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Arithmetic for Printers

J. W. Auble

ARITHMETIC
FOR PRINTERS

By
J. WOODARD AUBLE

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PREFACE TO BUTLER UNIVERSITY EDITION

Because of the changes in the content of the arithmetic courses in the grade schools and because of the specialized nature of the arithmetic used by printers, a special course is necessary to acquaint vocational printing students with the arithmetic necessary to become a successful printer.

Arithmetic as a subject in a vocational course in Printing is comparatively new. Until the change in the interpretation of the Smith-Hughes Industrial Education law which interpretation allowed reimbursement from Federal Government funds for related subject education, as a separate course, the mathematics of Printing was taught during the shop course as occasion demanded. Such instruction given with the shop course was not only in-

adequate to the needs of the student but was also depriving him of time which could profitably be spent with the study of mechanical operations.

With the separation of Arithmetic from the shop course there arose a need for a thorough, practical book containing information and examples of problems with which the printing apprentice would need to be familiar. A complete book of this nature is not available for several reasons, one, there is a very limited field for the sale of such a book, which means prohibitive costs of production, two, there has been insufficient time to prepare such a book, and three, there has been, to the knowledge of the author, no previous study of the possibilities, requirements, or content of such a book. Consequently, there has been

recently a great need for a book which would fulfill all the objectives of a course in Arithmetic for Printers.

The problems of preparing a Math book were chiefly those of material content and method and order of presentation. It was necessary first to determine just exactly what mathematics was required for the changing in status from apprentice to journeyman printer, and then to organize and present the selected material to the student in a manner approved by present-day tradesmen. This thesis does not concern itself so much with the problem as it does with the final solution of the problem. The question of content must be judged by the decision to include the topics which are contained in the book and the arguments for their inclusion are rather in the background. As an

example of this, the first exercise, Roman Numerals is cited. The questions in this example were, "Is the knowledge of Roman Numerals essential to the printer?" and "What does the average beginner in High School know of their use?" Following the exercise is the statement of the use of Roman numerals by the printer. The second question about the average person's knowledge of Roman numerals--the reason they are used as dates in books and in moving pictures is that they are not easily read by the ordinary person and an out-of-date book or picture does not give itself away.

The method employed in the solution of the problem depended to a large extent on the individual topic under consideration. The author profited greatly from an extensive trade analysis conducted by the United Typothetae of America School of Printing while he

was an instructor in this school. The trade analysis presented a great list of possible problems to be included in a Mathematics book. Interviews with former students determined the lack of adequate training or the sufficiency of the instruction received. They who had completed the course and who were now employed could tell what problems they were meeting and with what success they were meeting them. Other instructors not only of Printing but of related work brought their own particular problems to be included in the list. The problems of Proportion and of Copy fitting were suggested by the Design teachers. They had found that students needed this instruction and had decided that the instruction could best be given in the regular Mathematics class. The pressmen and binderymen suggested paper problems

to be solved and the typographers brought problems of type measurement. Finally, with the influence of the factors mentioned, typical work situations in the shop were set up and solved and the method of solution was incorporated into a lesson of additional examples of similar situations, beginning with simple exercises and progressing to complex conditions.

ARITHMETIC FOR PRINTERS contains selected lists of the many types of problems with which the printing apprentice should be familiar. The book also states the generally accepted manner which printers employ in solving these problems.

While primarily for the use of high school students this book can be used to advantage by the apprentice in the shop. If used as a high

school text book in Printing Arithmetic, it is intended that the work cover two semesters of one hour recitation and one and one-half hours home work each day.

The problems are based upon twenty years of practical trade and teaching experience, and are such as are encountered in practically every apprenticeship.

A book used by students of printing should be a model from which correct practice emerges. This correct practice is not 'happen-so' or incidental but is the result of careful planning combined with applied mathematics. Each part or detail of every book should be so planned as to give a well-proportioned, harmonious whole. This book will attempt to be such an example. To give one a general idea of the part played by mathematics in the plan

of a job in printing, the summary and reasons for each detail of this book are given here.

The paper stock is a smooth, modern paper because it needs to harmonize with modern type. Modern type is selected because mathematics necessarily contains many tables of figures. To secure alignment, modern figures must be used and to harmonize with the figures modern type is selected. Century type is used because it has been accepted as one of the easiest to read of the modern type faces and also because, being one of the older and more popular faces, it contains all the fractions, signs, and symbols necessary in a mathematics book.

The size of this book is 5-5/8 x 8-7/16 inches because book stock 25 x 38 inches will fold economically to that size and because 5-5/8 x 8-7/16 inches is a rectangle which has

acceptably pleasing proportions, 1:1.50. This size is also near to standard text book size. The size of the type page, 24 x 36 picas is such because it is accepted as a well-proportioned book which has 50% of the page area occupied by type and on which the type page has the same proportion, width to length, as the sheet. A page 24 x 36 picas has an area 50% of the area of the sheet 5-5/8 x 8-7/16 inches and also it has the same 1:1.50 proportion.

The 10-point type used in the text of this book is selected because the width of the measure, 24 picas, by custom decrees that the size of type for that measure be from 10- to 14-point. The 10-point type is used because this size will adapt itself better to the problem lists than will 12-point or 14-point. The margins, 3-1/2, 5-1/4, 6-1/2, and 9-1/2

are determined by mathematics.

INTRODUCTION

The chief interest of a printer in preparing a thesis is not the material content of the thesis but is rather the manner in which the thesis will be printed. He is more concerned with the size of the page, the size of the type, the kind of type face, the margins, the binding, and other mechanical details. While this thesis, Arithmetic for Printers, is primarily a text book on printing problems for printing students, some explanation is necessary for the person not familiar with printing in order that he may better understand the background for the problems.

The details of the mechanical properties and production problems of a book require as much if not more research and careful planning than the ordinary manuscript if one is to have a successful book.

The size of the book page is governed by

several factors: the size of book paper which can be purchased, the size of the press on which the book is to be printed, the number of copies of the book to be run, the number of pages in the book, the use to which the book is to be subject, the selling price, the correct ratio of width to length, the standards set by other publishers which have by common usage during many years become the acceptable and best standards, and numerous other minor details.

The factors governing size are so interdependent that they must be considered as a group rather than as separate problems. For example, if there were but a few copies to be run or there were but a small number of pages, neither the size of the press nor the size of the paper stock available would be material because the pages could be run one at a time instead of in forms of eight or sixteen pages, and practically any size stock sheet would cut economically to such a small size as that of one book page. Consequently, the following explanation is not given as a solution to any one book problem but rather to show the influence which the factor could have on the final selection of size of page.

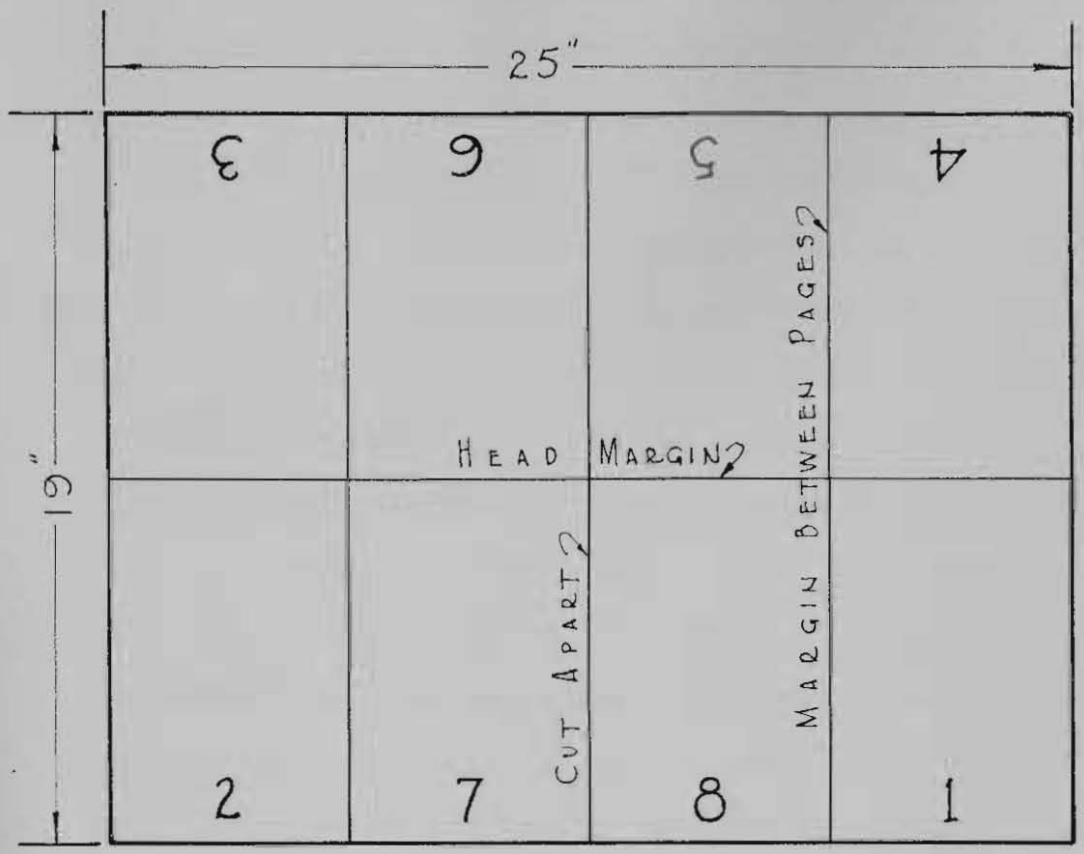


Illustration No.1--Showing the imposition of pages for an 8-page "work and turn" form of type pages. The folding of this sheet is shown in Illustration No. 2.

Book papers available to the printer can be purchased in the following sizes 24 x 36, 25 x 38, 28 x 42, and 32 x 44. Of these sizes 25 x 38 is the one which is used so much more than any other that it is known as the basic size. In order to understand why 25 x 38 is a standard size, one must have a knowledge of imposition, or the placing of pages in a type form such that they will be in the correct position and in correct numerical order when the sheet of paper is folded. Only one of the many kinds of forms is given here. This is known as a "work-and-turn" 8-page form. (The kind of form is determined by the kind of folding machine in the shop, the size of the press, the number of copies and many other factors.) See Illustration No. 1. This form is made up of pages 1 to 8 inclusive and is to be run on the press and printed first on one side and then turned and printed with the same form on the other side such that page 2 prints on the back of page 1, page 3 on the back of page 4, etc., and, after printing, the sheet will be cut into two parts making two complete copies of pages 1 to 8. This type of form is used because it saves press work.

For example, if one wants 1,000 copies of a single page, printed on two sides, he would ordinarily run 1,000 copies with page 1 form and then run page 2 on the back making a total of 2,000 impressions on the press. If he runs page 1 and page 2 both in the same form on double the size stock he need run but 500 on one side and the same 500 on the other side to get his 1,000 copies since each one printed on two sides makes two complete copies. Thus the planning printer has saved on a run of only 1,000 copies, 1,000 impressions on the press.

After the form has been printed and the sheet cut apart the half-sheet is folded such that pages 4 and 5 are inside and pages 1 and 8 are out, afterwards folding in the middle between pages 1 and 8 thus making one signature or section of the book containing pages 1 to 8.

It is noted that the tops of pages 1 and 4, and 5 and 8 are connected, however. This connecting part as well as the irregularities of the fold at the side and bottom must be trimmed away after the book is fastened together, so, in determining the size of the page, one must make allowance for

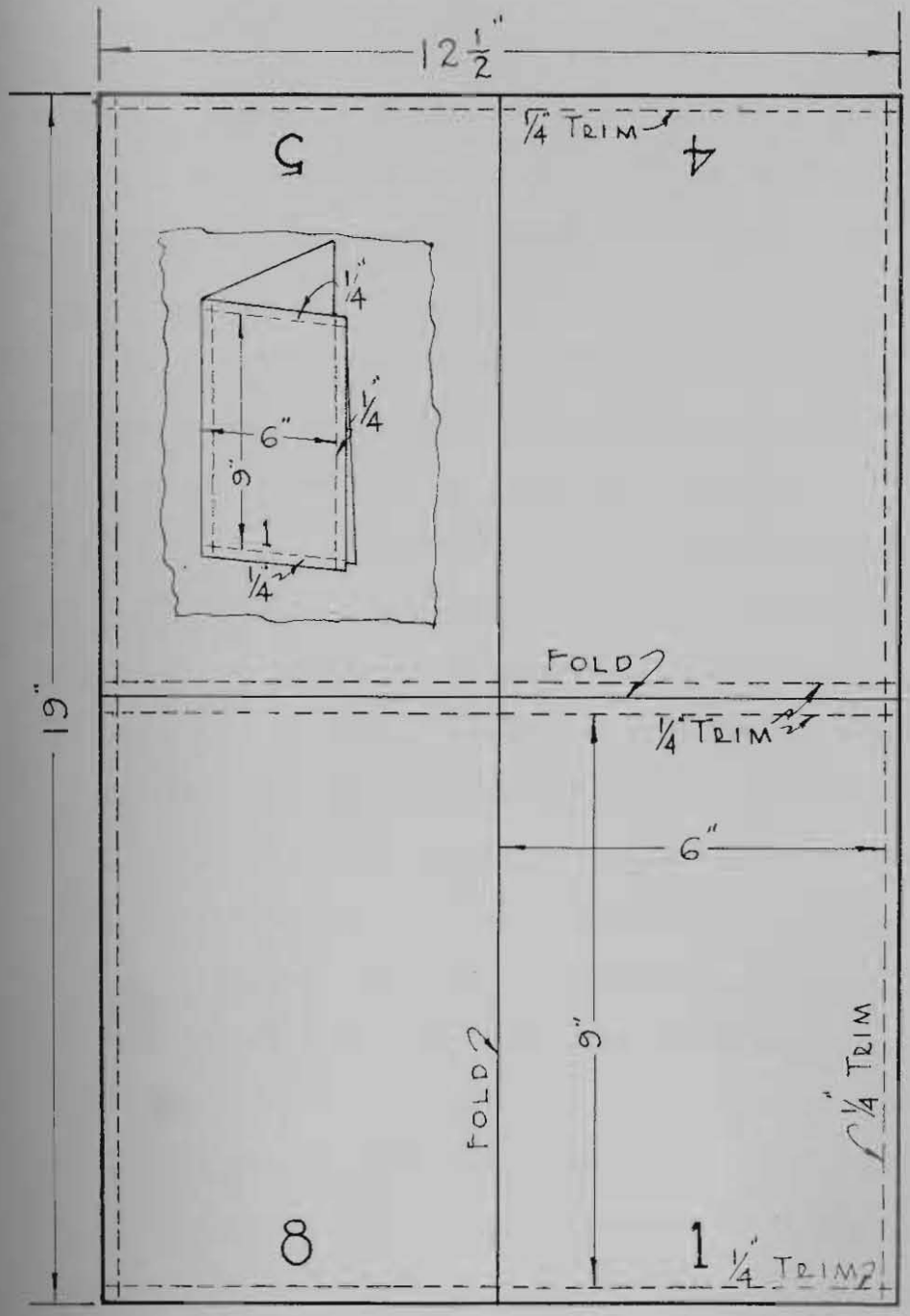


Illustration No. 2--Showing half of a "work and turn" layout with the allowance for trim on a 6 x 9 folder. Insert showing the

"trim". One side of one of the signatures is shown for a 6 x 9 book as an example of the allowance for trim and the placing of pages in a form. See Illustration No. 2.

It is understood that the sheet is to be folded before trimming but the allowance for trim must be made before the stock is printed.

The size of the press as a factor in the size of the book page determines the number of pages possible to run which in turn influence the size of the stock sheet. If one is to have an economically produced book, he will select a size of stock which will print the book with the least waste, consequently the press size has an influence on the page size. A factor having a lesser but still significant influence on size is the number of copies of the book to be run, whether it will be printed on a large automatic press which would take hours to get set for one run or whether it is to be run in smaller forms on a smaller press. On a long run the automatic or large size press is economical, on a small run the smaller press is economical. The size of the press determines the size of the stock sheet which

in turn influences the size of the page. The use to which the book is to be subject influences size. For example, we have pocket-size manuals and we have large encyclopedias, whose sizes are determined by their use.

A factor influencing size which is of great importance is the ratio of length to width of the page. Books are usually planned according to one of four ratios: The golden oblong which has the ratio 1:1.62, the hypotenuse or root-2 oblong which is 1:1.414, the regular oblong of 1:1.5, and the double hypotenuse or printers oblong which has the ratio of one is to the square root of three or 1:1.732. This factor as well as the factor of size of type page in reference to the size of the book page is governed by usage and is one instance in which "what is used is good because it is used." One must remember in testing the validity of that statement that books are made to be read and the easier they are to read the better are the books. The statement that familiarity with type, with page proportions, and with size of books and magazines, even an unconscious familiarity, makes for easy reading, has been proved

many times by advertising agencies. Another example proving that familiarity with the physical make-up of a book makes for easy reading is shown by the ease with which the German people read their type which is known as fractur and the difficulty they experience with our Roman type. The fact that the majority of their people wear glasses is indicative of the illegibility of their type.

Thus, what is being used by the publishers is familiar to the readers and what they read they are familiar with, this in turn produces the statement that what they are familiar with is easiest for them to read. This complicated reasoning does not preclude gradual change and improvement. One must remember that we still use the English system of measurement rather than the metric system not because it is better but because it is the one with which we are familiar and therefore the easiest one to use. When an advertiser pays $15,000 for the privilege of putting an advertisement in one issue of the Saturday Evening Post, he investigates carefully the habits of the reader and will make his 'ad' conform to those habits as nearly as possible--even sometimes

in opposition to the best taste. However, for effectiveness, the familiarity of the reader with the present usage is a strong argument for the continuance of such.

Accepting the theory that what is being done is most effective, the best method for determining the size, the margins, the ratio of type to page, and other features of books is to measure a large number of acceptable books to find the dimensions of the composite or average book.

Quoting from an article soon to appear in Industrial Arts and Vocational Education magazine, entitled "Securing Shape Harmony," the result of the investigation of 500 books selected at random from the library at Arsenal Technical Schools, Indianapolis, is given.

> "...'How does one tell how wide and how long to set the job?' The answer to this one question motivated a study of several weeks' duration which resulted in some rather unexpected findings.
>
> "An accurate measurement of five-hundred books, selected at random from the school library, was made to determine what had been and was being done with success in

the planning of books with the outcome expected being that the results obtained would give a standard from which one could place other books.

"One will realize the scope of the measurements from the following summary of averages. This one summarized, composite book would have:

Width of page	30.61 picas
Length of page	43.32 picas
Width of Type	21.72 picas
Length of type	35.40 picas
Proportion of type to page	1:.47
Page proportion	1:1.48
Type proportion	1:1.62
Inside margin	3.63 picas
Outside margin	5.10 picas
Top margin	3.50 picas
Bottom margin	6.27 picas

"The most valuable information obtained from this study was the proportion or per cent of type to page and the summary of the margins. There was not a great range in the proportion of type to page, not over ten per cent either way from fifty per cent in all of the books measured. This means that if one plans a book page such that half the area of the page will be filled with type, he will not be far from what has been done successfully in the past. The result of the margin study rather upsets the idea that one must have a 3:5:7:9, or there abouts, ratio to have pleasing proportions. Very few books had margins similar to this. In fact the top margin was slightly smaller than the inside margin.

"This book study revealed one other fault with present day books. The type

proportion did not in many cases follow the page proportion, that is, the "golden oblong" was being mixed with the "hypotenuse" or other rectangular shapes. This may have been caused by one of several factors: mechanical limitations, lack of the desire for the same proportions in each, or a lack of the knowledge or ability to have the two the same. The desirable book to be pleasing to the Art authorities should have the same proportions in both the type page and the sheet. If the book page is 6 x 9 then the type ratio should be 2:3.

"In answering the previously stated question as to how wide and how long to set the job, one must have the dimensions of the paper which are either decided by the customer or the paper supply house. The customer will say he wants a page of a certain size or the folding of a stock sheet will give the limitations.

"After the size of the sheet is determined it is necessary to find its proportions so that the type page may be made the same. To find this proportion one divides the length by the width. Trimmed size is understood: 6 x 9 is 1:1.50; 8-1/2 x 11 is 1:1.29; 5 x 8 is 1:1.60; 5-1/2 x 8-1/2 is 1:1.54; and 6 x 8-1/2 is 1:1.41. The next step in planning the book is to determine the area of the type page. This type area should be half, or near to half, the area of the page. Then, a 6 x 9 page whose area is 54 square inches should have approximately 27 square inches of type. Since the inch unit is so large that it will cause in the majority of cases unnecessary fractions, it is desirable to change all the measurements to picas [1/6 inch] and square picas in

planning the job. Having found the number of square picas to be filled with type it is necessary to find two dimensions which are the same proportion as the page and which when multiplied together will result in this number.

"For illustration and clarity let us take a page and plan it according to the preceding. Suppose the page size is 6 x 8-1/2 inches. Changed to picas this is 36 x 51, the proportion is 51÷36 or 1:1.41, and the area is 1836 square picas. Half the sheet area is 918 square picas which is to be the area of the type page.

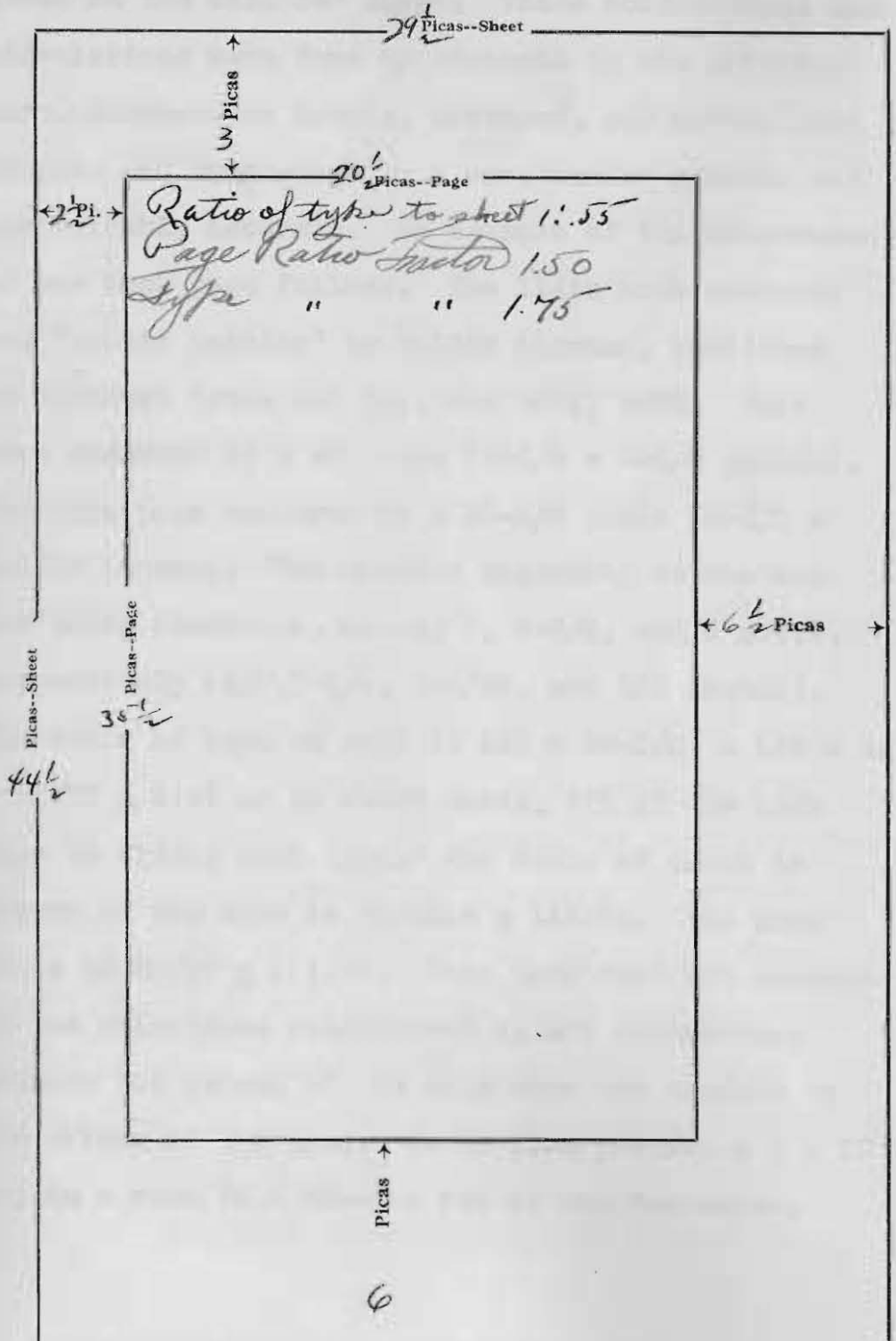
"The ratio 1:1.41 means that for each pica in width of the form the length will be 1.41 picas, or the length will be 1.41 times the width. If the width is 2 the length is 1.41 times 2, if 3 it is 1.41 times 3, or for any number it is 1.41 times that number. Suppose the width is W then the length is 1.41 times W or 1.41 W. In the example (6 x 8-1/2) the type area was to be 918 square picas. W (which is the width) multiplied by 1.41 W (which is the length) should equal 918 square picas. Putting this into a statement and solving for W,

$$W \times 1.41\,W = 918 \text{ square picas}$$
$$1.41\,W^2 = 918$$
$$W^2 = 651$$
$$W = \sqrt{651} = 25\text{-}1/2 \text{ picas} = \text{the width}$$
$$1.41\,W = 1.41 \times 25\text{-}1/2 = 36 \text{ picas} = \text{the length.}$$

Thus one has the dimensions of a type page (25-1/2 x 36) which has the exact proportion (1:1.41) which is found in the page 6 x 8-1/2."

To illustrate the measurements which were made, a representative book measurement is

Book. Alcott, L. M. Little Men
New York A. L. Burt Co. 1901



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given on the enclosed sheet. These measurements and calculations were done by students in the printing math.classes--the totals, averages, and ratios were checked and determined by a comptometer machine and are reliably accurate. An example of the measurement of one book page follows. The 114th book measured was "Public Opinion" by Walter Lippman, published by Harcourt Brace and Co., New York, 1922. This book measured 33 x 49 picas (5-1/2 x 8-1/6 inches). The type page measures 21 x 36-1/2 picas (3-1/2 x 6-1/12 inches). The margins beginning at the top and going clockwise, are 4, 7, 8-1/2, and 5 picas, respectively (2/3,1-1/6, 1-5/12, and 5/6 inches). The ratio of type to page is (21 x 36-1/2) ÷ (33 x 49) = 36/77 = 1:47 or in other words, 47% of the book page is filled with type. The ratio of width to length of the type is 21/36.5 = 1:1.71. The page ratio is 33/49 = 1:1.49. This book does not conform to the principles established by art authorities because the oblong of the page does not conform to the oblong of the type. It is like putting a 9 x 12 rug in a room 12 x 20--the two do not harmonize.

The main purpose of this survey was not as a basis for a thesis but was to determine the usual percentage of type to pages in order to devise a method of securing harmony between the shape of the type form and the shape of the page. The other findings are merely incidental. The method of securing the shape harmony evidently has the approval of the authorities for in reply to the acceptance of the article based on these findings Mr. John J. Metz of the Industrial Arts and Vocational Education magazine says: "'Thanks for the fine articles on 'Securing Shape Harmony'. May I accept it with the provision that we pay for it on publication?....I am afraid I am prejudiced in their [printers] favor, and am continually on the lookout for good articles for them. Your article on 'Securing Shape Harmony' is such a one, and I am glad to get it.' John J. Metz, Editor." This magazine has a wide circulation among printing teachers and an article passing the editor must be based on sound teaching as well as good technical practice.

The book accompanying this report does

not conform to the specifications as outlined. It was not intended that it conform. The pages were set up in type and printed only as the best method to present them to a class to try out the theories and problems of the book and they have been used as loose leaf lesson sheets rather than as a book. When the publisher gets these lesson sheets he will print them in book form as specified in the preface of the bound lesson sheets accompanying. This completed book will have the following specifications: Page size, 5-5/8 x 8-7/16 inches giving a ratio of 1:1.5. The type page will measure 4 x 6 which will be 50% of the sheet. The margins will be 3-1/2, 5-1/2, 6, and 9 picas--starting with the inside margin and going clockwise.

It must be understood that this book is intended to supplement and add to the value of a course in vocational printing and can not be separated from it. As now planned and in operation in most vocational schools, the printing course is a block course and consists of only the following subjects for the first year: Printing, a shop course

of four periods or three clock hours; Printing Design, a drawing course of one period; Printing English, a special type of English prepared especially for printers, of one period; and Printing Math. for one period each day. To plan and teach any one of these subjects without consideration of the others would be digressing from the main purpose of the course--that of making the student a well-rounded worker in the printing trades. This book on arithmetic considers the instruction received in the other subjects, especially that of Printing and Printing Design and supplements rather than duplicates such teaching. Consequently one not having the advantage of such training could not understand the printing problems such as spacing a line of type which must follow instead of precede instruction in the composition of type. The selection of a type face and size must follow instruction in Layout and Design as well as in Printing on these subjects. The explanation of why this particular type face as used in this book as well as why the size of type was selected, other than the brief reasons

as given in the preface, would be meaningless without previous printing experience.

It is to be realized also that there are no standardized tests in printing arithmetic--in fact there are not even any standardized methods of teaching the subject; there is no outlined course of study; one would be safe in saying there is no text book on the subject. Not having any of the above criteria for determining the effectiveness or success of the book one has to rest with the simple conviction that it is better than anything we have used up to date. Even this meaningless statement indicates a step in the proper direction. For the validity of the statement of comparison, a statement from Mr. Frederick W. Polley, head of the Graphic Arts department of Arsenal Technical Schools is cited. Mr. Polley says: "We have used lesson sheets and authorized text books on printing Math. in the printing course for several years, but we find the book, "Arithmetic for Printers" a more valuable text than anything we have used. It contains more practical problems, a greater amount of assignment

material, and since it has been used we have had fewer pupil failures in printing Math."

Anything more than Mr. Polley's statement as a criterion of the success of the book is not available because this school is the only one which has used the book and the use of it has been during the try-out stage. Nevertheless, it is with the idea of progress in the graphic arts that the book is offered as a small step in the forward direction.

To The Student

Success in the printing trades today depends on many years of intensive study and practice. Success also depends on the ability to do things well, accurately, and speedily. Success depends, too, on a well-rounded and unlimited foundation in the fundamentals of the trade. Printing mathematics is one of the fundamentals. It is studied by the printing apprentice because the large amount of arithmetic used by printers is different from that used by the average individual. The unit of measurement is much smaller than the inch unit. This smaller unit is necessary for denoting small differences which, if measured in inches, would result in meaningless fractions. If one would attempt to state the difference between the length and width of a room using the mile as a unit, he would see the necessity of a smaller unit. This same necessity is seen if one attempts to state the difference between two sizes of type using the inch as a unit.

Mathematics is one of the essential studies of the printer because of the precision of the work done by him. The page, an exact form of definite proportions and limits, is made up of countless small units each bearing a very definite relation to the whole. The printer must assemble these small units in such a way that they will form a page which will be exactly the same size as other pages in the book or magazine.

The problems selected for this book are arranged such that they will follow and supplement the instruction in the shop. They are, in the majority of cases, practical examples of the work which the printer will have to do. Each list of problems is divided into two groups; the first group is the practical minumum and the second part of each list consists of extra problems for further study and practice.

The assignment for each recitation is

the minimum group plus as many of the extra group as there is time. In each division of the work there are problems and, following the problems, there is an explanation of the procedure usually followed in solving such problems. Try the problems and test the solution and the answer. In many cases the instruction for solving problems is unnecessary. However, in case you have difficulty in understanding any problem, turn to the explanation following each division for help. Your teacher will probably want to give you his explanation before you begin a new division, too, and, in many cases, this will be sufficient instruction for solving any of the problems in the group. The beginning of this work is a general review of arithmetic and the fundamental process.

TABLE OF CONTENTS

Roman Numerals

Exercise 1

1. Write by the roman numeral system the nine simple numbers; as I, II, III, etc.

2. Write in roman numerals the nine tens; as X, XX.

3. Write in roman numerals the nine hundreds.

4. Write in roman numerals the numbers 1 to 15 using lower-case letters.

5. Write in roman numerals the following:

490	940	1899
550	1876	1812
1914	1935	1950

6. Write in arabic numerals:

MDCCXCIX	CDLIII	CIX
MDCCCX	LXVIII	XIX

Extra Problems

7. Express in arabic numerals: $\overline{V}$DCCIX; DCCXIX; MDCCCLXXXVI; XXIV; $\overline{D}$CCXIX.

8. Express in roman numerals: 13; 50,001; 1,938; 1,519.

9. Subtract MDXLIV from MMDCXI.

10. Add DCCC, CCXLIV, and $\overline{V}$DCCIX.

There are two methods of notation or writing numbers, the roman and arabic. No other group uses roman numerals more than the printer. Dates in books, volume numbers, chapter numbers, page folios of preliminary matter in a book, and inscriptions are usually in roman numerals. In the roman method of notation seven letters are employed and their values are: **I**, 1: **V**, 5; **X**, 10; **L**, 50; **C**, 100; **D**, 500; and **M**, 1000.

These letters are combined according to the following principles:

1. Repeating a letter repeats its value: as **II**, 2; **XX** 20; **CCC** 300.

2. When a letter is placed before another of greater value, its value is taken from that of the greater; as **IX**, 9; **XL**, 40; **XC**, 90.

3. When a letter is placed after another of greater value, their values are added; as **XI**, 11; **XV**, 15; **MD**, 1500; **LXXXII**, 82.

4. A bar placed over a number multiplies its value by 1000; as $\overline{\text{V}}$, 5,000 $\overline{\text{C}}$, 500,000.

5. A letter is placed before one of its own order or before one of the next higher order only, that is, units before units or tens only; tens before tens or hundreds only, hundreds before hundreds or thousands only. Hence **IM** is not used for 999, **IL** is not used for 49, nor **XD** for 490.

6. **V**, **L**, and **D** do not bear repetition. **VV**, **LL**, and **DD** represent numbers which have their own symbols.

Exercise 2

1. $24+3\times6\div3-2$ Answer is 28.
2. $3\times5+6\div2-4\div2$
3. $6+3-4+5-3+24-12$
4. $36-3-2+8-24+18$
5. $3\times5\times6+2-4+18\div3$
6. $10+7-4\times3+63\div7$
7. $9\times2\div3-5\times4\div10$
8. $11\times4-3\times3+63\div7\times2-6\times4$
9. $26\div13\times2+4-3\times2+9$
10. $15+5-4\times2+35\div7-2$

Extra Problems

11. $15+6-9\times2-4+6$
12. $72-84\div12\times2+16\div2\times8$
13. $9+2\times3-6\times3\div2+21\times2\div6$
14. $\dfrac{74\times12+2}{8+2}$
15. $\dfrac{64\times12+2}{14}$

Exercise 3

1. $(24+3)+3\times6\div3-2+(24+6)\div5$ Answer is 37.
2. $3\times(5+6)\div11\times3+(5+6+3)\div7$
3. $3\times5+6\div3-(4\times8\div16+3)$
4. $100\div(3+7)+20$
5. $(100-6\times6+2\times7-3)\div5$
6. $150\div[6\times8+2]$
7. $[20+9-2]\div3$
8. $[(16+4)\times2+16\div2]\div3$
9. $80\div(7+13)\times(2+5)$
10. $(50+23-43)\times2\div15+29$

Extra Problems

11. $(25+2)\div9+36-(24+6)$
12. $[13\times(65\div13+10-5)]+14\times2+3$
13. $(100-6\times6+2\times7-3)\div15+25$
14. $6\times[2+(21\div7)]\div4-4\div2$
15. $(50+23-43)\times2\div15+29+[(25+2)\div9+36-(24+6)$

Exercise 4

1. $\frac{24\times36\times12}{12\times2\times6}$ Answer is 72
2. $\frac{18\times72\times45\times9}{3\times12\times9\times2}$
3. $\frac{29\times2\times13\times72}{58\times26\times6}$
4. $\frac{19\times38\times42\times6\times96}{29\times44\times7\times57}$
5. $\frac{6\times54\times36\times72\times12}{18\times18\times18\times18}$
6. $\frac{6\times54}{18}\times\frac{29\times72}{9\times6}\times\frac{26\times25}{29\times6}$
7. $\frac{12\times72}{10}\times\frac{1}{4}\times\frac{1}{1000}\times\frac{9\times72}{10}\times\frac{22}{1}$
8. $\frac{24\times12}{8}\times\frac{36\times12}{8}\times\frac{1}{4}\times\frac{1}{1000}\times\frac{2.20}{1}$
9. $\frac{64\times6}{12}\times\frac{72\times6}{12}\times\frac{1}{4}$
10. $\frac{36\times7}{9}\times\frac{16\times14}{49\times5}\times\frac{50\times5}{5}$

Extra Problems

11. $\frac{16\times12+2}{12}\times\frac{14\times12}{12}\times\frac{1}{4}$
12. $\frac{5\frac{1}{2}\times72}{8}\times\frac{12\times72}{8}$
13. $\frac{6\times72}{5\frac{1}{2}}\times\frac{9\times72}{5\frac{1}{2}}\times\frac{1}{4}\times\frac{121}{1}$
14. $\frac{6\times72}{14}\times\frac{12\times72}{14}$
15. $\frac{19\times24}{100}\times\frac{36}{1}\times5\frac{1}{2}\times16\times\frac{1}{4}\times\frac{1}{1000}\times\frac{\$1.10}{1}$

Exercise 5

1. $1722 \div 12$
2. $10317 \div 19$
3. $37888 \div 37$
4. 35408×29
5. 534×19
6. $261564 \div 2307$
7. $755586 \div 78$
8. 159691×48
9. $774720 \div 96$
10. 35408×295

Extra Problems

11. A printer sets 126 lines of type per hour. How many lines can he set in 13 days of 8 hours each?

12. If each page of a book contains 120 lines in each of the 3 columns to the page, how many lines in a book of 96 pages?

13. A printer works 40 hours a week for 50 weeks. What is his yearly salary at $49.00 per week?

14. There are 159691 lines to be placed on 24 pages. How many lines will be on each page?

15. If 500 sheets of paper cost $4.95. What will 29,564 sheets cost?

There are four fundamental or basic processes in arithmetic. These are addition, subtraction, multiplication, and division. In problems in which several of the operations are to be performed, the processes of multiplication and division always precede those of addition and subtraction.

Examples.

1. $5\times12+3\times6-20\div10$
   $60+18-2=76$
2. $24\div3+16\times2-25\div5\times2$
   $8+32-10=30$
3. $25+5\times2-35\div7$
   $25+10-5=30$

In problems in which several of the operations are involved, it is desirable sometimes to have the processes of addition and subtraction precede those of multiplication and division. In such cases the parts to be solved first are enclosed in parentheses (), braces {}, or brackets [] and should be completed first. After the processes indicated by the enclosing marks are completed, the multiplication and division processes precede those of subtraction and division.

Examples.

1. $5\times(12+3)+3\times6-20\div10$
   $5\times15+3\times6-20\div10$
   $75+18-2=91$
2. $24\div3+[16\times2-12]-24+2\times4$
   $24\div3+\{32-12\}-24+2\times4$
   $24\div3+20-24+2\times4$
   $8+20-24+8=12$
3. $\{(19+2)\div7+10\}-24+2\times6$
   $\{21\div7+10\}-24+2\times6$
   $\{3+10\}-24+2\times6$
   $13-24+12=1$

In problems involving only multiplication and division, of which there are many in printing, it is best to solve by cancelling factors of numbers above and below the line.

Examples

1. $\dfrac{\overset{4}{2}\times\overset{3}{4}\times16\times\overset{3}{9}}{\underset{2}{8}\times\underset{3}{12}}=12$

2. $\dfrac{\overset{2}{24}\times\overset{3}{36}}{12}\times\dfrac{5\times13}{12\times3}=130$

Exercise 6

Find the Least Common Multiple of

1. 1/2; 1/3; 1/4; 1/6; 1/9

2. 1/16; 1/8; 1/4; 1/3; 1/18

3. 2/72; 3/45; 6/35; 1/7; 1/9; 1/8; 3/8

Perform the operation indicated.

4. 1/2+1/3+1/4+1/6+1/9

5. 3/16+3/8+3/4+2/3+5/18

6. 1/2+3/32×4/15+1/15+1/5+1/8+1/4

7. 3/8+1/4+1/2+3/16+5/32

8. 1/2−1/4

9. 3 1/3−2 1/2

10. 5 1/2+3 1/3−7 5/16

11. 3 5/16−1 9/32

12. 8 19/72−5 1/2

Extra Problems

13. 6 1/4+8 1/3+5/16+3 1/3−15 16/75

14. 1/3+1/5+1/7+1/9+1/11

15. 125/640−27/560

Exercise 7

1. $\frac{6\times72}{8}\times\frac{12\times6}{8}$
2. $\frac{9\times12}{10}\times\frac{20\times12}{18}$
3. $\frac{864}{1046}\div\frac{8}{523}$
4. $\frac{5\frac{1}{2}\times12}{6}\times\frac{8\times12}{6}$
5. $\frac{8\times72}{14}\times\frac{28\times56}{8\times3}\div\frac{72}{3}$
6. $\frac{8\frac{1}{2}\times11}{17\times22}$
7. $\frac{19\times24}{9\frac{1}{2}\times12}$
8. $\frac{3\times5}{25\times30}$
9. $38\frac{1}{3}\div3\ 4/5$
10. $42\ 7/9\div10\ 5/6$

Extra Problems

11. $\frac{\frac{3}{4}-\frac{1}{2}}{2\frac{1}{2}+\frac{3}{4}}$
12. $\frac{4/5\div\frac{2}{3}}{\frac{1}{4}\div3/5}$
13. $\frac{4\frac{1}{2}}{2\frac{2}{3}}$
14. $456\ 25/63+345\ 15/18$
15. $4221/25\times12\frac{3}{4}$

A fraction is one or more parts of a unit. It is written as $\frac{1}{3}$ or $\frac{3}{4}$. The part below the line represents the size of the parts and is called the denominator. The part above the line tells how many parts and is called the numerator. For example, in the fraction $\frac{2}{3}$, unity has been divided into three parts, and two of these parts are represented.

In order to add or subtract fractions their denominators must be the same number. For example, $\frac{1}{2}+\frac{1}{4}=\frac{3}{4}$; $\frac{1}{2}=\frac{2}{4}$ and it follows that $\frac{2}{4}+\frac{1}{4}=\frac{3}{4}$. In order to find a number which is common to all the denominators for the purpose of adding the fractions one finds the product of all the prime factors of the denominators. This product is called the least common multiple and is found by the following rule:

1. Write the denominators in a line, divide by any prime number that will exactly divide two or more of them, and write the quotients and undivided numbers in a line beneath.

2. Divide the resulting numbers in the same manner, and so continue until no two numbers are divisable by any prime number greater than 1. The product of the divisors and the numbers undivided will be the least common multiple.

Examples.

1.

2	36	63	84
2	18	63	42
3	9	63	21
3	3	21	7
7	1	7	7
	1	1	1

$2\times2\times3\times3\times7=252=\text{L. C. M.}$

2.

2	44	77	28
2	22	77	14
7	11	77	7
11	11	11	1
	1	1	1

$2\times2\times7\times11=308=$ L. C. M.

3. $\frac{10}{640}+\frac{6}{16}+\frac{1}{32}+\frac{5}{12}$

2	640	16	32	12
2	320	8	16	6
2	160	4	8	3
2	80	2	4	3
2	40	1	2	3
	20	1	1	3

$2\times2\times2\times2\times2\times20\times3=1920$

$$\frac{10}{640}=\frac{30}{1920}$$

$$\frac{6}{16}=\frac{720}{1920}$$

$$\frac{1}{32}=\frac{60}{1920}$$

$$\frac{5}{12}=\frac{800}{1920}$$

$$\frac{30}{1920}+\frac{720}{1920}+\frac{60}{1920}+\frac{160}{1920}=\frac{1610}{1920}=\frac{161}{192}$$

Division of fractions may be performed by inverting the divisor and multiplying. For example:

$$\frac{5}{6}\div\frac{3}{4}=\frac{5}{6}\times\frac{4}{3}=\frac{20}{18}=1\frac{2}{18}=1\frac{1}{9}$$

$$\frac{31}{32}\div\frac{9}{7}=\frac{31}{32}\times\frac{7}{9}=\frac{217}{288}$$

In order to multiply or divide mixed numbers, that is a whole number and a fraction, it is best to change them to improper fractions. This is done by multiplying the whole number by the denominator of the fraction and adding the numerator of the fraction, and then writing this number over the denominator. For example:

$12\frac{1}{2}=2\times12=24$

$24+1=25$

Hence $12\frac{1}{2}=\frac{25}{2}$

Exercise 8

What is the sum of:

1. 4.06, 32.07, 1.426.

2. 165.789, 34.9081, 65.86, 4001.0897.

3. 1.235, 127.6542, 6.0007, 6003.0879, 754.43002.

4. Eighteen and eighteen thousandths, one thousand one hundred twenty-five and one thousand one hundred nine ten-thousandths.

5. Thirty-seven and three thousand three hundred-thousandths, one hundred eighty-eight and one thousandths.

6. Six hundred seven thousand and six hundred seven thousandths, one and four tenths, three thousand three and eleven thousandths.

7. Three dollars four cents, twenty-five-dollars sixty-seven cents, seven dollars five cents, twenty-one dollars, seventy-five cents.

What is the difference between:

8. 20.19 and 4.18.

9. 90.678954 and 6.75.

10. 187.076 and 165.009823.

11. 33 dollars 6 cents and 22 dollars 8 cents.

12. .07 and 7 ten millionths.

13. 3003.673 and 2101.20023

14. $50.75 and $8.765

15. 320.32 and 18.764

Extra Problems

16. A compositor's income was $1256.56 and his expenses were $964. How much did he save?

17. 187.065+8.9341−156.00342

18. From the sum of 121.024 and 36.1,9621 take their difference.

19. To the difference between 121.024 and 36.19621 add their sum.

20. The compositors press time was as follows: 3.6, 5.4, .4, 3.9, 5.2, 5, 4.2, and .3 hours. What is the total for the week?

Exercise 9

1. $16. \times .12$
2. $384.31 \times .009$
3. 3.8431×9
4. $\$15.75 \times 16.2$
5. $\$3.98 \times 48.9$
6. $7.2 \times 7.2 \times 9$
7. $90.008 \times .0031$
8. 21.01×21.01
9. $16 \div .12$ (two decimal places)
10. $384.39 \div .009$
11. $.2576 \div 649$
12. $892 \div .02532$ (two decimal places)
13. $257.6 \div .649$
14. $\dfrac{24.62 \times 3.02}{25.03}$ (two decimal places)
15. $\dfrac{6239 \times .0023}{.023}$

Extra Problems

16. $\dfrac{21.01 \times .2101}{2101}$
17. $\dfrac{.2101 \times 21.01}{.2101}$
18. $\dfrac{90652 \times .251}{50.2}$
19. $\dfrac{6533 \times .3692}{22152}$
20. $\dfrac{42710 \times .009}{384.390}$

Exercise 10

A decimal fraction is one whose denominator is 10 or some product of 10.

Thus, $\frac{1}{10}$ is written .1

$\frac{2}{10}$ is written .2

In order to add decimals they must be arranged such that units of the same order shall stand in the same columns and then added as whole numbers; as

```
  8.22
216.007
  5.322
  8.9
   .004
6000.
6238.453
```

Subtraction is accomplished as in addition. If there be more decimal places in the subtrahend than in the minuend, fill the vacant orders with ciphers; as

```
  638.453000
- 25.624562
612.828438
```

In the multiplication of decimals one multiplies as in whole numbers, and points off in the product as many decimal places as there are in the multiplicand and the multiplier. In case there are not the required number of decimal places in the product, one prefixes as many ciphers as are necessary to make the required numbers; as

```
.024
 .32
 48
 72
.00768
```

In the division of decimals one divides as with simple numbers, and points off from the right of the quoteint as many decimal orders as the number of decimal orders in the dividend exceeds those in the divisor; as

```
      21650.2
.243|5261.0000
    486
    401
    243
    1580
    1458
     1220
     1215
```

Exercise 11

1. The employes in the shop were told that their wages were to be increased by 6%. What was the amount of increase of the men who had been receiving: $95, $125, $140, $150, and $175?

2. The employes in the shop were told that their wages were to be increased by 5%. What would be the wages of the men who had been receiving: *a*, $95? *b*, $125? *c*, $140? *d*, $150? *e*, $175?

3. A printer having 3,000 reams of paper, sold at one time 12½%, at another 25% of what remained, and at a third, sold 20% of what still remained. Find the value of what was still left at $25.00 per ream.

4. If an apprentice's salary is $800.00 the first year of service, and he gets a 10% increase each year for 5 years, what will be his salary the fifth year?

5. The salary of a printing salesman was $1,000 per year. He also received 3% of the amount of all sales over $25,000. What is his total income during a year when he sold $75,000 worth of goods?

6. A compositor earns $1,500 a year and saves 20% of it. How long will it take him to pay for a lot valued at $1,200?

7. Four per cent of the energy supplied by a pulley belt to a line shaft by a 12-horse-power engine in a certain printing plant is lost because of slipping of the belt. How much energy produced by the engine is actually delivered to the shaft?

8. In a large publishing plant 1,200 workmen are employed at an average wage of $3.50 per day. They ask for an increase of 10% in their wages. How much would this increase add to the pay roll of the company?

Extra Problems

9. A metal pot contains 1,950 pounds of foundry metal made up of the following ingredients: lead, 60½%; tin, 12%; antimony, 25%; copper, 2½%. How many pounds of each ingredient are in the mixture?

10. If 1820 pounds of monotype metal composed of lead, 72%; tin, 8¾%; antimony, 19%; and copper, ¼% were dumped into the mixture of problem 9, what would be the resultant percentage of each ingredient?

Exercise 12

1. 189 is 108% of what number?

2. 50% of a page 9×12 inches is filled with type. How many square inches of type are there?

3. If the type form is 60% of the page and contains 35 square inches, what is the area of the page?

4. If the scrap from a piece of paper 17×22 is 3×22 what is the percent of waste?

5. If the spoilage on a press run of 2800 was 9% what was the amount of spoilage?

Extra Problems

6. If the feeder missed 80 sheets in a run of 60,000, what was the percent of spoilage?

7. How many pounds of rags in a 20-pound ream of 30% rag paper?

Exercise 13

1. If 65% of the metal used in type is lead, how many pounds of the other ingredients in five tons of metal?

2. What is the percentage of scrap on a job cutting four 9×12 pieces out of a sheet 19×28?

3. Which is more economical to cut. Nine 6×9 pieces out of 19×28 stock or sixteen 6×9 pieces out of 25×38 stock? (Figure the percentage of waste in each case.)

4. A press produced 1200 copies of a program each hour. By increasing the speed 3% the output was increased by how many copies? How many copies per hour did the press produce at the increased speed?

5. If the length of a page was 150% greater than the width, what is the width of a page 12 inches long?

Extra Problems

6. Which is more economical, twenty-one 3×5 sheets from 17×22 or twenty-seven from a sheet 17×28?

7. The time spent on a job in the shop was as follows: Composition 6 hours, Make-up 1 hour, Press 8 hours, and Bindery 2 hours. What percent of the cost of the job is charged to each department?

Percentage is an application of decimal fractions in which the basis is hundredths.

1 per-cent written $1\% = \frac{1}{100}$ or .01

6 per-cent written $6\% = \frac{6}{100}$ or .06

The base in percentage problems is the number upon which the percentage is calculated.

The rate (or per-cent) is so many hundredths to be taken.

The percentage is the result of taking any per-cent of the base.

Example:

1. 5% of $600

$600 = base
.05 = rate
$30.00 percentage

2. 10% of 5 reams

5 reams = base
.10 = rate
.5 reams = percentage

3. If 3% is the per-cent of waste on a job of 2400 sheets, how many sheets will be needed for the run?

2400 sheets = base
.03 = rate of spoilage
72.00 sheets = spoilage
2400 + 72 = 2472 sheets needed.

To find the base where the percentage and rate are given, divide the percentage by the rate expressed as a decimal.

$$\text{Rate} = \frac{\text{Percentage}}{\text{Base}}$$

Examples:

1. 10% of a number is 40, what is the number?

$$\frac{40}{.10}=400$$

2. 152 is 32% of what number?

$$\frac{152}{.32}=475$$

3. The spoilage on a job was 2% or 16 reams. For how many reams did the order call?

$$\frac{16}{.02}=800 \text{ reams}$$

To find the rate when the base and percentage are given, divide the percentage by the base.

$$\text{Rate}=\frac{\text{percentage}}{\text{base}}$$

Examples:

1. 3 is what percent of 15?

$$\text{Rate}=\frac{3}{15}=\frac{1}{5}=.20=20\%$$

2. 29 is what percent of 580?

$$\text{Rate}=\frac{29}{580}=\frac{1}{20}=5\%$$

3. The pressman buys 25 sheets for spoilage on an order for 500 sheets. What is the rate of spoilage?

$$\text{Rate}=\frac{25}{500}=\frac{1}{20}=5\%$$

Percentage—Buying and Selling

In buying and selling, it is the custom in the majority of establishments to consider the cost as the base. The gain or loss is the percentage and the ratio of the gain or loss to the cost is the rate per cent. The amount is the selling price which is the cost plus the percentage in the case of a gain. If there is a loss, then the selling price is the cost minus the percentage.

Cost = 100%
Gain = Cost + Profit
Selling price = Cost minus profit (Loss)
Gain = Selling price minus Cost
Loss = Cost minus Selling price

$$\text{Gain}\% = \frac{\text{Profit}}{\text{Cost}}$$

$$\text{Loss}\% = \frac{\text{Loss}}{\text{Cost}}$$

Cost × gain% = Amount of Profit
Cost × loss% = Amount of Loss
Selling price% = 100% + profit%
Selling price% = 100% − loss%

Examples.

1. What is the selling price of an article costing $50 if the profit is $12?

$50 + $12 = $62 = Selling price.

2. What is the selling price of an article costing $50 if the loss is $10?

$50 − $10 = $40 = Selling price.

3. What is the percent of gain of an article costing \$50 and making a profit of \$12?

$$\text{Gain}\% = \frac{\text{Profit}}{\text{Cost}} = \frac{12}{50} = 24\%$$

4. What is the percent of loss on an article costing \$50 and sold at a loss of \$12?

$$\text{Loss}\% = \frac{12}{50} = 24\% \text{ loss}$$

5. What is the percent of gain on an article costing \$40 and selling for \$60?

Gain = Selling price minus cost = \$60 − \$40 = \$20

$$\text{Gain}\% = \frac{\text{Profit}}{\text{Cost}} = \frac{\$20}{\$40} = \frac{1}{2} = 50\%$$

6. What is the percent of loss on an article costing \$150 and selling for \$125?

Loss = Cost minus the loss = \$150 − \$125 = \$25

$$\text{Loss}\% = \frac{\text{Loss}}{\text{Cost}} = \frac{\$25}{150} = \frac{1}{6} = 16\tfrac{2}{3}\%$$

7. What is the profit on goods costing \$200 sold at a profit of 25%?

Profit = Cost × gain% = \$200 × 25% = \$50

8. What is the loss on goods costing \$200 and sold at a loss of 50%?

Loss = Cost × loss% = \$200 × 50% = \$100

The Point System—Equivalents

Exercise 16

1. How many points are there in a pica?
2. How many points are there in an inch?
3. How many picas are there in an inch?
4. Change 1152 points to picas.
5. Change 42 picas to inches.
6. Change 576 points to inches.
7. Change 9 inches to picas.
8. Change 8 inches to points.
9. Change 31 picas to points.
10. Change 9 picas to points.
11. Change 10 picas 6 points to points.
12. Change $4\frac{1}{2}$ inches to picas.
13. Change $2\frac{1}{4}$ inches to picas and points.
14. Change 8 points to picas.
15. A form is $5\frac{1}{2}$ inches wide. How many picas wide is it?

Extra Problems

16. A form is two-thirds the width of the paper upon which it is to be printed. If the paper is nine inches wide, how many picas wide is the form?

17. A form is printed on a sheet of paper 6 inches wide and $8\frac{1}{2}$ inches long. What are the dimensions of the form in picas if the job has a 1 inch margin at the top, a $1\frac{1}{2}$ inch margin at the bottom, and a $\frac{3}{4}$ inch margin at each side?

18. A customer orders cards 5×8 inches. Express the dimensions of the card in terms used by the printer.

19. A form 25 picas by 40 picas is centered on a card 5×8 inches. What are the margins in picas? in inches?

Exercise 17

1. How many points are there in 10 picas?
2. How many points are there in 4 inches?
3. How many inches are there in 30 picas?
4. Change 24 picas to inches.
5. Change 8½ inches to picas.
6. Change 1⅔ inches to picas.
7. Change 12 picas to points.
8. Change 1368 points to picas.
9. Change 1368 points to inches.
10. A form is 6½ inches wide. How many picas wide is it?
11. Change 9 picas to points.
12. A form is 3×5 inches. What are the dimensions in picas?
13. A page 6×9 inches has margins of one inch on each side, inch at the top and 1¼ inches at the bottom. How many picas long and wide is the form?
14. A form measures 27 picas. How many inches wide is each line?
15. A form is ¾ the width of the paper on which it is printed. How many picas wide is the form, if the paper is 7 inches wide?

Extra Problems

16. A page measures 7×10½ inches. It has margins of 1¼ inches at the top and 15 picas at the bottom. How long is the type form?
17. Give the inch equivalent to the following: 17 picas, 13 picas, 12½ picas, 35 picas, 25 picas.

The Point System is a system of measurement based on the typographical point, which measures .013833 inch. Twelve points make one pica or .166 inch. For all practical measurement printers use the fractional equivalents which are only approximately correct. The table of practical measurements below should be learned.

1 point = 1/72 inch
1 pica = 1/6 inch
1 point = 1/12 pica
12 points = 1 pica
72 points = 1 inch
6 picas = 1 inch

In changing from the inch unit to the point system, one uses the fractional equivalents rather than the decimal equivalents.

Examples:

1. Change 156 points to picas.
   12 points = 1 pica
   1 point = 1/12 pica
   156 points = 156 × 1/12 = 13 picas.

2. Change 7 inches to picas.
   1 inch = 6 picas
   7 inches = 7 × 6 = 42 picas.

3. Change 35 picas to points.
   1 pica = 12 points
   35 picas = 35 × 12 = 420 points.

4. Change 35 picas to inches.
   6 picas = 1 inch
   1 pica = 1/6 inch
   35 picas = 35 × 1/6 = 5 5/6 inches.

5. Change 7 inches to points.
   1 inch = 72 points
   7 inches = 7 × 72 = 504 points.

Exercise 18

1. Add 20 picas 4 points, 3 picas 3 points, 2 picas 2 points, and 5 picas 1 point.

2. Add 4 picas 3 points and 8 picas 6 points.

3. Add 20 picas, 20 picas 3 points, 8 picas 2 points, and 16 picas 5 points.

4. Add 13 picas 4 points, 12 picas 2 points, 3 picas 3 points, and 2 points.

5. Add 4 picas 3 points, 8 picas 4 points, and 4 picas 5 points.

6. Add 9 picas 8 points, 13 picas 5 points, and 16 picas 2 points.

7. Add 10 points, 8 picas 2 points, 24 picas, and 13 picas 9 points.

8. How wide is a page made up of the following lines: 4 picas 3 points, 5 picas 8 points, 16 picas 9 points, and 3 picas 2 points.

9. How wide is a page made up of two columns of type 3 picas 4 points and 8 picas 9 points.

10. Add 18 picas 4 points, 3 inches, 14 picas, 1⅓ inches, and 16 picas 14 points. (Change all measurements to picas and points.)

Extra Problems

11. How wide in picas and points is a page made up of the following parts: left margin 1⅔ inches, right margin 2 inches, a column 18 picas 4 points, one 13 picas 2 points, and one 5 picas 9 points.

12. Add 1⅛ inches, 13 picas, 9 points, 5½ inches, 16 picas 9 points, 5⅔ inches, and 15 picas 11 points.

Exercise 19

1. From 12 picas 4 points take 9 picas 2 points.

2. From 18 picas 11 points take 15 picas 8 points.

3. From 17 picas 6 point take 5 picas.

4. From 19 picas 10 points take 8 points.

5. From 16 picas 8 points take 2 picas 10 points.

6. From 24 picas take 13 picas 5 points.

7. A column measures 13 picas. A cut on one side is 5 picas 3 points. How long are the lines at the side of the cut?

8. A page is 5 inches wide. How wide in picas is the job if there is a 1-inch margin on each side?

9. A job is 28 picas wide. A cut 2½ inches wide is placed in one corner. How wide are the type lines at one side of the cut?

10. What are the dimensions in picas of a job placed on a page 8½×11 inches if there is a 1¼-inch margin on each side, a 1½-inch margin at the top and a 2-inch margin at the bottom?

Extra Problems

11. What is the total length in picas and points of the type in a job made up of the following: a column 18 picas 4 points with a cut 2⅓ inches wide, one 13 picas 2 points, and one 10 picas 2 points with a cut 2¼ inches wide.

12. How many hours and minutes does a compositor work who starts at 7:35 A. M. and quits at 11:45 A. M. and who works in the afternoon from 1:45 to 4:38?

13. How many hours can be charged to a job which took the following time: Composition 8:30 to 11 A. M. and 1:00 to 3:45 P. M., Press work 7:45 to 11:20 A. M., and Bindery from 1:50 to 5:30 P. M.

14. The total cost of a job was $119.00. If the paper cost $25.69 how much is to be charged to the other departments?

15. The width of a page of type is 54 picas. How many picas of type are there if plates measuring 2½ inches, 14 picas, and 12 picas 3 points are used?

Exercise 19A

1. A newspaper has 8 columns, each 12 picas with a 6-point rule between columns. If there are margins of 2½ picas on each side, how wide is the paper in inches?

2. How wide must one set a job to fit on a card 6⅝ inches wide if there be side margins of 13/16 inches each?

3. A job set 37 picas wide has a printing plate 1 1/6 inches in the center. How wide should the type be set on each side of the plate?

4. A job is to be set ⅝ as wide as the sheet. What would be the width of the type in picas for a sheet 10 inches wide?

5. A job set 38 picas wide has a cut 3¼ inches at one side. How wide is the type at the side of the cut?

6 How wide is the type page of 15 columns each 13 picas 4 points?

7. A form consisting of 4 columns of 3 picas 8 points each is to be reset into 3 columns. How wide will each column be?

8. A column is made up of 3 lines of 18-point type, 4 lines of 14-point type and 50 lines of 8-point type. How long is the column in picas and points?

Extra Problems

9. Make a layout for a job of 3 columns each 13 picas wide with 6-point space between columns, and side margins of ¾ inch each. The length is to be such that there will be a top margin of ½ inch, 3 lines of 24-point type, 4 lines of 12-point type, 30 lines of 5½ point type, and a bottom margin of 1¼ inches.

10. If in a line of 18 picas there is 9 picas 8½ points filled with letters, how much space must be filled with quads and spaces?

Exercise 20

1. How many picas wide is a form made up of four columns, each 4 picas 3 points?

2. How wide is a form made up of three columns, 8 picas 10 points each?

3. A form of eight columns of 4 picas 6 points each is to be reset in six columns. How wide will each column be?

4. Multiply 16 picas 8 points by 4.

5. Divide 14 picas 6 points by 3.

6. How many picas long is a column of fourteen lines of 18-point type?

7. How many picas long is a column made up of eight lines of 14-point type, three lines of 42-point type, three cuts 2½ inches each, and one cut 15 picas?

8. How many inches long is a column of twenty lines of 6-point, fifty lines of 8-point, three lines of 48-point, a cut 14 picas 6 points, and a cut 14 picas 2 points?

9. A form of eight columns 4 picas 8 points each is to be reset in ten columns. How wide will each column be?

10. A form made up of four columns of 10 picas 8 points each has to have a cut 1⅔ inches inserted. How wide will each column be in the new form?

Extra Problems

11. A form is made up of five columns, each 4 picas 8 point, and one 2-point rule between the columns. Draw a layout indicating the columns, the rules, and the total width.

12. A proof of a job consists of eight pages, each 15 picas wide, and margins as follows: two 6 picas, four 4 picas, two 9 picas, and one 20 picas. How many inches wide is the sheet?

In performing the fundamental operations with compound numbers in printing one proceeds as with the compound number feet and inches, in which the decimal unit is 12 instead of 10.

Examples

2 feet 3 inches
+9 feet 10 inches
12 feet 1 (13 inches = 1 foot 1 inch)

12 feet 3 inches
−9 feet 10 inches
2 feet 5 (10 inches from 3 inches + 1 foot) or 12 inches)

12 feet 3 inches
×10
122 feet 6 inches (10×3 = 30 inches = 2 ft. 6 inches)

8|10 ft. 3 inches
1 ft. 3⅜ inches

8 into 10 = 1 with 2 foot left; 2 foot = 24 inches + 3 inches = 27 inches 27 ÷ 8 = 3⅜

In picas and points the process is exactly as above.

2 picas 3 points
+9 picas 10 points
12 picas 1 (13 points = 1 pica 1 point)

12 picas 3 points
−9 picas 10 points
2 picas 5 (10 points from 3 points + 1 pica) or 12 points)

12 picas 3 points
×10
122 picas 6 points (10×3 = 30 points = 2 pi. 6 points)

8|10 pi. 3 points
1 pi. 3⅜ points

8 into 10 = 1 with 2 picas left; 2 picas = 24 points + 3 points = 27 points 27 ÷ 8 = 3⅜

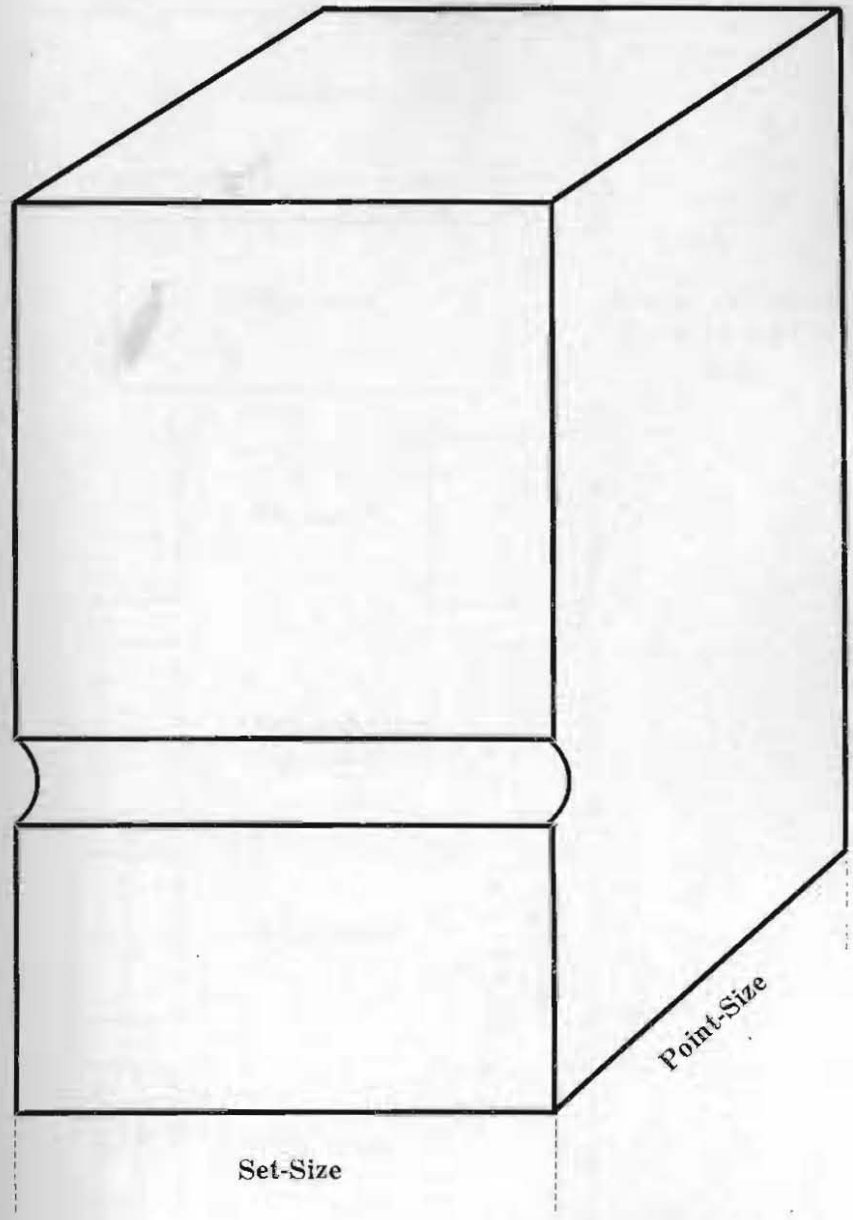
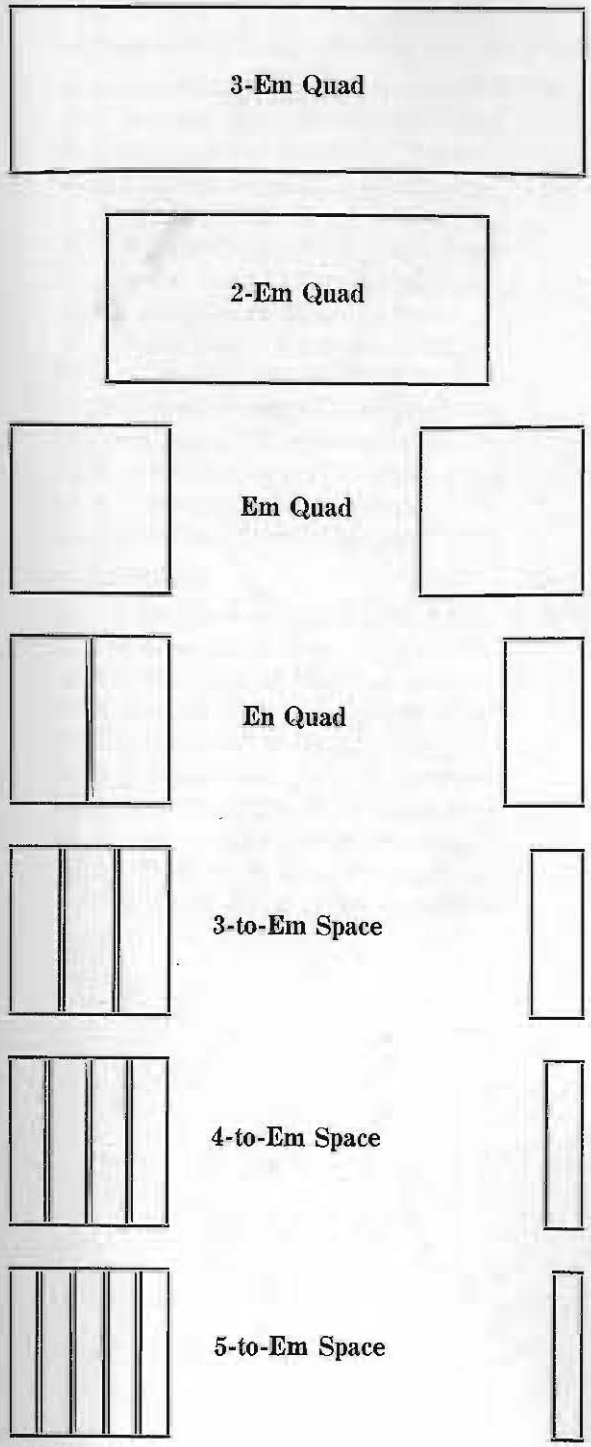


Figure 1



SPACES AND QUADS FOUND IN THE CASE

Figure 2

Exercise 21

Give the point-size and the set-size of each of the following:

1. A 3-em of 8-point type. Answer = 8×24 (point-size first).
2. A 5-to-em space of 36-point type.
3. An en quad of nonpareil (6-point type).
4. A 4-to-em space of 8-point type.
5. An em quad of 24-point type.
6. A 3-to-em space of 10-point type.
7. A 3-em quad of 10-point type.
8. An en quad of 8-point type.
9. A 2-em quad of 8-point type.
10. A 3-to-em space of 36-point type.
11. A 5-to-em space of nonpareil.
12. An en quad of 14-point type.
13. A 4-to-em space of 12-point type.
14. A 2-em quad of nonpareil.
15. A 3-to-em space of 18-point type.

Extra Problems

16. An em quad of 8-point type.
17. An en quad of 10-point type.
18. A 3-em quad of 12-point type.
19. A 5-to-em space of 8-point type.
20. A 2-em quad of 12-point type.
21. A 4-to-em space of 6-point type.
22. A 5-to-em space of 10-point type.
23. A 3-em quad of 10-point type.
24. An en quad of 14-point type.
25. A 4-to-em space of 36-point type.

Exercise 22

Give the point-size and the set-size of each of the following:

1. A 5-to-em space of 6-point type.
2. An en quad of 24-point type.
3. A 2-em quad of nonpareil.
4. A 3-to-em space of 30-point type.
5. A 3-em quad of 8-point type.
6. A 4-to-em space of 36-point type.
7. A 5-to-em space of 30-point type.
8. An em quad of 6-point type.
9. A 5-to-em space of 12-point type.
10. An en quad of 18-point type.
11. A 4-to-em space of 24-point type.
12. A 3-to-em space of 8-point type.
13. An em quad of 10-point type.
14. A 5-to-em space of 14-point type.
15. An en quad of 14-point type.

Extra Problems

16. An en quad of 30-point type.
17. A 4-to-em space of 30-point type.
18. A 3-to-em space of 24-point type.
19. An em quad of 12-point type.
20. A 3-em quad of 12-point type.
21. A 4-to-em space of 14-point type.
22. A 5-to-em space of 24-point type.
23. A 3-to-em space of 18-point type.
24. A 2-em quad of 6-point type.
25. A 3-to-em space of 14-point type.

Exercise 23

Give the total of the set-size of the following combinations of spaces and quads.

1. 8-point type: one em, one en, two 3-to-em spaces, one 4-to-em space, and three 5-to-em spaces.

Solution:

one em	=	8	points
one en	=	4	points
two 3s	=	5⅓	points
one 4s	=	2	points
three 5s	=	4	points
Total	=	24	points

2. 12-point type: one 3-em, one 2-em, one 3s, one 4s, and one 5s.

3. 6-point type: two 3-ems, one 2-em, and three 5s.

4. 10-point type: one 3-em, one em, one en, two 3s, and one 5s.

5. 10-point type: two 3s and three 5s.

Extra Problems

6. 10-point type: ten 3s, one em, one 4s, and one 5s.

7. 10-point type: twelve 3s, one 3-em, and two 5s.

Exercise 24

Give the total of the following combinations of spaces and quads in 10-point type.

Prob.	3-em quads	2-em quads	Em quads	En quads	3s	4s	5s
1.	1	1	1	1	1	1	1
2.	2	3	2	1	2	1	2
3.	3				2	1	
4.			2	1	2	1	
5.	1			1			3
6.		1		1			4
7.			1	1	1	1	4
8.	1		1		10	1	
9.	2				11		1
10.		1			13	1	1
Extra Problems							
11.			1	1	9	1	3
12.	2	1	1	1	16	1	2
13.	2		1	1	20	1	2
14.	3	1		1	21		3
15.			1	1	8		4

Exercise 25

Make a table of the combinations of 10-point type spaces and quads. Make this table on cardboard so that you may use it for solving problems in future lessons.

5s	4s	3s	En	Em	Total
1					2
	1				
		1			
2					
1	1				
			1		
1		1			
	1	1			
3					
2	1				
		2			
1			1		
2		1			
	1		1		
1	1	1			
4					
		1	1		
3	1				
1		2			
2			1		
	1	2			
3		1			
1	1		1		
2	1	1			
				1	
1		1	1		
4	1				
2		2			
	1	1	1		
3			1		
1	1	2			
4		1			
2	1		1		
		2	1		
3	1	1			
1				1	
2		1	1		
	1			1	
3		2			
1	1	1	1		
4			1		

Exercise 26

Give the fewest number of spaces and quads which will make the following total in 10-point type.

1. $58\frac{2}{3}$ points.

Solution:

(Get the fraction removed first. The only combination which will make $\frac{2}{3}$ point in 10-point type is two 3s which are $6\frac{2}{3}$ points. Subtract this from the total and the difference is 52 points. Next reduce the term to even ems which in this case is 50 points. To secure 2-points one uses one 5s. Next use as many 3-em quads and two-em quads in order as possible. Finish the total with em quads.)

Two 3s = $6\frac{2}{3}$
One 5s = 2
One 3-em = 30
One 2-em = 20
$58\frac{2}{3}$

2. $95\frac{1}{6}$ points.
3. $98\frac{5}{6}$ points.
4. 43 points.
5. $29\frac{1}{2}$ points.
6. $18\frac{1}{6}$ points.
7. 46 points.
8. $50\frac{2}{3}$ points.
9. $16\frac{1}{3}$ points.
10. $12\frac{1}{2}$ points.
11. $25\frac{1}{6}$ points.
12. $19\frac{1}{3}$ points.
13. 28 points.
14. 18 points.
15. $16\frac{2}{3}$ points.

Extra Problems

16. $28\frac{1}{6}$ points.
17. $15\frac{1}{2}$ points.
18. 96 points.
19. $98\frac{1}{3}$ points.
20. $58\frac{1}{3}$ points.

Exercise 27

Give the fewest number of spaces and quads which will make the following total in 10-point type.

1. $98\frac{1}{12}$ points.

Solution:

(In problems in which the fraction is one which is not found in the table of points—this case will be found in centering a line of type—one finds the nearest combination which does occur in the table, changes the fraction to this and procedes as in exercise 26. In this example there is a fraction of $\frac{1}{12}$ which does not occur in the 10-point table. The nearest combination to this is either $98\frac{1}{6}$ or 98. In either case there is a difference of but $\frac{1}{12}$ of a point or 1/864 inch which would not be enough to cause faulty justification. One usually selects the combination next smaller than the fraction which is not in the table. In this case it would be 98 secured by 4 5s and 3 3-em quads.

2. $33\frac{1}{12}$
3. $25\frac{1}{6}$
4. $42\frac{7}{12}$
5. $67\frac{1}{12}$
6. $96\frac{1}{12}$
7. $45\frac{1}{4}$
8. $22\frac{1}{2}$
9. $84\frac{2}{3}$
10. $73\frac{1}{12}$
11. $95\frac{2}{3}$
12. $49\frac{1}{2}$
13. $27\frac{1}{3}$
14. $38\frac{5}{12}$
15. $49\frac{1}{12}$

Extra Problems

16. $35\frac{1}{3}$
17. $25\frac{1}{6}$
18. $35\frac{1}{12}$
19. $35\frac{7}{12}$
20. $35\frac{5}{6}$

Exercise 28

1. Center a heading of 10-point type measuring 18 picas 5 points in a line measuring 24 picas. Plan the spacing on each side.

Solution:

24 picas
−18 picas 5 points
5 picas 7 points = 67 points, the amount of space.

67 points ÷ 2 = 33½ points space on each side.

33½ = one 4s = 2½
one en = 5
three 5s = 6
one 2-em = 20
33½

Center the following headings in 10-point type. Plan the spacing on each side.

	Length of type	Measure
2.	20 picas	27 picas
3.	15 picas	27 picas
4.	20½ picas	24 picas
5.	12 picas	18 picas
6.	14 picas	18 picas
7.	10½ picas	21 picas
8.	21 picas	27½ picas
9.	18 picas	29 picas
10.	15½ picas	27 picas

Extra Problems

11.	8 picas 4⅓ points	16 picas
12.	6 picas 9½ points	15 picas
13.	20¼ picas	31 picas

Exercise 29

Center the following headings in 10-point type. Plan the spacing on each side.

	Length of Line	Length of Measure
1.	17 picas 2 points	34 picas
2.	15 picas 9 points	21 picas
3.	13 picas 4 points	19 picas
4.	15 picas 8⅜ points	22 picas
5.	13 picas 4⅓ points	19 picas
6.	15 picas 9½ points	24 picas
7.	12 picas 6½ points	16 picas
8.	9 picas 8 points	12 picas
9.	15 picas 10¼ points	20½ picas
10.	16 picas 5 points	18 picas

Extra Problems

11.	10 picas 3⅓ points	14 picas
12.	6 picas 1 point	12 picas
13.	9 picas 11⅝ points	13 picas
14.	6 picas 11 points	9 picas
15.	8⅔ picas	19½ picas

The three measurements for all type are point-size, set-size, and heighth-to-paper (see Figure 1). The point-size is the body size or the measurement from the nick side to the side opposite the nick. The set-size is the measurement along the nick. Heighth-to-paper, called also type-high, is the measurement from the feet to the printing surface. In America type-high is uniformly .918 inch for characters which print and .8 inch for spaces and quads, which do not print.

In each case of type there is found, usually, four sizes of quads and three sizes of spaces. The names of these quads and spaces are the three-em quad, the two-em quad, the em quad, and the en quad, and the three-to-em space, the four-to-em space, and the five-to-em space (see Figure 2). As may be supposed from the names of the quads and spaces each of the sizes is based upon the em quad which is the square of the body size of the type. In 10-point type ("10-point type" means that the body size or measurement from the nick side to the side opposite the nick is ten points) the point-size would be ten points and the set-size or measurement along the nick would be ten points. In 8-point type the point size of the em is eight points and the set-size is eight points. In 6-point type the measure is 6×6 points for the em. What would be the measurement for the em quad of 24-point type? The sizes of quads larger than the em are the two-em and three-em quads. These are as the name indicates either two or three times as large as the em in set-size. Thus, in 10-point type, the two-em quad would measure ten points point-size and twenty points set-size.

The three-em quad would be 10×30. The quad size smaller than the em is the en quad. This size quad is half as large, set-size, as the em. In 10-point type, then, the en would measure 5×10 points. Two en quads side by side are the same as an em quad of any one size of type.

The spaces found in the case are all equal divisions of the em or square. The names, three-to-the-em, four-to-the-em, and five-to-the-em, have been shortend to three-to-em, four-to-em, and five-to-em. In the problems in this book space sizes will be designated as 3s, 4s, and 5s for three-to-em space, four-to-em space, and five-to-em space. One can see by the name that three three-to-em spaces would be the same size as an em (see Figure 2). Four four-to em sqaces make an em as well as five five-to-em spaces. In 10-point type the point-size is ten-points and the set-sizes of the various quads and spaces are: 3-em, 30-points; 2-em, 20-points; em, 10-points; en, 5-points; 3s, $3\frac{1}{3}$-points; 4s, $2\frac{1}{2}$-points; and 5s, 2-points.

Exercise 30

Give the amount in 60ths of an em of the following.

1. One 5s.
2. Two 5s and one 4s.
3. Eight 3s and one em.
4. Two 3s and one en.
5. Sixteen 3s and two 5s.
6. An em, an en, two 3s, four 5s, and one 4s.
7. Thirteen 3s, an em, and an en.
8. Nineteen 3s, a two em, and four 5s.
9. Eleven 3s, four 5s, two 3s, an en, and a 4s.
10. Three 5s and one 4s.

Extra Problems

11. Three 5s and two 3s.
12. Fourteen 3s, one 3-em, one 2-em, an em, and three 5s.

Exercise 31

Tell the nearest smaller combination and the nearest larger combination of spaces for the following total in 60ths of an em.

1. 46

Solution:

Nearest Smaller = 45

One 4s = 15

One en = 30

45

Nearest Larger = 47

One 5s = 12

One 4s = 15

One 3s = 20

47

2. 56¾

3. 73

4. 75 (In cases as this the combinations can be made exact, that is, 75 is one 4s and one em.)

5. 66¼

6. 53

7. 54⅓

8. 14

9. 13⅓

10. 57

Extra Problems

11. 70¼

12. 25

13. 15

14. 26

15. 44¼

Exercise 32

Give the nearest smaller combination and the nearest larger combination of the following total in 60ths of an em.

1. 63
2. 66
3. 40¼
4. 29½
5. 47⅓
6. 67
7. 37½
8. 44
9. 13
10. 76
11. 72
12. 44⅓
13. 65¼
14. 30
15. 39⅛

Extra Problems

16. 23¾
17. 19½
18. 54
19. 70½
20. 79

Exercise 33

Find the nearest smaller and nearest larger combinations to justify the following lines in any size of type.

1. Fourteen words and an em, a 4s, and 2 5s left at the end of the line.

Solution:

14 words = 13 spaces

13@20 = 260
em = 60
4s = 15
2-5s = 24

13|359|27 8/13
26
99
91
8/13

Nearest Smaller = 27
One 5s = 12
One 4s = 15
Nearest Larger = 30
One en = 30

2. Fourteen words, an em, an en, 2 3s, and a 4s.
3. Fourteen words, an em, and a 3-em.
4. Sixteen words, a 3-em, and an em.
5. Eight words, an em and 2 5s.

Exercise 34

Plan the spacing between words for the following lines:

1. 6 words; an em quad, an en quad, and a 4-to-em space quadding out the line.

2. 7 words; an en quad, a 3-to-em space, and a 5-to-em space quadding out the line.

3. 12 words; a 3-em quad, an en quad, and a 3-to-em space quadding out the line.

4. 8 words; a 3-em quad quadding out the line.

5. 10 words; a 2-em quad, an en quad, and four 5-to-em spaces quadding out the line.

6. 9 words; a 3-em quad, an en quad, and two 3-to-em spaces quadding out the line.

7. 11 words; an em quad, and a 4-to-em space quadding out the line.

8. 6 words; an em quad, and a 5-to-em space quadding out the line.

9. 5 words; a 2-em quad, and a 5-to-em space quadding out the line.

10. 8 words; an em quad, an en quad, and a 3-to-em space filling out the line.

Exercise 35

Center the following 10 point headings:

1. A heading of 15 picas in a line of 27 picas.
2. A heading of 7 picas in a line of 21 picas.
3. A heading of 13½ picas in a line of 21 picas.
4. A heading of 10 picas 4 points in a line of 30 picas.
5. A heading of 5 picas in a line of 10½ picas.

Plan the spacing between words for the following lines:

6. 12 words; an em quad, an en quad, and two 5-to-em spaces quadding out the line.
7. 11 words; a 2-em quad, and two 3-to-em spaces quadding out the line.
8. 8 words; an em quad, a 4-to-em space and two 5-to-em spaces quadding out the line.
9. 10 words; a 3-em quad, and a 4-to-em space quadding out the line.
10. 9 words; a 2-em quad, an en quad and four 5-to-em spaces quadding out the line.

Exercise 36

Using 60ths of an em, plan the spacing between words for the following:

1. A line of 12 words filled out with two em quads and a 5-to-em space.

2. A line of 11 words filled out with an em quad, an en quad, and a 3-to-em space.

3. A line of 14 words filled out with an em quad, a 3-to-em space, and a 4-to-em space.

4. A line of 10 words filled out with an en quad, two 3-to-em spaces, and a 4-to-em space.

5. A line of 8 words filled out with an en quad and three 5-to-em spaces.

6. A line of 9 words filled out with a 5-to-em, a 3-to-em, and an en.

7. A line of 11 words filled out with a 3-to-em space, a 4-to-em space, and a 5-to-em space.

8. A line of 12 words filled out with an em quad, a 4-to-em space, and a 5-to-em space.

9. A line of 7 words filled out with an en quad and a 4-to-em space.

10. A line of 15 words filled out with an en quad and a 5-to-em space.

Exercise 37

Plan the spacing between words for the following lines:

1. 7 words; an em quad, an en quad, and a 4-to-em space filling out the line.

2. 6 words; an en quad, a 3-to-em space, and a 5-to-em space filling out the line.

3. 12 words; a 3-em quad filling out the line.

4. 8 words; an em quad, an en quad, and a 3-to-em space filling out the line.

5. 9 words; a 2-em quad, an en quad, and a 5-to-em space filling out the line.

6. 10 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

7. 6 words; a 2-em quad, an en quad, and a 4-to-em space quadding out the line.

8. 11 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

9. 8 words; a 2-em quad, and a 5-to-em space filling out the line.

10. 5 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

Exercise 38

Plan the spacing between words for the following lines:

1. 6 words; an em quad, an en quad, and a 4-to-em space quadding out the line.

2. 7 words; an en quad, a 3-to-em space, and a 5-to-em space quadding out the line.

3. 12 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

4. 8 words; a 3-em quad quadding out the line.

5. 10 words; a 2-em quad, an en quad, and a 5-to-em space quadding out the line.

6. 9 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

7. 11 words; a 2-em quad, an en quad, a 4-to-em space, and a 5-to-em space filling out the line.

8. 6 words; an em quad and a 5-to-em space filling out the line.

9. 5 words; a 2-em quad and a 5-to-em space quadding out the line.

10. 8 words; an em quad, an en quad, and a 3-to-em space quadding out the line.

Exercise 39

Plan the spacing between words for the following lines:

1. 6 words; an en quad, a 3-to-em space, and a 5-to-em space quadding out the line.

2. 7 words; an em quad, an en quad, and a 4-to-em space quadding out the line.

3. 12 words; a 3-em quad filling out the line.

4. 8 words; an em quad, an en quad, and a 3-to-em space filling out the line.

5. 9 words; a 2-em quad, an en quad, and a 5-to-em space quadding out the line.

6. 10 words; an em quad, an en quad and, a 4-to-em space quadding out the line.

7. 6 words; an em quad, an en quad, and a 4 to-em space quadding out the line.

8. 11 words; a 2-em quad, and a 5-to-em space filling out the line.

9. 15 words; a 2-em quad, an en quad, and a 3-to-em space filling out the line.

Spacing a Line of Any Size Type

Spacing is the act of providing the white space between the words such that the words appear to be evenly separated. Justification is the act of making the line exactly fit the measure. The processes of spacing and justification must be considered together in setting every line of type. In order to make some words appear to be separated the same as other words it is sometimes necessary to place more space in some places and less space in other places to make the words appear evenly spaced. This uneven actual spacing is necessary because of the varying amount of white space between the face of the letter and the side of the body. For example the letters "w" and "v" coming together would appear to be separated, even if they be set solid. As a rule, there needs to be more actual space between tall letters such as b, d, l, and others than between short letters such as a, e, c, y, v, and others. The differences in the amount of space in various places in the line needs never be more than one combination difference: that is, one would not have an en in some places in the line and a three-to-em space in others because it is possible to have a difference in the size which is smaller and less noticeable. The proper size smaller than the en would be a four-to-em space and a five-to-em space used together. The combination table which was made earlier gives the varying sizes as follows: 5s, 4s, 3s, 2 5s, 5s and 4s, en, 3s and 5s, 3s and 4s, 3 5s, 2 5s and 4s, 2 3s, etc.

In using the various size spaces which are based on the em it is necessary to add the ⅓ em (three-to-em space), the ½ em (en), the ¼ em (four-to-em space), and the ⅕ em (five-to-em space). To add the fractions above it is desirable to change to the least common denominator which is 60ths. Then, an em quad would be a whole number or 60/60, an en or ½ em 30/60, a 3s 20/60 a 4s 15/60, and a 5s 12/60. See table of 60ths following.

In spacing a line one finds the total amount of space in the line and divides this amount by the number of spaces in the line. However, it is not always possible to secure a combination of spaces which is exactly the same as the result so obtained. In case there is no equal combination, one uses the combination nearest smaller in some places in the line and the combination nearest larger in other places in the line, the larger size being put between tall letters and the smaller between short letters. For example, if there were 25 points to be distributed into four places there should be 6¼ points in each place. In 10-point type it is impossible to get 6¼ points so one would use 6 points in some places and 6½ points in other places.

The manner by which one spaces a line may best be shown by examples. A problem such as: "How would one space a line of 10 words if he had left at the end of the line room enough for an en and two five-to-em spaces?" would be solved:

There are 10 words which would mean that there are 9 spaces. 9 spaces at 20/60 em each (in setting the line one puts a 3s between words) would be 180/60. The en at the end of the line would be 30/60 and two 5s at the end would be 24/60 em. This would make a total of 234/60 em, the total amount of space in the line to be divided into nine parts. $234 \div 9 = 54/60$. It may be seen from the table of combinations that it is possible to get a combination of spaces equaling 54/60 em (2-5s, 24/60 and one en, 30/60) so we would remove the 3s between words and replace them with 2-5s and an en.

Suppose we have a line of 20 words and have left in the line room enough for an em and a 4s. The solution would be:

20 words = 19 spaces
19@20 = 380
em = 60
4s = 15

$$19 \overline{)455} \; 23\tfrac{18}{19}$$
38
75
57
18

N. S. (Nearest Smaller Combination) 20
N. L. (Nearest Larger Combination) 24

This means that in some places in the line we would leave the 3s (20/60 em) and in other places (between tall letters preferably) we would use 2-5s (24/60 em).

To determine the amount of space to be filled in the line one quads out the line at the end and notes the number and sizes of spaces required to justify the line. This, in addition to the number and amount of the 3s between words is the total amount of space to be divided into the number of spaces in the line.

Table of 60ths Em

5s	4s	3s	En	Em	Total In 60th Em
1					12
	1				15
		1			20
2					24
1	1				27
			1		30
1		1			32
	1	1			35
3					36
2	1				39
		2			40
1			1		42
2		1			44
	1		1		45
1	1	1			47
4					48
		1	1		50
3	1				51
1		2			52
2			1		54
	1	2			55
3		1			56
1	1		1		57
2	1	1			59
				1	60
1		1	1		62
4	1				63
2		2			64
	1	1	1		65
3			1		66
1	1	2			67
4		1			68
2	1		1		69
		2	1		70
3	1	1			71
1				1	72
2		1	1		74
	1			1	75
3		2			76
1	1	1	1		77
4			1		78

Exercise 40

Plan the indention for a job set to the following specifications:

1. 10-point Century type, 21 picas measure.

Solution:

Normal line = $16\frac{3}{4}$ picas

$21 \div 16\frac{3}{4} = 1_{6}\frac{7}{7}$

$1_{6}\frac{7}{7}$ normal lines = 2 ems indention.

2. 10-point Century type, 15 picas measure.
3. 8-point Century type, 16 picas measure.
4. 12-point Caslon type, 21 picas.
5. 6-point Garamond, 7 picas.
6. 12-point Caslon type, 33 picas.
7. 10-point Caslon type, 19 picas.
8. 6-point Caslon type, 9 picas.
9. 18-point Century type, 36 picas.
10. 14-point Century type, 25 picas.

Extra Problems

11. 6-point Caslon type, 14 picas.
12. 6-point Caslon type, 30 picas.
13. 6-point Century type, 30 picas.
14. 10-point Caslon type, 14 picas.
15. 10-point Garamond type, 15 picas.

Exercise 41

1. Plan the spacing for the indention of a quotation of 8-point set in a page of 10-point set to a measure of 20 picas in Century type.

Normal line for 10-point Century = $16\frac{3}{4}$ picas

$20 \div 15\frac{3}{4} = 1\frac{3}{16}$ normal lines

$1\frac{3}{16}$ normal lines = 2 ems indention

2 ems 10-point = 20 points

In 8-point to get 20 points one would use

2 ems = 16

1 en = 4

20 points.

2. Plan the spacing for a quotation of 8-point set in a page of 10-point Garamond set to a measure of 21 picas.

3. Plan the spacing for an extract of 12-point set in a page of 10-point Caslon set to a measure of 16 picas.

4. Plan the spacing for a quotation set in 6-point in a page of 8-point Century set to 16 picas.

Extra Problem

5. Plan the spacing for a quotation of 8-point set in a page of 12-point Caslon set to 30 picas.

Exercise 42

1. A quotation of 6-point is set in a page of 12-point Garamond set to a measure of 24 picas. What 6-point spaces should be used to secure the indention equivalent to the 12-point indention? (Make a layout).

Solution:

12-point Garamond normal line is $16\frac{1}{2}$ picas

24 picas $\div$ $16\frac{1}{2}$ = $1\frac{5}{1}$ normal lines

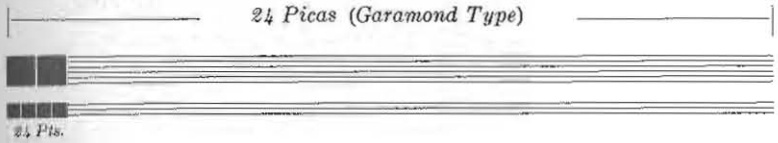
$1\frac{5}{1}$ normal lines = 2 ems indention

2 ems 12-point type = 24 points

In 6-point to secure 24 points one uses

4 ems = 24 points.

Layout:



2. An extract in 8-point is set in a page of 10-point Caslon, set to a measure of 21 picas. What spacing should be used to secure the proper indention? (Layout).

3. A quotation of 6-point is set in a page of 10-point Century, measuring 15 picas. Place the indention. (Layout).

4. An extract of 8-point is set in a page of 12-point Garamond, measuring 18 picas. Plan the indention. (Layout).

5. A paragraph of 6-point type is set in a page of 10-point Garamond, measuring 27 picas. Plan the indention. (Layout).

Extra Problems

6. A quotation of 12-point is set in a page of 8-point Caslon, measuring 15 picas. Plan the indention. (Layout).

7. A quotation in 8-point is set in a page of 12-point Caslon, measuring 36 picas. Plan the indention. (Layout).

Exercise 43

1. A quotation of 12-point is set in a page of 6-point Century, measuring 24 picas. Plan the indention. (Layout).

2. An extract of 10-point is set in a page of 8-point Caslon, measuring 18 picas. Plan the indention. (Layout).

3. A quotation of 10-point is set in a page of 6-point Garamond, measuring 30 picas. Plan the indention. (Layout).

4. A paragraph of 8-point is set in a page of 6-point Caslon, measuring 18 picas. Plan the indention. (Layout).

5. Plan the indention for a paragraph of 6-point set in a page of 8-point Caslon, measuring 33 picas. (Layout).

Plan the indention spacing for a page of 10-point Century 21 picas if there is to be inserted:

6. A paragraph in 12-point. (Layout).

7. A paragraph in 6-point. (Layout).

8. A paragraph in 18-point. (Layout). (Use a 2-point lead 1½ picas long).

Extra Problem

9. A paragraph in 14-point. (Layout). (Use 6-point type).

INDENTION

Indention of paragraphs depend upon two factors, the length of the measure and the size of the type. A wide measure requires more indention than a narrow measure for any one size of type. A small size of type requires more ems indention than a large size of type. The amount of indention is usually determined according to the following rule: "for each normal measure or fraction of the normal measure one em indention is used." By normal measure is meant the length of line best suited for any one size and style of type. There are several methods of determining the normal measure, the best of which is to set up the lower case alphabet, a, b, c, d, etc., including l and multiplying this by 1½, or in other words, one and one-half times the lower case alphabet from a to z inclusive. For example, this line of 39 characters of 10-point Century type measures 16¾ picas and would be considered a normal length of line for this

abcdefghijklmnopqrstuvwxyzabcdefghijklm

0 6 12 18

size and kind of type. Some faces of type are more "condensed" than others and their normal line is shorter than Century. Some printers roughly estimate the normal line by multiplying the type size by 2 but this method does not consider the many styles of faces. By using the first method of determining the normal line, and using 10-point Century type it is seen that any measure up to 17 picas would be indented one em, from 17 to 35 picas, 2 ems.

In Monotype Century type the "Alphabet and one-half" for the various sizes of type are:

6-point, 12 picas
8-point, 14 picas
10-point, 16¾ picas
12-point, 19 picas
14-point, 24 picas
18-point, 30¾ picas
24-point, 39 picas

Garamond type "Alphabet and one-half" measures:

6-point, 10¾ picas
8-point, 13 picas
10-point, 14½ picas
12-point, 16½ picas
14-point, 18½ picas

Caslon type normal lines are:

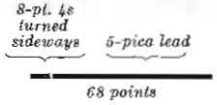
6-point, 10¼ picas
8-point, 12¾ picas
10-point, 16 picas
12-point, 19 picas
14-point, 29 picas

In any one book and in most cases in job composition for any one job, all paragraphs should be indented the same amount of space regardless of the size or kind of type. The type in which the major part of the book is set determines this indention. For example, if the main part of a book is set in 10-point type, all other sizes of type in the book should be indented to conform with the 10-point indention. If the 10-point is 2 ems or 20 points, an 8-point extract set in the book would be indented 20 points also. If some of the book were set in 12-point, it would be indented 20 points.

The forgoing rules for indention not only apply to normal or regular indention but they apply to hanging indention and squared indention as well.

Spaces as Leads

Lead are usually cut in exact pica lengths. Should a job require leads of a fraction of a pica length, various spaces of type are used to finish out the lead. For instance if a line of type measures 68 points, use a 5 pica lead and a 4s of 8-point turned with the nick side to the left instead of to the front.



Exercise 44

1. Name the spaces of 6-, 8-, and 10-point type that can be used as 2-point leads.

2. What measure will a 5-to-em space of 10-point space out when used as a 2-point lead? A 4-to-em space of 8-point? A 3-to-em space of 6-point?

3. Tell how to lead lines 18 picas 6 points long with 2-point leads.

4. Tell how to lead lines 24 picas 8 points long with 2-point leads.

5. Tell how to lead lines 20 picas 10 points long with 2-point leads.

6. A form is 20 picas wide. A cut in one corner takes up 8 picas 2 points of the width. How should the lines of type be leaded?

7. A form is 42 picas wide. A plate in one corner takes up 12 picas 4 points of the width. How must the lines of type be leaded?

8. A form is 48 picas wide. A plate 7 picas wide is centered. How must the lines on each side be leaded?

Extra Problems

9. A form is 27 picas wide. A plate 1 inch wide is centered. How must the type on each side be leaded?

10. A line is 14 picas 2 points long. How should it be leaded?

Exercise 45

1. A line is 18 picas 4 points long. How should it be leaded?

2. A line is 20 picas 6 points long. How should it be leaded?

3. A form is 24 picas wide. An electro in one corner takes up 8 picas 8 points of the width. How should the lines of type be leaded?

4. A form is 48 picas wide. A cut 2 picas 4 points wide is centered. How should the type on each side be leaded?

5. A form is 32 picas wide. A plate in one corner takes up 11 picas 6 points. How should the lines be leaded?

Extra Problem

6. A page is to be set in 10-point Garamond 18 picas wide. A 3-line initial letter in one corner takes up 20 points. Plan the leading at the side of the initial. (Make a layout).

Exercise 46

1. Plan the spacing combinations to justify a line which has 3s between the 24 words and which lacks an em, a 3s, and two 5s of justification.

Solution:

24 words = 23 spaces
23@20 = 460
Em = 60
3s = 20
2 5s = 24
Total space 564

564 ÷ 23 = $24\frac{2}{23}$ in each space
N. L. = 27
N. S. = 24
Difference = 27 − 24 = 3
23@24 = 552
564 − 552 = 12
12 ÷ 3 = 4

Proof:

4@27 = 108
(23 − 4) 19@24 = 456
Total = 564

2. Plan the spacing for 24 words if there is left at the end of the line, an em, an en, and two 5s.

3. Plan the spacing for 24 words if there is left at the end room enough for two ems.

4. Plan the spacing if there are 16 words and room left for a 3 em quad and a 4s.

5. Plan the spacing for 18 words with room enough left for an en and three 5s.

Extra Problem

6. Plan the spacing for a line of 18 words if there is room left for an em, an en, a 3s, a 4s, and a 5s.

Exercise 47

Plan the spacing between words for the following lines:

1. 8 words; an em quad, an en quad, and a 4s quadding out the line.

2. 10 words; an en quad, a 3s, and a 5s quadding out the line.

3. 10 words; a 3-em quad, an en quad, and a 3s quadding out the line.

4. 12 words; a 3-em quad quadding out the line.

5. 14 words; a 2-em quad, an en quad, and four 5s quadding out the line.

6. 11 words; a 3-em quad, an en quad, and two 3s quadding out the line.

7. 13 words; an em quad, and a 4s quadding out the line.

8. 8 words; an em quad, and a 5s quadding out the line.

9. 7 words; a 2-em quad, and a 5s quadding out the line.

10. 10 words; an em quad, an en quad, and a 3s quadding out the line.

Extra Problems

11. 14 words; an em quad, an en quad, and two 5s quadding out the line.

12. 13 words; a 2-em quad, and two 3s quadding out the line.

Exercise 48

Plan the spacing combinations between the words of the following lines:

1. 13 words; an en quad and a 5s quadding out the line.

2. 11 words; an em quad and a 4s quadding out the line.

3. 12 words; an en quad, a 3s, and a 5s quadding out the line.

4. 10 words; an em quad, a 3s, a 4s, and a 5s quadding out the line.

5. 9 words; a 2-em quad and a 5s quadding out the line.

6. 14 words; a 3-em quad, an en quad, and four 5s quadding out the line.

7. 17 words; a 3-em quad, a 2-em quad, two 3s, and four 5s quadding out the line.

8. 21 words; an em quad and three 5s quadding out the line.

9. 22 words; a 3-em quad, an en quad, and two 5s quadding out the line.

10 12 words; an em quad, an en quad, and two 3s quadding out the line.

Extra Problems

11. 9 words; an em quad, a 4s, and two 5s quadding out the line.

12. 20 words; a 3-em quad and a 4s quadding out the line.

Exercise 49

Plan the spacing for the following lines:

1. 8 words; an em quad, an en quad, and a 4s quadding out the line.

2. 9 words; an en quad, a 3s, and a 5s quadding out the line.

3. 14 words; an em quad, an en quad, and a 3s quadding out the line.

4. 10 words; a 3-em quad quadding out the line.

5. 12 words; a 2-em quad, an en quad, and a 5s quadding out the line.

6. 11 words; an em quad, an en quad, and a 3s quadding out the line.

7. 13 words; a 2-em quad, an en quad, a 4s, and a 5s filling out the line.

8 8 words; an em quad and a 5s filling out the line.

9. 7 words; a 2-em quad and a 5s quadding out the line.

10. 10 words; an em quad, an en quad, and a 3s quadding out the line.

"The most important problem in printing is spacing."

Extra Problems

11. 12 words; a 3-em quad filling out the line.

12. 8 words; an em quad, an en quad, and a 3s filling out the line.

13. 9 words; a 2-em quad, an en quad, and a 5s quadding out the line.

14. 10 words; an em quad, an en quad, and a **4s** quadding out the line.

Exercise 50

Plan the spacing for the following lines:

1. 7 words; an em quad, an en quad, and a 4s filling out the line.

2. 6 words; an en quad, a 3s, and a 5s filling out the line.

3. 4 words; a 3-em quad filling out the line.

4. 8 words; an em quad, an en quad, and a 3s filling out the line.

5. 9 words; a 2-em quad, an en quad, and a 5s filling out the line.

6. 10 words; an em quad, an en quad, and a 3s filling out the line.

7. 6 words; a 2-em quad, an en quad, and a 4s filling out the line.

8. 11 words; an em quad, an en quad, and a 3s filling out the line.

9. 8 words; a 2-em quad and a 5s filling out the line.

10. 8 words; an em quad, a en quad, and a 3s filling out the line.

"It requires very little training to put type characters in a composing stick, but it requires years of experience to space these characters properly."

Extra Problems

11. 6 words; an em quad, an en quad, and a 4s filling out the line.

12. 11 words; a 2-em quad and a 5s filling out the line.

13. 15 words; a 2-em quad, an en quad, and a 3s filling out the line.

14. 8 words; an em quad, an en quad, and a 4s filling out the line.

Exercise 51

Using 60ths of an em, plan the spacing between words for the following:

1. A line of 12 words filled out with a 2-em quad and a 5s.

2. A line of 11 words filled out with an em quad, an en quad, and a 3s.

3. A line of 14 words filled out with an em quad, a 3s, and a 4s.

4. A line of 10 words filled out with an en quad, two 3s, and a 4s.

5. A line of 8 words filled out with an en quad and three 5s.

6. A line of 9 words filled out with a 5s, a 3s, and an en.

7. A line of 11 words filled out with a 3s, a 4s, and a 5s.

8. A line of 12 words filled out with an em quad, a 4s, and a 5s.

9. A line of 7 words filled out with an en quad and a 4s.

10. A line of 15 words filled out with an en quad and a 5s.

"More attention is given to the parts of a printing job which do not print than to those which appear on the printed sheet."

Extra Problems

11. 9 words; a 2-em quad, an en quad, and four 4s quadding out the line.

12. 7 words; an en quad, a 3s, and a 5s quadding out the line.

13. 8 words; an em quad, an en quad, and a 4s quadding out the line.

14. 9 words; an em quad, a 3s, and a 5s quadding out the line.

15. 10 words; a 2-em quad, an en quad, and three 5s quadding out the line.

Exercise 52

This list of problems presumes that the type has been set and has had 3-to-em spaces between each word and that there remains to be inserted between the words the amount of space indicated.

Problem	Words	Em	En	3-em space	4-em space	5-em space
1	20	2		1		1
2	16		1	2	1	3
3	12			1		4
4	9	1	1		1	
5	8	2				
6	5					1
7	8		1		1	
8	21	2	1	1	1	
9	11	1	1	1	1	1
10	3	1				1

Exercise 53

Suppose that the table above referred to capital composition in which the common space is an en quad. Calculate the space required to justify each line.

Exercise 54

Italic which is sometimes spaced thinner than normal can be set using a 4-to-em space as the common space. Calculate the space required to justify each of the above lines.

Exact Spacing of any Size of Type

In the preceding exercises was explained the way one finds the combinations of spaces which would show the least difference in the sizes necessary to justify a line of type. This group of lessons will explain a method whereby one may determine the number of each of the two combinations to use. Probably the process can best be explained with some examples.

Example 1.

How would one space a line of 21 words if there remained room enough for an em, a 3s, and a 5s at the end of the line?

Solution:

Find the combination nearest smaller and nearest larger than the exact space as was explained previously.

21 words = 20 spaces
20@20 units or 60ths em each = 400
em = 60
3s = 20
5s = 12

$20\overline{)492}\,24\frac{12}{20}$

Nearest Larger Combination = 27
Nearest Smaller Combination = 24

The difference in the amount of space in the two combinations is 27−24 = 3. Suppose now that one would put the nearest smaller combination in each place in the line. 20@24 = 480 units. The line would still be short 12 units or 60ths. em (492 −480 = 12). Suppose now that one begins replacing the smaller combination, 24 units, with the larger combination, 27 units, each time one would make the change he would use up 3 units of the remainder left by using all of the smaller. One would continue replacing the smaller combination until all the space were used up—the remainder in this problem was 12 units. The number of times one would replace the smaller unit with the larger is as many times as the difference (3) is contained in the remainder (12).

Then the problem would appear:

21 words = 20 spaces
20@20 = 400
em = 60
3s = 20
5s = 12

$12\overline{)492}\,24\frac{11}{20}$

Nearest Larger Combination = 27
Nearest Smaller Combination = 24
Difference in Combinations = 3

20 spaces all at the smaller size is 20×24 = 480. 492−480 = 12 units left if all the smaller were used. 12÷3 = 4, the number of times the larger would have to be used to justify the line.

Proof:

4@27 = 108 units
16 (20−4) @24 = 384 units
492 units, the total amount of space in the line.

This would mean that in spacing the above line one would use a combination of a 4s and a 5s (27 units) in four places in the line and a combination of two 5s (24 units) in the remaining sixteen places.

This may seem a needless and lengthy process to pursue in spacing each line of type but in correct composition, which is always desirable, it is necessary. Any one can put the characters in the composing stick but it takes many years of experience and practice to space the line accurately after the characters are placed in the stick. With sufficient practice one soon learns to solve these spacing problems "in his head." The process has to be performed whether one does it "trial and error" or by arithmetic.

In cases where the Amount of Space left after the smaller combination is inserted divided by the combination difference (the number of the larger size) is a fraction other than "½" one uses the nearest whole number. (See examples 2 and 3). If this fraction is "½" one uses the nearest whole number smaller. (See example 4).

If the total amount of space divided by the number of spaces results in a number which is to be found on the table of combinations, he uses that number only, for example, in a problem of 21 words with enough room for an em and a 3s.

20 spaces @ 20 = 400
em = 60
3s = 20
20|480|24

24 units (2 5s) used in each of the 20 places will justify the line. 20×24 = 480 units.

Example 2.

Space a line of 15 words, with room enough in the end for a 3s, a 4s, and a 5s.

Solution:

15 words = 14 spaces
14@20 = 280
3s = 20
4s = 15
5s = 12

$14 \overline{)327} \; 23\frac{5}{14}$

Nearest Larger = 24
Nearest Smaller = 20
Difference = 4

14@20 = 280
327 − 280 = 47
47 ÷ 4 = $11\frac{3}{4}$ or 12 places

Proof:

12@24 = 288
2@20 = 40
328 units

This line would be one unit or $\frac{1}{60}$ em longer than justification but $\frac{1}{60}$ em in most sizes of type is so small that it is considered insignificant. In 12-point type $\frac{1}{60}$ em would measure $\frac{1}{5}$ point or $\frac{1}{360}$ inch.

Example 3.

9 words. Room left for an en and two 5s.

9 words = 8 spaces
8@20 = 160
en = 30
2 5s = 24
8 | 214 | $26\frac{6}{8}$
16
54
48
$\frac{6}{8}$

Nearest Larger = 27
Nearest Smaller = 24
Diff. = 3

8@24 = 192
214 − 192 = 22
22 ÷ 3 = $7\frac{1}{3}$ or 7

7@27 = 189
1@24 = 24
213 is 1 unit short.

Example 4.

10 words.

9@20 = 180
em = 60
3s = 15
2 5s = 24
9 | 279 | 31

N. L. = 32
N. S. = 30
Diff. = 2

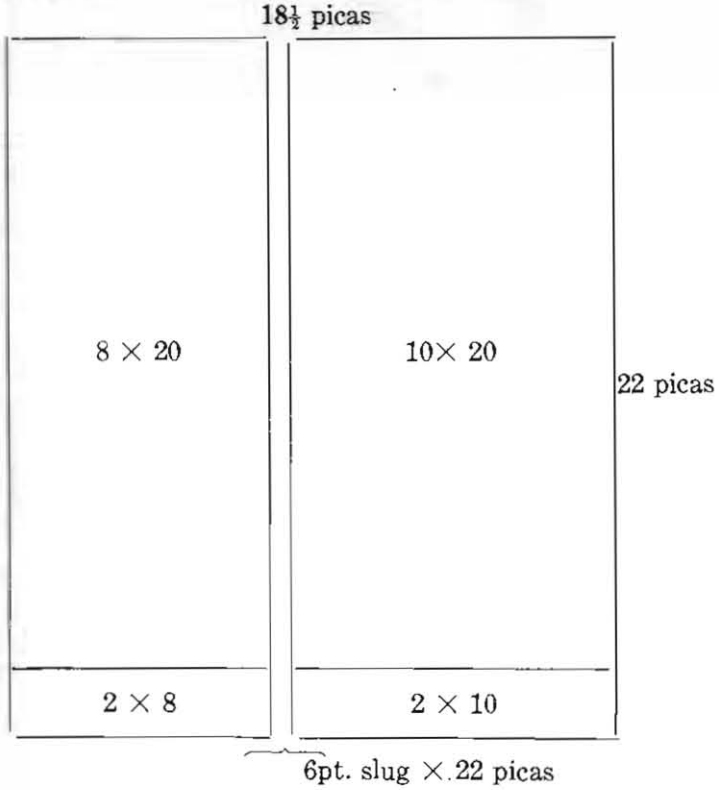
9@30 = 270
279 − 270 = 9
9 ÷ 2 = $4\frac{1}{2}$ or 4

4@32 = 128
5@30 = 150
278 = 1 unit short

Exercise 55

1. Make a layout showing how to space out an area $18\frac{1}{2} \times 22$ picas.

Solution:



2. Make a layout showing how to space out a form 10×18 picas.

3. Make a layout showing how to fill in an area $5\frac{1}{2} \times 8\frac{1}{2}$ picas.

4. Make a layout showing how to space out an area 38×52 picas.

5. Make a layout showing how to space out a form 16×33 picas.

Extra Problem

6. Make a layout showing how to fill in a space $9\frac{1}{2} \times 13$ picas.

Exercise 56

Make a layout showing how to space out the following with metal furniture.

1. 23 picas × 62 picas.
2. 12½ picas × 19 picas.
3. 24 picas × 37 picas.
4. 20 picas × 25 picas.
5. 36 picas × 48 picas.
6. 29 picas × 52 picas.

Extra Problem

7. 16 picas × 19 picas.

Exercise 57

Make a layout showing how to space out the following with metal furniture.

1. 16 picas × 24 picas.
2. 15 picas × 3½ picas.
3. 8½ picas × 11 picas.
4. 4¼ inches × 8⅔ inches.
5. 6⅓ inches × 8½ inches.
6. 5¼ inches × 9½ inches.
7. 27½ picas × 13 picas 2 pts.

Extra Problems

8. 27 picas 8 pts. by 19 picas 10 pts.
9. 14 picas 6 pts. by 13 picas 2 pts.
10. 16⅔ picas by 19⅓ picas.

Spacing Out Blank Areas

A peculiar and distinctive attribute of printing is the fact that more attention is given to the parts of a job which do not print than to those which appear on the printed sheet. In the very beginning one learns about the space appearing around the individual letter between the face and body of the character as it effects the spacing to be used between words. One learns about the shoulder of the type, that space at the bottom of the face and the nick side of the body, as it determines the amount of space between lines of type. The next space area to be considered is that which occurs between the separate parts of a job, or between the reading matter and the border, or other blank portions. This all must be filled in with some kind of spacing material. Even the blank pages of a book must be filled in when the job is run on the press.

The materials available for spacing blank areas are quads and spaces, leads and slugs, and furniture. Quads and spaces are cast accurately to a definite point measurement. For example a 36-point em is exactly 3 picas by 3 picas. An en of 36-point measures $1\frac{1}{2} \times 3$ picas. A 3s of 36-point is 1×3 picas. Following is a table of the size in picas of those quads and spaces which are commonly used as spacing materials.

Pica Sizes of Spaces and Quads

Point	Em	En	3s	4s	5s
6	$\frac{1}{2}\times\frac{1}{2}$	$\frac{1}{4}\times\frac{1}{2}$	$\frac{1}{6}\times\frac{1}{2}$		
12	1×1	$\frac{1}{2}\times1$	$\frac{1}{3}\times1$	$\frac{1}{4}\times1$	
18	$1\frac{1}{2}\times1\frac{1}{2}$	$\frac{3}{4}\times1\frac{1}{2}$	$\frac{1}{2}\times1\frac{1}{2}$		
24	2×2	1×2	$\frac{2}{3}\times2$	$\frac{1}{2}\times2$	
30	$2\frac{1}{2}\times2\frac{1}{2}$	$1\frac{1}{4}\times2\frac{1}{2}$	$\frac{5}{6}\times2\frac{1}{2}$		
36	3×3	$1\frac{1}{2}\times3$	1×3	$\frac{3}{4}\times3$	
48	4×4	2×4	$1\frac{1}{3}\times4$	1×4	
60	5×5	$2\frac{1}{2}\times5$	$1\frac{2}{3}\times5$	$1\frac{1}{4}\times5$	1×5
72	6×6	3×6	2×6	$1\frac{1}{2}\times6$	

Leads are usually two points thick by what ever length in picas one desires. Slugs are usually six points thick and may be secured in any pica length. Furniture is larger spacing material which comes in accurate pica measurements and may be had either in wood or metal. In spacing inside a page or in blank pages one uses metal furniture because it is more nearly accurate than wood. One uses wood furniture in spacing out large areas when type is locked up in the chase.

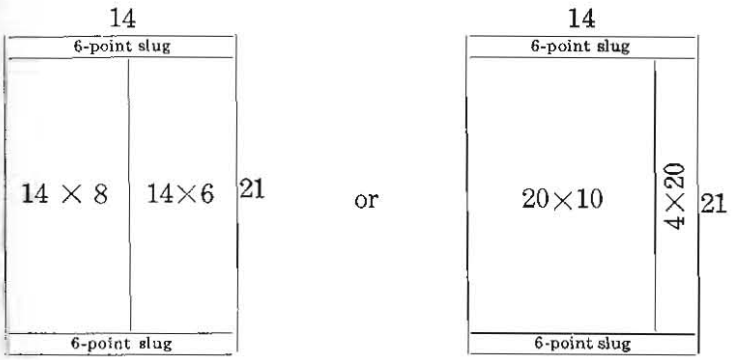
Leads, slugs, and furniture are usually purchased in assortments called labor-saving fonts. Leads and slugs are assorted in half-pica lengths from 3 to 10 picas and in pica lengths from 10 to 35 picas. They measure 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10, 11, 12, 13, etc., up to 35 picas. Metal furniture is assorted in labor-saving fonts according to the following table.

Width In Picas	Length in picas										
	4	5	6	8	10	15	20	25	30	40	50
2	2x4	2x5	2x6	2x8	2x10	2x15	2x20	2x25	2x30	2x40	2x50
3	3x4	3x5	3x6	3x8	3x10	3x15	3x20	3x25	3x30	3x40	3x50
4	4x4	4x5	4x6	4x8	4x10	4x15	4x20	4x25	4x30	4x40	4x50
5		5x5	5x6	5x8	5x10	5x19	5x20	5x25	5x30	5x40	5x50
6			6x6	6x8	6x10	6x15	6x20	6x25	6x30	6x40	6x50
8				8x8	8x10	8x15	8x20	8x25	8x30	8x40	8x50
10					10x10	10x15	10x20	10x25	10x30	10x40	10x50

In spacing out a blank area one may use any one or combination of the spacing materials. As few and as large pieces as possible should be used.

Following are a few examples of the use of spacing materials:

1. Filling a space 14 × 21 picas.



Exercise 58

1. Find the number of ems of 6-point type in a line set to a measure of 14 picas. Answer is 28.

2. Find the number of ems of 8-point type in a line set to 20 picas.

3. Find the number of ems of 10-point type in 21 lines set to 30 picas.

4. Find the number of ems of 12-point type in 27 lines set to 15 picas.

5. Find the number of ems of 6-point type in a line set to a measure of 3 inches.

6. Find the number of ems of 8-point type in a form of 32 lines set to 3½ inches.

7. Find the number of ems of 10-point type in a line set to 5 inches.

8. Find the number of ems of 12-point type in a line set to 4 inches.

Extra Problems

9. Find the number of ems of 8-point type in 45 lines set to 21 picas.

10. Find the number of ems of 10-point type in a line set to 3 inches.

Exercise 59

Find the number of ems in the following lines.

1. 8-point ems in a line 20 picas long. Answer is 30.
2. 10-point ems in a line 20 picas long.
3. 18-point ems in a line 50 picas long.
4. 14-point ems in a line 42 picas long.
5. 6-point ems in a line 12 picas long.
6. 12-point ems in a line 18 picas long.
7. 10-point ems in a line 14 picas long.
8. 12-point ems in a line 25 picas long.
9. 8-point ems in a line 25 picas long.
10. 24-point ems in a line 49 picas long.
11. 8-point ems in a line 28 picas long.
12. 8-point ems in a line 34 picas long.
13. 30-point ems in a line 65 picas long.
14. 24-point ems in a line 45 picas long.
15. 10-point ems in a line 25 picas long.

Extra Problems

16. 6-point ems in a line 23 picas long.
17. 5½-point ems in a line 11 picas long.
18. 5½-point ems in a line 23 picas long.
19. 14-point ems in a line 21 picas long.
20. 8-point ems in a line 17 picas long.

Exercise 60

Find the number of ems in:

1. 20 lines of 8-point set to a measure of 19 picas.

Solution:

$$\frac{19\times12}{8}\times20\text{ lines}=570\text{ ems.}$$

2. 24 lines of 10-point set to a measure of 16 picas.
3. 16 lines of 8-point set to a measure of 14 picas.
4. 29 lines of 12-point set to a measure of 13 picas.
5. 40 lines of 14-point set to a measure of 20 picas.
6. 18 lines of 6-point set to a measure of 15 picas.
7. 25 lines of 5½-point set to a measure of 9 picas.
8. 16 lines of 12-point set to a measure of 30 picas.
9. 22 lines of 14-point set to a measure of 29 picas.
10. 13 lines of 6-point set to a measure of 9 picas.

Extra Problems

11. A job of 16 pages of 38 lines each, set in 10-point type to a measure of 18 picas.

12. A job of 8 pages of 24 lines each, set in 8-point type to a measure of 13 picas.

13. A job of 4 pages of 28 lines each, set in 14-point type to a measure of 28 picas.

14. A newspaper column of 204 lines of 5½-point type, set to a measure of 12½ picas.

15. A newspaper column of 500 lines of 6-point type, set set to a measure of 13 picas.

Exercise 60

Find the number of ems in:

1. 20 lines of 8-point set to a measure of 19 picas.
Solution:
$$\frac{19\times12}{8}\times20\text{ lines}=570\text{ ems.}$$
2. 24 lines of 10-point set to a measure of 16 picas.
3. 16 lines of 8-point set to a measure of 14 picas.
4. 29 lines of 12-point set to a measure of 13 picas.
5. 40 lines of 14-point set to a measure of 20 picas.
6. 18 lines of 6-point set to a measure of 15 picas.
7. 25 lines of 5½-point set to a measure of 9 picas.
8. 16 lines of 12-point set to a measure of 30 picas.
9. 22 lines of 14-point set to a measure of 29 picas.
10. 13 lines of 6-point set to a measure of 9 picas.

Extra Problems

11. A job of 16 pages of 38 lines each, set in 10-point type to a measure of 18 picas.

12. A job of 8 pages of 24 lines each, set in 8-point type to a measure of 13 picas.

13. A job of 4 pages of 28 lines each, set in 14-point type to a measure of 28 picas.

14. A newspaper column of 204 lines of 5½-point type, set to a measure of 12½ picas.

15. A newspaper column of 500 lines of 6-point type, set set to a measure of 13 picas.

Exercise 61

1. A form is 18 picas wide. If set in 10-point type, how many ems will there be in one line? If set in 6-point type? If set in 8-point type? If set in 12-point type?

2. Find the number of ems of 10-point type in a form of 61 lines set to 10 picas.

3. Find the number of ems of 12-point type in a form of 21 lines set to 30 picas.

4. Find the number of ems of 5½-point type in a form of 8 lines set to 24 picas.

5. Find the number of ems in a job made up of 8 forms each containing 20 lines of 6-point type set to 18 picas.

6. Find the number of ems in a job made up of 2 forms each containing 27 lines of 8-point type set to 30 picas.

6. At 70 cents per thousand ems what will it cost to set 10 forms each containing 30 lines of 10-point type set to 30 picas.

8. An apprentice can set about 500 ems per hr. How long should it take him to set 6 forms each containing 24 lines of 8-point type set to a measure of 18 picas? (Answer in hours, minutes, and seconds.)

Extra Problems

9. A journeyman can set about 800 ems per hour. How long should it take him to set 4 forms each made up of 60 lines of 10-point type set to 21 picas? (Answer in hours, minutes, and seconds.)

10 At $.50 per thousand ems what does a compositor earn setting 12 forms each containing 30 lines of 6-point type set to 27 picas?

Exercise 62

1. If a form is set 22 picas wide in 8-point type how many ems are there in 80 lines?

2. Find the cost at $.90 per thousand ems for the composition of 8 pages, each containing 40 lines of 8-point if the lines are 3½ inches long.

3. How many ems of composition at the side of a cut 3 inches wide in a form 38 picas wide? The type is set in 10-point and there are 22 lines at the side of the cut.

4. If a compositor can set 900 ems per hour what will be the cost at $1.25 per hour for setting a job consisting of 16 pages of 18-point type, each page containing 54 lines set 48 picas wide?

Extra Problem

5. If a compositor sets type at the rate of 1600 ems per hour, what will be the cost of composition at $2.50 per hour for setting a job consisting of 32 pages of 5½-point type set to a measure of 14 picas if there are 44 lines to each page?

Exercise 63

1. Find the number of lines of 8-point type in a form 6 inches long.

2. Find the number of lines of 6-point type in a form 21 picas long.

3. Find the number of lines of 10-point type in a form 30 picas long.

4. Find the number of lines of 12-point type in a form 8 inches long.

5. Find the number of ems in a form 3×8 inches set in 10-point.

6. How many lines in a form 3×5 inches (width is always given first) set in 12-point type?

7. How many ems in a page 3×7 inches set in 8-point type?

8. Find the number of lines in a page 8½ inches long set in 8-point type.

9. How many ems in a page 4½×8½ inches set in 8-point type?

10. How many ems in a page 4½×8½ inches set in 12-point type?

Extra Problems

11. Find the number of ems in a form 20 picas × 14 picas set in 8-point type.

12. Find the number of 6-point ems in a form 20 picas × 30 picas.

13. Find the number of 12-point ems in a form 24 picas × 36 picas.

14. Find the number of 8-point ems in a form 24 picas × 31 picas.

15. Find the cost of composition at $.70 per thousand ems for 8 forms each 5×8 inches set in 6-point type.

Exercise 64

A job of 6 forms 8×9 inches is to sell at $.80 per thousand ems.

1. How much would the composition cost if it were set in 12-point type?

Solution:

$$\frac{\overset{6}{8\times 72}}{12}\times\frac{\overset{6}{9\times 72}}{12}\times\frac{6}{1}\times\frac{1}{1000}\times\frac{80}{100}=\frac{1244160}{100000}\text{ or }\$12.4416$$

2. How much would the composition cost if set in 6-point?
3. How much would the composition cost if set in 8-point?
4. Figure the cost if set in 10-point type.

A job of 10 forms 5 inches by 50 picas is to sell at 50 cents per thousand ems.

5. What would be the cost of composition in 10-point type?
6. Find the cost in 24-point type.
7. Find the cost if set in 30-point type.

A job of 20 forms each 18 picas by 7 inches costs 85 cents per thousand ems.

8. What is the cost of composition in 12-point type?
9. Find the composition cost of the above if it is set in 36-point type.

Extra Problem

10. If a compositor can set 500 ems per hour how long will it take him to set up 4 forms each 20×80 picas set in 8-point type.

Exercise 65

1. A compositor can set 800 ems per hour. How much will it cost to set 5 forms, each 24×40 picas in 12-point type if the per-hour rate for composition is $2.75? Answer is $16.50.

2. The rate for composition is $2.80 per hour. How much will it cost to have set 16 forms, each 5×8 inches if the compositor can set 1600 ems per hour? The forms are to be set in 10-point type.

3. How long will it take a compositor to set 6 forms of 8-point type at 1200 ems per hour if the forms are 25 picas by 7 inches? Answer in hours, minutes, and seconds.

4. How long will it take to set the forms in Problem 3 if set in 10-point type?

5. How long will it take to set 6 forms in 14-point type, each form 6 inches by 45 picas if the compositor can set 1600 ems per hour?

Measurement of Composition in Ems

One can readily see that there is just as much labor involved in setting up a job in 36-point type as in setting the same job in 6-point type. There are as many trips to the boxes to secure the letters, as many words to space, and as many lines in one size as in the other. It is seen then that a square inch basis, if the rate per square inch is the same, would be unfair because one square inch of 6-point would contain approximately 36 times as many characters as 36-point type. About the fairest means of determining the rate would be for the number of characters. Such a method has been devised by printers, which method is based on the normal line. The system is called the em (or square) system. An em as you know is the square of the body size of type. For example an em of 8-point type is 8×8. An em of 6-point will contain on the average two characters—an em of the other sizes will be the same—so if we can find the number of ems in a job we are well on the way toward a solution to the number of characters and spaces in the job no matter in what size it is set.

To find the number of ems in a line it is well first to deal with a measure with which we are usually more familiar. Suppose that one has a board 14 feet long and wished to mark it off into lengths of 8 inches each. We would first multiply the 14 by 12 in order to find out how many inches long the board was. Then it is an easy matter to divide by the 8 inches to find out how many pieces we would have. $\frac{14\times12}{8}=21$ pieces.

In determining the number of ems in a line of type one uses identically the same process. For example, to determine the number of lengths of 8-points each in a line 14 picas long, we would say $14 \times 12 =$ the number of points long $\div 8$ the size of the unit we would get 27 or the number of 8-point units in the line.

To find the number of lines in solid matter one finds the length in points and divides by the size of the type.

Some examples:

1. Find the number of ems in a page of 6-point type 14 by 30 picas.

$\frac{14 \times 12}{6} =$ number of ems in each line.

$\frac{30 \times 12}{6} =$ number of lines.

$\frac{14 \times 12}{6} \times \frac{30 \times 12}{6} = 1680$ ems in the job.

2. Find the number of ems in a job of 8-point type 14 by 30 picas.

$\frac{14 \times 12}{8} \times \frac{30 \times 14}{8} = 945$ ems.

3. Find the number of ems in a job 3 inches by 30 picas set in 10-point type.

$\frac{3 \times 72}{10} \times \frac{30 \times 12}{10} = 777.6$ ems.

Note that in the first part of this problem the 3 is multiplied by 72. Why?

4. How much will it cost at $1.50 per thousand ems for setting 6 forms each 4 inches by 58 picas set in 14-point type.

Solution:

$$\frac{4\times72}{14}=\text{numbers of ems per line}$$

$$\frac{58\times12}{14}=\text{number of lines}$$

$$\frac{4\times72}{14}\times\frac{58\times12}{14}\times6=\text{the total number of ems.}$$

Divide this result by 1000 to determine the number of thousand ems in the job and multiply by the price per thousand ems we would find the cost.

$$\frac{4\times72}{14}\times\frac{58\times12}{14}\times\frac{6}{1}\times\frac{1}{1000}\times\frac{\$1.50}{1}=\$9.208+$$

5. How long will it take if a compositor can set 900 ems per hour to set 6 forms each 13 inches by 12 inches in 24-point type.

Solution:

$$\frac{13\times72}{24}\times\frac{12\times72}{24}\times\frac{6}{1}\times\frac{1}{900}=9.36\text{ hrs.}$$

$$\frac{36}{100}\times\frac{60\text{ minutes}}{1}=21.6\text{ minutes}$$

$$\frac{6}{10}\times\frac{60}{1}=36\text{ seconds}$$

Answer is 9 hours, 21 minutes, and 36 seconds.

6. How much will it cost to set 5 forms, each 20 picas by 6 inches at $2.10 per hour if the compositor can set 1200 ems per hour. The job is to be set in 10-point type.

Solution:

$$\frac{20\times12}{10}\times\frac{6\times72}{10}\times\frac{5}{1}\times\frac{1}{1200}\times\frac{2.10}{1}=\$9.072$$

Exercise 66

1. How many lines in a form 4×8 inches set in 10-point leaded? Answer is 48.

2. How many lines in a form 6×9 inches set in 18-point double leaded?

3. How many ems in a job 5×8 inches set in 8-point leaded? $\frac{5\times72}{8}\times\frac{8\times72}{8+2}$

4. How many ems in a job consisting of 5 forms each 3×7 inches set in 6-point double-leaded?

5. How many ems in four forms 21 by 35 picas set in 12-point leaded?

6. How many more ems in a job set solid than one set 2-point leaded if set in 8-point and the job consists of 3 forms, each 4×8 inches?

7. How many ems per square inch of 6-point? 8-point? 10-point? 12-point?

8. How many ems per square inch of 2-point leaded matter of 6-point? 8-point? 12-point?

9. How many ems of 6-point type in a job 3×5 inches? Determine this also by using the information found in problem 8.

10. How many ems of 8-point type in a job 3×5 inches set solid?

Exercise 67

1. Find the number of lines of 8-point leaded type in a form 24 picas long.

2. Find the number of lines of 10-point leaded type in a form 12 inches long.

3. Find the number of lines of 12-point leaded type in a form 6 inches long.

4. Find the number of lines of 6-point double-leaded in a form 33 picas long.

5. Find the number of lines of 8-point double-leaded in a form 42 picas long.

6. Find the number of lines of 6-point triple-leaded in a form 39 picas long.

7. Find the number of lines of type in a form 24 picas long set in 8-point solid.

8. Find the number of lines of 10-point solid in a form 8 inches long.

9. Find the number of lines of 8-point leaded in a form 27 picas long.

10. Find the number of lines of 8-point double-leaded in a form 30 picas long.

Extra Problems

11. Find the number of ems of 6-point type in a form containing 45 lines set to 18 picas.

12. Find the number of ems of 8-point type in a form 33×48 picas.

13. Find the number of ems of 10-point type in a form 6×8½ inches.

14. Find the number of ems of 6-point leaded type in a form 27×36 picas.

15. Find the number of ems of 8-point leaded type in a form 5½×9 inches.

Exercise 68

1. Find the number of ems of 6-point type in a line set to 14 picas.

2. Find the number of 8-point lines in a form 21 picas long.

3. Find the number of ems of 12-point in a form 27×33 picas.

4. Find the number of lines of 10-point leaded in a form 42 picas long.

5. Find the number of ems of 8-point leaded in a form 4×6 inches.

6. Find the number of lines of 6-point double-leaded in a form 10 inches long.

7. Find the number of ems of 6-point double-leaded in 4 forms each 42×33 picas.

8. Find the number of lines of 8-point type in a form 31 picas long.

9. Fine the number of lines of 12-point leaded in 8 forms 54 picas long.

10. At $.70 per thousand ems, find the cost of setting 7 pages, each 30×35 picas set in 6-point leaded.

Extra Problems

11. Find the number of 8-point ems in 4 forms each containing 32 lines set to 30 picas.

12. At $.50 per thousand ems, what will a compositor earn setting 4 forms each 30×35 picas set in 10-point type.

13. An apprentice sets about 500 ems per hour. How long will it take him to set 8 forms 24×33 picas in 6-point leaded?

14. Find the number of ems of 6-point double-leaded in a form 4×6 inches.

15. Find the number of ems of 8-point leaded in 3 forms each 18×21 picas.

LEADED COMPOSITION

To determine the number of lines of leaded matter one determines the number of points long the form is and divides this number by the size of the type plus the amount of leading. One usually drops any fraction of a line since the lines cannot be cut into the long way. However in considering the number of ems in a leaded job one uses the fraction of the line. In specifications of a page the width is always first and unless otherwise specified, the type is to be considered as solid. Some examples of leaded composition follow:

1. Find the number of lines in a job 6×9 inches set in 8-point leaded.

Solution $\frac{9\times72}{8+2}=\frac{648}{10}=64.8$ or 64 lines.

2. To find the number of ems in the above we can multiply $64.8\times\frac{9\times72}{8}$ or as originally learned,

$$\frac{6\times72}{8}\times\frac{9\times72}{10}=3499.2$$

3. Find the cost of composition at $1.60 per hour for 4 forms each 5×8 inches set in 12-point leaded if the compositor can set 1100 ems per hour.

Solution

$$\frac{5\times72}{12}\times\frac{8\times72}{14}\times\frac{1}{600}\times\frac{\$1.60}{1}\times\frac{4}{1}=\$9.87+$$

4. Find the difference between the number of ems per square inch of 6-point solid and 6-point leaded.

Solution

$$\text{6-point solid}=\frac{72}{6}\times\frac{72}{6}=144$$

$$\text{6-point leaded}=\frac{72}{6}\times\frac{72}{6+2}=108$$

$144-108=36$ ems.

Exercise 69

1. Find the length in inches of a form containing 25 lines of 10-point.

2. Find the length and width in inches of a form containing 60 lines of 8-point set to a measure of 18 picas.

3. Find the length in inches of a form containing 41 lines of 14-point leaded.

4. Find the length in inches, and in picas, of a form containing 72 lines of 8-point leaded.

5. Find the length and width in inches of a form 27×39 picas.

6. Find the length in inches of a form of 78 lines of 8-point.

7. Find the length in inches of a form of 60 lines of 6-point double-leaded.

8. Find the length and width in inches of a form of 24 lines of 8-point leaded set to 27 picas.

Extra Problems

9. Find the number of square inches in a form 16×31 picas.

10. Find the number of square inches in a form containing 27 lines of 6-point solid set to 36 picas.

Exercise 70

1. Find the length in inches of a form containing 90 lines of 6-point leaded.

2. Find the number of square inches in a form 30×24 picas.

3. Find the number of pounds of type in a form 3×5¼ inches.

4. Find the number of pounds of type in a form 24×42 picas.

5. Find the number of square inches of type in a form containing 30 lines of 10-point set to a measure of 14 picas.

6. Find the number of square inches of type in a form 21×35 picas.

7. Find the number of square inches in a form of 61 lines of 8-point leaded set to 18 picas.

Extra Problems

8. Find the number of square inches in 4 forms each containing 21 lines of 12-point leaded set to 18 picas.

9. Find the number of square inches in a form containing 18 lines of 5½ point set to 14 picas.

10. Find the cost at $.40 per pound of type in a form 20×30 picas.

Exercise 71

1. Find the length in inches of a form of 124 lines set in 6-point leaded.

2. Find the number of square inches in 4 forms 16×31 picas.

3. Find the weight of type in 6 forms each 30×24 picas.

4. Find the cost of type at $.80 per pound in 8 forms each 3×5¼ inches.

5. Find the number of square inches of type in a form 24×42 picas.

6. Find the weight of type in 2 forms each containing 30 lines of 10-point set to 14 picas.

7. Find the cost at $.85 per pound of type for 16 forms each 21×35 picas.

8. Find the number of square inches in a form containing 21 lines of 12-point leaded set to 18 picas.

Extra Problems

6. Find the weight of 8 forms each containing 18 lines of 5½-point set to 14 picas.

10. Find the cost at $.80 per pound of type for 8 forms each 20×30 picas.

Exercise 72

1. Find the number of square inches in one 2-point lead 12 picas long.

Solution: $\text{width} = \frac{12}{6}$ inches

$\text{length} = \frac{2}{72}$ inches

$\frac{12}{6} \times \frac{2}{72} = \frac{1}{18}$ square inches.

2. Find the number of square inches in one 3-point lead 15 picas long.

3. Find the weight of one 6-point slug 24 picas long.

4. Find the number of square inches in twenty 2-point leads 12 picas long.

5. Find the number of square inches in thirty-one 3-point leads 24 picas long.

6. Find the weight of sixty 6-point slugs 15 picas long.

7. Find the number of square inches in ninety 4-point leads 31 picas long.

8. Find the weight of one 6-point slug 27 picas long.

9. Find the cost at \$.20 per pound of forty double-leads 24 picas long.

10. Find the cost at \$.15 per pound of twenty-seven 6-point slugs 18 picas long.

Exercise 73

1. Find the number of leads in a form of 61 lines set in 6-point leaded.

2. Find the number of leads in a form of 36 lines set in 3-point double-leaded.

3. Find the number of leads in a form 20 picas long set in 6-point leaded.

4. Find the number of leads in a form 24×31 picas set in 8-point leaded.

5. Find the number of leads in a form 10 inches long set in 10-point leaded.

6. Find the number of leads in a form 42 picas long set in 6-point double-leaded.

7. Find the number of leads in a form of 72 lines set in 8-point double-leaded.

8. Find the number of leads in a form 36×21 picas set in 6-point leaded.

Extra Problems

9. Find the number of leads in a form 30 picas long set in 6-point triple-leaded.

10. Find the number of leads in a form 6×8 inches set in 8-point leaded.

Exercise 74

1. Find the number of square inches in 27 double-leads 33 picas long.

2. Find the of leads in a form 42 picas long set in 6-point leaded.

3. Find the number of square inches of leading in a form of 61 lines of 8-point leaded set to 14 picas.

4. Find the number of square inches of leading in a form of 57 lines of 6-point double-leaded set to 14 picas.

5. Find the number of square inches of leading in a form 20×30 picas set in 8-point leaded.

6. Find the weight of leads in a form containing 25 lines of 10-point triple-leaded set to 21 picas.

7. Find the number of square inches of leading in a form of 21 lines of 14-point triple-leaded set to 25 picas.

8. Find the number of square inches of leading in 4 forms each 20×31 picas set in 6-point double-leaded.

Extra Problems

9. Find the number of square inches of leading in a form 3½×5 inches set in 10-point leaded.

10. Find the number of square inches of leading in 8 forms each 24×30 picas set in 8-point leaded.

Exercise 75

1. Find the number of square inches of leading in 4 forms each containing 25 lines of 10-point triple-leaded set to 21 picas.

2. Find the number of leads in a form 42 picas long set in 8-point leaded.

3. Find the number of square inches of leading in 21 forms each 20×14 picas set in 6-point leaded.

4. Find the weight of leads for 8 forms each containing 61 lines of 6-point leaded set to 14 picas.

5. Find the weight of leads for 64 forms each containing 57 lines of 8-point double-leaded set to 18 picas.

6. Find the weight of leads for 4 forms each 3×6 inches set in 6-point leaded.

7. Find the cost at 13 cents per pound of leads for 4 forms each 20×14 picas set in 8-point leaded.

8. Find the number of pounds of leads required for 16 forms each $3\frac{1}{2}\times5$ inches set in 10-point leaded.

Extra Problems

9. Find the number of pounds of leads required for 2 forms each 16×31 picas set in 6-point leaded.

10. Find the number of pounds of leading required for 8 forms each 24×30 picas set in 8-point leaded.

Exercise 76

1. Find the number of square inches in a 6-point slug 36 picas long.

2. Find the number of leads in a form of 72 lines of 8-point leaded.

3. Find the number of leads in a form 33 picas long set in 8-point double-leaded.

4. Find the number of square inches of leading in 4 forms each 24×30 picas set in 6-point leaded.

5. Find the number of pounds of leading in 8 forms each 24×42 picas set in 8-point leaded.

6. Find the cost at $.20 per pound of leading for 6 forms each containing 21 lines of 14-point triple-leaded set to 25 picas.

7. Find the cost at $.20 per pound of leading to set 4 forms each 20×31 picas set in 6-point double-leaded.

8. Find the cost at $.20 per pound of leading for 8 forms each 6×8 inches set in 6-point leaded.

9. Find the weight of leading for 16 forms each 16×31 picas set in 10-point leaded.

10. Find the cost at $.20 per pound of leading for a form 24×28 picas set in 6-point double-leaded.

Exercise 77

1. If there are 50 lines of 6-point type to a page, how many lines of 8-point will occupy the same area?

Solution:

50 lines × 6-points each = 50×6 = 300 points.

300 ÷ 8-points = 37½ or 37 lines.

2. If a page contains 40 lines of 12-point type, how many lines of 8-point will the same page contain?

3. If a page contains 50 lines of 8-point type, how many lines of 18-point will the same page contain?

4. If a page contains 56 lines of 12-point type, how many 10-point lines will occupy the same space?

5. If a page contains 50 lines of 8-point solid how many lines of 8-point leaded will occupy the same space?

6. If there are 300 pages of 8-point type set 80 lines to the page how many pages will there be if the job is set in 8-point leaded?

7. If there are 400 pages of 6-point type running 64 lines to the page, how many pages will there be if the job is leaded?

8. If there are 400 pages of 8-point leaded type running 48 lines to the page, how many pages will there be if set in 8-point solid?

9. If there are 400 pages of 8-point double-leaded type running 40 lines to a page, how many pages will there be if set in 8-point leaded?

10. If there are 400 pages of 10-point double-leaded type running 30 lines to a page, how many pages will there be if set in 10-point solid?

Extra Problems

11. A booklet set in 8-point solid is to be double-leaded. If there are now 36 pages of 45 lines each, how many pages will there be when re-set?

12. A book of 350 pages set in 8-point leaded runs 40 lines to the page. How many pages will there be if re-set in 8-point solid?

Exercise 78

1. One square inch of 5½-point type will contain how many ems? $\frac{72}{5\frac{1}{2}} \times \frac{72}{5\frac{1}{2}} = 171.37$

2. One square inch of 6-point type will contain how many ems?

3. Make a table showing the number of ems per square inch of 6, 8, 10, 12, 14, 18, 24, 30, and 36-point type per square inch.

4. How many ems in a job 3×5 inches in 18-point type? (From the table in problem 3.)

5. How many ems of 6-point in 16 square inches?

6. How many ems of 24-point in 16 square inches?

7. How many ems of 12-point in 16 square inches?

8. How many ems of 10-point in a job 3×8 inches?

9. How many ems of 10-point in a job 30 picas by 6 inches?

10. How many ems of 14-point in a job 30 picas by 6 inches?

Extra Problems

11. How many 8-point ems in 3 pages each 4×8 inches?

12. How many 24-point ems in 3 pages each 4×8 inches?

Exercise 79

1. One square pica of 5½-point type will contain how many ems? $\frac{12}{5\frac{1}{2}} \times \frac{12}{5\frac{1}{2}} = 4.76$

2. One square pica of 6-point will contain how many ems?

3. Make a table showing the number of ems per square pica of 6, 8, 10, 12, 14, 18, 24, 30, and 36-point, correct to three decimal places.

4. How many ems in a job 18×30 picas set in 18-point type? (Use the table in problem 3.)

5. How many ems of 6-point in 576 square picas?

6. How many ems of 24-point in 576 square picas?

7. How many ems of 12-point in 576 square picas?

8. How many ems of 10-point in a job 18×50 picas?

9. How many ems of 10-point in a job 30 picas by 6 inches?

10. How many ems of 14-point in a job 30 picas by 6 inches?

Extra Problems

11. How many 8-point ems in 3 pages each 48×72 square picas?

12. How many 24-point ems in 3 pages each 48×72 square picas?

Weight and Cost of Type Metal

For all practical purposes four square inches of type weigh one pound. Since type metal is sold by the pound it is necessary only to find the number of square inches and multiply by ¼. Leads and slugs are also sold by the pound and as type a square inch of leads equals approximately ¼ pound.

To determine the length of a form in inches when he knows the number of lines one multiplies the size of the type by the number of lines and divides by 72, the number of points per inch. If the type is leaded it will be the number of lines times the size of the type plus the amount of leading divided by 72.

Example:

1. Find the length in inches of a form of 80 lines of 8-point. $\frac{80\times8}{72}=9.89$ inches.

2. Find the length in inches of a form of 80 lines of 8-point leaded.

$$\frac{80\times8+2}{72}=\frac{800}{72}=11.11 \text{ inches.}$$

3. Find the cost of metal at 50 cents per pound in a form of 52 lines of 8-point type set to 22 picas.

Solution:

$$\frac{22}{6} = \text{width in inches}$$

$$\frac{52\times 8}{72} = \text{length in inches}$$

$$\frac{22}{6}\times\frac{52\times 8}{72} = \text{square inches in the form}$$

$$\frac{22}{6}\times\frac{52\times 8}{72}\times\frac{1}{4} = \text{the number of pounds of metal}$$

$$\frac{22}{6}\times\frac{52\times 8}{72}\times\frac{1}{4}\times\frac{.50}{1} = \$2.61 = \text{cost of metal.}$$

4. Find the cost of metal at 75 cents per pound for 48 lines of 10-point, leaded, type set to a measure of 24 picas.

Solution:

$$\frac{24}{6}\times\frac{48\times 12}{72}\times\frac{1}{4}\times\frac{.75}{1} = \$6.00.$$

Exercise Work Division 1

1. A journeyman can set 800 ems per hour and his apprentice can set 200 ems per hour. How long will it take them to set a book of 16 pages, each 25×40 picas set in 10-point type?

2. A run of 80,000 on the press is duplicated and run on two presses one with a speed of 900 per hour and the other with a speed of 1200 per hour. How long will it take to run the job?

3. A run of 75,000 is to be put on two folders one with a capacity of 1800 per hour and the other with a capacity of 2100 per hour. How long will it take to run the job?

4. If a run of 100,000 is triplicated and run on 3 presses with speeds of 3000, 2500, and 1500 per hour respectively, how long will it take to complete the run?

Extra Problem

5. A journeyman can set 900 ems per hour and his apprentice 300. The wages are to be $2.50 per 1000 ems. How much will each make on a book of 24 pages, each 5 by 8 inches set in 8-point type. How long will it take them to set the job?

Exercise Work Division 2

1. How long will it take to set a job containing 4 forms each 30×45 picas if one printer can set 900 ems per hour and another 700 ems, of 10-point type?

2. A run of 100,000 is sent to 4 presses with speeds of 5000, 3000, 2500, and 1000 per hour. How long will it take to run the job?

3. The above job is put on three folders with a speed of 2100, 1800, and 1500 per hour. How long will it take to fold them?

4. A journeyman can set 800 ems per hour and his apprentice can set 600 ems per hour. The wages are to be $2.50 per 1000 ems. How much will each make on 5 forms each 30×54 picas set in 8-point type? How long will it take them to set the job?

Extra Problem

5. A run of 75,000 is duplicated and run on two presses one with a speed of 2100 per hour and the other with a speed of 1900 per hour. How long will it take to run the job?

Exercise Work Division 3

1. An apprentice can set 1000 ems per hour and a journeyman can set 1600 ems per hour. How long will it take them both to set a job of 24,000 ems?

2. How long would it take to set a form 9×12 inches of 6-point, if one printer can set 800 ems per hour and another can set 1000 ems?

3. A journeyman can set 850 ems per hour and his apprentice can set 650 ems. The wages are to be $3.00 per 1000 ems. How long will it take them to set a book of 16 pages, each 5×8 inches set in 8-point type? What will each of their wages be?

4. If a run of 500,000 sheets 19×21 is sent to five presses with the speed of 3500, 3300, 3000, 2500, 1500 per hour each, how long will it take to run the job?

Extra Problem

5. How long would it take a journeyman and his apprentice to set a job of 80,000 ems, if the apprentice can set 800 ems per hour and the journeyman 1000 ems per hour?

Unequal Division of Work

When a printing job is distributed to two or more machines of unequal speed as is often done, or when work is assigned to persons with different rates of speed, there results a problem of estimating the time. For example: How long will it take a journeyman and an apprentice to set a job if they work together? If the journeyman were working alone he could complete the job in 8 hours. It would take the apprentice 25 hours if he worked alone. The Solution is:

The journeyman could do 1/8 of the job in one hour. The apprentice could do 1/25 of it in an hour. Working together they could do 1/8+1/25 or 16/100 of it in an hour. 16/100=1 hour, 1/100=1/16 hour, 100/100 or all the job = 100/1×1/16= 6¼ hours.

Example 2. If "A" can do a piece of work alone in 16 days and B, alone, can do the same work in 9 days, how long would it take if both worked together?

A=16 days, could do 1/16 in one day

B=9 days, could do 1/9 in one day

Both together could do 1/16+1/9 in one day.

$\frac{1}{16}+\frac{1}{9}=\frac{25}{144}$ = fraction of work they could do together in one day.

$\frac{25}{144}$ = one day

$\frac{1}{144}=\frac{1}{25}$ day

$\frac{144}{144}=\frac{144}{25}=5\frac{19}{25}$ days.

Example 3. If press number one will print 1500 per hour and press number two, 2100, how long will it take both running together to print a run of 85,000 copies?

No. 1 $=\frac{1500}{85{,}000}$ of the job in one hour.

No. 2 $=\frac{2100}{85{,}000}$ of the job in one hour.

Together $\frac{1500}{85,000}+\frac{2100}{85,000}=\frac{3600}{85,000}$ in 1 hour.

$\frac{3600}{85,000}=\frac{36}{850}=$ 1 hour.

$\frac{850}{850}=\frac{859}{36}=23\frac{11}{18}$ hours.

Example 4. A job of 100,000 is to be folded on two folders, one with a capacity of 3000 per hour, and the other with a capacity of 4200 per hour. How long will it take both folders working together to complete the job?

Folder No. 1 $=\frac{3000}{100,000}$ or $\frac{3}{100}$ per hour.

Folder No. 2 $=\frac{4200}{100,000}=\frac{42}{1000}$ per hour.

Together $\frac{3}{100}+\frac{42}{1000}=\frac{72}{1000}$ per hour.

$\frac{72}{1000}=$ 1 hour

$\frac{1000}{1000}=\frac{1000}{72}=$13 hours, 53 minutes, and 20 seconds.

Example 5. A job of 50,000 impressions is set up in 3 identical forms and put on 3 separate presses. Press number one runs 1200 per hour, number two, 1400, and number three, 3000 per hour. How long will it take to run the job.

No. 1 $=\frac{1200}{50000}$ in 1 hour.

No. 2 $=\frac{1400}{50000}$ in 1 hour.

No. 3 $=\frac{3000}{50000}$ in 1 hour.

Together $\frac{1200}{50000}+\frac{1400}{50000}+\frac{3000}{50000}=\frac{5200}{50000}$ in 1 hour.

50,000 $=\frac{50000}{5200}=9\frac{8}{13}$ hours.

Ratio and Proportion 1

Find the missing term in each of the following proportions.

1. $8:16::5:x$
2. $9:x::24:8$
3. $x:7::25:5$
4. $36:4::x:5$
5. $a:3::5:27$
6. $2 \div y = 3 \div 21$
7. $9/24 = 3/w$
8. $7 \div 42 = d \div 12$
9. $5:x = 20 \div 8$
10. $m/8 = 14/16$
11. $20:30::6:h$
12. $3:7::h:9$
13. $5:2::r:35$
14. $3:c::9:14$
15. $5:a::3:6$
16. $r:3::6:7$
17. $3:6::7:n$
18. $6:7::m:19$
19. $7:b::19:5$
20. $19:c::5:6$

Exercise Ratio and Proportion 3

1. If 100 pound of type metal contains 62 pound of tin, how many pounds of tin in 836 pounds of metal?

Solution:

$$100:836::62:x$$

$$100x = 836 \times 62$$

$$x = \frac{836 \times 62}{100} = 527.32 \text{ pound.}$$

2. If 756 pound of metal contains 189 pounds of antimony how many pounds of antimony in 7652 pounds of metal?

3. If there 8 ounces of blue ink in 3 pounds of green how many ounce in 4½ pounds? Do not change the pounds to ounces.

4. If the size of a cut is 18x23 picas what would be the length of a cut 24 inches wide to be in the same proportion?

5. If a job is 33x42 picas how long will be a sheet of paper on which it is printed if the sheet is 7 inches wide and is to be in the same proportion?

6. If a piece of paper is 6x8½, how wide must a type form be if the length is 42 picas and the type form is to be in proportion?

7. If a job in 6-point Caslon occupies 96 square picas what will be the approximate area of the same job in 8-point type.

Ratio and Proportion

Ratio is the relation between or the comparison of two numbers. Things measured by the same unit may be compared in two ways, by subtraction and by division. One may say that a page 6 inches long is 3 inches longer than one 3 inches long or he could say it was 6/3 or twice as long. A comparison of two things by division is known as ratio. Only like things or like units can be compared, such as the width of one line with the width of another. A ratio indicates a division and may be expressed $6 \div 3$, 6/3, or 6 : 3. In the second case the dots are omitted from the division sign and in the third case the line is omitted but each means that the 6 is to be divided by the 3. When two ratios are equal they are said to be in proportion. For example, if a post 3 feet high casts a shadow 4 feet long then one 6 feet high would cast a shadow 8 feet long. The ratio of the posts is 3:6 (read 3 is to 6) and the ratio of the shadows is 4:8. Thus one has the two ratios $3/6 = 4/8$, or $3:6 = 4:8$, or $3:6::4:8$ (read 3 is to 6 as 4 is to 8) which would make a proportion. In a proportion, the first and fourth terms are known as the extremes and the second and third terms are known as the means. The means or middle terms in the proportion $3:6::4:8$ are 6 and 4 and the extremes or end terms are 3 and 8.

One of the fundametal laws of proportion is that *the product of the means is equal to the product of the extremes*, or, as in the example, $3 \times 8 = 4 \times 6$. This law will help solve any porportion problem in which one of the terms is missing. For example,

$3:x = 4:8$

$4x = 24$ (Product of means = product of extremes)

$x = 6$ (Dividing both sides by 4)

or,

$a:6::4:8$

$8a = 24$

$a = 3$

or,

$3:6::r:8$

$6r = 24$

$r = 4$

or,

$3:6::4:w$

$3w = 24$

$w = 8$

The relation of the length of a page to its width or the ratio of the page can be either pleasing or distasteful, for example, a square page is not pleasing, that is, the ratio of length to width is not pleasing. Certain ratios which have been used many years are pleasing because of their long usage. One of these pleasing ratios is called the Golden Oblong which is near the ratio 3 : 5. The actual ratio of the Golden Oblong is 1 : 1.62. The ratio 3 : 5 may be reduced to 1 : 1.66 by means of the proportion,

$$3 : 5 :: 1 : x$$
$$3x = 5$$
$$x = 5/3 = 1.66$$

This means that for each unit in width the length will be 1.66 times that unit. For example, to determine how long a job must be if it is to be according to the Golden Oblong and is 6 inches wide we would multiply $6 \times 1.66 = 10$ inches. One usually speaks of a ratio as 1 : 1.66 rather than 3 : 5.

Another pleasing rectangle is the hypotenuse rectangle. This is a rectangle whose length is the same as the diagonal of a square the same size as the width of the rectangle. For example, what would be the hypotenuse oblong of a square 3 inches wide? This square would have a diagonal which is equal to $\sqrt{3^2 + 3^2}$ or $\sqrt{18} = 4.24$. Then the oblong would be 3 x 4.24 or 3 x 4¼. The ratio of the hypotenuse oblong is $1 : \sqrt{2}$ or 1 : 1.414.

An interesting and valuable feature of the hypotenuse oblong is that no matter how many times the sheet is folded the resultant sheet will have the same ratio.

Another oblong much used by printers is known as the printers oblong or the Double Hypotenuse Oblong. This oblong is made by taking the diagonal of the hypotenuse oblong and using this measurement as the height of the new oblong. The ratio of the Printers Oblong is $1 : \sqrt{3}$ or 1 : 1.732. A fourth pleasing oblong is the Regular Oblong whose ratio is 1 : 1.5.

COMMONLY-USED RATIOS

Golden Oblong	1:1.62
Hypotenuse Oblong	1:1.414 or $1:\sqrt{2}$
Regular Oblong	1:1.5
Double Hypotenuse or Printer's Oblong	1:1.732 or $1:\sqrt{3}$

To find the longer side of a rectangle of which the shorter side is known or given one multiplies this known side by the larger term of the ratio desired. For example, what will be the length of a form whose width is 30 picas and a Hypotenuse Oblong is desired? 30=the known width. 1.414 is the largest term of the Hypotenuse ratio. $30\times1.414=42.42$ picas=the length of the oblong. Then the form would measure 30×42.42 picas to be a Hypotenuss Oblong. What would be the length of a Double Hypotenuse Oblong whose width is 30 picas? $30\times1.732=51.96$ picas. A regular oblong with a width of 30 picas would be 45 picas tall.

To find the width of an oblong of which the length is known, one divides by the larger term of the ratio desired. For example, what is the width of a Golden Oblong whose length is 30 picas? 30 picas$\div1.62=18.5$. The width of a Regular oblong would be 20 picas.

Bond Paper—Weight and Sizes

Bond as applied to paper is a term which was formerly applied to an all-rag paper intended for government bonds, but now the term applies to a strong and rattly, more or less translucent paper with a hard surface, made of rag or sulphite-treated wood or both, and used largely for letter heads and for typewriter or any other form on which writing is to be done in ink. Bond as well as other paper is manufactured in different thicknesses and different sizes to meet the various needs of the printing trade.

Some of the factors which govern the selection of the thickness of a sheet of paper are the style of the printed piece, whether it is to be stitched or handled loose, the number of pages in the book or job, whether it is to be mailed with other materal or not, the size of the printed piece, tbe amount of handling which the printed piece will receive, the cost of production, and the mailing cost of the finished product. The thickness of the sheet determines the weight of the paper. The basis for the weight of paper is the weight of 500 sheets or one ream. For example, a ream or 500 sheets of bond paper 17×22 inches in size may be secured in any of the following thicknesses or weights, 13, 16, 20, and 24 pounds. Paper is known as 13, 16, 20, or 24 pound paper regardless of the number of sheets or the size. Considerable experiences is necessary before one can readily determine the difference between the various weights. A sheet of 24-pound paper is almost twice as thick as a sheet of 13 pound.

Paper is made in many sizes for the convience of the printer. The sizes in which Bond paper is made are found in the table below. Those marked * are usually carried in stock by most paper supply houses while those not marked can be ordered from the paper mill.

Bond Paper Sizes

16 × 21	18 × 23	21 × 32	23 × 36
17 × 22*	19 × 24*	21 × 33	24 × 38*
17 × 28*	20 × 28	22 × 34	28 × 34*

The size most used is 17 × 22 inches. 17 × 22 is known as the basic size from which the weights of the other sizes are determined. For example, a ream of paper marked 17 × 22—20 means that 500 sheets 17 × 22 will weigh 20 pounds, and the

paper is known as 20-pound substance or merely 20-pound paper. A ream of the same thickness of paper in a larger size would of course, weigh more. To determine how much more, or less, a ream, different from the basic or 17×22 size, will weigh one uses either one of two methods.

The first method is the square inch method which considers the number of square inches in each of the two sizes and determines the weight of one by a comparison with the known weight. For example, what is the weight of a ream of 20-pound paper 17×28. This means that a ream 17×22, the basic size, weighs 20 pound.

17×22 is 374 square inches
17×28 is 476 square inches
374 square inches = 20 pounds

$$476 \text{ square inches} = \frac{476}{374} \times 20 \text{ pounds} = 25.45$$

Then a ream of 20-pound paper 17×28 would weigh 25.45 or as it is known by the paper companies 25.5 pounds

The second method known as the proportion method often often saves much multiplication because one is able to cancil some of the terms. The formula for finding the weight is.

$$\text{Weight of the new size} = \frac{\text{Basic Weight} \times \text{New Size}}{\text{Basic Size}}$$

In the problem above one would have

$$\text{Weight of the new size} = \frac{20 \times 17 \times 28}{17 \times 22} = \frac{280}{11} = 25.45$$

The proportion method is determined by the following statements:

New weight is to the old weight as the new size is to the old size.

New weight: old weight:: new size: old size
New weight × old size = old weight × new size

$$\text{New Weight} = \frac{\text{old weight} \times \text{new size}}{\text{old size}}$$

Applying this to a problem.

Find the weight of a ream of paper 28×34 basic-size weight is 24 pounds.

Solution:

The new weight is what is required.
The old weight in this case is 24 pounds.
The new size is 28×34
The old size (or basic size) is 17×22
New weight: 24 pound:: 28×34: 17×22
New weight × 17×22 = 24×28×34

$$\text{New weight} = \frac{24 \times 28 \times 34}{17 \times 22} = \frac{24 \times 28}{11} = 61 \text{ pounds.}$$

Exercise Copyfitting 1.

Make block layouts showing how to center the following capital lines. Example: 18 characters in 12-point Caslon in a measure of 24 picas.

$18 \times .69 = 12.42$ or $12\frac{1}{2}$ picas

24 picas $- 12\frac{1}{2}$ picas $= 11\frac{1}{2}$ picas

$11\frac{1}{2}$ picas $\div 2 = 5\frac{3}{4}$ picas

$5\frac{3}{4}$ picas		$12\frac{1}{2}$ picas		$5\frac{3}{4}$ picas
Problem	Number of Characters	Kind of Type	Size of Type	Measure in Picas
1	24	Caslon	14	28
2	18	Bodoni	18	35
3	14	Goudy	30	32
4	16	Kennerley	36	42
5	12	Bodoni	36	42
6	13	Caslon	24	35
7	15	Century	18	36
8	20	Century	10	20
9	32	Bodoni	8	18
10	16	Caslon	24	40
11	18	Kennerley	18	37
12	36	Bodoni	6	18
13	19	Caslon	8	17
14	17	Century	6	13
15	13	Bodoni	24	48
16	15	Caslon	18	37
17	12	Century	36	47
18	10	Kennerley	24	46
19	8	Goudy	36	45
20	6	Goudy	30	32

Exercise Copyfitting 1

1. Determine the factor for the following type:

Nearly every system of copyfitting depends to a large extent on a character count of the copy. Praeticolly every layout man has a particular system of his own which he has adapied by experience to his own needs. This experience rather than his chart makes his own system the best one for his own use.

8-point Century Italic, 17 picas.

2. How long would a line of 384 characters of copy be if it were set in 6-point Century?

3. How long would a line of 40 characters be if set in 8-point Bodoni?

4. How much longer will a line of 49 characters be if set in 8-point Caslon Bold than if it were set in Caslon O. S.?

5. If 360 characters are to be set in 12-point Kabel Light in a measure of 9 picas, how many lines would there be?

6. Make a block layout showing how one would center 20 characters of 18-point Bodoni Bold in a measure of 28 picas.

Extra Problems

7. How many lines of 10-point Century Expanded will 1696 characters be if set to a measure of 13 picas?

8. Center a line (block layout) of 35 characters if set in 14-point Bodoni Bold in a measure of 30 picas?

9. Make a block layout showing how one would center a line of 28 characters set in 18-point Century Expanded set in a measure of 20 picas.

Exercise Copyfitting 2.

Center in a block layout the following lines:

Problem	Nnmber of Characters	Kind of Type	Size of Type	Measure in Picas
1	92	Caslon O. S.	6	20
2	46	Caslon Bold	12	22
3	35	Kabel Light	18	34
4	16	Century Bold	18	24
5	32	Caslon O. S.	12	29
6	38	Caslon Bold	18	30
7	16	Caslon O. S.	18	30
8	16	Bodoni	14	16
9	15	Bodoni Bold	18	16
10	12	Bodoni	14	15
11	92	Caslon O. S.	8	20
12	46	Caslon Bold	14	28
13	16	Kabel Bold	18	16
14	13	Century Exp.	18	12
15	19	Century Bold	14	14
16	45	Bodoni	8	24
17	45	Bodoni Bold	8	24
18	45	Century	8	24
19	45	Caslon O. S.	8	24
20	45	Century Italic	8	24

Exercise Copyfitting 3

1. How many characters of 8-point Caslon O. S. can be put in 10 lines 13 picas wide?

2. How many lines 13 picas wide of 10-point Century Bold will 875 characters make?

3. If the copy contains 429 characters, the space allotted on the layout is 10 picas, and the layout is to be in Caslon O. S., what is the length of the form if set in 10-point. What is the length of a form if set in 10-point leaded?

4. What will be the length of a form of 8-point Bodoni Bold set to 11 picas if there are 892 characters in the copy?

5. What will be the length of a line of 85 characters set in 10-point Century Expanded.

Extra Problems

6. From the first paragraph starting the explanation of Copyfitting on the page following this, determine the factor for this size and kind of type.

7. How many pages of 30 lines each will 186,943 characters make if set in 10-point Century Expanded, leaded? The measure is 24 picas.

Copyfitting Layouts

It is often necessary in making layouts to know how much space a given amount of copy will occupy. From experience and measurements a good layout man can fairly accurately determine and plan the various parts of his layout as to the space each will fill. Most of the systems of copyfitting are based on what is called a character count method, that is, some one has counted all the characters and spaces in an ordinary job and determined how much space the job occupies. From this count and calculation they have determined the average number of characters per line pica. This average number of characters per line pica is known as the factor for the particular size of type. For example, in the following piece of copy set in 12-point Cloister old style (Foundry) there are 296 characters and spaces in 6½ lines of 17 picas each. This makes 296 characters for 111 picas or 2.6 characters per line pica.

> Nearly every system of copyfitting depends to a large extent on a character count of the copy. Practically every layout man has a particular system of his own which he has adapted by experience to his own needs. This experience rather than his chart makes his own system the best one for his own use.

One may use this factor in detemining the number of picas any number of characters set in 12-point Cloister will occupy. For example, how long will a line of 90 characters be if it is set in 12-point Cloister O.S.? 90÷2.6=35 picas.

The following table gives a few of the kinds and sizes of type with the average number of characters per line pica.

Number of Characters Per Line Pica

TYPE*	6-PT.	8-PT.	10-PT.	12-PT.	14-PT.	18-PT.
Century Exp. 20A	3.8	3.0	2.5	2.2	1.9	1.2
Caslon O.S. 337E	4.3	3.4	2.7	2.3	2.0	1.5
Caslon Bold 79J Bodoni Bold 275J	3.4	2.8	2.3	1.7	1.5	1.2
Kabel Light 329	4.1	3.3	2.9	2.5	2.1	1.7
Kabel Bold 330	3.8	3.1	2.5	2.3	2.1	1.7
Bodoni 175A Century Bold 118J Cochan O.S. 61E	3.8	3.1	2.7	2.2	2.0	1.3

Following is the word "Prose" set in Goudy Heavy (Monotype 380) in 14-point. This line measures 3.9 picas, and has a cap factor of .79, almost the same as 18-point Kennerley.

PROSE

AN AVERAGE LINE OF TYPE CHA 52

AN AVERAGE LINE OF TYPE CHAR

After the cap factor for the type is determined, one multiplies the number of characters in the copy by this factor to find out how many picas long the line will be. For example how long will a line of 140 characters of 18-point Kennerley be,

Solution:

Average character width is .726 picas.

140 characters equal $140 \times .726 = 102$ picas.

Following is a table giving the cap factor for a few ordinary faces.

CAP FACTOR FOR A FEW ORDINARY FACES

		6	8	10	12	14	18	24	30	36
Caslon O. S.	337E	.37	.46	.57	.69	.74	.89	1.26	1.36	1.56
Bodoni Bold	275	.412	.489	.574	.697	.760	.975	1.26	1.551	1.736
Goudy Heavy	294				.708	.787		1.032		2.10
Kennerley	268					.713	.727		1.31	1.66
Century	20	.407	.494	.607	.667	.802	1.012	1	1.639	1.949

Example 1. If there are 896 characters in the copy to be set in 8-point Century type how many picas would there be? If the 896 characters were to be set in a measure of 10 picas, how many lines would there be?

Solution:

$896 \div 3.0$ (the factor for 8-point Century) $= 298.6$ picas of type or one line 298.6 picas long. If we divide this into lines 10 picas each there would be $298.6 \div 10 = 29.86$ lines or 30 lines.

Example 2. If you were going to set copy containing 950 characters in a measure of 12-picas in 10-point Bodoni Bold, how many lines would there be?

Solution:

$950 \div 2.3 = 413$ picas

$413 \div 12 = 35$ lines.

Example 3. Center a line of 29 characters of 18-point Caslon O. S. in a measure of 35 picas.

Solution:

$29 \div 1.5 = 19.3$ picas

$35 \text{ picas} - 19.3 = 15.7$ picas

$15.7 \div 2 = 7.9$ picas on each side.

Then if one were making a layout of the above line he would measure from the beginning 7.9 picas and start sketching in the letters which would run for the next 19.3 picas.