LOG OF
RADIO MATERIAL SCHOOL
SAN DIEGO
First Week.
Mathematics.

G.B.TODD, RMlc.

3.5

QUESTION #1. What is a simple fraction, an improper fraction, a mixed fraction?

ANSWER #1. A fraction is one or more of the equal parts into which a whole may be divided. All fractions may be expressed as common fractions by two numbers or terms separated by a horizontal line. The denominator, (lower term), names the parts or size of the fractional unit. The numerator, (upper term), shows the number of fractional units in the given fraction. In reading, the numerator is invariably read first.

A simple fraction is one whose numerator is smaller than its denominator; whose value is less than unity.

An improper fraction is one whose numerator is larger than its denominator; whose value is greater than unity.

A mixed fraction is an expression containing an integer and a simple fraction.

In final results, simple fractions are reduced to lowest terms by dividing the numerator and the denominator by a common prime factor (cancellation), and an improper fraction is expressed as a whole or mixed number.

To change an improper fraction to a whole or mixed number, divide the numerator by the denominator.

QUESTION #2. Give rule for finding the Least Common Denominator.

ANSWER #2. Divide the denominators, of the given fractions, by the lowest prime factor as many times as one or more of the denominators will contain it without a remainder bringing down the numbers that will not contain it. Then proceed to the next highest prime factor. Continue until the quotient of all the denominators is one. Multiply the prime factors used to find the Least Common Denominator.

QUESTION #3. Find the L.C.D. of $\frac{1}{12}, \frac{3}{5}, \frac{9}{14}, \frac{8}{11}, \frac{3}{33}, \frac{5}{16}$.

ANSWER #3.

2	12	5	14	11	33	16
2	6	5	7	11	33	8
2	3	5	7	11	33	4
2	3	5	7	11	33	2
3	3	5	7	11	33	1
5	1	5	7	11	11	1
7	1	1	7	11	11	1
11	1	1	1	11	11	1
	1	1	1	1	1	1

2 x 2 x 2 x 2 x 3 x 5 x 7 x 11 = 18,480 L.C.D.

QUESTION #4. Give rule for addition of fractions.

ANSWER #4. Change all mixed fractions to improper fractions.
Find the L.C.D.
Divide the L.C.D., separately, by each of the original denominators and multiply the quotient by the original numerator to find the new numerator of each fraction.
Add the numerators, placing the sum over the L.C.D.
Reduce to lowest terms, by cancellation if possible, and, in case of an improper fraction, divide the numerator by the denominator to reduce it to a mixed fraction.

QUESTION #5. Add: $\frac{3}{9}, \frac{4}{5}, \frac{7}{63}$, $2\frac{3}{4}, \frac{16}{3}, \frac{1}{24}$.

ANSWER #5.

3	9	5	63
3	3	5	21
5	1	5	7
7	1	1	7
	1	1	1

$3 \times 3 \times 5 \times 7 = 315$ L.C.D.

$\frac{315}{9} \times 3 = 105$

$\frac{315}{5} \times 4 = 252$

$\frac{315}{63} \times 7 = \frac{35}{392}$

$\frac{105}{315} + \frac{252}{315} + \frac{35}{315} = \frac{392}{315} = 1\frac{11}{45}$ Ans.

$2\frac{3}{4} + \frac{16}{3} + \frac{1}{24} = \frac{11}{4} + \frac{16}{3} + \frac{1}{24} =$

$\frac{66}{24} + \frac{128}{24} + \frac{1}{24} = \frac{195}{24} = 8\frac{1}{8}$ Ans.

L.C.D by inspection is 24. $\frac{24}{4} \times 11 = 66$

$\frac{24}{3} \times 16 = 128$

$\frac{24}{24} \times 1 = \frac{1}{195}$

QUESTION #6. Give rule for subtraction of fractions.

ANSWER #6. Change all mixed fractions to improper fractions.
Find the L.C.D.
Divide the L.C.D., separately, by each of the original denominators and multiply the quotient by the original numerator to find the new numerator of each fraction.
Subtract the lesser from the greater numerator, placing the difference over the L.C.D.
Reduce to lowest terms.

QUESTION #7. Subtract: $14\frac{5}{8}$ from $27\frac{5}{16}$, $\frac{9}{5}$ from $8\frac{7}{25}$.

ANSWER #7. $27\frac{5}{16} - 14\frac{5}{8} =$ L.C.D. by inspection is 16.

$\frac{437}{16} - \frac{117}{8} =$ $\frac{16}{8} \times 117 = 234.$

$\frac{437}{16} - \frac{234}{16} = \frac{162}{25} = 6\frac{12}{25}$ Ans.

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$8\frac{7}{25} - \frac{9}{5} =$ L.C.D by inspection is 25.

$\frac{207}{25} - \frac{9}{5} =$ $\frac{25}{9} \times 9 = 45.$

$\frac{207}{25} - \frac{45}{25} = \frac{162}{25} = 6\frac{12}{25}$ Ans.

QUESTION #8. Give rule for multiplication of fractions.

ANSWER #8. Change each factor of the problem to an improper fraction. The product of the numerators will be the numerator of the answer. The product of the denominators will be the denominator of the answer. Reduce to lowest terms.

QUESTION #9. Multiply: $\frac{3}{17} \times \frac{5}{9}$, $23\frac{1}{2} \times \frac{7}{16} \times \frac{3}{32}$.

ANSWER #9. $\frac{3}{17} \times \frac{5}{9} = \frac{\cancel{15}^{5}}{\cancel{153}_{51}} = \frac{5}{51}$ Ans.

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$23\frac{1}{2} \times \frac{7}{16} \times \frac{3}{32} =$

$\frac{47 \times 7 \times 3}{2 \times 16 \times 32} = \frac{987}{1024}$ Ans.

QUESTION #10 Give rule for division of fractions.

ANSWER #10 Change the divisor and dividend to improper fractions. Invert the divisor and proceed as in multiplication of fractions.

QUESTION #11 Divide: $\frac{3}{21}$ by $\frac{7}{18}$, $23\frac{1}{2}$ by $\frac{7}{32}$.

ANSWER #11 $\frac{3}{21} \div \frac{7}{18} = \frac{3}{21} \times \frac{21}{7} = \frac{\cancel{54}^{18}}{\cancel{147}_{49}} = \frac{18}{49}$ Ans.

ANSWER #11 (Continued)

$$23\frac{1}{8} \div \frac{7}{32} = \frac{185}{8} \times \frac{32}{7} = \frac{740}{7} = 105\frac{5}{7} \text{ Ans.}$$

QUESTION #12. What is a decimal fraction, vulgar fraction?

ANSWER #12. A decimal fraction has a denominator, divisible by ten, which is understood, the decimal point standing for the unit in the denominator.

A vulgar fraction has a denominator indivisible by ten.

To change a vulgar fraction to a decimal fraction, divide the numerator by the denominator.

QUESTION #13. Express as decimal fractions: $\frac{1}{13}, \frac{3}{4}, \frac{1}{64}$.

ANSWER #13.

$$\begin{array}{r} .0769 = .077 \text{ Ans.} \\ 13\,\overline{)1.0000} \\ 91 \\ \hline 90 \\ 78 \\ \hline 120 \\ 117 \\ \hline 3 \end{array}$$

$$\begin{array}{r} .75 \text{ Ans} \\ 4\,\overline{)3.00} \\ 28 \\ \hline 20 \\ 20 \\ \hline \end{array}$$

$$\begin{array}{r} .0156 = .016 \text{ Ans.} \\ 64\,\overline{)1.0000} \\ 64 \\ \hline 360 \\ 320 \\ \hline 400 \\ 384 \\ \hline 16 \end{array}$$

QUESTION #14. Give rule for addition of decimals.

ANSWER #14. Arrange the terms with all decimal points directly under each other. Proceed as in ordinary addition. Place the decimal point in the sum directly under the decimal points of the terms.

QUESTION #15. Add: 0.965, 3.85, 1.075, 0.0056.

ANSWER #15.

$$\begin{array}{r} 0.965 \\ 3.85 \\ 1.075 \\ \underline{0.0056} \\ 5.8956 \text{ Ans.} \end{array}$$

QUESTION #16. Give rule for subtraction of decimals.

ANSWER #16. Arrange the terms with all decimal points directly under each other, affixing ciphers as necessary. Proceed as in ordinary subtraction. Place the decimal point in the difference directly under the decimal point of the subtrahend and minuend.

QUESTION #17. Subtract: 0.01 from 9, 96.005 from 128.9.

ANSWER #17.

$$\begin{array}{r} 9.00 \\ \underline{.01} \\ 8.99 \text{ Ans.} \end{array} \qquad \begin{array}{r} 128.900 \\ \underline{96.005} \\ 32.895 \text{ Ans.} \end{array}$$

QUESTION #18. Give rule for multiplication of decimals.

ANSWER #18. Multiply as with whole numbers, placing as many decimal places in the product as there are in both the multiplier and the multiplicand.

QUESTION #19. Multiply: 0.397 x 0.005, 0.027 x 60.

ANSWER # 19.

$$\begin{array}{r} 0.397 \\ \underline{0.005} \\ .001985 \text{ Ans.} \end{array} \qquad \begin{array}{r} 0.027 \\ \underline{60} \\ 1.620 \text{ Ans.} \end{array}$$

QUESTION #20. Give rule for division of decimals.

ANSWER #20. Place the divisor, in relation to the dividend, the same as with whole numbers. If the divisor is a decimal fraction, move the decimal point to the right as many places as is necessary to make the divisor a whole number being careful to move the decimal point in the dividend an identical number of places to the right, affixing ciphers if necessary. Proceed as in division of whole numbers, placing the decimal point in the quotient directly over the decimal point in the dividend.

QUESTION #21. Divide: 36.744 by 24, 0.196 by 0.004, 6 by 0.01.

ANSWER #21.

$$\begin{array}{r} 1.531 \text{ Ans.} \\ 24 \,/\, 36.744 \\ \underline{24} \\ 12\ 7 \\ \underline{12\ 0} \\ 74 \\ \underline{72} \\ 24 \\ \underline{24} \\ \end{array} \qquad \begin{array}{r} 49. \text{ Ans} \\ \times 004 \,/\, \times 196. \\ \underline{16} \\ 36 \\ \underline{36} \\ \end{array} \qquad \begin{array}{r} 600 \text{ Ans.} \\ \times 01. \,/\, 6 \times 00. \end{array}$$

QUESTION #22. What is meant by the root of a quantity?

ANSWER #22. The root of a quantity is that number, which, when multiplied by itself as many times as is indicated by the index of the radical, will equal the given quantity. The process of extracting roots is termed evolution.

QUESTION #23. Give the rule for extracting the square root of a number.

ANSWER #23. 1. Beginning at the decimal point, separate the number, each way, into groups of two figures. (The outermost period on the left may have only one place)
2. Find the greatest square of the left hand period. Its root is the first figure in the required root.
3. Subtract the square from its period and bring down the next period. As a trial divisor use twenty times the root value already found. Divide, placing the quotient over the second period from the left, and add the quotient to the trial divisor. Multiply the divisor by the second figure of the root and subtract, bringing down the next period. (In some cases the quotient obtained with the trial divisor will be too great to add to the trial divisor and still obtain a product less or equal to the preceding period, in which case use the next smaller number for the root and the last figure of the divisor).
4. Multiply the figures of the root, already found, by twenty for the trial divisor, and proceed as befor
Note. In the case of fractions, either take the square root of the numerator and denominator separate -ly, or reduce the fraction to the decimal form.
Note. When the remainder, at any stage, will not contain the trial divisor, write a cipher in the root, and bring down the next period. If there are no fur--ther periods, periods of two ciphers may be added to the original number and the root determined to any desired number of decimal places.

QUESTION #24. Extract the square root of 401,956, 0.001296.

ANSWER #24.

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      6  3  4  Ans.
   √40'19'56
120  36
  3
123   419
      369
1260   5056
   4   5056
1264
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      .  0  3  6  Ans.
   √.00'12'96
       9
60     396
 6     396
66
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QUESTION #25. What is meant by the power of a quantity?

ANSWER #25. The products obtained by taking any number two or more times as a factor, are termed powers of that number. The process of finding the powers of numbers is termed involution. Powers are expressed by writing the number with a small raised figure or exponent showing the times it is taken as a factor.

QUESTION #26. Raise to the power indicated: $0.13^2, 10^8, 17.1^4$

ANSWER #26.

$$\begin{array}{r} 0.13 \\ \underline{0.13} \\ 39 \\ \underline{13} \\ .0169 \text{ Ans.} \end{array}$$

$10^8 = 100{,}000{,}000$ Ans.
(In powers of ten, moving the decimal point is equivalent to multiplication.)

$$\begin{array}{r} 17.1 \\ \underline{17.1} \\ 171 \\ 1197 \\ \underline{171} \\ 292.41 \\ \underline{17.1} \\ 29241 \\ 204687 \\ \underline{29241} \\ 5000.211 \\ \underline{17.1} \\ 5000211 \\ 35001477 \\ \underline{5000211} \\ 85503.6081 \text{ Ans.} \end{array}$$

QUESTION #27. What is meant by percent?

ANSWER #27. Per cent is the standard term for hundredths, meaning "by the hundreds" The term is represented by the symbol "%"

The rate percent is the number of hundredths taken.

The percentage of a quantity is the value of the hundredths taken.

The base is the number on which the percentage is reckoned.

$$\text{PERCENTAGE} = \text{Base} \times \text{Rate percent}$$

$$\text{RATE PERCENT} = \frac{\text{Percentage}}{\text{Base}}$$

$$\text{BASE} = \frac{\text{Percentage}}{\text{Rate percent}}$$

Percentage may also be determined by proportion.

QUESTION #28. Find $2\frac{1}{2}\%$ of 1297, 150% of 0.6, 16.5% of 50.

ANSWER #28.

$$\begin{array}{r} 1297 \\ \underline{.025} \\ 6485 \\ \underline{2594} \\ 32.425 \text{ Ans.} \end{array}$$

$$\begin{array}{r} .6 \\ \underline{1.50} \\ .900 \text{ Ans.} \end{array}$$

$$\begin{array}{r} 50 \\ \underline{1.65} \\ 250 \\ 300 \\ \underline{50} \\ 82.50 \text{ Ans} \end{array}$$

QUESTION #29. What per cent of 52 is 39, 0.8 is 0.9?

ANSWER #29. $\frac{39}{52} = \frac{.75}{52/39.00} = 75\%$ Ans.

364
260
260

.8 is to 100 as .9 is to what number?

$$\frac{100 \times .9}{.8} = \frac{112.5}{.8/90.0} = 112\frac{1}{2}\% \text{ Ans.}$$

QUESTION #30. What is meant by ratio? How are ratios expressed?

ANSWER #30. Division offers a means of comparing numbers. By it one may determine how many times as great one number is than another. The numbers compared must be like numbers. The quotient is always abstract. This quotient whether represented or computed is termed a ratio.

The ratio may be expressed by any of the signs of division, or by the colon. The numbers involved are called terms, the first term being the antecedent and the second the consequent. The value of the ratio is determined by performing the represented division.

QUESTION #31. What is the difference between a direct and an inverse ratio?

ANSWER #31. The direct ratio of a number is the ratio of the antecedent to the consequent. The inverse ratio is the ratio of the consequent to the antecedent. In a direct ratio the consequent is the divisor and in an inverse ratio the antecedent is the divisor.

Formula: $$\text{RATIO} = \frac{\text{ANTECEDENT}}{\text{CONSEQUENT}}$$

$$\text{ANTECEDENT} = \text{RATIO} \times \text{CONSEQUENT}$$

$$\text{CONSEQUENT} = \frac{\text{ANTECEDENT}}{\text{RATIO}}$$

QUESTION #32. What is the value of the direct and inverse ratio of: 9 to 81, 0.1 to 0.003, $\frac{1}{2}$ to $\frac{1}{4}$?

ANSWER #32. 9 to 81 $= \frac{9}{81} = \frac{1}{9} = .11\frac{1}{9}$ direct ratio. Ans.

81 to 9 $= \frac{81}{9} = 9.$ inverse ratio. Ans.

.1 to .003 $= \frac{33\frac{1}{3}}{.003/.100.} = 33\frac{1}{3}$ direct ratio. Ans.

ANSWER #32 (Continued). $.003$ to $.1 = \frac{1.}{0.03}$ .03 inverse ratio. Ans.

$\frac{1}{2}$ to $\frac{1}{4} = \frac{\frac{1}{2}}{\frac{1}{4}} = 2$ direct ratio. Ans.

$\frac{1}{4}$ to $\frac{1}{2} = \frac{\frac{1}{4}}{\frac{1}{2}} = \frac{1}{2}$ inverse ratio. Ans.

QUESTION # 33. What is meant by proportion?

ANSWER #33. A proportion is an equality of ratios. In a proportion the first and fourth terms are the extremes and the second and third are the means.
When solving a problem by proportion always use the fourth term for the unknown number and the third for the known number of the same kind. Determine whether the unknown should be smaller or larger than the number to which it is being compared. If the fourth term is larger than the third term, the second term should be larger than the first, and vice versa.

QUESTION #34. What is the rule for finding an unknown mean of a proportion, an unknown extreme?

ANSWER #34. To find an unknown mean, divide the product of the extremes by the known mean. To find an unknown extreme divide the product of the means by the known extreme.

QUESTION #35. What is meant by an inverse proportion?

ANSWER #35. An inverse proportion is a proportion in which one of the ratios varies inversely as the other. To change the direct proportion to an inverse proportion invert the divisor of one of the ratios.

QUESTION #36. What number is to 4 as 3 is to 6? 20 is to 24 as what number is to 30? 18 is to 32 as 45 is to what number?

ANSWER #36. $6 : 3 :: 4 : x \quad \frac{\overset{2}{\cancel{4}} \times \cancel{6}}{\cancel{6}\ \cancel{3}} = 2$ Ans.

$24 : 20 :: 30 : x \quad \frac{\overset{5}{\cancel{20}} \times \overset{5}{\cancel{30}}}{\cancel{24}\ \cancel{4}\ 1} = 25$ Ans.

$18 : 32 :: 45 : x \quad \frac{\overset{16}{\cancel{32}} \times \overset{5}{\cancel{45}}}{\cancel{18}\ \cancel{2}\ 1} = 80$ Ans.

QUESTION #37. Solve by proportion: If 25 men can finish a certain job in 30 days, how many days will be required by 35 men to do the same job?

ANSWER #37. $35 : 25 :: 30 : x \quad \frac{\cancel{25}^{5} \times 30}{\cancel{35}_{7}} = \frac{150}{7} = 21\frac{3}{7}$ days. Ans.

QUESTION #38. Give a brief explanation of the powers of ten and their uses.

ANSWER #38. It is sometimes necessary, when making calculations, especially when using extremely large or small numbers, to change the numbers to the lowest whole number times some power of ten. This is done to eliminate lengthy calculations. Any positive number, whether integer or decimal fraction, can be expressed in terms of units times power of ten. The rule for changing a number to the lowest whole number times some power of ten is as follows: Move the decimal point to the right or left until one significant figure is on the left of the decimal point. Write the significant figures with the newly placed decimal point and write "x10" or "•10" after the number. The exponent of 10 will be equivalent to the number of places the decimal point was moved. If moved to the left it will be positive. If moved to the right it will be negative. The exponents of 10 follow the laws of exponents, making it possible to multiply, divide, and find powers and roots. The laws of exponents are: To multiply, add, algebraically, the exponents; to divide, subtract, algebraically, the exponent of the divisor from the exponent of the dividend; to find the power, multiply, algebraically, the exponent of the number by the power to which the number is to be raised; to find the root, divide, algebraically, the exponent of the number by the index of the required root.

QUESTION #39. Write a table of the basic powers of ten.

ANSWER #39.

10,000,000,000	equals	10^{10}
1,000,000,000	equals	10^{9}
100,000,000	equals	10^{8}
10,000,000	equals	10^{7}
1,000,000	equals	10^{6}
100,000	equals	10^{5}
10,000	equals	10^{4}
1,000	equals	10^{3}
100	equals	10^{2}
10	equals	10^{1}
1	equals	10^{0}
.1	equals	10^{-1}
.01	equals	10^{-2}
.001	equals	10^{-3}
.0001	equals	10^{-4}
.00001	equals	10^{-5}
.000001	equals	10^{-6}
.0000001	equals	10^{-7}
.00000001	equals	10^{-8}
.000000001	equals	10^{-9}
.0000000001	equals	10^{-10}

QUESTION #40. Express the following numbers to the lowest whole number times power of ten: 37,569, 39.8754, 0.000493

ANSWER #40. $3.7569 \cdot 10^{4}$ Ans. $3.98754 \cdot 10^{1}$ Ans. $4.93 \cdot 10^{-4}$ Ans.

QUESTION #41. Change the following numbers to the lowest whole number times power of ten and multiply, expressing the answer in lowest whole number times power of ten: 8000 x 950000, 0.0034 x 765000, 0.000075 x .3 x 6000.

ANSWER #41. $8 \cdot 10^{3} \times 9.5 \cdot 10^{5} = 76 \cdot 10^{8} = 7.6 \cdot 10^{9}$ Ans.

$3.4 \cdot 10^{-3} \times 7.65 \cdot 10^{5} = 26.01 \cdot 10^{2} = 2.601 \cdot 10^{3}$ Ans.

$7.5 \cdot 10^{-5} \times 3 \cdot 10^{-1} \times 6 \cdot 10^{3} = 135 \cdot 10^{-3} = 1.35 \cdot 10^{-1}$ Ans.

QUESTION #42. Change the following numbers to the lowest whole number times power of ten and divide, expressing the answer in lowest whole number times power of ten: 10^{8} by 10^{3}, 6000 by 0.065

ANSWER #42. $\frac{10^{8}}{10^{3}} = 1 \cdot 10^{5} = 10^{5}$ Ans.

$\frac{6000}{0.065} = \frac{6 \cdot 10^{3}}{6.5 \cdot 10^{-2}} = .923076+ \cdot 10^{5} = 9.23077 \cdot 10^{4}$ Ans.

QUESTION #43. Change the following numbers to the lowest whole number times power of ten and solve, expressing the answer in lowest whole number times power of ten: 6000 x 95000 x 0.00350 divided by 80000 x 0.750 x 800000.

ANSWER #43.

$$\frac{6 \cdot 10^{3} \times 9.5 \cdot 10^{4} \times 3.5 \cdot 10^{-3}}{8 \cdot 10^{4} \times 7.5 \cdot 10^{-1} \times 8 \cdot 10^{3}} = \frac{1.33 \cdot 10^{4}}{3.2 \cdot 10^{8}} =$$

$.415625 \cdot 10^{-4} = 4.15625 \cdot 10^{-5}$ Ans.

QUESTION #44. Draw TB Transmitter.

ANSWER #44. See drawing on separate sheet.