

A STUDY OF THE ORIGINAL EXERCISES OF
FIFTEEN PLANE GEOMETRY TEXTBOOKS
WRITTEN SINCE 1925

by

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Contributions of the Graduate School
Indiana State Teachers College
Number 191

Submitted in Partial Fulfillment
of the Requirements for the
Master of Arts Degree
in Education

1934

ACKNOWLEDGMENTS

In making this study, the writer has needed both guidance and criticism. To her thesis committee, Dr. W. O. Shriner, chairman, Dr. Welborn, and Miss Morris, she wishes to express her sincere gratitude for their kindly counsel and helpful criticism.

D. D. R.

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I. INTRODUCTION

A. Problem

This is the study of the original exercises in fifteen textbooks in plane geometry. All of the books used in this study have been written since 1925. This study is concerned chiefly with finding (1) the number of original exercises contained in each text, (2) the number of applied exercises, (3) the distribution of the original exercises and applied exercises with respect to the introduction, rectilinear figures, circles, ratio, proportion, similarity, areas of polygons, regular polygons and circles.

B. Purpose of the Study

It is hoped that this study will

1. Show how the texts books studied compare with respect to the number and distribution of original exercises and applied exercises.
2. Show how the textbooks studied compare with the study by Shibli¹ with respect to the number of originals.
3. Furnish information for those teaching geometry or interested in its development.
4. Serve as reference material when choosing supplementary work.

¹J. Shibli, Recent Developments in the Teaching of Geometry (State College, Pa.: J. Shibli, 1932).

C. Method of Procedure

The textbooks used in this study were analyzed in order that a comparison might be made. The books were then ranked with respect to number of original and applied exercises.

Each text was divided into six divisions. The divisions or groups chosen were the ones which were used by a majority of the textbooks. Each original exercise in the texts was classified according to the group to which it belonged. The same procedure was used for the applied exercises. An applied exercise was taken to mean any exercise or problem which made reference to any object other than those used in geometry as pencil, ruler, compasses, paper, protractor, and eraser.

D. Criteria

The criteria used in this study are:

1. Distribution of exercises with respect to six divisions.
2. Number of original exercises.
3. Number of applied exercises.

IBID., p. 101.

IBID., pp. 105, 108.

IBID., p. 108.

II. HISTORY OF INTRODUCTION OF ORIGINAL EXERCISES

A. Previous Studies

"When geometry became a high school subject after the middle of the nineteenth century, the textbooks had no original exercises for the pupils."¹ The Elements of Euclid was made up entirely of propositions fully proved, preceded by statements of definitions and assumptions. The aim of those who studied geometry was to master the elegant logical proofs which were presented by the author of the textbook studied. "There is no record that any unproved theorems were proposed to the students for original proofs."²

During the 18th and 19th centuries certain periodicals such as the Ladies Diary, were used to publish geometric exercises in popular form and challenge their readers to solve them. "It is probable that out of such sources as this some collections of exercises were made."³

The first collection of exercises found by Shibli⁴ is in the library of Teachers College, Columbia University. It is called "Geometrical Problems Deducible from the First Six Books of Euclid". It was prepared by Miles Bland and its second edition was published in Cambridge, England in 1821. The first part of this publication is made up of 363 exercises. These exercises are arranged in groups and not

¹J. Shibli, op. cit., p. 155.

²Ibid., p. 155.

³Ibid., pp. 155, 156.

⁴Ibid., p. 156.

distributed throughout the book. The second part of the book consists of the complete solution of these exercises.

The first textbook containing originals that Shibli⁵ has seen is an edition of Simson's Euclid published in 1853 by Ingram, Cooke, and Co., London. The preface states that "a number of exercises on each Book has been given, the solution of which will be published separately."⁶ The total number of exercises in the six groups is 89.

"The first text⁷ with a comparatively large number of originals is Todhunter's Euclid, published by Macmillan in 1862. In the preface Todhunter states that several collections of exercises already existed, but that they were too difficult. This text 'finishes with a collection of exercises. They are taken principally from College and University papers, and have been tested by long experience with pupils.' This statement shows that work with originals was being done in some schools even before the texts included them. Todhunter's list contains 625 exercises nearly all of which are on plane geometry. "To him belongs largely the credit of making originals an important feature of the geometry text. He speaks of them as affording a most valuable discipline for a student of mathematics."⁸

⁵J. Shibli, op. cit., p. 156.

⁶Ibid., p. 156.

⁷Ibid., p. 156.

⁸Ibid., p. 156.

The first American text with originals is Greenleaf's Geometry (1862).⁹ In the preface the author makes the following statement: "The miscellaneous exercises, which follow are calculated to test the thoroughness of the scholar's geometric knowledge." This list contains 99 exercises. Chauvenet's Geometry (1870) contains 281 exercises grouped in five groups, one for each Book. The author says that as the student can make no solid acquisitions in geometry without frequent practice in the application of the principles he has acquired, a copious collection of exercises is given in the appendix.

Olney's Elementary Geometry (1872) contained at the end of each section exercises covered by the work in that section. The total number of exercises in parts I and II is 287. "In 1875, Davies published his last edition of Legendre."¹⁰ In the preface it says that geometry must be made a more practical science. To accomplish this an appendix is added embracing many problems of geometrical constructions and many applications of algebra to geometry. There was a key made for the use of teachers. The list has 90 exercises.

"The first Wentworth geometry appeared in 1877 and contained 47 exercises in four groups, one group at the end of each of the first four Books. The second edition (1888) contained 479 exercises in groups at the end of each Book, with scattered exercises inserted at the bottom of pages

⁹ Benjamin Greenleaf, Elements of Geometry and Trigonometry (Boston: Robert S. Davis and Co., 1862), Preface.

¹⁰ J. Shibli, Recent Developments in the Teaching of Geometry (State College, Pa.: J. Shibli, 1932), p. 157.

where a few lines were needed to fill the page."¹¹ In the preface of this edition the author states that no geometry can now receive favor unless it provides exercises for independent investigation, which must be of such a kind as to interest the student as soon as he becomes acquainted with the methods and the spirit of geometrical reasoning.

Before the end of the nineteenth century original exercises had become a permanent feature of the geometry text and their number was gradually increasing.

During the first decade of the present century, there was a general movement attempting to make school work function in the everyday life of the individual. There was an increasing demand that subjects taught in the schools should give, as nearly as possible, a true conception of the way it is actually used in real life.

Interest which is so desirable in the teaching of any subject may often be obtained through the original exercise in the opinions of D. E. Smith, Arthur Schultze, and J. Shibli. "It becomes necessary to make the work more concrete, and to give a much larger number of simple exercises in order to create the interest that comes from independent work, from a feeling of conquest, and from a desire to do something original."¹²

"Every successful textbook since 1910 provides a good number of applied problems. They have become a permanent

¹¹J. Shibli, op. cit., p. 157.

¹²D. E. Smith, The Teaching of Geometry (New York: Ginn and Co., 1911), p. 70.

feature of the course. When they are properly selected and wisely used, they not only help to maintain interest by vitalizing geometry and correlating it with other subjects but they also serve to discipline the mind probably as well as the pure geometric exercises."¹³ "...For any normal youth likes 'to do', likes to accomplish something. The discovery of a simple mathematical fact is far more interesting, and far more satisfactory, than the studying of pages of information."¹⁴

"The important part of a modern course in geometry is the solution of exercises; the regular book demonstrations are a means to be used in working originals."¹⁵ Summed up in Breslich's words "...a course in demonstrative geometry will not be of greatest value to the pupils if the major objective of the teacher is to train them in reproducing facts, theorems, and proofs exactly as given in the textbook. However, if the teacher chooses as the major objective the development of power to solve original exercises and to think logically, he will plan a course of a very different character....He will spend his time teaching pupils to attack problems, to reason correctly, and to make discoveries. The tests will be tests of understanding and of ability to apply and use geometry in practical situations."¹⁶

¹³J. Shibli, op. cit., p. 160.

¹⁴Arthur Schultze, The Teaching of Mathematics in Secondary Schools (New York: Macmillan Co., 1931), pp. 99-103.

¹⁵J. Shibli, op. cit., p. 166.

¹⁶E. R. Breslich, The Administration of Mathematics in Secondary Schools (Chicago: University of Chicago Press, 1933), p. 149.

"One of the means of vitalizing geometry is the introduction of applied problems that are encountered in the various practical fields of human activity."¹⁷

In 1910 the Stone-Millis Geometry¹⁸ appeared, with applied problems as a prominent feature. "It was the first American geometry with practical problems, with the exception of Olney's Geometry (1872), which had a few practical problems in its introductory part."¹⁹

Shibli²⁰ summarizes the findings of his study on original exercises, by saying that the average number of original exercises for the nineteenth century is 264; for texts of the first decade of the present century, 776; for texts of the second decade, 1258; and for the texts of the third decade, about 1700. The average number of applied exercises in the ten texts written since 1923, investigated by Shibli, was 124.

B. Agencies Which Have Influenced Original Exercises

During the early part of the twentieth century, there were a number of influences in evidence making for the

¹⁷J. Shibli, op. cit., p. 159.

¹⁸J. C. Stone and J. F. Millis, Plane Geometry (Sanborn, 1910).

¹⁹J. Shibli, op. cit., p. 160.

²⁰Ibid., p. 164.

betterment of mathematical education in the high schools. Some of these are (1) work of the International Commission on the Teaching of Mathematics, (2) work of the National Committee on Mathematical Requirements, (3) work of the College Entrance Examination Board, (4) the rise of the junior high schools, (5) the work of the schools of education in the universities, (6) the Spirit of the Times.

These forces are primarily responsible for the changes which have been made in textbook contents, especially within the last ten years.

1. The International Commission on the Teaching of Mathematics has brought together experts from various countries for discussion of mutual problems and exchange of ideas; it has fostered the publication of a large number of reports showing the nature of the work done in mathematics in schools of all types throughout most of the world.

2. The report of the National Committee on Mathematical Requirements was prepared in close cooperation with bodies of teachers throughout the country. It sets forth clearly the aims of mathematical instruction in the various years of both the Junior and Senior high schools; it presents model courses for the various types of schools and considered the question of college entrance requirements, setting up objectives for the several courses. It also fostered various other investigations.

3. The influence of the College Entrance Examination Board should receive due praise. It brought about a general agreement among colleges as to the fundamentals in high

school mathematics. Its list of fundamentals is based upon a sound pedagogical and practical foundation. It advocated the elimination of many of the complicated phases of mathematics which had no practical value. It not only reduced the amount of mathematical content but encouraged greater concentration on the fundamentals.

4. The rise of the Junior high school has played considerable part in the progress in mathematical instruction. It was not hampered by any examination system and was free to experiment. It enabled our schools to introduce intuitive geometry in a satisfactory manner in Grade VII, and thereby made it possible to devote more time in senior high school to the demonstrative geometry.

5. The work of schools of education in the colleges, universities, and teacher training institutions has done much to stimulate progress. They have done much to bring public school administrators and teachers together with college instructors in the solution of mutual problems. Most of the leaders in the investigation of problems in secondary education have been either university instructors or secondary school teachers working under their guidance.

6. Modern scientific progress is developing a greater need of mathematical knowledge in the realms of business, economics, science, and research in education. More literature, graduate courses, organization of mathematics teachers associations and clubs are all evidences that a need has

been felt not only for some reorganization but an evidence that a solution of some sort is being sought by mathematicians.

W. D. Reeve²¹ in speaking of the purpose of proving theorems says, "It should never be assumed that proofs are given only to be memorized; they are given in order that a student should have, every day or two, a model for his treatment of the important exercises, these constituting the field in which his originality, his insight into geometry, and his ability to think logically are to be shown." He also states "...emphasize the work on original exercises..." as a good plan for teachers to follow.

The textbooks written within the past ten years have been influenced by the information set forth by these committees and other agencies. In geometry the original exercises have come in to prominence.

²¹National Council of Teachers of Mathematics, Fifth Yearbook (New York: Bureau of Publications, Teachers College, Columbia University, 1930), pp. 24, 25.

III. ANALYSIS OF THE FIFTEEN TEXTBOOKS

A. Books Used in Study

The fifteen textbooks chosen for this study have been written since 1925. They have been written since the investigations and reports have been made in the field of secondary mathematics. The names of the books used are (1) Clark-Otis, "Modern Plane Geometry", (2) Mirick-Mewell-Harper, "Modern Plane Geometry", (3) Hawkes-Luby-Touton, "New Plane Geometry", (4) Morgan-Foberg-Breckenridge, "Plane Geometry", (5) McCormack, "Plane Geometry", (6) Seymour, "Plane Geometry", (7) Cowley, "Plane Geometry", (8) Avery, "Plane Geometry", (9) Bernard, "Plane Geometry", (10) Wells-Hart, "Modern Plane Geometry", (11) Welchons-Krickenberger, "Plane Geometry", (12) Sykes-Comstock-Austin, "Plane Geometry", (13) Hassler, "Plane Geometry", (14) Stone-Mallory, "Modern Plane Geometry", (15) Strader-Rhoads, "Plane Geometry".

Hereafter these books¹ will be referred to by the numbers used in the above list.

B. Procedure

Each book has been analyzed into six divisions, viz. (1) introduction, (2) rectilinear figures, (3) circles, (4) ratio, proportion, and similarity, (5) areas of polygons,

¹Names of publishers and dates of publication may be found in the bibliography.

TABLE I

RANKING OF FIFTEEN TEXTBOOKS WITH
RESPECT TO ORIGINAL EXERCISES

| Rank | Text | Number of Originals |
|------|------|---------------------|
| 1 | XIV | 2304 |
| 2 | IV | 1864 |
| 3 | V | 1793 |
| 4 | VI | 1770 |
| 5. | XII | 1706 |
| 6 | XV | 1683 |
| 7 | X | 1679 |
| 8 | XI | 1662 |
| 9 | III | 1606 |
| 10 | VII | 1514 |
| 11 | I | 1452 |
| 12 | II | 1143 |
| 13 | VIII | 1061 |
| 14 | XIII | 949 |
| 15 | IX | 922 |

TABLE II

NUMBER OF ORIGINAL EXERCISES IN EACH OF SIX DIVISIONS
IN TERMS OF WHOLE FOR FIFTEEN TEXTS

| Division | Number of Original Exercises | | | | | | | | | | | | | | |
|---|------------------------------|------|------|------|------|------|------|------|-----|------|------|------|------|------|------|
| | Text I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV |
| I. Introd. | 26 | 90 | 159 | 48 | 156 | 257 | 38 | 47 | 0 | 110 | 164 | 19 | 141 | 267 | 167 |
| II. Rectilin- ear Figs. | 443 | 277 | 366 | 705 | 490 | 345 | 615 | 317 | 202 | 414 | 493 | 699 | 233 | 429 | 535 |
| III. Circles | 279 | 212 | 327 | 342 | 339 | 367 | 317 | 281 | 185 | 339 | 294 | 266 | 153 | 509 | 317 |
| IV. Ratio, Pro- portion, Similarity | 300 | 228 | 401 | 414 | 389 | 272 | 220 | 176 | 173 | 246 | 419 | 371 | 211 | 474 | 313 |
| V. Areas | 238 | 132 | 186 | 181 | 244 | 211 | 124 | 101 | 152 | 352 | 164 | 160 | 128 | 345 | 168 |
| VI. Regular Polygons | 166 | 204 | 167 | 174 | 175 | 318 | 200 | 139 | 210 | 218 | 128 | 191 | 83 | 280 | 183 |
| Total | 1452 | 1143 | 1606 | 1864 | 1793 | 1770 | 1514 | 1061 | 922 | 1679 | 1662 | 1706 | 949 | 2304 | 1683 |

TABLE II (Continued)

| Division | Per Cent of Total | | | | | | | | | | | | | | |
|---|-------------------|-------|--------|------|--------|-------|------|-------|--------|-------|--------|-------|-------|--------|-------|
| | Text I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV |
| I. Introd. | 1.8 | 7.9 | 9.9 | 2.5 | 8.7 | 14.5 | 2.5 | 4.4 | 0.0 | 6.5 | 9.9 | 1.1 | 14.9 | 11.6 | 9.9 |
| II. Rectilin- ear Figs. | 30.5 | 24.2 | 22.8 | 37.8 | 27.3 | 19.5 | 40.6 | 29.9 | 21.9 | 24.7 | 29.7 | 41.0 | 24.6 | 18.6 | 31.8 |
| III. Circles | 19.2 | 18.5 | 20.4 | 18.3 | 18.9 | 20.7 | 20.9 | 26.5 | 20.1 | 20.2 | 17.7 | 15.6 | 16.1 | 22.1 | 18.8 |
| IV. Ratio, Pro- portion, Similarity | 20.7 | 19.9 | 25.0 | 22.2 | 21.8 | 15.4 | 14.5 | 16.6 | 18.8 | 14.7 | 25.2 | 21.7 | 22.2 | 20.6 | 18.6 |
| V. Areas | 16.3 | 11.5 | 11.6 | 9.7 | 13.6 | 11.9 | 8.2 | 9.5 | 16.5 | 20.9 | 9.9 | 9.4 | 13.5 | 15.0 | 10.0 |
| VI. Regular Polygons | 11.4 | 17.8 | 10.4 | 9.3 | 9.8 | 18.0 | 13.2 | 13.1 | 22.8 | 13.0 | 7.7 | 11.2 | 8.7 | 12.2 | 10.9 |
| Total | 99.9 | 99.8+ | 100.1- | 99.8 | 100.1- | 100.0 | 99.9 | 100.0 | 100.1- | 100.0 | 100.1- | 100.0 | 100.0 | 100.1- | 100.0 |

(6) regular polygons and circles. The number of original exercises for each division in each textbook was found; also the number of applied exercises (any exercise or problem that makes reference to any object other than tools used in geometry) in each division was tabulated.

Several of the books studied were divided by the authors into the six divisions which are used in this study. Texts I to X inclusive were so divided. Text XIV was divided into eight units but a suggestion was given by the author of that text for the grouping used in this study. It was necessary to group the exercises in the other four texts as nearly as possible into these six divisions.

Some of the texts contained supplementary lists of exercises at the back of the book. These exercises were placed as nearly as possible in the proper division.

After the textbooks were separated into the six divisions, the second step was to find the number of original and applied exercises in each division of each textbook. This was done by placing the number of the page with the corresponding number of exercises for each of the six divisions in each text. This material may be found in the Appendix.

C. Findings

1. The Number of Original Exercises. The number of original exercises in the fifteen textbooks studied ranged from 922 to 2304 as may be seen in Table I. Text IX has the smallest number of exercises and text XIV has the largest number.

TABLE III

RANKINGS OF FIFTEEN TEXTBOOKS WITH RESPECT TO NUMBER
OF ORIGINALS IN EACH OF SIX DIVISIONS

| Rank | Divisions | | | | | | | | | | | |
|------|-----------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|
| | I | | II | | III | | IV | | V | | VI | |
| | Text | No. Ex- ercises | Text | No. Ex- ercises | Text | No. Ex- ercises | Text | No. Ex- ercises | Text | No. Ex- ercises | Text | No. Ex- ercises |
| 1 | XIV | 267 | IV | 705 | XIV | 509 | XIV | 474 | X | 352 | VI | 318 |
| 2 | VI | 257 | XII | 699 | VI | 367 | XI | 419 | XIV | 345 | XIV | 280 |
| 3 | XV | 167 | VII | 615 | IV | 342 | IV | 414 | V | 244 | X | 218 |
| 4 | XI | 164 | XV | 535 | X | 339 | III | 401 | I | 238 | IX | 210 |
| 5 | III | 159 | XI | 493 | V | 339 | V | 389 | VI | 211 | II | 204 |
| 6 | V | 156 | V | 490 | III | 327 | XII | 371 | III | 186 | VII | 200 |
| 7 | XIII | 141 | I | 443 | XV | 317 | XV | 313 | IV | 181 | XII | 191 |
| 8 | X | 110 | XIV | 429 | VII | 317 | I | 300 | XV | 168 | XV | 183 |
| 9 | II | 90 | X | 414 | XI | 294 | VI | 272 | XI | 164 | V | 175 |
| 10 | IV | 48 | III | 366 | VIII | 281 | X | 246 | XII | 160 | IV | 174 |
| 11 | VIII | 47 | VI | 345 | I | 279 | II | 228 | IX | 152 | III | 167 |
| 12 | VII | 38 | VIII | 317 | XII | 266 | VII | 220 | II | 132 | I | 166 |
| 13 | I | 26 | II | 277 | II | 212 | XIII | 211 | XIII | 128 | VIII | 139 |
| 14 | XII | 19 | XIII | 233 | IX | 185 | VIII | 176 | VII | 124 | XI | 128 |
| 15 | IX | 0 | IX | 202 | XIII | 153 | IX | 173 | VIII | 101 | XIII | 83 |

TABLE IV
 RANKINGS OF FIFTEEN TEXTBOOKS
 WITH RESPECT TO NUMBER OF
 APPLIED EXERCISES

| Rank | Text | Number of Applied Exercises |
|------|------|-----------------------------|
| 1 | V | 283 |
| 2 | XIV | 271 |
| 3 | III | 199 |
| 4 | XIII | 164 |
| 5 | VI | 142 |
| 6 | XI | 139 |
| 7 | XII | 136 |
| 8 | IV | 120 |
| 9 | II | 109 |
| 10 | X | 105 |
| 11 | I | 103 |
| 12 | VII | 94 |
| 13 | XV | 84 |
| 14 | VIII | 51 |
| 15 | IX | 29 |

2. The Distribution of the Original Exercises. The distribution of the original exercises with respect to the six divisions used in this study is shown in Table II. In division I the exercises ranged from 0 to 267, with median 110; in division II, they ranged from 202 to 705 with a median of 429; in division III, they ranged from 153 to 509 with the median of 317; in division IV, they ranged from 173 to 474 with a median of 300; in division V, they ranged from 101 to 352 with a median of 168; in division VI, they ranged from 83 to 318 with a median of 183. Table III shows the ranking of the fifteen textbooks with respect to the number of originals in each division.

3. The Average Number of Original Exercises. The average number of original exercises for the fifteen textbooks studied is 1416. The following Texts had more than the average, I, III, IV, V, VI, VII, X, XI, XII, XIV, XV. Texts II, VIII, IX, and XIII had fewer than 1416 exercises.

4. The Number of Applied Exercises. The number of applied exercises in the fifteen textbooks studied ranged from 29 to 283. The rankings of the texts with respect to the total number of applied exercises may be found in Table IV. Text X has the smallest number of applied exercises and Text V has the largest number.

5. The Distribution of the Applied Exercises. The distribution of the applied exercises in the books studied with respect to each of the six divisions is shown in Table V. In division I, the applied exercises ranged from 0 to 30 with a median of 17; in division II, they ranged from 5 to 57 with a median of 27; in division III, they ranged from 0 to 32 with a median of 13; in division IV,

TABLE V

NUMBER OF APPLIED EXERCISES IN EACH OF SIX DIVISIONS
IN TERMS OF WHOLE FOR FIFTEEN TEXTS

| Division | Number of Applied Exercises | | | | | | | | | | | | | | |
|-----------------------------------|-----------------------------|-----|-----|-----|-----|-----|-----|------|----|-----|-----|-----|------|-----|----|
| | Text I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV |
| I. Introd. | 5 | 17 | 20 | 3 | 24 | 28 | 16 | 3 | 0 | 9 | 11 | 23 | 30 | 18 | 21 |
| II. Rectilinear Figs. | 40 | 20 | 26 | 18 | 54 | 30 | 13 | 7 | 9 | 29 | 44 | 27 | 36 | 57 | 5 |
| III. Circles | 10 | 13 | 13 | 19 | 27 | 31 | 5 | 6 | 0 | 8 | 17 | 14 | 11 | 32 | 18 |
| IV. Ratio, Proportion, Similarity | 15 | 16 | 57 | 31 | 82 | 20 | 32 | 20 | 7 | 27 | 27 | 43 | 53 | 83 | 15 |
| V. Areas | 15 | 15 | 25 | 11 | 43 | 10 | 11 | 7 | 2 | 11 | 27 | 16 | 12 | 34 | 16 |
| VI. Regular Polygons | 18 | 28 | 58 | 38 | 53 | 23 | 17 | 8 | 11 | 21 | 13 | 13 | 22 | 47 | 9 |
| Total | 103 | 109 | 199 | 120 | 283 | 142 | 94 | 51 | 29 | 105 | 139 | 136 | 164 | 271 | 84 |

TABLE V (Continued)

| Division | Per Cent of Total | | | | | | | | | | | | | | |
|-----------------------------------|-------------------|------|-------|-------|-------|------|------|-------|------|-------|-------|-------|-------|------|-------|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV |
| | Text | " | " | " | " | " | " | " | " | " | " | " | " | " | " |
| I. Introd. | 4.8 | 15.6 | 10.1 | 2.5 | 8.5 | 19.7 | 17.0 | 5.9 | 0.0 | 8.6 | 7.9 | 16.9 | 18.3 | 6.6 | 25.0 |
| II. Rectilinear Figs. | 38.8 | 18.3 | 13.1 | 15.0 | 19.1 | 21.1 | 13.8 | 13.7 | 31.0 | 27.6 | 31.7 | 19.9 | 22.0 | 21.0 | 6.0 |
| III. Circles | 9.7 | 11.9 | 6.5 | 15.8 | 9.5 | 21.8 | 5.3 | 11.8 | 0.0 | 7.6 | 12.2 | 10.3 | 6.7 | 11.8 | 21.4 |
| IV. Ratio, Proportion, Similarity | 14.5 | 14.6 | 28.6 | 25.8 | 29.0 | 14.1 | 34.0 | 39.2 | 24.1 | 25.7 | 19.4 | 31.6 | 32.3 | 30.6 | 17.9 |
| V. Areas | 14.5 | 13.8 | 12.6 | 9.2 | 15.2 | 7.0 | 11.7 | 13.7 | 6.9 | 10.5 | 19.4 | 11.8 | 7.3 | 12.5 | 19.0 |
| VI. Regular Polygons | 17.6 | 25.7 | 29.1 | 31.7 | 18.7 | 16.2 | 18.1 | 15.7 | 37.9 | 20.0 | 9.4 | 9.6 | 13.4 | 17.3 | 10.7 |
| Total | 99.9 | 99.9 | 100.0 | 100.0 | 100.0 | 99.9 | 99.9 | 100.0 | 99.9 | 100.0 | 100.0 | 100.1 | 100.0 | 99.8 | 100.0 |

they ranged from 7 to 83 with a median of 27; in division V, they ranged from 2 to 43 with a median of 15; in division VI, they ranged from 8 to 58, with a median of 21. Table VI shows the ranking of the fifteen textbooks with respect to the number of applied exercises in each division.

6. The Average Number of Applied Exercises. The average number of applied exercises for the fifteen books used in this study was 135, plus. Texts III, V, VI, XI, XII, XIII, and XIV have more than the average number of applied exercises; Texts I, II, IV, VII, VIII, IX, X, and XV have fewer than the average number of applied exercises.

7. Divisions Containing Largest Number of Originals. The three divisions containing the largest number of original exercises for the entire group of texts in rank order are (1) rectilinear figures, (2) circles, (3) ratio, proportion and similarity.

8. Divisions Containing Largest Number of Applied Exercises. The divisions are in rank order (1) ratio, proportion and similarity, (2) regular polygons and circles, (3) rectilinear figures.

9. Comparison of the Number of Applied Exercises with the Number of Originals. Since applied exercises seem to be particularly important, it is of interest to know what per cent of the total number of exercises consists of applied exercises. Table VII shows the per cent for each text. The average is 8.7%. Text XIII, which ranks first, contains applied exercises in the ratio of 1 to 6, while Text IX, which ranks lowest, has a ratio of only 1 to 30.

TABLE VI

RANKINGS OF FIFTEEN TEXTBOOKS WITH RESPECT
TO NUMBER OF APPLIED EXERCISES
IN EACH OF SIX DIVISIONS

| Rank | Divisions | | | | | |
|------|-----------|---------------------|------|---------------------|------|---------------------|
| | I | | II | | III | |
| | Text | Number of Exercises | Text | Number of Exercises | Text | Number of Exercises |
| 1 | XIII | 30 | XIV | 57 | XIV | 32 |
| 2 | VI | 28 | V | 54 | VI | 31 |
| 3 | V | 24 | XI | 44 | V | 27 |
| 4 | XII | 23 | I | 40 | IV | 19 |
| 5 | XV | 21 | XIII | 36 | XV | 18 |
| 6 | III | 20 | VI | 30 | XI | 17 |
| 7 | XIV | 18 | X | 29 | XII | 14 |
| 8 | II | 17 | XII | 27 | II | 13 |
| 9 | VII | 16 | III | 26 | III | 13 |
| 10 | XI | 11 | II | 20 | XIII | 11 |
| 11 | X | 11 | IV | 18 | I | 10 |
| 12 | I | 5 | VII | 13 | X | 8 |
| 13 | VIII | 3 | IX | 9 | VIII | 6 |
| 14 | IV | 3 | VIII | 7 | VII | 5 |
| 15 | IX | 0 | XV | 5 | IX | 0 |

TABLE VI (Continued)

| Rank | Divisions | | | | | |
|------|---------------|---------------------|-------|---------------------|------|---------------------|
| | IV | | V | | VI | |
| | Text | Number of Exercises | Text | Number of Exercises | Text | Number of Exercises |
| 1 | XIV | 83 | V | 43 | III | 58 |
| 2 | V | 82 | XIV | 34 | V | 53 |
| 3 | III | 57 | XI | 27 | XIV | 47 |
| 4 | XIII | 53 | III | 25 | IV | 38 |
| 5 | XII | 43 | { XII | 16 | II | 28 |
| 6 | VII | 32 | | XV | 16 | VI |
| 7 | IV | 31 | { I | 15 | XIII | 22 |
| 8 | { X | 27 | | II | 15 | X |
| 9 | | XI | 27 | XIII | 12 | I |
| 10 | { VI | 20 | { X | 11 | VII | 17 |
| 11 | | VIII | | 20 | VII | 11 |
| 12 | II | 16 | { IV | 11 | XII | 13 |
| 13 | { I | 15 | | VI | 10 | IX |
| 14 | | XV | 15 | VIII | 7 | XV |
| 15 | IX | 7 | IX | 2 | VIII | 8 |

TABLE VII

NUMBER OF ORIGINAL EXERCISES, APPLIED EXERCISES, AND RANKINGS
OF TEXTS ACCORDING TO PER CENT OF APPLIED EXERCISES

| Text | Total Original Exercises | Total Applied Exercises | Per Cent of Applied Exercises | Rank |
|------|--------------------------|-------------------------|-------------------------------|------|
| XIII | 849 | 164 | 17.3 | 1 |
| V | 1793 | 283 | 15.8 | 2 |
| III | 1606 | 199 | 12.4 | 3 |
| XIV | 2304 | 271 | 11.8 | 4 |
| II | 1143 | 109 | 9.5 | 5 |
| XI | 1662 | 139 | 8.4 | 6 |
| VI | 1770 | 142 | 8.0 | 7 |
| XII | 1706 | 136 | 7.9 | 8 |
| I | 1452 | 103 | 7.1 | 9 |
| IV | 1864 | 120 | 6.4 | 10 |
| X | 1679 | 105 | 6.3 | 11 |
| VII | 1514 | 94 | 6.2 | 12 |
| XV | 1683 | 84 | 5.0 | 13 |
| VIII | 1061 | 51 | 4.8 | 14 |
| IX | 922 | 29 | 3.1 | 15 |

IV. GENERAL SUMMARY, LIMITATIONS AND SUGGESTIONS

FOR FURTHER RESEARCH

A. General Summary

1. Number of Originals. The range of the total number of originals was from 922 to 2304, with an average of 1416.

The number of exercises found in the present study seems to be about the same as that found by Shibli.¹ He found an average of 1258 for books of the second decade of the present century and 1700 for books of the third decade.

2. Divisions Receiving Emphasis. Emphasis with respect to original exercises is being placed on (1) rectilinear figures, (2) circles, (3) ratio, proportion and similarity. This is in keeping with the recommendations of the leading authorities. With respect to the applied exercises, the divisions receiving the most emphasis are (1) ratio, proportion and similarity, (2) regular polygons and circles, (3) rectilinear figures.

3. Number of Applied Exercises. The range of the applied exercises for the fifteen textbooks was from 29 to 283, with a mean of 135.

4. The Percentage of Applied Exercises. The percentage of applied exercises ranged from 3.1 to 17.3, with a mean of 8.7.

5. Significance of Findings. The original exercises are becoming a more important part of the content of the plane geometry textbooks. The same may be said of the applied exercises.

¹ J. Shibli, op. cit., p. 164.

The textbooks written within the past 10 years have followed closely the recommendations made by authorities in the field of mathematics. Interest should be easier to obtain, hence learning should take place more readily when use is made of the findings in this study when choosing textbooks for supplementary work.

B. Limitations and Suggestions for Further Research.

1. Methods of Attack. Further study might very profitably be carried on to see what results might be obtained by using different methods of attack on originals.

2. Transfer of Training. Experiments should be carried on to determine the extent of the transfer of training received in original exercises over to other subjects.

3. Individual Differences. A study of the various provisions made by authors of plane geometry textbooks to care for individual differences of pupils might be made.

4. Emphasis. A few basic propositions might be chosen and a study made of their importance as found in the content of modern plane geometry textbooks.

5. Need of Studies Based on More Adequate Criteria. The number of exercises is but one of many criteria necessary for evaluating exercises in plane geometry. A text with comparatively few well-chosen original exercises would be preferable to one with many poor exercises. Studies based on more adequate criteria for evaluating exercises are needed.

6. Texts. More textbooks might have been used in making

the study. The ones used here were the ones which were offered for state adoption last year.

V. APPENDIX

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B. Materials Used in Study

ORIGINAL EXERCISES
TEXT I

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
|---------|-----|------------------------|-----|---------|-----|---------------------------------------|-----|-------------|-----|---------------------|-----|
| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
| 1 | 1 | 44- 45 | 28 | 122 | 7 | 208 | 10 | 181 | 1 | 263 | 2 |
| 2 | 5 | 46 | 5 | 123 | 6 | 211 | 49 | 182 | 4 | 265 | 3 |
| 3 | 2 | 47 | 19 | 124 | 2 | 212 | 3 | 183 | 4 | 269 | 5 |
| 4 | 2 | 51 | 7 | 125 | 4 | 214 | 4 | 184 | 5 | 270- 271 | 12 |
| 5 | 1 | 52- 53 | 20 | 126 | 5 | 215 | 6 | 185 | 7 | 272 | 2 |
| 8 | 1 | 57 | 5 | 127 | 5 | 217 | 4 | 186- 187 | 19 | 273 | 4 |
| 9 | 4 | 58- 59 | 24 | 128 | 3 | 218 | 6 | 189 | 14 | 274- 275 | 19 |
| 13 | 4 | 60 | 1 | 130 | 3 | 219 | 4 | 190- 191 | 23 | 276 | 6 |
| 16 | 2 | 61 | 2 | 133 | 1 | 220 | 1 | 192- 193 | 22 | 277 | 3 |
| 17 | 1 | 62 | 3 | 135 | 2 | 222 | 7 | 195 | 9 | 279 | 6 |
| 18 | 1 | 63 | 4 | 136 | 11 | 223 | 3 | 196 | 9 | 280 | 4 |
| 21 | 1 | 65 | 7 | 137 | 1 | 226 | 14 | 197 | 4 | 284 | 3 |
| 25 | 1 | 66- 67 | 28 | 140 | 3 | 228 | 13 | 198- 199 | 26 | 285 | 7 |
| | | 70- 71 | 10 | 141 | 3 | 229 | 2 | 200- 201 | 31 | 288- 289 | 17 |

TEXT I (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|------|-----|------|-----|-------------|-----|------|-----|-------------|-----|------|-----|
| | | 73 | 4 | 142 | 3 | 230 | 9 | 202- 204 | 46 | 292 | 8 |
| | | 74 | 1 | 143 | 4 | 231 | 12 | 205 | 14 | 293 | 15 |
| | | 75 | 3 | 145 | 9 | 232 | 13 | | | 294 | 11 |
| | | 76 | 5 | 146 | 1 | 234 | 4 | | | 295 | 11 |
| | | 77 | 5 | 147 | 4 | 235 | 3 | | | 296 | 14 |
| | | 78 | 3 | 148 | 2 | 237 | 1 | | | 297 | 14 |
| | | 81 | 3 | 149 | 5 | 238 | 1 | | | | |
| | | 83 | 4 | 152 | 6 | 239 | 5 | | | | |
| | | 84 | 14 | 153 | 10 | 240 | 1 | | | | |
| | | 85 | 19 | 154 | 3 | 241 | 1 | | | | |
| | | 88 | 8 | 156 | 5 | 242 | 3 | | | | |
| | | 89 | 17 | 157 | 4 | 243 | 4 | | | | |
| | | 90 | 1 | 158- 159 | 23 | 245 | 9 | | | | |
| | | 91 | 3 | 160- 161 | 8 | 246 | 3 | | | | |
| | | 92 | 7 | 162- 163 | 12 | 247 | 3 | | | | |
| | | 93 | 3 | 164 | 3 | 248 | 5 | | | | |
| | | 95 | 8 | 166 | 15 | 249 | 4 | | | | |
| | | 97 | 6 | 167 | 13 | 250 | 8 | | | | |
| | | 99 | 8 | 169 | 1 | 251 | 4 | | | | |
| | | 100 | 13 | 171 | 9 | 252 | 12 | | | | |
| | | 101 | 17 | 172- 175 | 32 | 253 | 5 | | | | |

ORIGINAL EXERCISES
TEXT II

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
|-----------|-----|------------------------|-----|-------------|-----|---------------------------------------|--------|-------------|-----|---------------------|-----|
| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
| 6 | 5 | 46 | 2 | 124 | 2 | 195- 196 | 21 | 169 | 5 | 247 | 13 |
| 9 | 6 | 48- 50 | 18 | 126 | 6 | 198 198 | 1 1 | 170 | 5 | 248 | 4 |
| 10 | 5 | 52- 53 | 20 | 127 | 4 | 199 | 2 | 171- 172 | 18 | 251 | 11 |
| 11 | 3 | 54- 55 | 5 | 128 | 6 | 200 | 1 | 176- 178 | 34 | 252 | 1 |
| 12 | 3 | 56- 57 | 12 | 130 | 12 | 202 | 2 | 179 | 1 | 253 | 22 |
| 14 | 4 | 59 | 7 | 132 | 3 | 203 | 3 | 180 | 4 | 255 | 8 |
| 19- 21 | 20 | 60 | 2 | 133 | 4 | 204- 206 | 25 | 181 | 4 | 258 | 3 |
| 24- 25 | 8 | 61 | 7 | 134 | 5 | 207 | 3 | 183 | 14 | 260 | 4 |
| 27 | 3 | 62 | 2 | 136 | 2 | 210 | 1 | 186- 189 | 33 | 261 | 2 |
| 29- 30 | 5 | 63 | 6 | 137 | 3 | 211 | 3 | 189- 190 | 14 | 264 | 7 |
| 31 | 2 | 64 | 5 | 138 | 8 | 212 | 4 | | | 267 | 7 |
| 35 | 9 | 66 | 5 | 139 | 5 | 213 | 8 | | | 270- 272 | 28 |
| 38 | 13 | 69 | 3 | 140- 141 | 27 | 214 | 1 | | | 272- 273 | 12 |
| 43- 44 | 4 | 70 | 8 | 144 | 1 | 215 | 2 | | | 273- 274 | 15 |

TEXT II (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|------|-----|-------------|-----|------|-----|------|-----|------|-----|------|-----|
| | | 114- 117 | 32 | | | | | | | | |

ORIGINAL EXERCISES
TEXT III

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
|-----------|-----|------------------------|-----|---------|-----|---------------------------------------|-----|-------------|-----|---------------------|-----|
| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
| 5- 6 | 18 | 40 | 1 | 148 | 6 | 231- 232 | 30 | 315- 316 | 3 | 357 | 6 |
| 7 | 3 | 40 | 5 | 149 | 2 | 235- 238 | 36 | 319- 320 | 12 | 360 | 6 |
| 8- 9 | 6 | 43 | 5 | 151 | 1 | 238 | 9 | 322- 323 | 19 | 362 | 2 |
| 9- 12 | 22 | 45- 46 | 6 | 152 | 3 | 242 | 3 | 325 | 5 | 364 | 2 |
| 13- 14 | 7 | 46 | 4 | 153 | 4 | 245 | 8 | 327 | 6 | 367 | 9 |
| 18- 19 | 3 | 48 | 6 | 157 | 3 | 247 | 2 | 330 | 5 | 369 | 9 |
| 19 | 1 | 51- 52 | 10 | 159 | 10 | 250- 251 | 13 | 331 | 4 | 371- 372 | 8 |

TEXT III (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|-------------|-----|-----------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|
| 26- 27 | 20 | 52 | 3 | 160 | 2 | 253 | 6 | 333 | 10 | 375 | 4 |
| 29- 30 | 12 | 55 | 5 | 161 | 2 | 256 | 6 | 336 | 6 | 377 | 7 |
| 30- 31 | 4 | 56 | 5 | 162 | 2 | 259 | 4 | 337 | 13 | 380- 381 | 13 |
| 32- 34 | 43 | 62 | 8 | 163- 164 | 5 | 260- 261 | 7 | 337- 339 | 13 | 383 | 17 |
| 402- 403 | 8 | 65- 66 | 4 | 165 | 2 | 263 | 7 | 340- 341 | 17 | 384- 386 | 22 |
| 403- 404 | 12 | 70 | 4 | 166 | 3 | 264 | 5 | 343 | 2 | 387- 388 | 12 |
| | | 71 | 5 | 169- 170 | 16 | 265- 266 | 9 | 345 | 10 | 391 | 3 |
| | | 73 | 6 | 173 | 3 | 267- 268 | 13 | 347- 348 | 15 | 393 | 3 |
| | | 75 | 6 | 174- 175 | 5 | 269 | 4 | 350 | 9 | 395- 396 | 13 |
| | | 77 | 6 | 175 | 11 | 270 | 3 | 351- 352 | 25 | 396- 398 | 25 |
| | | 78 | 4 | 178 | 6 | 272 | 9 | 414- 415 | 12 | 416- 417 | 16 |
| | | 81- 82 | 20 | 179 | 2 | 273 | 3 | | | | |
| | | 84 | 1 | 181 | 2 | 275 | 4 | | | | |
| | | 85 | 2 | 182- 183 | 12 | 277 | 2 | | | | |
| | | 87 | 1 | 185- 186 | 12 | 280 | 11 | | | | |
| | | 92- 94 | 25 | 188 | 3 | 282 | 5 | | | | |

TEXT III (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|------|-----|-------------|-----|-------------|-----|-------------|-----|------|-----|------|-----|
| | | 95- 96 | 9 | 189 | 6 | 283 | 2 | | | | |
| | | 97 | 6 | 193 | 5 | 284- 286 | 21 | | | | |
| | | 99 | 2 | 193- 194 | 10 | 287 | 5 | | | | |
| | | 100 | 2 | 195 | 2 | 288- 289 | 11 | | | | |
| | | 101 | 3 | 197 | 11 | 289- 292 | 29 | | | | |
| | | 102 | 5 | 199 | 5 | 293- 294 | 12 | | | | |
| | | 103- 104 | 30 | 199- 203 | 29 | 294- 297 | 21 | | | | |
| | | 105- 107 | 20 | 203 | 6 | 302- 303 | 9 | | | | |
| | | 108 | 2 | 206- 207 | 7 | 303- 304 | 9 | | | | |
| | | 111 | 3 | 207- 209 | 20 | 306- 307 | 24 | | | | |
| | | 115 | 4 | 210- 212 | 19 | 308 | 9 | | | | |
| | | 118 | 7 | 212- 213 | 9 | 309- 311 | 32 | | | | |
| | | 118 | 3 | 214 | 2 | 411- 414 | 18 | | | | |
| | | 121- 122 | 10 | 218 | 2 | | | | | | |
| | | 124 | 12 | 219- 222 | 35 | | | | | | |

ORIGINAL EXERCISES
TEXT IV

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
|-----------|-----|------------------------|-----|-------------|-----|---------------------------------------|-----|-------------|-----|---------------------|-----|
| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
| 4- 5 | 10 | 23- 27 | 25 | 180 | 7 | 251 | 4 | 325- 326 | 18 | 354 | 9 |
| 8- 11 | 24 | 30- 33 | 23 | 181 | 1 | 252- 253 | 9 | 328- 329 | 21 | 355 | 5 |
| 12- 13 | 7 | 34 | 55 | 183 | 8 | 255 | 3 | 331 | 10 | 357- 358 | 20 |
| 19 | 7 | 42 | | 185 | 10 | 258- 259 | 10 | 335- 339 | 49 | 360 | 2 |
| | | 44- 47 | 29 | 188 | 4 | 261- 262 | 24 | 341 | 6 | 361 | 2 |
| | | 49- 53 | 26 | 188 | 1 | 263 | 8 | 343 | 5 | 363 | 9 |
| | | 55 | 13 | 190- 191 | 17 | 265- 267 | 24 | 345 | 8 | 365- 367 | 25 |
| | | 56 | 3 | 194 | 2 | 268- 269 | 10 | 347- 348 | 12 | 371- 375 | 43 |
| | | 58 | 12 | 197 | 10 | 271 | 6 | 349- 350 | 10 | 376 | 4 |
| | | 60 | 5 | 199 | 3 | 273 | 5 | 375 | 2 | 377 | 2 |
| | | 61 | 10 | 201- 202 | 12 | 274 | 4 | 376 | 2 | 378 | 2 |
| | | 67- 68 | 17 | 203 | 1 | 276- 278 | 18 | 377 | 4 | 379 | 1 |
| | | 69 | 1 | 206 | 13 | 279- 281 | 23 | 378 | 4 | 382 | 2 |
| | | 70 | 2 | 208 | 5 | 286- 289 | 42 | 379 | 4 | 385 | 1 |

TEXT IV (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|
| | | 75 | 29 | 209 | 2 | 291- 292 | 4 | 381 | 1 | 386 | 2 |
| | | 78- 79 | 25 | 211 | 10 | 292- 295 | 27 | 384 | 5 | 387 | 6 |
| | | 80- 81 | 13 | 213 | 3 | 297 | 8 | 385 | 2 | 388 | 2 |
| | | 82- 83 | 8 | 214 | 5 | 299- 302 | 23 | 386 | 4 | 389 | 7 |
| | | 88 | 3 | 215- 216 | 8 | 303 | 3 | 387 | 3 | 389- 390 | 1 |
| | | 92- 95 | 25 | 216- 219 | 23 | 305 | 9 | 387- 388 | 1 | 390 | 1 |
| | | 96- 97 | 14 | 223 | 2 | 307 | 4 | 388 | 3 | 392 | 3 |
| | | 99 | 11 | 224 | 3 | 309 | 4 | 426- 427 | 7 | 398 | 2 |
| | | 100 | 3 | 227- 228 | 11 | 315- 318 | 28 | | | 399 | 5 |
| | | 103 | 7 | 229- 231 | 24 | 375 | 1 | | | 427- 430 | 18 |
| | | 105 | 3 | 235 | 5 | 376 | 2 | | | | |
| | | 106- 108 | 19 | 237 | 3 | 377 | 1 | | | | |
| | | 109 | 2 | 238- 242 | 36 | 378 | 3 | | | | |
| | | 111- 114 | 21 | 244- 245 | 15 | 379 | 3 | | | | |
| | | 114- 116 | 18 | 245- 247 | 48 | 380 | 3 | | | | |
| | | 117 | 17 | 377 | 1 | 381- 382 | 6 | | | | |

ORIGINAL EXERCISES
TEXT V

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
|-----------|-----|------------------------|-----|-------------|-----|---------------------------------------|-----|-------------|-----|---------------------|-----|
| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
| 7- 8 | 12 | 36- 41 | 48 | 129- 131 | 30 | 192- 193 | 25 | 257- 258 | 8 | 291 | 4 |
| 8- 9 | 12 | 42- 45 | 25 | 133 | 12 | 197- 198 | 13 | 259- 263 | 50 | 294 | 5 |
| 10 | 1 | 47- 48 | 14 | 135- 137 | 27 | 200- 201 | 11 | 267- 271 | 54 | 297- 301 | 33 |
| 11- 12 | 10 | 49- 54 | 34 | 140- 145 | 41 | 205- 215 | 102 | 272- 274 | 20 | 304 | 1 |
| 13- 14 | 9 | 58- 60 | 20 | 150- 154 | 42 | 219- 226 | 69 | 275- 278 | 33 | 305 | 4 |
| 14- 15 | 6 | 63 | 17 | 147 | 2 | 227 | 3 | 279 | 11 | 309- 313 | 60 |
| 17- 19 | 31 | 66 | 16 | 156- 160 | 32 | 228 | 8 | 284- 285 | 15 | 314 | 1 |
| 21 | 7 | 69 | 3 | 161- 163 | 18 | 230- 233 | 33 | 285- 288 | 28 | 315 | 1 |
| 22- 24 | 22 | 74- 76 | 24 | 166 | 6 | 237 | 5 | 335 | 2 | 318- 321 | 35 |
| 24- 27 | 25 | 77 | 1 | 167- 168 | 3 | 239 | 6 | 345- 347 | 23 | 323- 326 | 31 |
| 28- 29 | 11 | 79- 82 | 38 | 169 | 5 | 240- 241 | 6 | | | | |
| 30- 31 | 10 | 85- 88 | 47 | 176- 179 | 24 | 241- 242 | 14 | | | | |
| | | 89 | 10 | 179 | 1 | 245- 247 | 34 | | | | |

TEXT V (Continued)

| Page | No. | Page | No. | Page | No. | Page | No. | Page | No. | Page | No. |
|------|-----|-------------|-----|-------------|-----|-------------|-----|------|-----|------|-----|
| | | 91- 93 | 30 | 181 | 5 | 249- 250 | 18 | | | | |
| | | 95- 96 | 19 | 182- 183 | 13 | 252- 256 | 42 | | | | |
| | | 98 | 9 | 183- 186 | 20 | | | | | | |
| | | 100 | 1 | 187- 189 | 32 | | | | | | |
| | | 104- 109 | 40 | 331- 332 | 6 | | | | | | |
| | | 113- 114 | 18 | 333 | 3 | | | | | | |
| | | 120- 123 | 36 | 334- 336 | 14 | | | | | | |
| | | 328 | 1 | 338- 339 | 3 | | | | | | |
| | | 330 | 7 | | | | | | | | |
| | | 333- 334 | 6 | | | | | | | | |
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| 27- 28 | 10 | 117 | 1 | 168 | 8 | 237- 238 | 12 | | | | |
| 29 | 13 | 118 | 9 | 169- 171 | 29 | 239 | 3 | | | | |
| 31 | 12 | 119- 120 | 19 | 172 | 6 | 240 | 3 | | | | |
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| 39 | 2 | 314 | 6 | 187 | 10 | 316 | 5 | | | | |
| 43 | 3 | 320 | 3 | 189 | 9 | 317 | 5 | | | | |
| 45 | 1 | 320 | 3 | 190 | 1 | 321 | 3 | | | | |
| 47 | 1 | 322 | 6 | 191 | 1 | 323 | 1 | | | | |
| 48 | 1 | 323 | 2 | 192 | 2 | | | | | | |
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| | | 68 | 9 | 195- 196 | 8 | 270- 271 | 11 | | | | |
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| | | 48 | 1 | 162 | 15 | 239 | 11 | | | | |
| | | 49 | 2 | 164 | 2 | 242 | 2 | | | | |
| | | 55 | 2 | 173 | 6 | 243 | 6 | | | | |
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| | | 57 | 12 | 175- 176 | 14 | | | | | | |
| | | 58 | 1 | 179- 180 | 2 | | | | | | |
| | | 61 | 14 | 180- 181 | 12 | | | | | | |
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| | | 69 | 7 | 183 | 3 | | | | | | |

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| | | 37 | 1 | 139 | 4 | 187 | 2 | 237 | 1 | 271 | 2 |
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| 25 | 15 | 51 | 2 | 156 | 4 | 222 | 2 | 279 | 7 | 311 | 5 |
| 26- 28 | 13 | 51 | 1 | 156- 157 | 4 | 223 | 3 | 279 | 2 | 311 | 3 |
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| 11 | 3 | 21 | 2 | 198 | 1 | 264 | 3 | 319 | 14 | 378 | 3 |
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| | | 82 | 9 | 229 | 1 | 169 | 4 | | | | |
| | | 84- 85 | 7 | | | 170- 171 | 8 | | | | |
| | | 88- 90 | 25 | | | 172- 173 | 8 | | | | |
| | | 215 | 6 | | | 175- 176 | 10 | | | | |
| | | 217 | 4 | | | 176 | 8 | | | | |
| | | 218 | 4 | | | 215- 216 | 4 | | | | |
| | | 220 | 7 | | | 222 | 5 | | | | |
| | | 222 | 2 | | | 227 | 1 | | | | |
| | | 223 | 2 | | | 232 | 4 | | | | |
| | | 224 | 7 | | | 233 | 2 | | | | |
| | | 227 | 6 | | | 235 | 3 | | | | |
| | | 229 | 2 | | | 235 | 2 | | | | |
| | | | | | | 236 | 4 | | | | |

ORIGINAL EXERCISES
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| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 8- 9 | 13 | 61 | 4 | 159 | 4 | 257- 258 | 14 | 324 | 13 | 369 | 8 |
| 11 | 2 | 64 | 9 | 160 | 5 | 259- 260 | 15 | 325- 326 | 15 | 371 | 7 |
| 13- 14 | 11 | 65 | 4 | 161 | 3 | 261 | 5 | 328 | 13 | 373 | 12 |
| 15- 16 | 11 | 67 | 8 | 162 | 2 | 263 | 4 | 329- 331 | 21 | 375 | 5 |
| 18- 19 | 7 | 69- 70 | 12 | 163 | 3 | 263- 265 | 20 | 332 | 5 | 376 | 7 |
| 21- 22 | 19 | 73- 74 | 21 | 164 | 11 | 265 | 4 | 333- 334 | 15 | 377- 378 | 14 |
| 23 | 1 | 75- 76 | 7 | 165 | 4 | 266- 267 | 3 | 335 | 4 | 379- 380 | 12 |
| 24 | 11 | 77 | 8 | 166 | 2 | 267- 268 | 15 | 337- 338 | 8 | 382 | 13 |
| 25 | 1 | 79- 80 | 11 | 168 | 2 | 270 | 3 | 339- 340 | 14 | 383 | 5 |
| 26- 27 | 14 | 82 | 13 | 169 | 1 | 270 | 11 | 340- 341 | 12 | 384- 385 | 9 |
| 28- 29 | 6 | 83 | 2 | 171- 172 | 26 | 271- 272 | 8 | 341- 342 | 9 | 387 | 7 |
| 31 | 16 | 84 | 4 | 173 | 4 | 272 | 1 | 343- 344 | 12 | 389- 390 | 15 |
| 34- 35 | 17 | 86- 87 | 20 | 174 | 3 | 273 | 8 | 346 | 2 | 394- 395 | 17 |

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| 39 | 1 | 89 | 1 | 176- 178 | 15 | 275- 277 | 27 | 349 | 6 | 400- 402 | 42 |
| 40 | 9 | 90 | 3 | 179 | 3 | 278 | 3 | 350- 351 | 14 | 402- 407 | 46 |
| 41- 42 | 17 | 91 | 18 | 180 | 3 | 279 | 1 | 353 | 12 | 408- 411 | 29 |
| 44- 46 | 13 | 92- 94 | 40 | 181 | 2 | 280- 281 | 10 | 354 | 3 | | |
| 48 | 5 | 106- 107 | 12 | 182 | 3 | 282- 283 | 15 | 355 | 4 | | |
| 49- 50 | 12 | 109- 110 | 12 | 183 | 5 | 284 | 9 | 357 | 7 | | |
| 50- 51 | 13 | 111 | 2 | 185- 186 | 15 | 285 | 2 | 359- 361 | 39 | | |
| 51- 53 | 7 | 113 | 3 | 188- 189 | 22 | 287 | 13 | 361- 364 | 47 | | |
| 53- 55 | 44 | 114- 115 | 15 | 189- 191 | 24 | 288- 290 | 28 | 364- 366 | 20 | | |
| | | 116- 117 | 10 | 192- 194 | 11 | 291 | 9 | 428- 429 | 2 | | |
| | | 118 | 4 | 203 | 2 | 292 | 3 | 431 | 5 | | |
| | | 119 | 4 | 204 | 2 | 293- 294 | 26 | 432- 433 | 5 | | |
| | | 121- 122 | 22 | 206- 207 | 12 | 295 | 3 | | | | |
| | | 124- 125 | 9 | 208 | 5 | 296 | 5 | | | | |
| | | 126 | 3 | 209- 211 | 21 | 297 | 7 | | | | |

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| | | 128 | 11 | 213 | 13 | 299- 300 | 38 | | | | |
| | | 131 | 1 | 214 | 4 | 301- 304 | 53 | | | | |
| | | 132 | 4 | 217 | 5 | 305- 310 | 32 | | | | |
| | | 133- 134 | 10 | 218 | 8 | 428 | 2 | | | | |
| | | 135 | 1 | 222 | 13 | 429- 430 | 20 | | | | |
| | | 136- 137 | 13 | 223 | 4 | 431- 432 | 5 | | | | |
| | | 138 | 4 | 225- 226 | 9 | | | | | | |
| | | 140 | 2 | 228- 229 | 17 | | | | | | |
| | | 143- 144 | 20 | 231 | 2 | | | | | | |
| | | 146- 147 | 14 | 232- 233 | 16 | | | | | | |
| | | 147- 149 | 22 | 234 | 6 | | | | | | |
| | | 150- 153 | 18 | 235- 236 | 4 | | | | | | |
| | | 425- 427 | 23 | 236- 239 | 26 | | | | | | |
| | | | | 239- 242 | 29 | | | | | | |
| | | | | 243- 244 | 40 | | | | | | |

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| | | | | 249 | | | | | | | |
| | | | | 250- | 17 | | | | | | |
| | | | | 253 | | | | | | | |
| | | | | 427- | 13 | | | | | | |
| | | | | 429 | | | | | | | |
| | | | | 431 | 4 | | | | | | |
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ORIGINAL EXERCISES
TEXT XV

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 3 | 10 | 43 | 3 | 121- | 10 | 178 | 8 | 168 | 10 | 267 | 2 |
| | | | | 122 | | | | | | | |
| 7 | 4 | 44 | 7 | 123 | 6 | 180 | 5 | 171 | 4 | 271 | 12 |
| 11 | 7 | 46 | 2 | 124 | 10 | 182- | 12 | 173 | 4 | 273 | 10 |
| | | | | | | 183 | | | | | |
| 13 | 5 | 46 | 8 | 125 | 13 | 184- | 11 | 175 | 14 | 273 | 5 |
| | | | | | | 185 | | | | | |
| 15 | 10 | 48- | 6 | 128 | 4 | 187 | 5 | 177 | 5 | 274 | 6 |
| | | 49 | | | | | | | | | |
| 15- | 4 | 50 | 4 | 130- | 10 | 189 | 6 | 198- | 34 | 277 | 9 |
| 16 | | | | 131 | | | | 202 | | | |

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| 16 | 2 | 50 | 5 | 131 | 10 | 194 | 8 | 205- 206 | 9 | 283 | 2 |
| 17 | 5 | 51 | 8 | 133- 134 | 3 | 196 | 1 | 241- 242 | 17 | 286- 287 | 15 |
| 17 | 10 | 53 | 3 | 134 | 11 | 197- 198 | 12 | 244 | 6 | 287 | 15 |
| 19 | 5 | 55 | 5 | 137 | 8 | 202 | 8 | 245 | 6 | 288- 290 | 12 |
| 19 | 11 | 56- 57 | 6 | 143 | 11 | 206 | 5 | 246 | 7 | 290- 291 | 11 |
| 21- 22 | 13 | 57 | 6 | 144- 145 | 11 | 208 | 6 | 257 | 12 | 291- 292 | 20 |
| 24 | 8 | 58- 59 | 15 | 145- 146 | 11 | 210 | 5 | 262- 263 | 9 | 294- 296 | 20 |
| 25 | 6 | 59- 60 | 8 | 146 | 5 | 212 | 9 | 338 | 9 | 340 | 14 |
| 26- 27 | 20 | 60 | 3 | 149 | 10 | 212 | 6 | 364 | 1 | 363 | 1 |
| 28- 29 | 13 | 60 | 5 | 150 | 4 | 215 | 2 | 365 | 4 | 364 | 3 |
| 30- 31 | 9 | 62 | 3 | 152- 153 | 15 | 217 | 2 | 366 | 4 | 365 | 1 |
| 31- 32 | 11 | 63 | 6 | 154 | 11 | 219 | 4 | 367 | 1 | 366 | 6 |
| 36 | 5 | 63 | 3 | 155- 156 | 7 | 220- 221 | 8 | 371- 372 | 6 | 367 | 3 |
| 37 | 3 | 68 | 12 | 158- 159 | 8 | 223 | 4 | 377 | 2 | 374- 375 | 7 |
| 38 | 6 | 70 | 16 | 159- 163 | 45 | 223- 224 | 10 | 378 | 4 | 377 | 3 |
| | | 71 | 5 | 165- 166 | 18 | 227 | 6 | | | 378 | 6 |

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| | | 73 | 11 | 309 | 3 | 229- 230 | 10 | | | | |
| | | 75 | 4 | 310- 311 | 9 | 230 | 8 | | | | |
| | | 76 | 12 | 313 | 3 | 232- 233 | 7 | | | | |
| | | 77 | 3 | 331 | 8 | 233- 234 | 19 | | | | |
| | | 78 | 11 | 341 | 4 | 236 | 6 | | | | |
| | | 79- 80 | 3 | 347- 348 | 11 | 237- 238 | 9 | | | | |
| | | 82 | 11 | 348- 349 | 12 | 246- 247 | 7 | | | | |
| | | 83 | 4 | 363 | 1 | 248 | 4 | | | | |
| | | 83- 84 | 15 | 364 | 1 | 248 | 1 | | | | |
| | | 84 | 5 | 365 | 1 | 251- 252 | 15 | | | | |
| | | 85 | 2 | 366- 367 | 1 | 252- 253 | 10 | | | | |
| | | 86 | 2 | 367 | 2 | 254- 257 | 30 | | | | |
| | | 88 | 11 | 370- 371 | 8 | 263 | 11 | | | | |
| | | 91 | 13 | 375- 376 | 10 | 335 | 8 | | | | |
| | | 92 | 5 | 378 | 2 | 363 | 1 | | | | |
| | | 95 | 16 | | | 364 | 4 | | | | |
| | | 98 | 17 | | | 365 | 3 | | | | |
| | | 101 | 14 | | | 366 | 1 | | | | |

APPLIED EXERCISES
TEXT II

| Introd. | | Rectilinear Figs. | | Circles | | Ratio, Proportion, Similarity | | Areas | | Regular Polygons | |
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| 6 | 5 | 49-50 | 2 | 164-166 | 13 | 205-206 | 4 | 176-178 | 4 | 248 | 1 |
| 10 | 2 | 73 | 1 | | | 230 | 3 | 186-187 | 11 | 251 | 2 |
| 11 | 2 | 78 | 1 | | | 240-241 | 9 | | | 255 | 1 |
| 14 | 3 | 94-95 | 3 | | | | | | | 270-271 | 9 |
| 21 | 2 | 98 | 2 | | | | | | | 273 | 3 |
| 38 | 3 | 116-117 | 11 | | | | | | | 274-277 | 12 |

APPLIED EXERCISES
TEXT III

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 16- 17 | 5 | 66 | 1 | 209 | 2 | 237 | 5 | 318- 319 | 3 | 375 | 1 |
| 26 | 5 | 75 | 2 | 409- 411 | 11 | 250 | 1 | 331 | 4 | 377 | 1 |
| 29- 30 | 6 | 92 | 1 | | | 283 | 2 | 340- 341 | 9 | 380- 381 | 10 |
| 30- 31 | 4 | 140- 141 | 9 | | | 285- 286 | 2 | 414- 415 | 9 | 383 | 1 |
| | | 403 | 1 | | | 287 | 5 | | | 385 | 2 |
| | | 407- 409 | 12 | | | 288- 289 | 11 | | | 388 | 1 |
| | | | | | | 290- 292 | 9 | | | 391 | 3 |
| | | | | | | 304 | 1 | | | 395- 396 | 9 |
| | | | | | | 306- 307 | 3 | | | 396- 398 | 16 |
| | | | | | | 310 | 1 | | | 416- 417 | 14 |
| | | | | | | 411- 414 | 17 | | | | |

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TEXT IV

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| 5 | 2 | 36 | 1 | 206 | 1 | 281 | 1 | 336 | 1 | 366-367 | 11 |
| 9 | 1 | 41 | 1 | 229-230 | 5 | 287-288 | 4 | 341 | 2 | 374-375 | 2 |
| | | 115 | 1 | 239 | 1 | 294 | 1 | 386 | 1 | 376 | 1 |
| | | 151 | 1 | 418-420 | 11 | 317-318 | 4 | 426-427 | 7 | 378 | 1 |
| | | 413-418 | 14 | | | 377 | 1 | | | 385 | 1 |
| | | | | | | 421 | 20 | | | 386 | 1 |
| | | | | | | | | | | 387 | 1 |
| | | | | | | | | | | 389-390 | 1 |
| | | | | | | | | | | 392 | 1 |
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TEXT V

| Introd. | | Rectilinear Figs. | | Circles | | Ratio, Proportion, Similarity | | Areas | | Regular Polygons | |
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| 7-8 | 6 | 39-41 | 11 | 137 | 2 | 205-206 | 3 | 260 | 1 | 298 | 1 |
| 8-9 | 5 | 45 | 2 | 143-145 | 8 | 212-215 | 24 | 261-262 | 14 | 299 | 2 |
| 18 | 5 | 52-54 | 9 | 153-154 | 2 | 220 | 3 | 263 | 2 | 300-301 | 10 |
| 21 | 4 | 76 | 3 | 157 | 1 | 221-222 | 3 | 271 | 6 | 311-313 | 23 |
| 26-27 | 4 | 82 | 5 | 169 | 1 | 224-226 | 15 | 276 | 1 | 324-326 | 17 |
| | | 88 | 6 | 181 | 5 | 231 | 1 | 277-278 | 13 | | |
| | | 93 | 2 | 185-186 | 7 | 232-233 | 6 | 287-288 | 5 | | |
| | | 96 | 2 | 334 | 1 | 237 | 1 | 347 | 1 | | |
| | | 107-109 | 10 | | | 239 | 1 | | | | |
| | | 114 | 3 | | | 241 | 1 | | | | |
| | | 330 | 1 | | | 245-247 | 19 | | | | |
| | | | | | | 249-250 | 4 | | | | |
| | | | | | | 254 | 1 | | | | |

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| 11 | 1 | 89 | 1 | 198 | 1 | 241 | 2 | 292 | 2 | 343- 344 | 9 |
| 17 | 1 | 109 | 2 | 207 | 1 | 242 | 1 | 303- 305 | 7 | 345- 348 | 8 |
| 32 | 8 | 110 | 1 | 208- 209 | 1 | 251 | 2 | 307 | 2 | | |
| 41 | 1 | 116 | 1 | 226 | 1 | 252- 253 | 2 | | | | |
| 60- 61 | 5 | 118 | 1 | 229 | 1 | 262 | 1 | | | | |
| | | 137 | 5 | | | 266 | 2 | | | | |
| | | 153 | 1 | | | 267 | 3 | | | | |
| | | 163 | 1 | | | 270 | 2 | | | | |
| | | | | | | 281- 282 | 7 | | | | |
| | | | | | | 282- 283 | 3 | | | | |
| | | | | | | 287- 288 | 6 | | | | |
| | | | | | | 289 | 1 | | | | |

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TEXT VIII

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| xviii | 3 | 20 | 1 | 135 | 1 | 212 | 1 | 259 | 4 | 302 | 3 |
| | | 57 | 1 | 173 | 5 | 225 | 9 | 261 | 2 | 305 | 2 |
| | | 61 | 1 | | | 230- 231 | 2 | 272 | 1 | 306 | 2 |
| | | 100 | 1 | | | 239 | 2 | | | 309 | 1 |
| | | 102 | 3 | | | 320- 321 | 6 | | | | |

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TEXT IX

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| | | 36 | 1 | | | 216 | 1 | 245 | 1 | 262 | 1 |
| | | 39 | 1 | | | 293- 294 | 6 | 299 | 1 | 278 | 1 |
| | | 39 | 1 | | | | | | | 284 | 1 |
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| 5 | 1 | 25 | 1 | 114 | 1 | 151 | 1 | 206 | 2 | 239 | 1 |
| 11 | 2 | 29 | 1 | 138 | 2 | 166 | 2 | 207 | 6 | 249 | 6 |
| 12 | 2 | 33 | 2 | 149 | 1 | 176 | 1 | 213 | 1 | 252 | 5 |
| 13 | 1 | 36 | 3 | 150 | 4 | 177 | 4 | 299 | 1 | 253 | 6 |
| 24 | 3 | 63 | 1 | | | 179 | 1 | 300 | 1 | 261 | 1 |
| | | 64 | 7 | | | 180 | 1 | | | 308 | 1 |
| | | 272- 277 | 14 | | | 186 | 4 | | | 309 | 1 |
| | | | | | | 192- 193 | 11 | | | | |
| | | | | | | 291 | 1 | | | | |
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TEXT XI

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 12 | 1 | 60- 61 | 11 | 167 | 4 | 238 | 1 | 268 | 1 | 310 | 1 |
| 16 | 2 | 71 | 1 | 179 | 1 | 244 | 3 | 270 | 3 | 317 | 2 |
| 29- 30 | 4 | 80 | 2 | 180 | 2 | 244 | 1 | 271 | 2 | 318 | 5 |
| | | 88 | 1 | 184 | 2 | 245 | 1 | 271 | 1 | 321 | 2 |
| | | 89- 90 | 4 | 190 | 1 | 247 | 1 | 273 | 1 | 324 | 1 |
| | | 90- 91 | 10 | | | 253 | 1 | 274 | 1 | | |
| | | 111 | 6 | | | 255 | 2 | 280 | 2 | | |
| | | 120 | 1 | | | 256 | 2 | 289 | 2 | | |
| | | 123 | 1 | | | 259 | 1 | 290 | 4 | | |
| | | | | | | | | 290 | 2 | | |
| | | 126 | 1 | | | 336 | 7 | 291- 292 | 4 | | |
| | | 129 | 1 | | | 337 | 5 | | | | |
| | | 130 | 1 | | | | | | | | |
| | | 134 | 1 | | | | | | | | |
| | | 344 | 1 | | | | | | | | |
| | | 348 | 1 | | | | | | | | |

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TEXT XIII

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 4 | 5 | 37- 38 | 10 | 104 | 2 | 129 | 2 | 181 | 3 | 211- 214 | 20 |
| 6- 7 | 4 | 53 | 3 | 106 | 1 | 135 | 1 | 187 | 2 | 216 | 2 |
| 8 | 7 | 64- 66 | 5 | 108- 109 | 5 | 140 | 6 | 190 | 5 | | |
| 14 | 2 | 67 | 4 | 112 | 2 | 142 | 3 | 191 | 1 | | |
| 19- 20 | 5 | 82 | 2 | 215 | 1 | 143- 144 | 4 | 216 | 1 | | |
| 21 | 6 | 85 | 4 | | | 149- 150 | 5 | | | | |
| 26 | 1 | 88- 90 | 6 | | | 156 | 1 | | | | |
| | | 217 | 1 | | | 158 | 1 | | | | |
| | | 223 | 1 | | | 165- 168 | 5 | | | | |
| | | | | | | 172- 173 | 6 | | | | |
| | | | | | | 175- 176 | 7 | | | | |
| | | | | | | 176 | 7 | | | | |
| | | | | | | 222 | 3 | | | | |
| | | | | | | 232 | 1 | | | | |
| | | | | | | 235 | 1 | | | | |

APPLIED EXERCISES
TEXT XIV

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 15 | 1 | 77 | 5 | 217 | 1 | 271- 272 | 8 | 324 | 2 | 394- 395 | 5 |
| 16 | 1 | 84 | 1 | 225 | 1 | 276- 277 | 17 | 334 | 1 | 397 | 3 |
| 22 | 1 | 86 | 1 | 237 | 2 | 280- 281 | 10 | 335 | 3 | 400- 401 | 3 |
| 23 | 1 | 87 | 1 | 249 | 1 | 289 | 5 | 338 | 1 | 403- 404 | 12 |
| 26 | 2 | 88 | 4 | 250- 253 | 17 | 304 | 8 | 341- 342 | 2 | 408- 411 | 21 |
| 27 | 3 | 116- 117 | 7 | | | 305- 310 | 32 | 344 | 1 | 441 | 1 |
| 51- 53 | 7 | 124- 125 | 7 | | | 432 | 2 | 347 | 1 | | |
| | | 143 | 7 | | | | | 349 | 3 | | |
| | | 150- 152 | 16 | | | | | 357 | 2 | | |
| | | 426 | 1 | | | | | 359 | 1 | | |
| | | | | | | | | 365 | 2 | | |
| | | | | | | | | 431 | 3 | | |
| | | | | | | | | 433 | 2 | | |

APPLIED EXERCISES
TEXT XV

| Introd. | | Rectilin- ear Figs. | | Circles | | Ratio, Pro- portion, Similarity | | Areas | | Regular Polygons | |
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| 3 | 6 | 60 | 1 | 123 | 2 | 202 | 1 | 177 | 2 | 288 | 1 |
| 7 | 4 | 63 | 1 | 124 | 5 | 230 | 1 | 198- 199 | 4 | 290 | 3 |
| 11 | 7 | 78 | 1 | 125 | 1 | 233 | 1 | 241 | 3 | 292 | 1 |
| 19 | 1 | 111 | 1 | 134 | 1 | 252 | 2 | 242 | 3 | 295 | 3 |
| 28 | 1 | 114 | 1 | 153 | 1 | 252 | 3 | 258 | 1 | 296 | 1 |
| 30 | 2 | | | 309 | 1 | 253 | 4 | 262 | 2 | | |
| | | | | 341 | 3 | 256 | 3 | 263 | 1 | | |
| | | | | 347 | 4 | | | | | | |