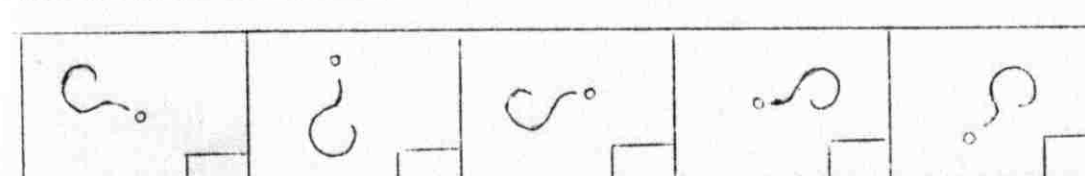
२६



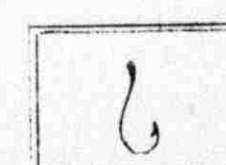
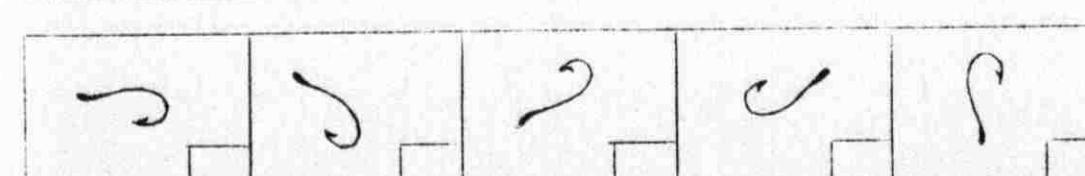
२७



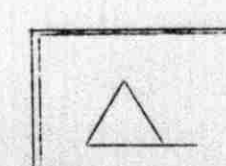
२८



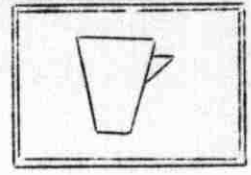
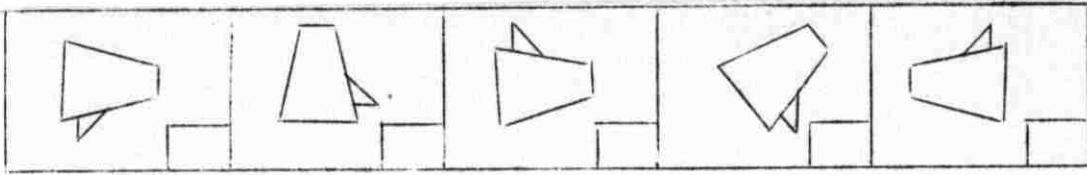
२९



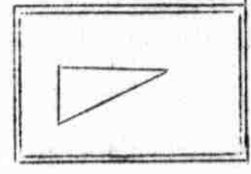
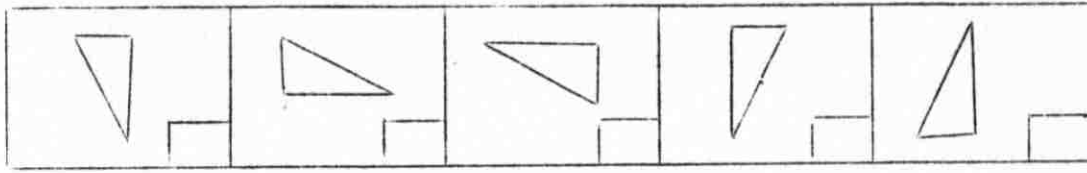
३०



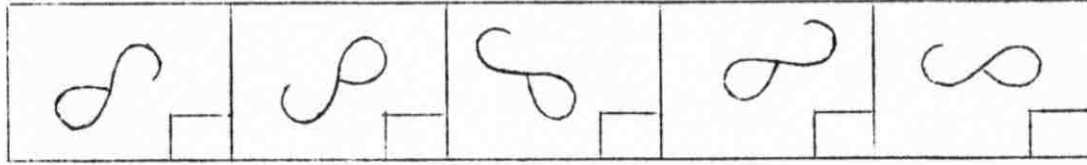
३१



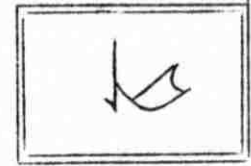
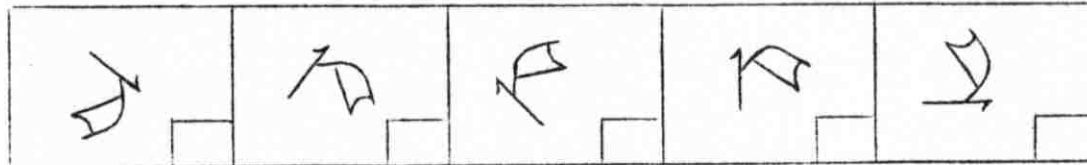
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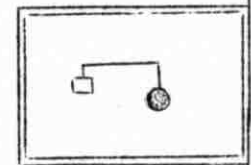
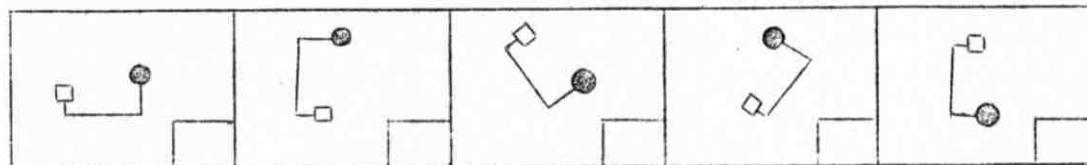
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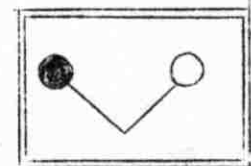
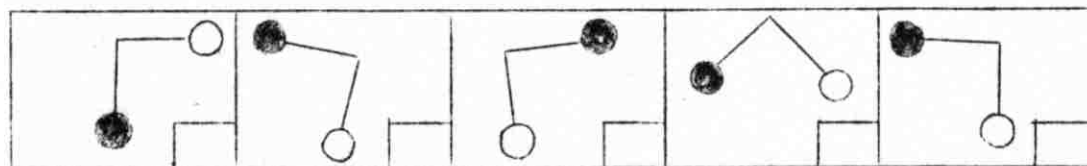
۳۴



۳۵



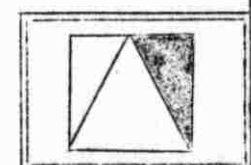
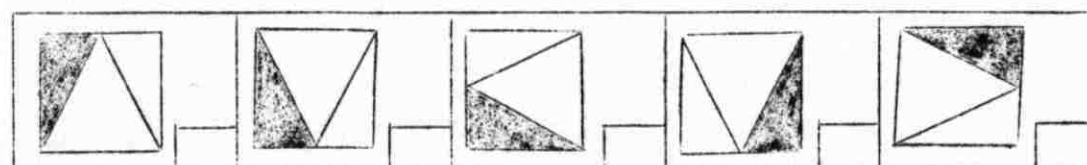
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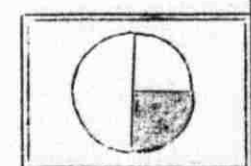
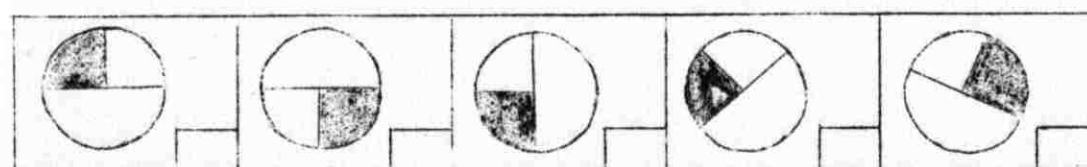
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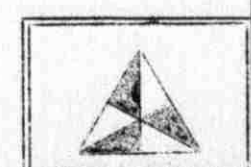
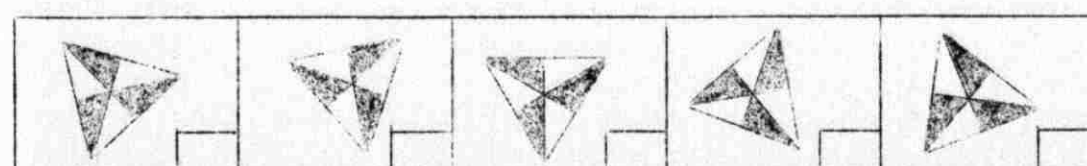
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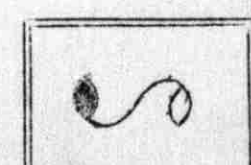
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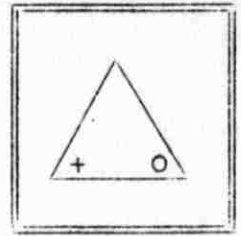
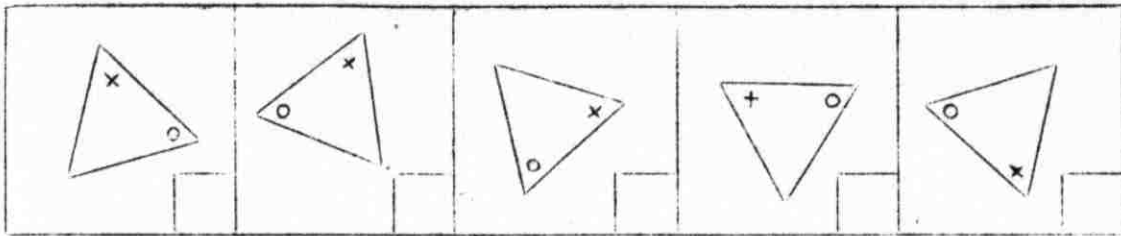
۴۰



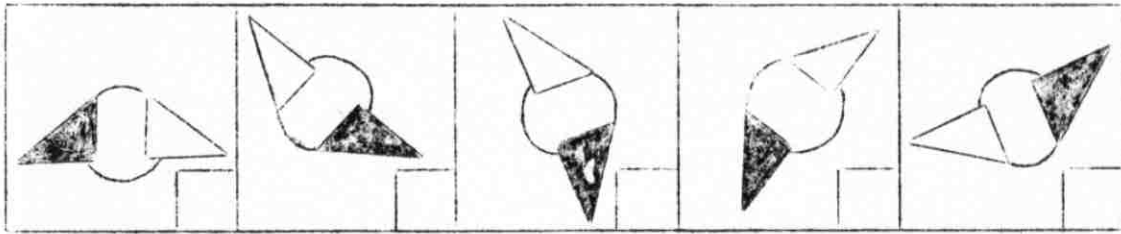
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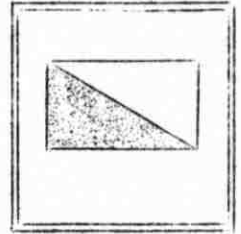
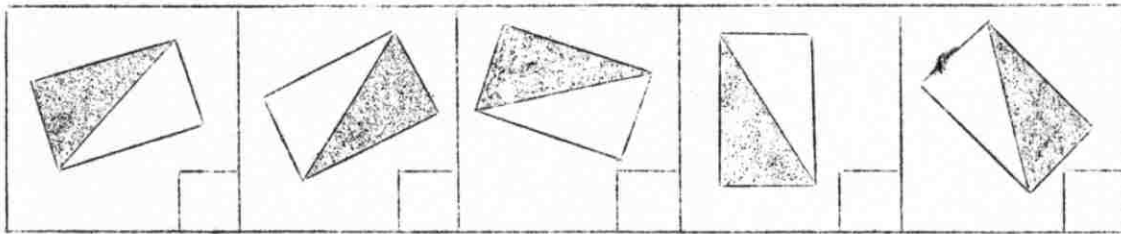
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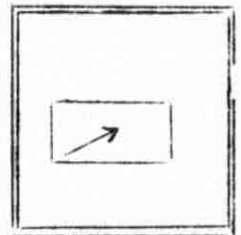
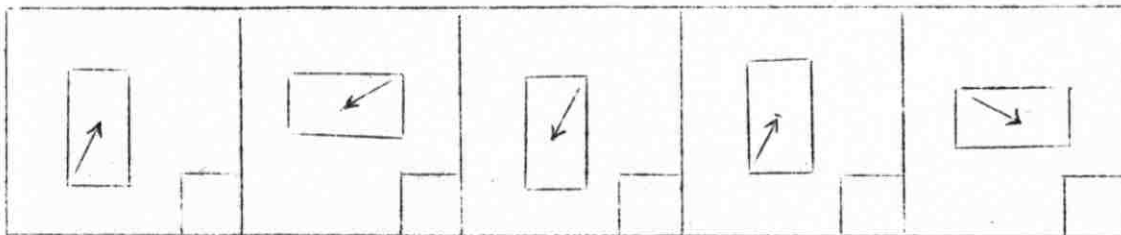
02



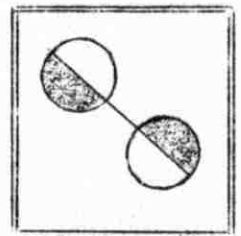
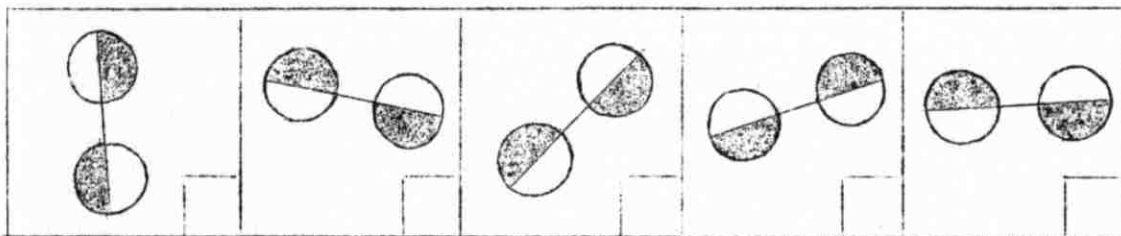
03



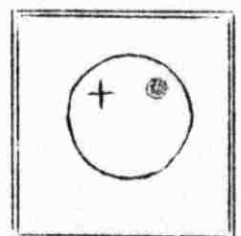
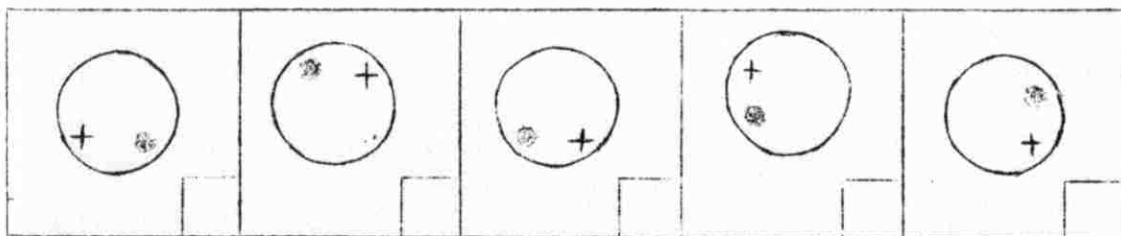
00



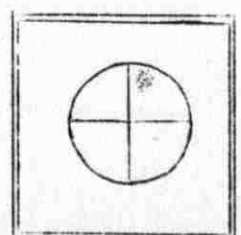
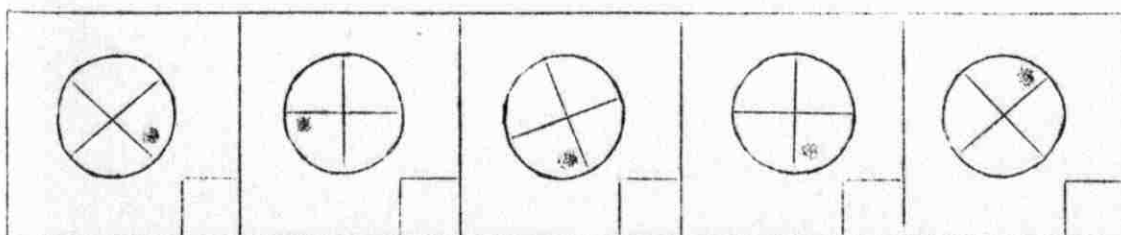
07



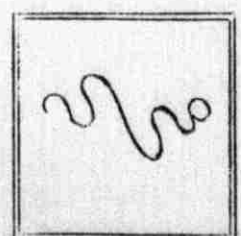
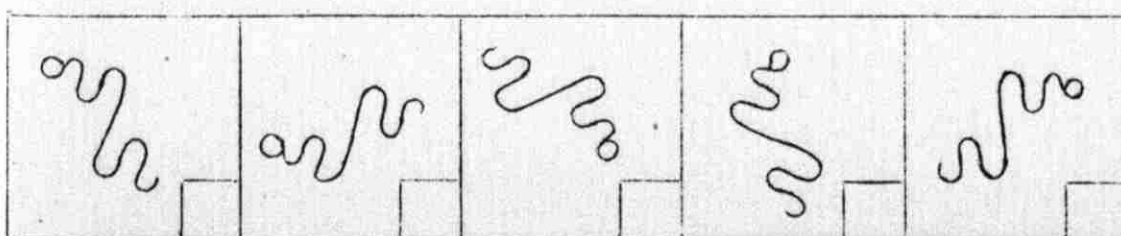
07



08



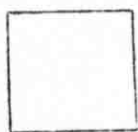
09



10

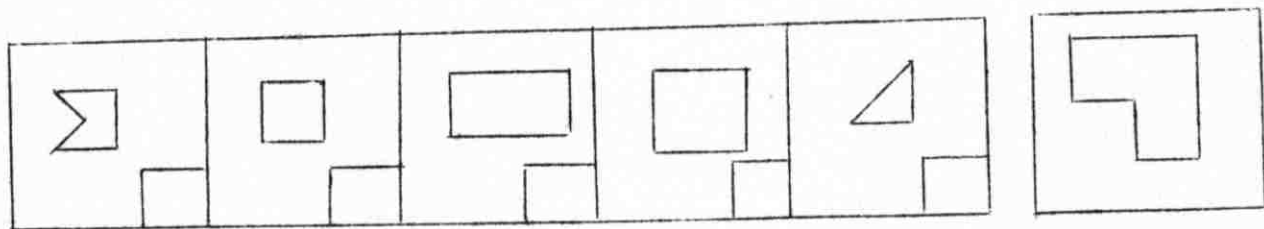
اختبار في اكمال الاشكال الناقصة

- هنا نوع آخر من الاختبارات • واليك تمرينا منه على سبيل المثال •
- انظر الى المربع المرسوم امامك :



شكل نموذجي

- ثم انظر الى الشكل رقم (١) الموجود ادناه •



شكل (١) شكل (٢) شكل (٣) شكل (٤) شكل (٥) شكل (٦)

فقرى انه يشبه المربع المرسوم اعلاه ، الا ان جزءا منه ناقص •

(٢) انظر الى الاشكال الخمسة التي تلي الشكل رقم (١) وفشى عن الرسم الذي

حالما تجمعه الى الشكل رقم (١) ، يؤولف محه مربعا مثل المربع المرسوم اعلاه •

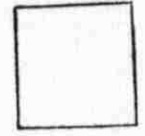
(٣) رسم واحد من بين الاشكال الخمسة هو الجواب الصحيح المطلوب •

(٤) ضع علامة (x) في المربع الصغير الموجود ضمن الرسم المطلوب ليكمل الشكل رقم (١)

(٥) لا تقلب الصفحة حتى يشير اليك المراقب بذلك •

اختبار في أعمال الأشغال الناقصة

التعليمات: الشكل النموذجي هو المربع المرسم اعلاه .
المطلوب هو ان تقرر من الشكل الذي متى اضفته الى الشكل (1)
يولفمعه مربعا مثل المربع النموذجي . ابدأ .



شكل نموذجي

شكل (1)

شكل (7)

شكل (5)

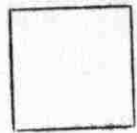
شكل (4)

شكل (1)

شكل (2)

					1
					2
					3
					4
					5
					6
					7

التعليقات: الشكل النموذجي هو المربع المرسم اعلاه .



شكل نموذجي
شكل (1)

المطلوب هو ان تفتش عن الشكل الذي متى اضيفه الى الشكل (1)

يؤلف معه مربعاً مثل المربع النموذجي . ابدأ .
شكل (7) شكل (7) شكل (7) شكل (7) شكل (7)

شكل (6)

						- 8
						- 9
						- 10
						(1) 10
						(ب) 10
						(ت) 10
						(ث) 10

(٢) السؤال هو ان تفتش عن الشكل الذي متى اضفته الى الشكل

رقم (١) يولف معه دائرة مثل الدائرة النموذجية •

الشكل النموذجي

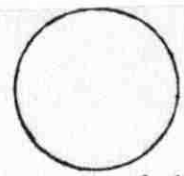


شكل (٦)	شكل (٥)	شكل (٤)	شكل (٣)	شكل (٢)	شكل (١)	
						-١١
						-١٢
						-١٣
						-١٤
						-١٥
						-١٦
						-١٧

التلميحات: (٢) الشكل النموذجي هو الدائرة المرسومة الى جانب هذا الكلام

(٢) السؤال وان تفتح عن الشكل الذي متى اشفته الى

الشكل رقم (١) يوافق منه دائرة مثل الدائرة النموذجية



الشكل النموذجي

شكل (١)

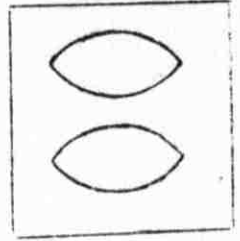
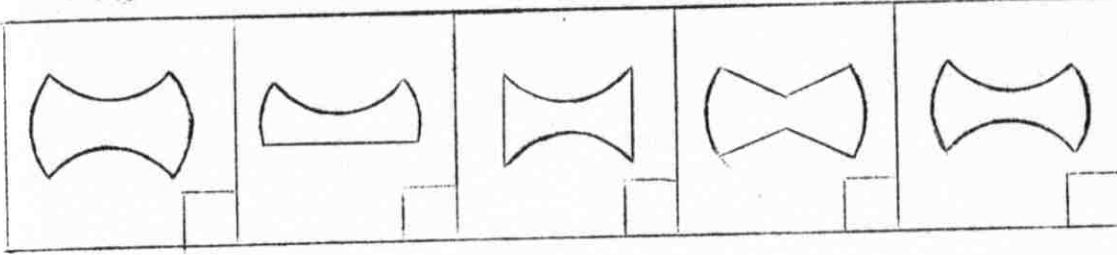
شكل (٦)

شكل (٥)

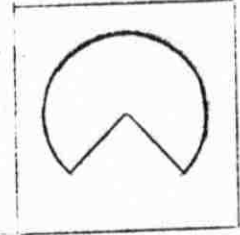
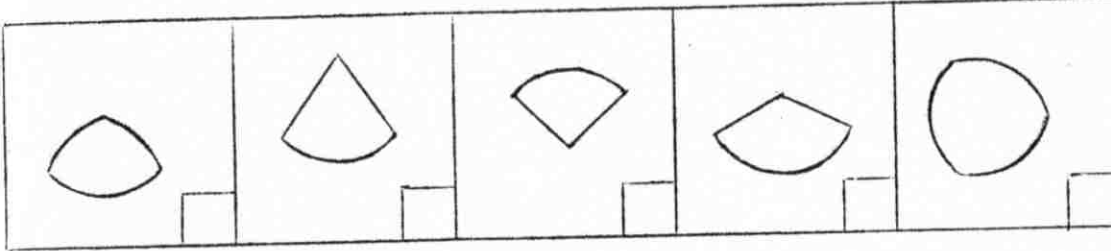
شكل (٤)

شكل (٣)

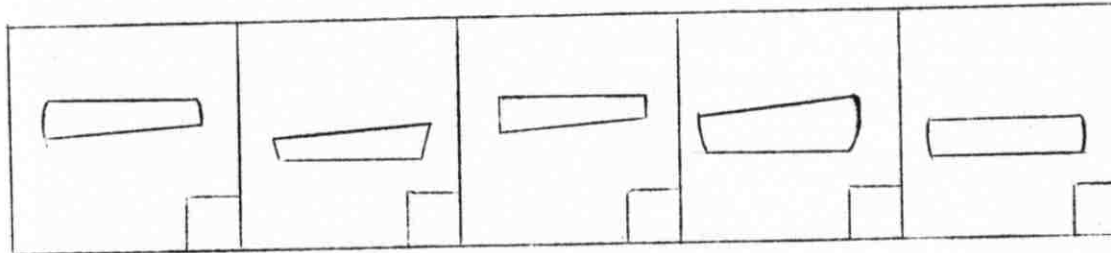
شكل (٢)



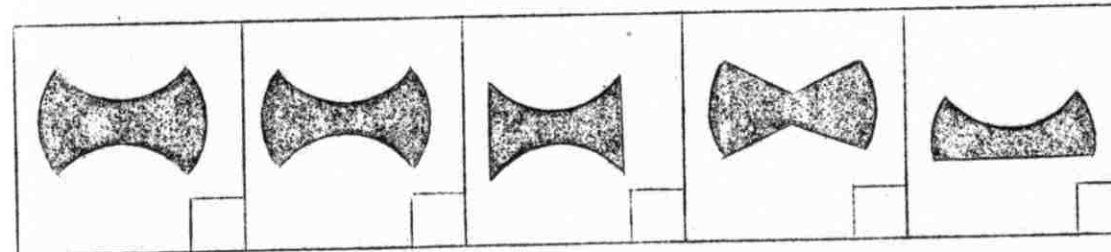
-١٨



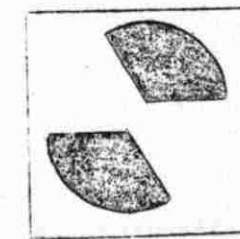
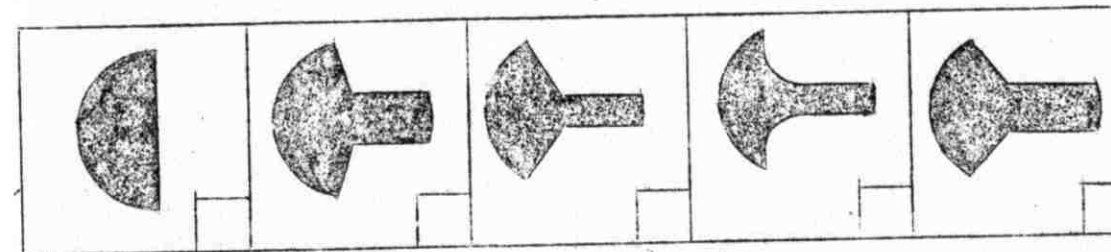
-١٩



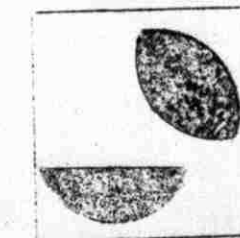
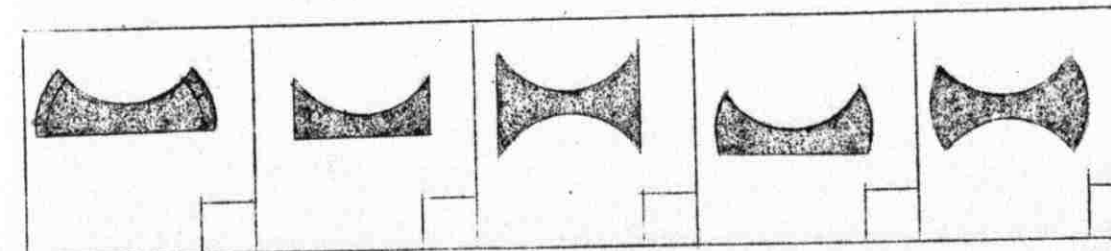
-٢٠



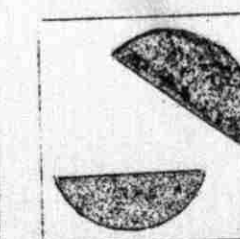
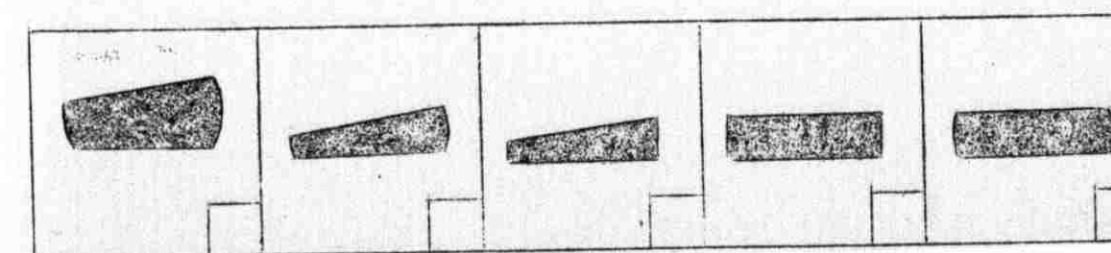
(١) ٢٠



(ب) ٢٠



(ت) ٢٠



(ث) ٢٠

التعليقات: (١) الشكل رقم (١) من كل من الاسئلة التالية ناقص.

واخذ من الاشكال الخمسة الباقية يكمله.

(١) المطلوب هو ان تفتش بين الاشكال الخمسة الباقية

عن الشكل الذي يوئلف مع الشكل (١) رسماً كاملاً . ابدأ.

شكل (١) شكل (٢) شكل (٣) شكل (٤) شكل (٥) شكل (٦)

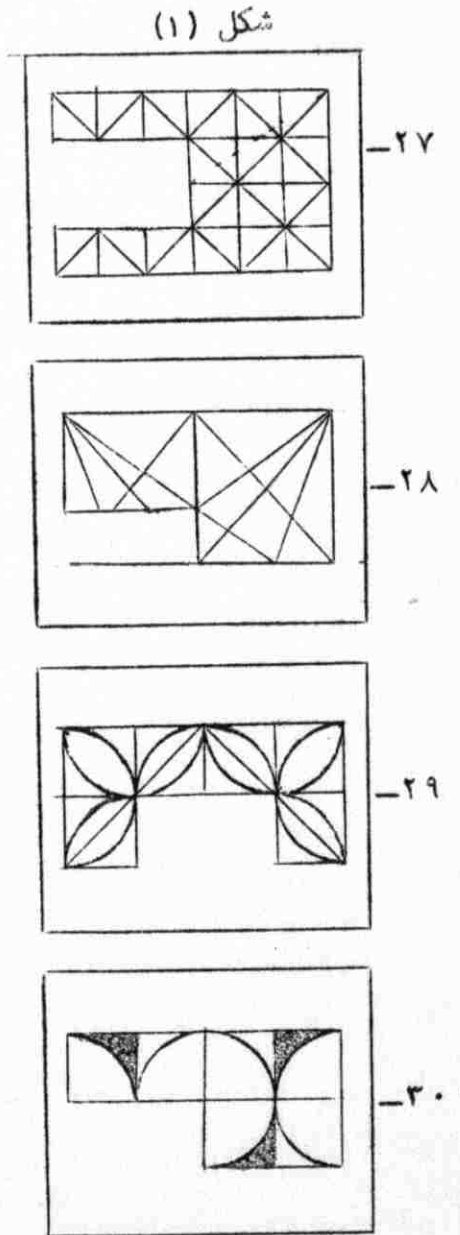
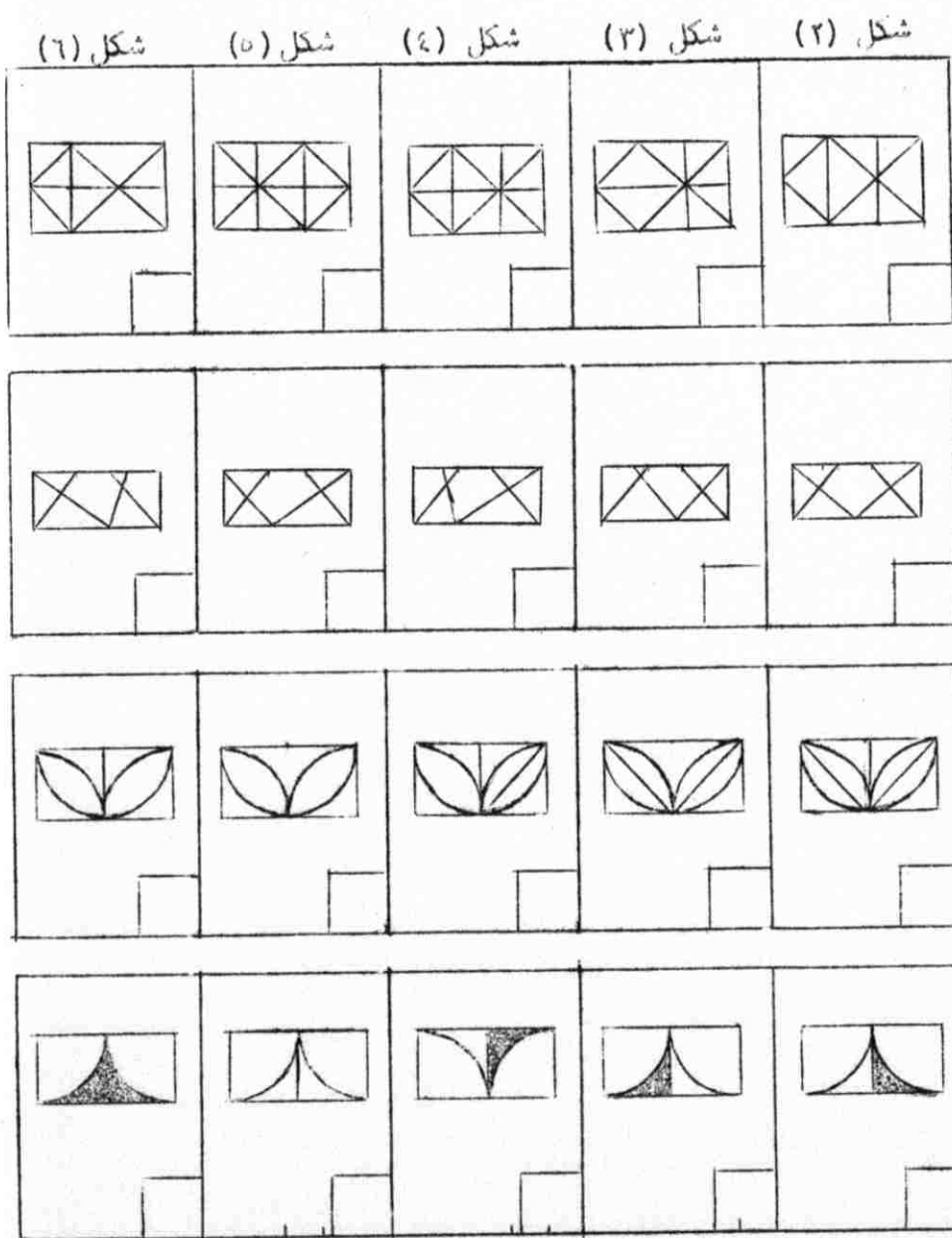
						شكل (١)	٢١-
						شكل (١)	٢٢-
						شكل (١)	٢٣-
						شكل (١)	٢٤-
						شكل (١)	٢٥-
						شكل (١)	٢٦-

التعليمات: (١) الشكل رقم (١) من كل من الاسئلة التالية ناقص . واحد

من الاشكال الخمسة الباقية يكمله .

(٢) المطلوب هو ان تفتش بين الاشكال الخمسة الباقية عن الشكل

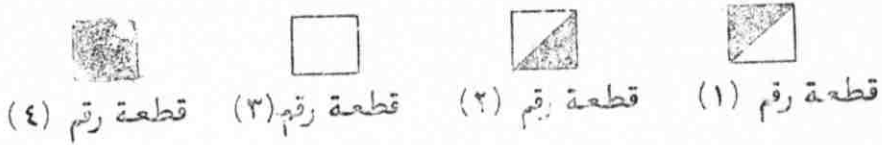
الذي يوئلف مع الشكل (١) رسما كاملا . ابدأ .



٢ - اختبار في تنظيم الرسم بواسطة جمع القطع

(١) هنا عدد آخر من الاسئلة .

لدينا اربعة انواع من القطع ، هي :



ولدينا من كل نوع عدد كبير من القطع .

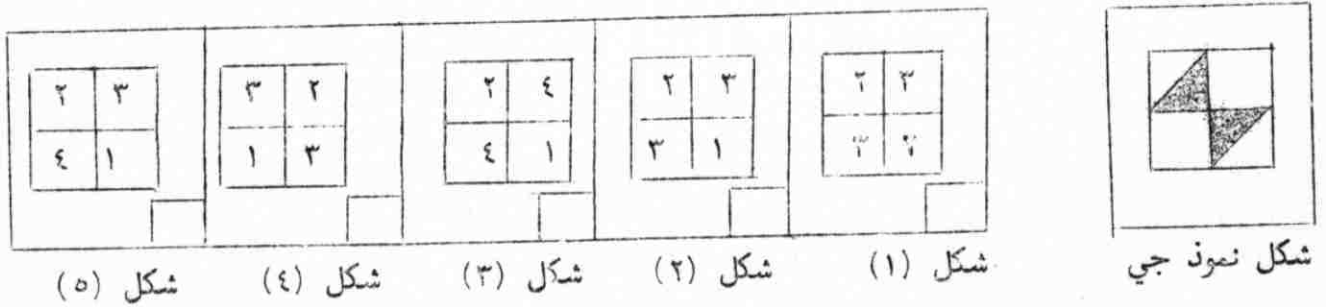
(٢) اذا جمعت هذه القطع بعضها الى بعض في ترتيب ما ، يكون لدينا رسمة

من نوع ما ، واذا جمعتها في ترتيب آخر ، يكون لدينا رسمة من نوع آخر .

(٣) في السؤال المعطى ادناه ، الصورة الموجودة الى اليمين على انفراد ، هي

شكل نمونجي . والاشكال التي تلي الصورة النمونجية هي ترتيبات مختلفة

للقطع الموجودة اعلاه حسب ارتدادها



(٤) هناك شكل واحد من الاشكال الخمسة فيه القطع مرتبة بطريقة تشبه تماما الرسم

النمونجي .

(٥) فتح عن هذا الشكل ، وضع علامة (x) في المربع الصغير المخصص للجواب .

(٦) لا تقلب الصفحة متى يوزع اليك بذلك . الاسئلة في هذا الاختبار مقسومة الى

ثلاث صفحات وفي كل صفحة ، قطع البناء من نوع جديد ، كما سترى في اعل كل

صفحة ، فانتهه لذلك .

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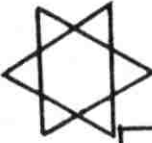

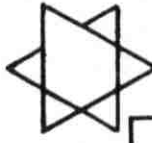

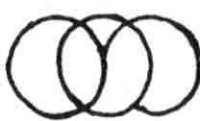
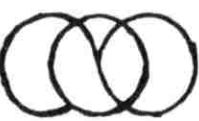
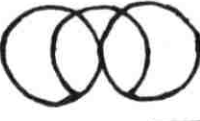


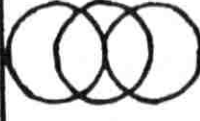






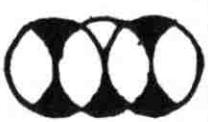
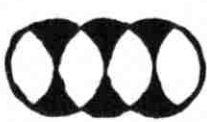
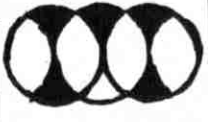
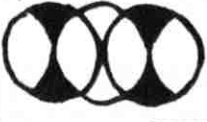
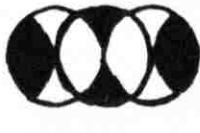
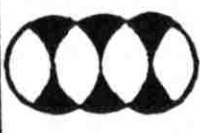






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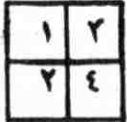
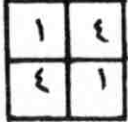
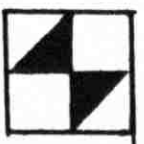
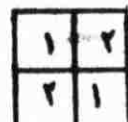
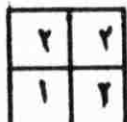
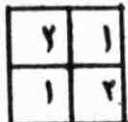
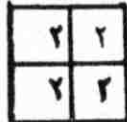
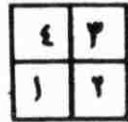

APPENDIX C

AGE TEN

MATCHING-OF-DESIGN TEST

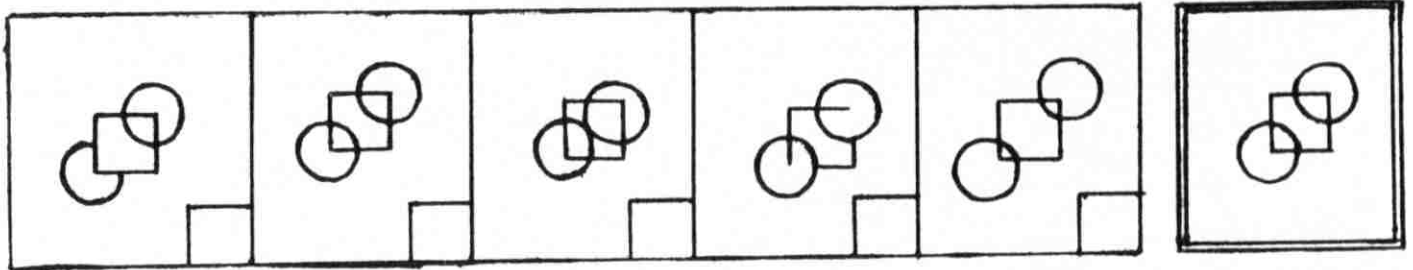
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DESIGN-MAKING TEST

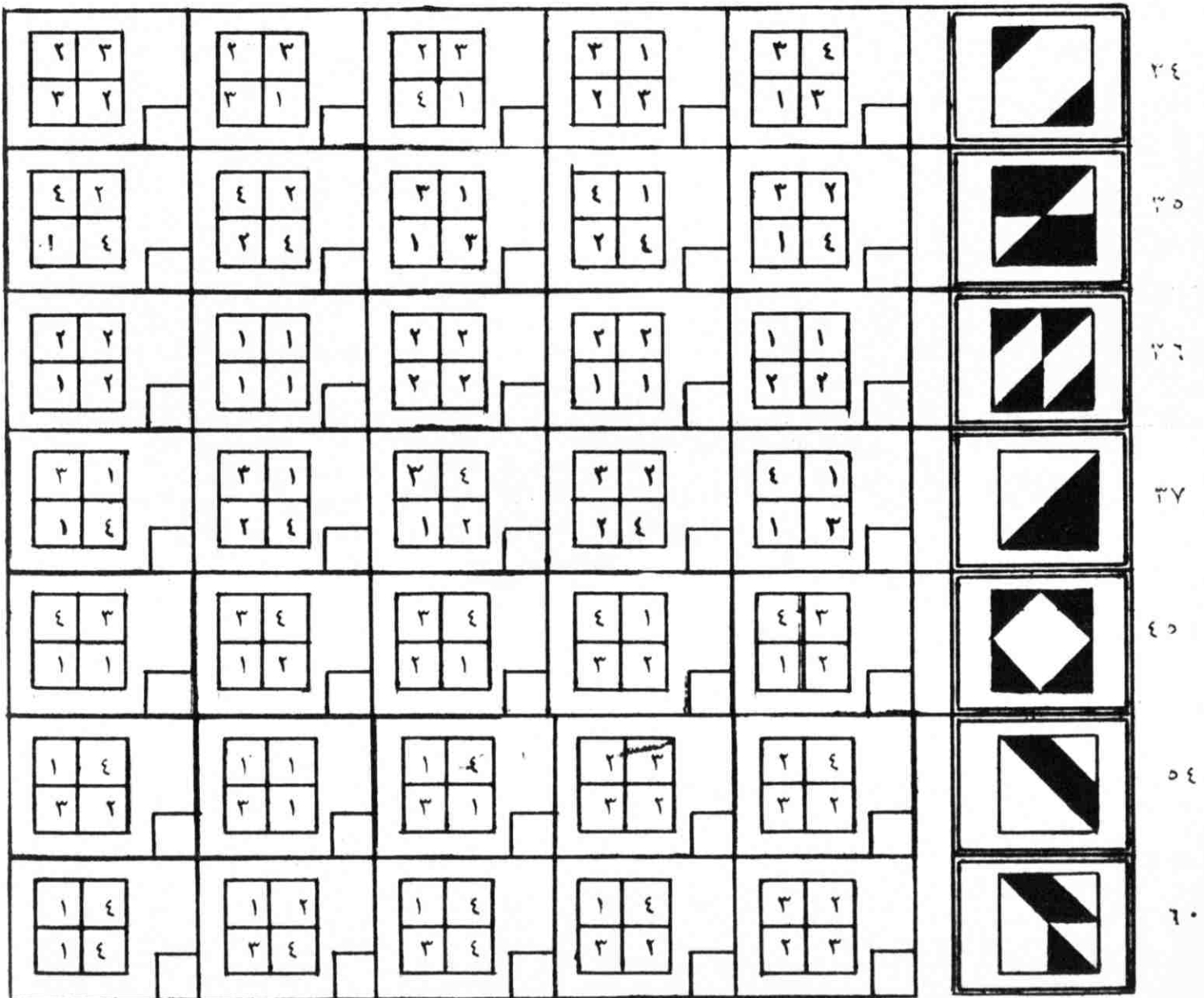
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Age Eleven

MATCHING-OF-DESIGN TEST



DESIGN-MAKING TEST



Age Twelve
MATCHING OF DESIGN TEST

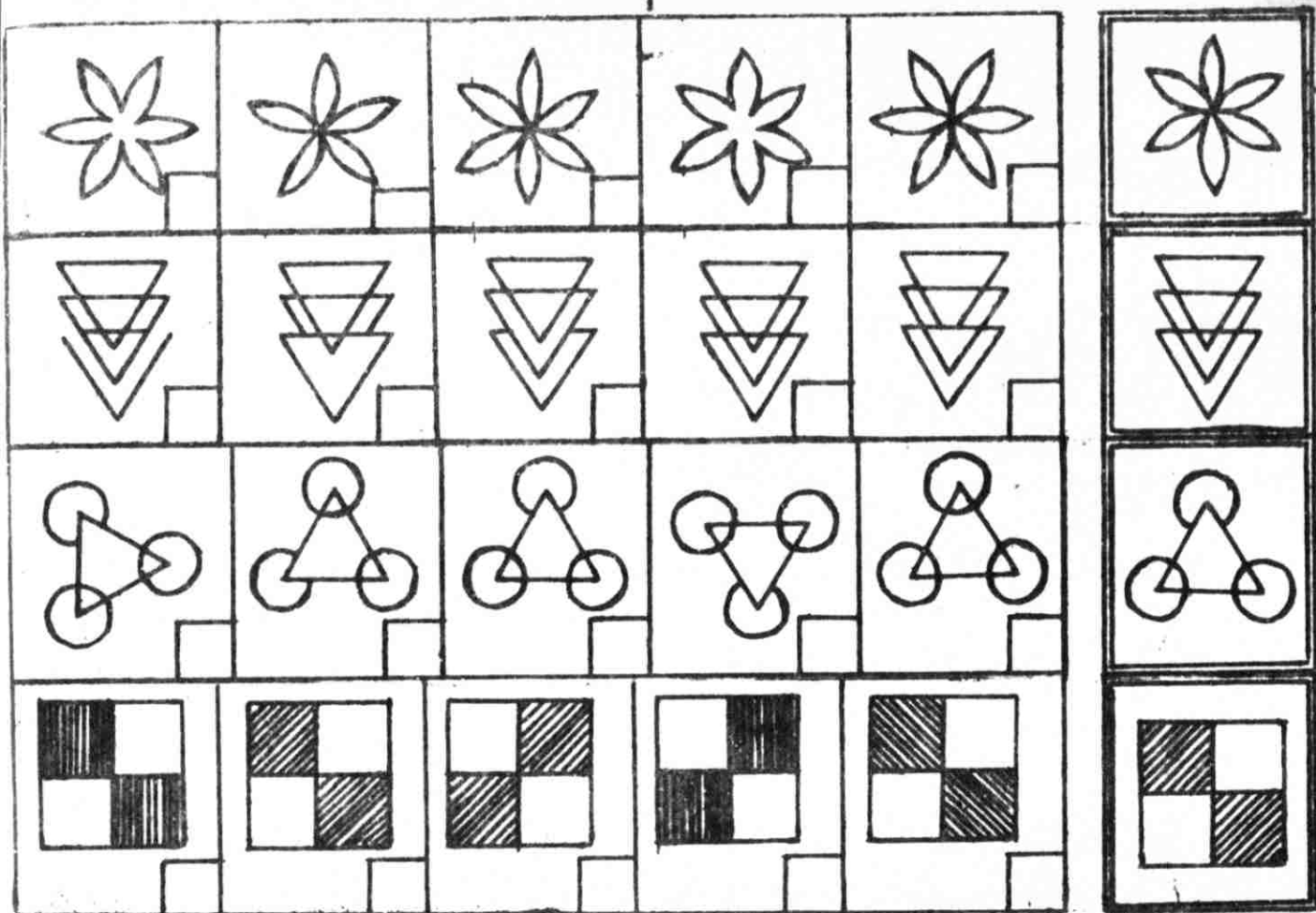
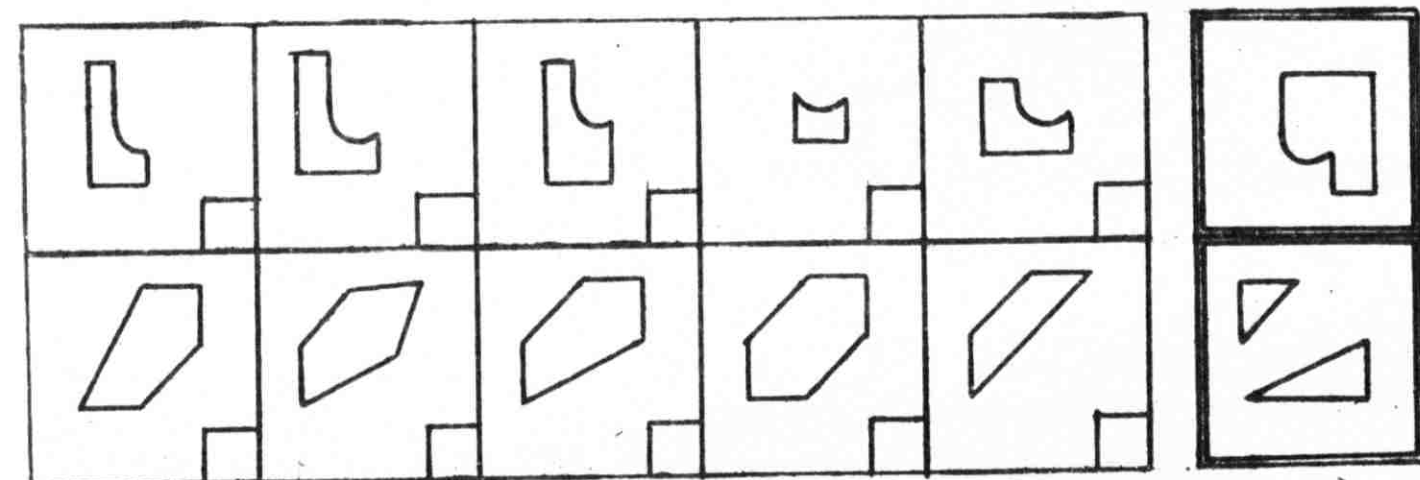
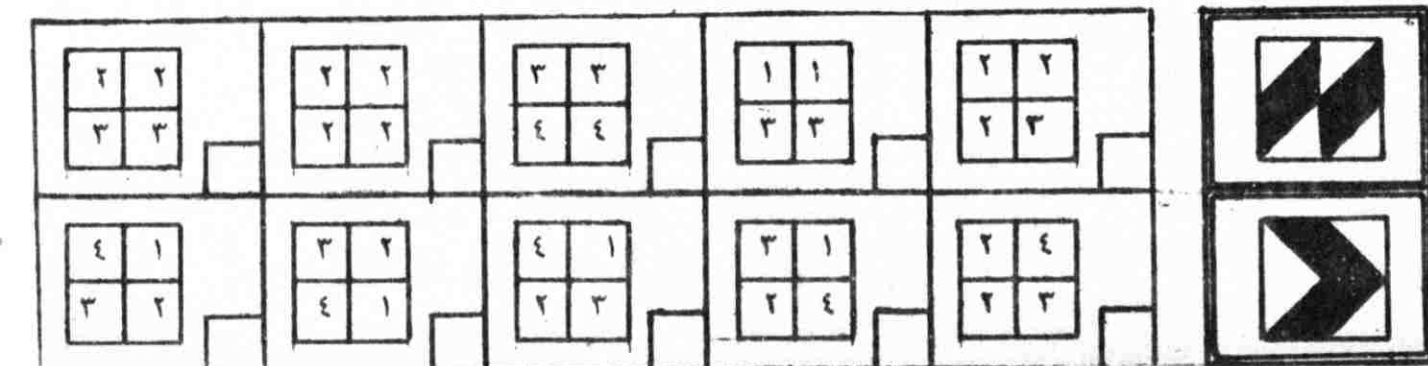


FIGURE COMPLETION TEST



DESIGN-MAKING-TEST



Age Thirteen

INVERSION TEST

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FIGURE COMPLETION TEST

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DESIGN MAKING

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Age Fourteen

INVERSION TEST

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FIGURE COMPLETION TEST

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DESIGN MAKING TEST

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Age Fifteen INVERSION TEST

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FIGURE COMPLETION TEST

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