INSTRUCTIONAL GAMES AS DEVICES TO IMPROVE ATTITUDE AND ACHIEVEMENT IN SECONDARY MATHEMATICS

by

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CHAPTER ONE

THE NATURE AND SCOPE OF THE STUDY

Introduction

Students of general mathematics are seldom motivated toward high academic performance (Bachman, 1971). Stafford (1972) has indicated that this low level of motivation is due, in part, to parental attitudes toward scholastic achievement, and partly to early failures in scholastic undertakings. The author has noted the excessive frustration and distaste experienced by secondary students during a one year study of required mathematics.

Weiss (1973) reported that disadvantaged students perform better in a mathematics class which is taught informally. Bachman (1971) stressed that low-motivated, as well as low-achieving pupils need active in-class participation and problems of a confidence-building nature.

Edwards (1974) has demonstrated that the use of non-simulation mathematical games contributes many of the factors necessary to the improvement of general mathematics classes. He suggests that games stimulate interpersonal interaction, decrease perceived difficulty, and increase student satisfaction toward the mathematics course. Many

investigators have reported that games are effective in increasing both favorable attitudes toward mathematics classes and achievement in mathematics (Jones, 1968; Livingstone, 1972; Edwards, 1974).

Although the literature suggests that an attempt to employ classroom gaming would prove beneficial, it appears as though few teachers of mathematics have yet done so. In a survey taken in the Kern High School District, while 61 per cent of the students surveyed indicated that they would enjoy instructional games, only 14 per cent responded that they had ever experienced the use of such games in mathematics classes (Thoene, 1974).

The problems under investigation in this study are as follows:

1. What is the correlation between attitude and achievement among students of general mathematics?

2. Does the use of non-simulation games significantly improve mathematics achievement in general mathematics classes?

3. Does the use of non-simulation games significantly improve the attitudes of students of general mathematics classes toward mathematics?

Review of the Literature

Bachman (1971) reported that gaming in mathematics classes lowered absenteeism and produced more student smiling in class, both of which he cited as evidence of improved affective response. Jones (1968) found an eight-fold improvement in the attitudes of students in classes using games over those in a traditional setting. Edwards (1974) reported a significant improvement in attitude in classes using games at the junior high school level ($p < .05$). Finally, Aiken (1970) reported that gaming significantly improved the attitudes of students in secondary-level remedial mathematics classes.

On the other hand, Aiken (1972) suggested that some games show little benefit or even a negative effect on attitudes, and Fink (1972) supports this statement in regard to culturally disadvantaged elementary students. Furthermore, Yasui (1967) supplied the information that there appeared to be no significant difference in attitude improvement between secondary students taught in traditional settings as opposed to those in modern mathematics classes (incorporating the use of games).

With regard to achievement in general mathematics classes using instructional games, significant improvement has been reported by Hestwood (1973) and by Livingstone (1972). Several studies conducted by Edwards (1972, 1974) have indicated that junior-high level achievement in mathematics is significantly improved ($p < .01$) by the thrice weekly use of the game Equations. Further investigation by Edwards (1974)

has suggested that this improvement in achievement is chiefly in computational skills ($p < .0001$), and not in the students' abilities to produce divergent solutions.

Several researchers found results differing from the above cited findings. Carlson (1969) found no significant difference between gaming and traditional classes. In addition, he pointed out that gaming aided neither critical thinking nor attitudes. Tansey (1969) felt that gaming is valuable in that it frees the instructor from being both critic and judge, but may be harmful to students by encouraging cheating.

The correlation between attitude and achievement in mathematics has been investigated by many researchers, and their findings vary widely. Weiss (1973) stated that, "A child's attitudes affect what he learns." Lyda (1963) supported this view, indicating that, "...associated with changed attitudes are significant gains in arithmetic achievement." Aiken (1972) reported a significant correlation between attitude and achievement at all levels of mathematics, but suggested further that attitude may predict perseverance more accurately than achievement. Shepps (1971) recorded a correlation between attitude and achievement at the sixth grade level of .29, while Bassham (1964) reported a moderate to high correlation among eighth grade students of mathematics.

In discussing the reasons for the wide variety of reported findings, one could reference Thorndike (1955) who stated that while the Likkert summed-score method of attitude measurement is fairly reliable ($r = .80$'s), the responses

may be easily faked. Clarifying this yet further is Dutton (1956), who stated that, "Pupils tend to overrate themselves on their general feelings toward arithmetic, when left to use self-appraisal methods."

Statement of the Hypotheses

The following major hypothesis is submitted as reflective of the need to further investigate the use of games in general mathematics classes:

> The use of games in place of traditional drill in general mathematics classes will not significantly improve both student achievement in, and attitude towards, mathematics.

Subordinate to this major hypothesis are the following secondary hypotheses:

> H-1 The use of games as a substitute for drill will not significantly improve the achievement test scores of students of general mathematics over such pupils in a traditional classroom setting.
>
> H-2 The use of games as a substitute for drill will not significantly improve the attitudes toward mathematics of students of general mathematics over such pupils in a traditional setting.

The $p < .05$ level of significance was chosen as appropriate for this study since it is liberal enough to accomodate a small sample size, yet restrictive enough to reduce the possibility of a Type I error.

This study will also include an analysis of the correlation between attitude and achievement. Such a correlation will not be treated as a null hypothesis, but the statistical procedure will indicate whether the resultant correlation coefficient is significant or not.

Operational Definitions

The following definitions will be used in this study for the terms listed below:

1. Attitude: "A predisposition to respond to certain objects, conditions or events either positively, negatively or neutrally. Classroom attitudes are dimensions of motivation directly related to the learning process." (Callahan, 1971)

2. Achievement: The level of cognitive ability attained in regard to instruction in general mathematics, as shown by the number of correct responses to standardized test items.

3. Games: "Learning games are activity structures in which players use a body of knowledge as a resource in competition with other players to achieve a stated goal." (Edwards, 1972) "Something enjoyable, however serious, involving competition for specified objectives, and observing rules." (Deighton, 1971)

4. Traditional class: A classroom procedure characterized by fifteen to twenty minutes of lecture, followed by five minutes of examples, and concluded by twenty minutes of study time or drill.

5. Achievement test: The Kern High School District's Minimum Mathematics Competency Test (Alternate Form), consisting of 58 multiple-choice items.

6. Attitude test: A survey instrument constructed according to Likkert's summed rating method, and yielding scores showing a positive attitude toward mathematics ranging from a low of 22 to 110.

7. Games class: A general mathematics class employing the use of instructional games in place of study-time or drill.

Significance of the Study

This study will endeavor to provide supportive evidence as to whether gaming is or is not an effective method of instructing general mathematics classes. Furthermore, this study will attempt to examine the relationship between attitude and achievement in general mathematics classes. Finally, this study will endeavor to provoke instructors of general mathematics to employ instructional gaming in their classrooms as a means of interesting and involving low-motivated and low-achieving students.

CHAPTER TWO

METHODS OF THE STUDY

Primary Concerns

Because this study addressed itself to an investigation of the relationships between achievement and gaming, attitude and gaming, and to the correlation between attitude and achievement, the experiment sought evidence relative to the following questions:

1. Is there a significant difference between the achievement scores of a games class as opposed to a traditional class?
2. Is there a significant difference between the attitude scores of a games class as opposed to a traditional class?
3. What is the correlation between attitude and achievement?

The Design

The sample chosen for the study consisted of two classes of general mathematics being taught by the researcher. The administrative necessities of keeping the classes intact precluded any possibility of randomly assigning the class members.

One of the classes was randomly designated Games and the other Traditional. The following instructional sequence then occurred:

1. Games: The Games group received fifteen to twenty minutes of lecture on each day's topic, followed by examples. This group was then involved in one or more of the instructional games listed below under Resources.

2. Traditional: The Traditional group received carefully controlled lectures that resembled as much as possible that instruction given to the Games group. The same examples were utilized. The Traditional group then engaged in a period of drill for the remainder of the period, working the same items used in the Games format. Students were allowed to work singly or in small groups, as they wished.

Both groups had access to the correct answers. The Games group received the correct responses as part of the game, while the Traditional group was allowed free use of the teacher's edition of the textbook.

Duration

This study commenced with the pretesting of both groups for attitude and achievement in general mathematics. The classes then received instruction as per the Design, for a three month period. During this time, both groups studied operations involving decimal fractions, per cent problems, and problems involving units of measurement.

At the conclusion of the experiment, both groups were again tested to provide both attitude and achievement scores.

Resources

The following resources were used in the conduct of this study:

1. Achievement test: The achievement test employed in this study was the Kern High School District's Minimum Mathematics Competency Test (Alternate Form). It consists of 58 multiple-choice items covering the required objectives for a one semester general mathematics course. No statistics are available regarding either validity or reliability. (A copy is appended).

2. Attitude test: The attitude instrument used in this study was a questionnaire consisting of 22 statements expressing either favorable or unfavorable attitudes toward mathematics. Although patterned after some already extant devices, none of them seemed appropriate; therefore this instrument was specifically designed for the study by the author. To each statement the student may strongly agree, agree, be undecided, disagree or strongly disagree. Statements favorable to mathematics are scored five points for strongly agreeing four points for agreeing and so on. Statements which reflect an unfavorable attitude toward mathematics are scored in the reverse order. The summed score allows a rating of favorable attitudes ranging from 22 to 110. Although no reliability or validity statistics are available, Thorndike (1955) indicates reliability on similarly constructed tests to exist in the .80's. (A copy is appended).

3. Textbook: The textbook used during this study was Stein's Fundamentals of Mathematics. It was used primarily as a source of problems.

4. Games: The games used in this study included a variety of already published items, as well as a few author-prepared forms. Specifically, the games used included:

   Math Rummy--A game played with three by five cards, in groups of ten players. Each player tries to collect a set of three cards representing equivalent fractions (such as 1/2, 2/4, 3/6) and to discard any which do not fit the set. When an individual has a set, he grabs a piece of chalk from the middle of the ring of players. All other players must now grab a piece of chalk, thus eliminating one player, because for n players there are n-1 pieces of chalk. After each play, one piece of chalk is removed, continuing until only one player remains. (Brown, 1973)

   Multo--A game similar to Bingo in which the teacher states an operation (such as 1/4 X 2/3) and each student tries to mark off the appropriate answer on his sheet. The first player to complete a straight line on a three by three array wins. (Kerr, 1974)

   Math Bowl--A team game in which students are grouped in teams of four players. The teacher poses a problem which the teams attempt to answer. The first team answering correctly scores 5, 10 or 15 points depending on the difficulty of the question. The team with the highest score at the end of the period wins.

   Math Baseball--The class is divided into two teams. One team is at bat, while the other is out in field. Each player comes up individually and elects to try a problem varying from a one base to a home run, with difficulty varied accordingly. If he answers correctly he goes to a designated location in the room. Should he answer incorrectly, the opposing team has one opportunity to

answer, and if correct the batter is out. Should they be incorrect, the batter is allowed one more question, and if he again fails to answer correctly, he is considered struck out. Two outs retires a side, and play continues until time is up. Runs are scored as in baseball, and the higher score at game's end wins.

Math Relays--A team game in which the class is divided into three teams. Each team sends one player to the chalkboard at a time, where all three attempt to work the same problem for both accuracy and speed. One point is allotted to the team whose member is the first finished with the correct answer. Play continues until time is up, and the team with the highest point total wins.

Statistical Procedures

The analysis of achievement and attitude scores in this study came from a design recommended by Campbell (1966) for use in experiments involving intact classes, called the Non-Equivalent Control Group Design (see Figure 2.1).

Figure 2.1 Non-Equivalent Control Group Design (Campbell, 1966)

PRETEST	→	TREATMENT (Control)	→	POSTTEST
PRETEST	→	TREATMENT (Experiment)	→	POSTTEST

The above design was utilized in handling both the attitude and achievement scores. The pretest scores were

analysed via an analysis of variance and since no significant differences were found, an analysis of variance of the post-test scores was implemented. The rejection level regarding the null hypotheses was established at the $p < .05$ level of significance. Finally, the correlation between attitude and achievement was examined by means of a Pearson Product-Moment Correlation.

CHAPTER THREE

DATA ANALYSIS

Introduction

This chapter presents the data that were collected and analysed to test the hypotheses discussed in Chapter One. Also included in this chapter are the reports of the analyses of the data for interpretation of the findings.

Descriptive Statistics of Pre and Post Test Group Means

Table 3.1 reports the means obtained for both Control and Experimental groups during pre and post tests of both attitude and achievement. Also included are the corresponding standard deviations for those same tests.

The statistics revealed a pretest mean of 33.0 for achievement, a pretest mean of 71.11 for attitude, and post-test means of 43.0 and 69.47 for achievement and attitude respectively, in the experimental group. Furthermore, the statistics indicated a pretest mean of 35.24 for achievement, a pretest mean of 72.20 for attitude, and posttest means of 39.96 and 70.04 for achievement and attitude, respectively in the control group.

Additionally, the statistics indicated a pretest standard deviation for achievement of 8.79, for attitude of 17.43, and posttest standard deviations of 7.33 and 19.28 for achievement and attitude respectively, in the experimental group. Regarding the control group, the pretest standard deviations were 10.63 for achievement and 14.80 for attitude, while the posttest scores revealed standard deviations of 9.39 and 13.48 for achievement and attitude, respectively.

Table 3.1 Means and Standard Deviations of Pretest and Posttest Scores of Attitude and Achievement in Experimental and Control Groups

	Experimental (N=19)		Control (N=25)	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Achievement				
Pretest	33.00	8.79	35.24	10.63
Posttest	43.00	7.33	39.96	9.39
Attitude				
Pretest	71.11	17.43	72.20	14.80
Posttest	69.47	19.28	70.04	13.48

Analysis of Variance

The first method of analysis was an analysis of variance performed to compare the pretest group mean attitude and achievement scores. As indicated by Table 3.2, the analysis of variance yielded an F-ratio of 0.53 for achievement and an F-ratio of 0.048 for pretest attitude scores. Neither of these ratios are significant at the $p < .05$ level. This result was as desired because this analysis was performed before any treatment had taken place.

Table 3.2 Comparison of Variance of Test and Control Group Means for Pretest Attitude and Achievement

	M.S.	D.F.	F	$p < .05$
Achievement	101.09	43	0.53	N.S. *
Attitude	264.85	43	0.048	N.S. *

*Not Significant

An analysis of variance was also performed on the post-test attitude and achievement scores. As indicated by Table 3.3, the F-ratio for achievement is noted to be 1.299, and for attitude to be 0.013. No significant differences at the $p < .05$ level are shown to exist. The statistics support the null hypotheses as stated in Chapter One.

Table 3.3 Comparison of Variance of Test and Control Group Means for Posttest Attitude and Achievement

	M.S.	D.F.	F	$p < .05$
Achievement	77.32	43	1.299	N.S. *
Attitude	270.03	43	0.013	N.S. *

*Not Significant

Correlational Studies

In addition to the analyses of variance, a Pearson Product-Moment Correlation was performed relating attitude and achievement scores on both pre and posttests, for both groups. As reported in Table 3.4, no significant level of correlation was indicated for neither the experimental group pretest nor the control group posttest. The correlation coefficient for the pretest scores of the control group was 0.434. This was significant at the .05 level of significance for 23 degrees of freedom. Additionally, the coefficient of correlation for the posttest scores of the experimental group was 0.538, also attaining the .05 level of significance for 17 degrees of freedom.

Table 3.4 Pearson Product-Moment Correlation Coefficients between Attitude and Achievement Pre and Posttest Scores for both Groups.

	Experimental			Control		
	D.F.	r	p	D.F.	r	p
Pretest	17	0.395	N.S.	23	0.434	.05
Posttest	17	0.538	.05	23	0.339	N.S.

Summary

In summary, the evidence compiled by the use of the analyses of variance yielded no between-groups differences which reached the $p<.05$ level of significance. The Pearson Product-Moment Correlation coefficients indicated significance at the .05 level for both the pretest control group scores and the posttest experimental group scores.

CHAPTER FOUR

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Basic Purpose of the Study

The basic purpose of the study was to ascertain the relationship, if any, between attitude toward, and achievement in secondary general mathematics, and to examine the effects of gaming as an instructional technique on the two aforementioned variables. A Pearson Product-Moment Correlation was used to determine the relationship between attitude and achievement. An analysis of variance was utilized to test the significance of the differences between the experimental group and the control group.

Both groups were pretested in October, 1974, using the Kern High School District's Minimum Mathematics Competency Test to measure achievement. Coincident with the administration of the achievement test was the use of an author-constructed survey to measure attitudes.

The two classes were both general secondary mathematics classes being taught by the researcher. During the period from October, 1974, to January, 1975, both groups were instructed in the areas of decimal fractions, per cent problems, and units of measurement. The experimental group used various mathematical games as a substitute exercise for

the drill arranged for the control group, with other between group variables kept to a minimum.

Following the three month period of instruction, the two groups were posttested with the same two instruments. The data were collected and the null hypotheses tested for significance at the $p < .05$ level.

Limitations of the Study

Conclusions drawn from this study should be examined in the light of the following limitations:

The sample was limited to one high school, and to intact classes within that school. These classes, while similarly containing low-achieving, low-motivated Anglo and Chicano students of general mathematics, were in no sense matched or randomized. Due to these factors, generalizations of this study should be restricted to similar instances of course content and student population.

The period of treatment was short. Therefore, generalizations to longer periods of time might not result in comparable statistical conclusions.

As regards the correlational portion of the study, the sample sizes were extremely small, so caution should be exercised when generalizing.

The attitude survey employed in this study is linked with no reliability or validity data. Additionally, Thorndike (1955) has suggested that students, even when encouraged to

answer forthrightly, still disguise their true feelings in the belief that an inappropriate response might be detrimental to their grades or class-standing. Thus the accuracy with which the attitude survey actually measures attitudes could be possibly suspect, and data interpretation therefrom should be handled carefully.

Conclusions

Considering the hypotheses presented in Chapter One and the Statistical data recorded in Chapter Three, the researcher drew the following conclusions relative to the hypotheses:

H-1 The use of games as a substitute for drill will not significantly improve the achievement scores of students of general mathematics over such students in a traditional classroom setting.

Conclusion: Test score analysis of both experimental and control group performance on the Kern High School District's Minimum Mathematics Competency Test did not indicate a significant difference between the two groups.

H-2 The use of games as a substitute for drill will not significantly improve the attitudes of students of general secondary mathematics toward mathematics over such students in a traditional setting.

Conclusion: Test score analysis of both experimental and control group performance on the author-produced attitude survey indicated no significant between-groups difference.

Additionally, this project examined the correlation between attitude and achievement in general secondary mathematics. The conclusion is as follows:

> Conclusion: Both the pretest control group scores and the posttest experimental group scores demonstrate correlation coefficients at the .05 level of significance. The other two coefficients do not indicate a significant level of correlation. This seeming exchange of positions tends to disguise whatever significance might exist in the findings, and tends to confuse any generalizations therefrom. Accordingly, no conclusion as to the significance of the correlation between attitude and achievement in general secondary mathematics is offered.

Recommendations for Future Studies

The investigator suggests that the following recommendations be carefully considered when dealing with future studies of gaming as an instructional technique, or of the correlation between attitude and achievement in general secondary mathematics:

1. A revised, or wholly different method of evaluating student attitudes is desirable. There is much discrepancy between the apparent affective response from students in class and that level which appeared on the survey used in this study.

2. A longer treatment time should be used. At least one entire semester is recommended, but statistical differences could be more accurately predicted

after one school year's treatment, in order to diminish the Hawthorne or novelty effect.

3. Randomization of the samples would be desirable, if one could escape the administrative difficulties of breaking up intact classes. Parallel to this recommendation is a simple one for larger sample sizes.

Implications

This study seemed to suggest the following evidence relative to the questions asked in Chapter Two:

1. Is there a significant difference between the achievement scores of a class using gaming as opposed to a traditional class?

Evidence: Students in a class employing gaming will neither gain nor lose significantly in achievement level in general secondary mathematics as compared with a traditional class.

2. Is there a significant difference between the attitude scores of a class using gaming as opposed to a traditional class?

Evidence: Students in a class employing gaming will neither improve nor deteriorate significantly in attitudes toward mathematics as compared with a traditional class.

3. Is there a significant correlation between attitude and achievement in general secondary mathematics?

Evidence: There is a low-to-moderate correlation between attitude and achievement in general secondary mathematics, which borders on being significant at the .05 level.

Concluding Statement

While the analysis of variance statistical procedure sustained the null hypotheses as presented in this study, that result can itself be regarded as germane to the use of gaming as an instructional technique in general secondary mathematics. It is apparent that while gaming cannot be said to be more effective than traditional lecture-and-drill, it is, on the basis of this study, no less valuable a strategy. One cannot help but view as desirable a device which stimulates class participation in a heretofore teacher-dominated environment, inasmuch as it is not detrimental to either attitude or achievement. The inconclusive nature of the correlational portion of this study merely stresses again the necessity for further examination of the relationship between attitude and achievement, and specifically for improved methods of evaluating attitudes.

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APPENDICES

FORM A

KHSD

TEST OF MATHEMATICS ACHIEVEMENT

KERN HIGH SCHOOL DISTRICT
BAKERSFIELD, CALIFORNIA

INSTRUCTIONS

1. This test is to measure your knowledge of basic mathematics.
2. Work each problem on a separate piece of scratch paper, then choose the answer from the four given. Blacken the space under its letter on the answer card.
3. There is no time limit, but work as fast as you can.
4. If you cannot work a problem, leave the answer card blank for that problem.
5. If you change an answer, be sure to erase completely.

DIRECTIONS

Work each problem on a separate piece of paper. Choose the correct answer from the four given to the right of the problem. Mark the corresponding letter of the correct answer on the answer card provided. Look at the sample below.

Sample: Add

3 + 4

a. 5
b. 6
c. 7
d. 8

Answer Sheet

a b c d

"C" has been marked on your answer card.

↓ READ DOWN

DO NOT MARK ON THIS TEST

1. The 5 in the number 4,953 has a value of ___?___.

a. 5
b. 50
c. 500
d. 5,000

2. The 2 in the number 5,247 has a value of ___?___.

a. 2
b. 20
c. 200
d. 2,000

3. Add

4 + 17 + 390 + 96

a. 407
b. 497
c. 507
d. 508

4. Add

4,632 + 89 + 796 + 9,203

a. 13,720
b. 14,620
c. 14,719
d. 14,720

5. Subtract

$$\begin{array}{r} 4{,}730 \\ -1{,}604 \\ \hline \end{array}$$

a. 3,026
b. 3,126
c. 3,134
d. 3,136

6. Subtract

$$\begin{array}{r} 6{,}304 \\ -1{,}368 \\ \hline \end{array}$$

a. 4,936
b. 4,946
c. 5,936
d. 5,046

7. Multiply

$$\begin{array}{r} 5{,}132 \\ \times\ 346 \\ \hline \end{array}$$

a. 1,774,672
b. 1,775,572
c. 1,775,662
d. 1,775,672

8. Multiply

$$\begin{array}{r} 4{,}078 \\ \times\ 809 \\ \hline \end{array}$$

a. 362,942
b. 3,239,102
c. 3,299,092
d. 3,299,102

9. Divide

$23\overline{)28{,}405}$

a. 1,230 R22
b. 1,234 R 1
c. 1,235
d. 12,340

10. Divide

$74\overline{)67{,}207}$

a. 98 R15
b. 907
c. 908 R15
d. 918

11. Reduce to lowest terms.

$\frac{4}{12} = ?$

a. $\frac{2}{6}$ c. $\frac{1}{2}$
b. $\frac{1}{3}$ d. $\frac{2}{3}$

12. Reduce to lowest terms.

$\frac{6}{15} = ?$

a. $\frac{2}{5}$ c. $\frac{2}{3}$
b. $\frac{3}{5}$ d. $\frac{5}{2}$

13. Change to an improper fraction.

$1\frac{1}{3} = ?$

a. $\frac{3}{4}$ c. $\frac{4}{3}$
b. $\frac{3}{3}$ d. $\frac{5}{3}$

14. Change to an improper fraction.

$5\ \frac{7}{8} = ?$

a. $\frac{12}{8}$ c. $\frac{35}{8}$
b. $\frac{20}{8}$ d. $\frac{47}{8}$

15. Change to a mixed number.

$\frac{3}{2} = ?$

a. $\frac{2}{3}$ c. $1\frac{1}{2}$
b. $1\ \frac{1}{3}$ d. $1\ \frac{5}{2}$

16. Change to a mixed number.

$\frac{80}{7} = ?$

a. $\frac{7}{80}$ c. $11\ \frac{3}{7}$
b. $9\ \frac{8}{7}$ d. $12\ \frac{4}{8}$

17. Change to a decimal equivalent to three places.

$\frac{3}{5}$

a. .125
b. .375
c. .500
d. .600

18. Change to a decimal equivalent to three places.

$\frac{9}{4} = ?$

a. 1.500
b. 2.125
c. 2.250
d. 4.444

19. Change to a common fraction.

.25 = ?

a. $\frac{1}{4}$ c. $\frac{3}{4}$
b. $\frac{1}{2}$ d. $1\frac{1}{2}$

20. Change to a common fraction.

.62 = ?

a. $\frac{31}{100}$ c. $\frac{62}{50}$
b. $\frac{31}{50}$ d. $6\ \frac{1}{5}$

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DO NOT MARK ON THIS TEST

21. Add

$$\begin{array}{r} \frac{3}{4} \\ +\frac{3}{4} \\ \hline \end{array}$$

a. $\frac{3}{8}$ c. $\frac{3}{4}$
b. $\frac{9}{16}$ d. $1\frac{1}{2}$

22. Subtract

$$\begin{array}{r} \frac{5}{8} \\ -\frac{2}{8} \\ \hline \end{array}$$

a. $\frac{3}{64}$ c. $\frac{3}{8}$
b. $\frac{3}{16}$ d. $\frac{3}{0}$

23. Add

$$\begin{array}{r} \frac{3}{5} \\ +\frac{1}{2} \\ \hline \end{array}$$

a. $\frac{3}{10}$ c. $\frac{4}{7}$
b. $\frac{2}{5}$ d. $1\frac{1}{10}$

24. Add

$$\begin{array}{r} 1\frac{3}{4} \\ +5\frac{1}{2} \\ \hline \end{array}$$

a. $6\frac{1}{4}$ c. $7\frac{1}{4}$
b. $6\frac{1}{2}$ d. $7\frac{3}{8}$

25. Subtract

$$\begin{array}{r} \frac{4}{5} \\ -\frac{1}{3} \\ \hline \end{array}$$

a. $\frac{3}{15}$ c. $\frac{7}{15}$
b. $\frac{3}{8}$ d. $\frac{3}{2}$

26. Subtract

$$\begin{array}{r} 4\frac{2}{3} \\ -1\frac{3}{4} \\ \hline \end{array}$$

a. $2\frac{3}{4}$ c. $2\frac{11}{12}$
b. $2\frac{6}{7}$ d. $3\frac{1}{12}$

27. Multiply

$\frac{2}{3} \times \frac{1}{2}$

a. $\frac{1}{3}$ c. $\frac{1}{2}$
b. $\frac{2}{5}$ d. $\frac{3}{5}$

28. Multiply

$1\frac{1}{2} \times 3\frac{2}{3}$

a. $5\frac{1}{2}$ c. 6
b. $5\frac{2}{3}$ d. $6\frac{1}{3}$

29. Divide

$\frac{3}{8} \div \frac{5}{6}$

a. $\frac{5}{16}$ c. $\frac{8}{14}$
b. $\frac{9}{20}$ d. $2\frac{2}{9}$

30. Divide

$2\frac{2}{3} \div 5\frac{1}{6}$

a. $\frac{9}{124}$ c. $\frac{16}{31}$
b. $\frac{5}{11}$ d. $10\frac{1}{9}$

31. Add

79.61 + 2.3 + .428

a. .08412
b. 81.338
c. 82.338
d. 84.12

32. Add

$$\begin{array}{r} 8.437 \\ 9.82 \\ +\ 17.6 \\ \hline \end{array}$$

a. 25.857
b. 34.857
c. 35.757
d. 35.857

33. Subtract

$$\begin{array}{r} 15.80 \\ -\ 7.93 \\ \hline \end{array}$$

a. .0787
b. 7.87
c. 8.87
d. 8.93

34. Subtract

186.4 − 4.86

a. 1.378
b. 1.8154
c. 181.54
d. 181.66

35. Multiply

$$\begin{array}{r} 21.3 \\ \times\ 4.05 \\ \hline \end{array}$$

a. 9.585
b. 86.265
c. 862.65
d. 8626.5

36. Multiply

$$\begin{array}{r} .986 \\ \times\ 74.5 \\ \hline \end{array}$$

a. 73.457
b. 73.557
c. 724.57
d. 734.57

37. Divide

$14\overline{)18.48}$

a. .132
b. 1.32
c. 13.2 R 4
d. 132

38. Divide

$57\overline{).9633}$

a. .0153
b. .0169
c. .153
d. .169

39. Round off to the nearest cent.

$49.326

a. $49.00
b. $49.30
c. $49.32
d. $49.33

40. Round off to the nearest tenth.

3.249

a. 3.2
b. 3.24
c. 3.25
d. 3.3

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41. Change to a percent.

.35

a. .35%
b. 3.5%
c. 35%
d. 350%

42. Change to a percent.

$\frac{3}{5}$

a. $\frac{3}{5}$%
b. 6%
c. 40%
d. 60%

43. Change to a decimal.

79%

a. .079
b. .79
c. 7.9
d. 79

44. Change to a fraction.

30%

a. $\frac{3}{100}$
b. $\frac{30}{99}$
c. $\frac{3}{10}$
d. $\frac{3}{4}$

45. What is 40% of 20?

a. 8
b. 10
c. 16
d. 80

46. Eight is what percent of 20?

a. 4%
b. 25%
c. 33%
d. 40%

47. What is the simple interest on $400 at 7% for 3 years

a. $ 8.40
b. $12.00
c. $28.00
d. $84.00

48. What is the simple interest on $756 at 5½% for 6 months ?

a. $20.79
b. $27.50
c. $41.58
d. $83.16

49. Compute the sales tax.

Purchase: $20.00
Tax rate: 5%

a. $ .10
b. $ 1.00
c. $ 2.00
d. $10.00

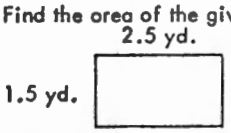
50. What is the sales tax on a $13.94 purchase if the tax rate is 4½% ?

a. $ .56
b. $ .63
c. $1.63
d. $6.27

51. What is the area of a rectangle if its length is 12 inches and its width is 14 inches?

a. 26 sq. in.
b. 52 sq. in.
c. 168 in.
d. 168 sq. in.

52. Find the area of the given rectangle.



a. 3.75 sq. yd.
b. 4.0 sq. yd.
c. 8.0 sq. yd.
d. 37.5 sq. yd.

53. What is the change from a $20 bill for a purchase of $11.87 ?

a. $7.23
b. $8.13
c. $8.23
d. $9.13

54. How much change should the customer receive?

Purchase: $23.69
Paid: $50.00

a. $26.31
b. $26.41
c. $27.31
d. $27.41

55. Add

3 yds. 2 ft. 8 in.
+ 2 yds. 1 ft. 10 in.

a. 5 yds. 1 ft. 6 in.
b. 6 yds. 6 in.
c. 6 yds. 8 in.
d. 6 yds. 1 ft. 6 in.

56. Subtract

3 gal. 1 qt. 1 pt.
− 1 gal. 2 qt. 2 pt.

a. 2 gal. 1 pt.
b. 1 gal. 2 qt. 3 pt.
c. 1 gal. 2 qt. 1 pt.
d. 1 gal. 1 qt. 1 pt.

57. Multiply

14 lb. 7 oz.
x 3

a. 15 lb. 5 oz.
b. 43 lb. 5 oz.
c. 43 lb. 21 oz.
d. 44 lb. 1 oz.

58. Divide

2)3 yds. 1 ft.

a. 2 ft.
b. 1 yd. 1 ft.
c. 1 yd. 2 ft.
d. 2 yd.