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A Study to Determine the Effectiveness  
of Various Factors in the Reduction  
of Mathematics Anxiety

by  
Mindy S. Hutter

A Thesis

Submitted in partial fulfillment of the requirements of the  
Master of Arts Degree in the Graduate Division  
of Rowan College in Mathematics Education  
1995

Approved by

John Soof

Date Approved 5/1/95

## ABSTRACT

Mindy S. Hutter, A study to determine the effectiveness of various factors in the reduction of mathematics anxiety, 1995, Thesis Adviser: J. Sooy, Mathematics Education.

The purpose of this study was to determine if increasing the amount of problem solving, journal writing, group work, and praise would decrease the level of mathematics anxiety experienced by eighth grade students. The forty-seven students involved included twenty-one average to below average students and twenty-six average to above average students. Both groups were pretested and posttested using the Mathematics Anxiety Rating Scale - A. During a six week period, class time contained a high concentration of problem solving, journal writing, group work, and praise. A dependent t test was used to analyze the results.

The conclusions showed a significant decrease in the level of mathematics anxiety experienced by the average to above average students at the 0.01 level. There was no significant difference between the pretest and posttest scores of the average to below average group at the 0.05 level.

## MINI-ABSTRACT

Mindy S. Huttrer, A study to determine the effectiveness of various factors in the reduction of mathematics anxiety, 1995, Thesis Adviser: J. Sooy, Mathematics Education.

The purpose of this study was to determine if increasing the amount of problem solving, journal writing, group work, and praise would decrease the level of mathematics anxiety experienced by eighth grade students. In the group with average to below average students, there was no significant decrease in mathematics anxiety. In the group with average to above average students, the level of mathematics anxiety dropped significantly.

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## CHAPTER I

### Introduction to the Study

#### Introduction

According to Sheila Tobias (1993), an expert in mathematics anxiety, the fear of mathematics is often covering for resentment, starting when a person was first embarrassed or intimidated in mathematics class. Other suggested sources include: time pressure, humiliation, emphasis on the right answer, and working in isolation (Tobias, 1981). Although mathematics anxiety is not related to general intelligence (Morris, 1981; Skiba, 1990), there is a general agreement that mathematics anxiety is harmful to mathematics achievement. Clearly, a student's attitude, not just ability, is crucial in determining failure or success (Digilio, 1987).

Many studies have been aimed at alleviating mathematics anxiety at the college level. However, students in early adolescence report an increase in the level of mathematics anxiety (Meece, Wigfield, & Eccles, 1990). It is essential to develop, test, and implement effective strategies to relieve mathematics anxiety in eighth grade students before it reaches its peak.

#### Background

The attention given to mathematics anxiety increased due to the feminist movement of the 1970's (Williams, 1980). According to Tobias (1991), women and minorities experience higher levels of mathematics

anxiety. However, the participants of the studies that reached this conclusion were high school and college students (Wigfield & Meece, 1980).

Unfortunately, little is known about the existence of gender differences in mathematics anxiety of younger students, but one study concluded that gender differences were not as strong as grade-level differences (Wigfield & Meece, 1980).

As a matter of fact, most studies dealing with any aspect of mathematics anxiety have drawn their conclusions based on the responses of high school and college students, and little is known about mathematics anxiety in younger students. Also, of the many studies completed, most remedies include counseling of some kind, and few, if any, provide tested remedies that can be employed solely by the classroom teacher.

"The concept of math anxiety has historically been recognized as a psychological problem that may cause a variety of detrimental consequences. Effective remediation has been deemed essential, although the parameters of such a treatment have not been established" (Green, 1986).

#### Statement of the Problem

The purpose of this study is to determine if increasing the amount of problem solving, journal writing, group work, and praise will decrease the level of mathematics anxiety experienced by eighth grade students.

### Significance of the Problem

Mathematics anxiety has long been recognized as a serious problem. It can occur not only in testing situations but also when faced with any mathematical task (Hadfield, 1988). A consistent relationship exists between mathematics anxiety and mathematics achievement. Students with high mathematics achievement, from elementary school through college, have low mathematics anxiety (Reyes, 1984). Accordingly, students with higher levels of mathematics anxiety tend to score lower on mathematics performance tests (Engelhard, 1990; Dwyer, 1989).

Studies have reported an increase in the level of mathematics anxiety in early adolescent years with a peak in ninth grade (Meece et al., 1990; Wigfield & Meece, 1988). Those afflicted with mathematics anxiety are less likely to enroll in advanced high school mathematics courses or to choose a mathematics-related college major (Meece et al., 1990). Mathematics teachers must do what they can to prevent mathematics anxiety because mathematics-anxious students are likely to become mathematics avoiders. As a result, they cannot fully participate in today's technological society.

Experts in the fields of education and mathematics as well as sufferers of mathematics anxiety have offered their suggestions for alleviating mathematics anxiety. However, too few of these prescribed strategies have been adequately tested.

### Limitations

The study was restricted to eighth grade students in Washington Township located in Gloucester County, New Jersey. These students were grouped homogeneously based on previous mathematics performance and recommendation by their seventh grade mathematics teacher. The students in the study are classified as Level 2 or Level 3. The students are upper middle-class with few minorities. Approximately 85% - 90% of the students that graduate high school attend college.

### Definition of Terms

Level 2: These students are considered average to below average. They did not meet the requirements for the Basic Skills program. They were placed into this level by teacher recommendation based on previous performance.

Level 3: These students are considered average to above average. They did not meet the requirements to place them into the advanced class, Algebra I. They were placed into this level by teacher recommendation based on previous performance.

MARS: This test was designed to assess the degree of mathematics anxiety in adults. It consists of 98 statements to be rated on a five point scale measuring anxiety from "Not at all" to "Very much".

MARS-A: This test was designed specifically for adolescents to assess

the degree of mathematics anxiety. It consists of 98 statements to be rated on a five point scale measuring anxiety ranging from "Not at all" to "Very much". The test takes approximately twenty to thirty minutes to complete.

Mathematics Anxiety: "Feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551).

Stress Inoculation Training: This consists of three phases. The first, conceptualization, "focuses on establishing a collaborative relationship with participants while helping them to understand better the nature of stress and its disruptive effects on behavior and performance. The second phase, skills acquisition and rehearsal, focuses on the development of coping skills such as the use of adaptive self-statements, and the development of relaxation and problem-solving skills. The third phase consists of application and follow-through. This phase includes both invitro (imaginal and behavioral rehearsal) and invivo (applications to actual life situations) training experiences" (Schneider & Nevid, 1993, p. 285).

Systematic Desensitization: This treatment consists of "progressive muscle relaxation, followed by imaginal pairings of hierarchically-arranged mathematics anxiety-provoking stimuli with relaxation" (Schneider & Nevid, p. 285).

### Procedures

The population used for this experiment was comprised of eighth grade students attending Chestnut Ridge Middle School in Washington Township. The sample used included two mathematics classes of differing levels of ability. These classes were taught by the researcher for the entire 1994-1995 school year. There were twenty-one students in the Level 2 class and twenty-six students in the Level 3 class.

Letters were sent home informing parents about the study requesting permission for their children to participate. The students completed the Mathematics Anxiety Rating Scale - A (MARS-A). During the six weeks following this test, the instructor involved students in at least one word problem each day, journal writing twice a week, group work at least once a week, and praise several times daily. The students then completed the MARS-A a second time. A dependent t-test was used to analyze the results.

## CHAPTER II

### Review of Related Research and Literature

#### Introduction

In 1984, Reyes gave an overview of the existing knowledge of mathematics anxiety, its definitions, nature, and its relationship to test anxiety, general anxiety, and mathematics achievement. Reyes concluded that the amount of suggested intervention strategies designed to reduce mathematics anxiety far outweighed the amount of research done to test those same strategies or to investigate the relationship between teaching and mathematics anxiety. The intervention strategies that had been tested involved mostly college students and adults who did not attend school. Unfortunately, a decade later, the same is still true.

#### Review of Related Research

Much of the research designed to evaluate strategies for alleviating mathematics anxiety involves college students and counseling of some kind. For example, Handler (1983), who used MARS as a pretest and posttest, compared college students in two classes taught by the same instructor with one class meeting weekly with a counselor in mathematics anxiety reduction techniques. The students in the class with weekly counseling sessions decreased their level of mathematics anxiety while increasing their mathematics competence.

However, another study involving college students, performed by Schneider and Nevid (1993), showed that while stress-inoculation training and systematic desensitization significantly reduced students' self-ratings of mathematics anxiety, these treatments did not improve performance. Yet another study involving college students, performed by Crumpton (1978), used MARS to identify highly anxious college students. Crumpton then used the Mathematical Competency Test to identify areas of incompetence and designed a course of study to increase competency of these students in their weak areas. Using MARS again as a posttest, the results showed that an increase of mathematical competency decreased mathematics anxiety.

Two other studies attempting to find a method for the reduction of mathematics anxiety have been performed by DeBronac-Meade (1980) and Fitzgerald (1984). DeBronac-Meade used MARS initially to measure the subjects' levels of mathematics anxiety. Those involved ranged from fourteen to fifty-eight years of age. Using MARS again as a posttest, the results showed that cognitive behavior modification did not significantly reduce mathematics anxiety. Fitzgerald tested the effectiveness of relaxation therapy with students enrolled in college algebra. The results were not statistically significant.

Green (1986) also conducted a study to examine a relief from mathematics anxiety. After controlling for working status, age and sex, the

findings demonstrated that practicing mathematical problems significantly reduced levels of mathematics anxiety.

In addition to the research involving college students, there have also been several studies conducted using adolescent students. Aksu and Saygi (1988) used corrective feedback to relieve mathematics anxiety of sixth grade Turkish students determined to be highly math-anxious by MARS-A. Returning quiz papers with missing answers completed and incorrect answers corrected had a significant positive influence on the mathematics anxiety levels.

Mevarech (1987) analyzed the effects of computer-assisted instruction on various aspects of mathematics anxiety found in sixth grade Israeli students. The students who received computer-assisted instruction manifested lower levels of mathematics anxiety relating to their worries about learning mathematics and their attitudes toward learning mathematics with computers than those students with a non-computer-assisted instruction curriculum. However, there were no significant differences in their fear of failure in mathematics class or their difficulties in solving mathematics problems.

A study involving students in grades seven through nine was performed by Meece, Wigfield, and Eccles (1990) to evaluate the predictors of mathematics anxiety as well as to assess its influence on course enrollment intentions and performance in mathematics. The results showed that

mathematics anxiety is directly related to students' mathematics ability perceptions, performance expectancies, and value perceptions.

Engelhard (1990) conducted a study with thirteen year old students in the United States and Thailand to investigate the relationship between mathematics performance and mathematics anxiety, mother's education, and gender. Engelhard used mother's education, gender, and the effects of previous achievement in mathematics as control elements and concluded that an inverse relationship exists between mathematics anxiety and performance. Although this relationship was found in students from both the United States and Thailand, it was more pronounced in the students from the United States.

#### Review of Related Literature

Understanding the causes of mathematics anxiety is a necessary part of learning to relieve it. Brush (1981) believes that mathematics anxiety levels rise as mathematics becomes more difficult and more abstract. Students' attitudes towards mathematics become more negative as the mathematics content becomes more abstract. Teachers in middle grades tend to use fewer concrete approaches. The average student is not ready for the abstraction without a more basic, concrete understanding of the concepts (Boling, 1991).

Others blame the source of mathematics anxiety on the style of the mathematics classroom. As students progress through school, the amount of lecture in the teaching of mathematics increases with more regular testing

(Brush, 1981). What students wish for in the mathematics classroom are more opportunities for debate or discussion (Tobias, 1987). Gourgey (1992) believes that all too often students learn mathematics by the teacher always telling them how. Students taught by this method of instruction feel helpless and deficient. These students will then feel anxious and fear failure. Students need to be actively engaged in doing mathematics rather than passively subject to a teacher's delivery of information.

A number of education and mathematics professionals as well as actual sufferers of mathematics anxiety have enumerated a variety of suggested strategies to deal with mathematics anxiety. Morris (1981) believes teachers should listen intently when students ask questions and then willingly explain in order to create an accepting atmosphere. Teachers should reassure their students that they, too, experience frustration at times with mathematics and that there is no such thing as a "math mind". Another way teachers can help their students to deal with their mathematics anxiety is to encourage educated guessing. This is conducive to a risk-taking climate (Morris, 1981).

According to Gourgey (1992), "Students need to realize that hard work, tedium, confusion, trial and especially error are all normal parts of the learning process" (p. 14). Perseverance, not intelligence, is often the differentiating factor between success and failure.

Yet another suggestion is to show the relevance of mathematics.

Rader-Konofalski (1991) believes that teachers should use visual aids, share personal experiences, and relate mathematics topics being taught to everyday situations to positively affect the attitudes of their students. Schultz (1985) agrees that making mathematics meaningful and relevant, using examples to which students can relate, will reduce mathematics anxiety.

The suggestions most often cited recommend group work, journal writing, problem solving, and using praise in a supportive atmosphere (Ben-Jacob, 1981; Boling, 1991; Dodd, 1992; Garofalo, 1989; Greenwood, 1984; Kennedy, 1985; Morris, 1981; Rader-Konofalski, 1991; Sherard, 1981; Skiba, 1990; Tobias, 1981, 1987, 1991, 1993).

Allowing students to work in groups can help to reduce mathematics anxiety for several reasons. Students feel less threatened and less alone when working in groups because responsibility is shared. Often, they learn better by explaining to each other and thinking aloud (Morris, 1981). Students in grades five through eight in particular relate better to one another than they do to the teacher so discussing mathematical concepts with each other will help them to understand and relieve anxiety in the process (Boling, 1991). Another benefit to group work is that it allows students to be social and to be active learners (Dodd, 1992).

Writing is another way for a student to be actively engaged in learning mathematics. Several reasons why writing will reduce mathematics anxiety

follow. Some students will feel more comfortable explaining to the teacher that they do not understand through writing. Journals allow students to admit their difficulties and anxieties privately. This not only enhances student motivation but also gives insight to the teacher about problems that need addressing (Dodd, 1992; Kennedy, 1985). Writing also helps students to clarify their thinking, uncover problems, and generate questions.

Students can use writing on their own to help alleviate their mathematics anxiety. When working a problem, math-anxious students should be taught to divide the page into two columns. On the left, these students should record their feelings and thoughts; on the right, they record their notes and calculations. This process aids the student in discovering obstacles they create for themselves. It allows them to keep working when they cannot figure out the next mathematical step. This strategy aids students in recognizing when panic starts so they can learn how to stop it without stopping their work on the problem at hand (Tobias, 1987). "As math learners become more and more familiar with their own learning blocks, they become more able to discover self-cures" (Tobias, 1993, p. 243).

Experts believe problem solving will help in the reduction of mathematics anxiety (Garofalo, 1989; Greenwood, 1984; Rader-Konofalski, 1991; Sherard, 1981). Like group work and writing, it allows students to be active learners. Solving problems also helps students to relate mathematics to

everyday situations, making it relevant and meaningful (Schultz, 1985). When students see mathematics as relevant and meaningful, they are motivated to learn and to continue trying.

Praise has been suggested to relieve mathematics anxiety for several reasons. Encouraging and expressing confidence in students helps to develop confidence in their mathematical abilities (Sherard, 1981). Students confident in their mathematical abilities will be more persistent in their efforts to learn. Praise for perseverance and educated guessing is essential. It encourages the use of intuition and creativity, valuable qualities in the pursuit of mathematical knowledge (Morris, 1981).

Although the suggestions to alleviate mathematics anxiety are endless, those receiving the most acknowledgement are group work, writing, problem solving and praise.

## CHAPTER III

### Procedures

#### Introduction

The procedures used by the researcher to conduct this study are described in this chapter. The problem under consideration was to determine if increasing the amount of problem solving, journal writing, group work, and praise will decrease the level of mathematics anxiety experienced by eighth grade students. The two groups of students who participated in the study are described, and the time schedule is explained.

#### Participants

The study was restricted to forty-seven eighth grade students who were previously placed into the eighth grade mathematics class (Level 2) or into the Pre-Algebra class (Level 3). The classification was based on previous mathematics performance and recommendation by their seventh grade mathematics teacher. The Level 2 class contained twenty-one students and was taught during the second period of the day (9:03 a. m. to 9:48 a. m.). The Level 3 class contained twenty-six students and was taught during sixth period (12:18 p. m. to 1:03 p. m.).

#### Procedures

A letter was sent home with each student on January 26, 1995 informing the parents/guardians of the study and requesting permission for each student to

take part in it (See Appendix A). The study began on February 6, 1995 and continued for six weeks. On the first day, the students in both classes were pretested using the MARS-A (See Appendix B). The students were given as much time as they needed to complete the test. Most finished within a twenty to thirty minute period of time.

### Cooperative Learning

The students were placed in cooperative learning groups. Each group was composed of one high-achieving student (with an A or B average), one low-achieving student (with a D or F average), and usually two but in some cases three average-achieving students. On the day the study began, after all students completed the MARS-A, the students were asked to list three positive characteristics that they possessed. They were then directed to different areas of the room to meet their group members and to share these characteristics. The students were told that they may be called on to introduce a group member to the class, sharing their good qualities. At the end of class, several students were called on to introduce a group member. For the next few days, several students were asked each day to introduce a group member to the class.

During the first week of the study, the Level 3 class met with their groups a second time to complete a problem solving lesson. They were asked to explore and to find patterns and rules for multiplying and dividing powers of ten. The questions they were asked to answer were reviewed at the end of the period. The

students called out their responses in unison.

During the second week of the study, the Level 2 class met with their groups on two occasions to discuss answers to the problem solving questions given at the start of class. The students did discuss their work and reach a consensus, but many times their conclusions were not valid. The Level 3 class met with their groups for a full period to review for a unit test. The students were told that if one group member's paper was collected and graded, all group members would receive that grade. The papers were not collected.

The Level 2 class met with their groups twice the third week. The first meeting was brief. The directions were to discuss the eighth problem in their problem solving packet. They had each worked on this problem earlier on their own, but no one was able to justify his/her answer. The second meeting lasted most of the forty-five minute period. The students were working on a lesson, learning how to solve problems by solving a simpler problem.

The Level 3 class also met with their group members twice. During the first meeting, the students were asked to complete an example in their notes section based on the lesson for that day involving renaming fractions as percents. They were also asked to compare their answers for the problem of the day. The second time the students completed a "Percents to Know" chart. They were asked to copy a chart from the board in which either the percent, decimal, or fraction was given. They needed to rename the given amount so that their charts

were filled in with each amount as a percent, decimal, and fraction.

During the fourth week, both classes met with their groups three times to work on problems in preparation for the Early Warning Test. The students worked out of their Test Best Mathematics booklets (See Appendix D) and completed as much as they could with their group.

The students completed the Early Warning Test on Tuesday, Wednesday, and Thursday of the fifth week. Neither class had mathematics on those days due to the testing. Both classes worked in groups on sample Early Warning Test problems on Monday of that week.

During the final week of the study, the students in both classes met with their groups only once. The assignment for both classes was to complete a group quiz. Their quiz papers should show the work for each problem. They were told that only one quiz per group would be collected and graded. Every member of the group would receive the same grade.

#### Problem Solving

The problem solving problems used were taken directly from the 1992 Early Warning Test (See Appendix C). The students were each given their own packet. They were asked not to work ahead but to solve problems as directed. The students usually solved one or two problems each day. They solved more during the fourth week of the study in preparation for the Early Warning Test. Sometimes the problems were completed at the start of class. Other times the

students worked on problems in their cooperative learning groups.

During the fourth week of the study, the students spent the majority of each class period solving problems from booklets with sample Early Warning Test problems. The booklets were distributed and collected each day (See Appendix D).

### Journals

The students were asked at the start of the school year to have a section in their notebooks for journal entries. Prior to the start of the study, journal entries were completed approximately once a month. They were only collected at the end of a marking period. Throughout the study, students completed journal entries twice a week, and journals were collected and read every other week. The students are given credit for completing the journal entries. The students' grades are not based on the accuracy of the answers. Positive comments are returned on correct answers and suggestions and encouraging remarks on others.

During the first week, the same journal entries were given to both classes. They were first asked to complete the following sentence. "When I get stuck on a math problem, I . . ." The second entry asked students to explain how to find the sale price of jeans regularly priced at \$52 if they were on sale at 25% off.

During the second week, the Level 2 class was asked first to explain why the number two is the only even prime number and then to explain how they go about deciding if a number is prime or composite. The Level 3 class was given

the following questions. 1) Write a paragraph that explains the difference in the way in which decimal points are treated in addition, subtraction, multiplication, and division. 2) What happens when you divide a number by smaller and smaller numbers? 3) Will the product of  $(-3.5)^5$  and  $(-2.8)^{32}$  be positive or negative? Explain.

During the third week, both classes responded to the same questions. The first assignment was to explain how to find 25% of 44 and to find the answer in as many different ways as possible. The second journal entry asked the students to tell what they know about perimeter and area and give examples of how to find each.

Both classes again responded to the same entries for the fourth week of the study. Although the classes are taught using different textbooks, both classes were in the middle of a unit about percent. The students were asked to write explaining what they understand about percent (with examples), what they do not understand, and what they are wondering about. Their second assignment was to complete the following sentences. When I make a mistake in math, I . . . . When I'm embarrassed about doing math, I . . . .

The entries given the fifth week were to complete the following sentences. One thing I like about doing math is. . . . Doing math makes me feel. . . . The second entry for that week was free writing. The students were asked to write for five minutes regarding any questions, concerns, or anything that came to mind

regarding mathematics.

For the final week, the first entry asked the students to explain how to find a percent of a number using examples. They were asked to do this in as many different ways as they knew. The second assignment was to write what their mathematics average is currently and to explain why they earned that grade. The students were told that if the problem was poor test or quiz grades, then they should explain why they thought they earned such low scores.

Both classes completed the MARS-A test again at the end of the sixth week of the study. Students were allowed as much time as they needed. Their scores were computed. A dependent t-test was performed to analyze the results. The level of significance was set at 0.05. A complete analysis of the data is presented in the following chapter.

## CHAPTER IV

### Analysis of Data

#### Introduction

The purpose of this study was to determine the effectiveness of group work, problem solving, journal writing and praise in reducing mathematics anxiety. There were two groups tested including forty-seven eighth grade students. The Level 2 class included twenty-one students, and the Level 3 class included twenty-six students.

#### Presentation of the Data

The Mathematics Anxiety Rating Scale - A (MARS-A) was used as a pretest and posttest for both groups to determine a mathematics anxiety score for each student. The score is high if a student is mathematically anxious; therefore a low score is desirable. A dependent t-test was performed. The level of significance was set to 0.05. The MARS scores for both groups are presented in Tables 1 and 2.

In the Level 2 class, the average difference in pretest and posttest scores was a drop of 10.86 points. The t value was calculated as -1.65 (See Table 3). This is higher than the critical point of -1.725 with degrees of freedom equal to 20. Therefore, the null hypothesis concerning the Level 2 group was accepted.

In the Level 3 class, the average difference in pretest and posttest

scores was a drop of 18.81 points. The  $t$  value was calculated as  $-2.83$  (See Table 4). This is lower than the critical point of  $-2.485$  with degrees of freedom equal to 25. This was significant at the 0.01 level. Therefore, the null hypothesis concerning the Level 3 group was rejected.

#### Discussion of the Results

The results involving the Level 2 class indicated that group work, problem solving, journal writing and praise used in combination did not effectively decrease the amount of mathematics anxiety felt by the students. The difference between the pretest and posttest scores on the MARS-A was not statistically significant. The null hypothesis was accepted.

The results involving the Level 3 class indicated that the combination of group work, problem solving, journal writing, and praise created a statistically significant difference between the pretest and posttest scores on the MARS-A. The null hypothesis was rejected.

#### Summary

The analysis of the data has been presented in this chapter. A dependent  $t$ -test was used to determine that the combination of group work, problem solving, journal writing, and praise was unsuccessful in reducing levels of mathematics anxiety in the Level 2 group but successful in the Level 3 group. Thus, the null hypothesis was accepted for the Level 2 group and rejected for the Level 3 group.

TABLE 1

Results of Mathematics Anxiety Rating Scale  
Level 2 Group

Student	Pretest	Posttest	Difference
$f_1$	236	273	+37
$f_2$	244	284	+40
$f_3$	253	258	+ 5
$f_4$	176	142	-34
$f_5$	204	212	+ 8
$f_6$	282	290	+ 8
$f_7$	217	201	-16
$f_8$	306	261	-45
$f_9$	269	218	-51
$f_{10}$	191	208	+17
$m_1$	159	113	-46
$m_2$	147	103	-44
$m_3$	243	226	-17
$m_4$	365	320	-45
$m_5$	207	164	-43
$m_6$	155	127	-28
$m_7$	188	175	-13
$m_8$	121	109	-12
$m_9$	239	229	-10
$m_{10}$	145	177	+32
$m_{11}$	256	285	+29

TABLE 2  
Results of Mathematics Anxiety Rating Scale  
Level 3 group

Student	Pretest	Posttest	Difference
$f_1$	158	145	-13
$f_2$	185	157	-28
$f_3$	299	303	+ 4
$f_4$	186	177	- 9
$f_5$	169	145	-24
$f_6$	269	209	-60
$f_7$	290	295	+ 5
$f_8$	299	320	+21
$f_9$	196	159	-37
$f_{10}$	261	165	-96
$f_{11}$	313	290	-23
$f_{12}$	307	321	+14
$f_{13}$	235	170	-65
$f_{14}$	242	221	-21
$m_1$	210	202	- 8
$m_2$	279	238	-41
$m_3$	222	202	-20
$m_4$	230	253	+23
$m_5$	218	254	+36
$m_6$	169	116	-53
$m_7$	182	115	-67

TABLE 2, CONTINUED

Student	Pretest	Posttest	Difference
m <sub>8</sub>	279	318	+39
m <sub>9</sub>	199	190	-9
m <sub>10</sub>	195	139	-56
m <sub>11</sub>	250	258	+8
m <sub>12</sub>	229	220	-9

TABLE 3

Results of Dependent t Test  
Level 2 Group

n	$\bar{d}$	s <sub>d</sub>	t
21	-10.86	30.21	-1.65

TABLE 4

Results of Dependent t Test  
Level 3 Group

n	$\bar{d}$	s <sub>d</sub>	t
26	-18.81	33.84	-2.83*

\*significant at the .01 level

## CHAPTER V

### Summary, Conclusions, and Recommendations

#### Introduction

Although there are many studies showing the detrimental effects of mathematics anxiety with even more suggestions on how to combat it, very few studies have been performed to find strategies that work, especially with adolescent students. The purpose of this study was to determine if an increase in the amount of group work, problem solving, journal writing, and praise decreases the level of mathematics anxiety experienced by eighth grade students. The Mathematics Anxiety Rating Scale - A was used as a pretest and posttest on the two groups tested. One group was a Level 2 mathematics class, and the other group was a Level 3 mathematics class.

#### Summary of Findings

A dependent t-test was used to analyze the data. The results indicated that the use of group work, problem solving, journal writing, and praise did not significantly decrease the level of mathematics anxiety measured in the Level 2 group. The results were not significant at the 0.05 level, and the null hypothesis was accepted. These strategies did significantly decrease the level of mathematics anxiety measured in the Level 3 group. The results were significant at the 0.01 level. Thus, the null hypothesis was rejected. The strategies tested significantly decreased mathematics anxiety experienced by

students in the higher level of the two groups tested.

### Conclusions

Incorporating group work, problem solving, journal writing, and praise will help to reduce mathematics anxiety in some students, most likely those in an average to above average level. Several factors, such as the administration of the Early Warning Test during the six week experimentation period, may have effected the results. Both groups of students decreased their level of mathematics anxiety on the average. Only in the Level 3 group was the amount of decrease enough to be considered significant.

Several factors may have influenced the results of this study. Many of the students in the Level 2 group are enrolled in the Basic Skills Reading class or Basic Skills English class. Problem solving is thought to reduce mathematics anxiety by showing students the need for mathematics and relating it to every day problems. The comprehension difficulties experienced by these students may have counter-acted the benefits of problem solving and in fact increased the levels of mathematics anxiety experienced by some students.

Also, all eighth grade students involved in this study took the Early Warning Test during the six week experimentation period. The pressure from the test may have had a detrimental effect on the level of mathematics anxiety experienced by some students. And, although most students in both groups seemed to have little to no difficulty cooperating with the students in their

groups, the interactions which took place may have affected the mathematics anxiety levels of students differently.

### Recommendations

Mathematics anxiety is a serious problem which needs to be addressed. Prevention seems to be the most logical solution. On average, the students involved in this study did benefit from the steps taken to reduce their mathematics anxiety. The effects of problem solving, group work, journal writing, and praise should be tested individually in longitudinal studies using larger samples of students.

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**Appendix A**

**Parent Letter**

To: 8R Parents  
From: Miss Hutter  
Re: Master's Thesis  
Date: January 25, 1995

Hello, again, and happy new year to all of you.

As you know from my previous letter, I am completing my master's degree in mathematics education at Rowan College, and I am in the process of writing my thesis. The purpose of my thesis is to reduce the amount of mathematics anxiety experienced by my students.

I spent the first part of this year researching mathematics anxiety and found several studies whose results have shown that students with high levels of mathematics anxiety tend to score lower on mathematics achievement tests. Some experts believe that mathematics anxiety peaks in the ninth grade. My goal is to help alleviate some of this anxiety before it reaches that peak.

The students, with your permission, will be administered the Mathematics Anxiety Rating Scale as a pretest and posttest. During a six week period between those tests, I will be increasing the amount of problem solving, journal writing, and cooperative learning in class. The names of the students will not be used in the study.

If you have any questions at all regarding this matter, please feel free to send in a note with your child or to call me. The school phone number is 582-3535, and I am available from 10:00 - 10:30 a.m. and from 2:00 - 3:10 p.m. I will get back to you as soon as possible.

Please circle your choice, sign below, and return. Thank you!

I do / do not agree to allow my child to be a part of the study described above.

---

**Appendix B**

**Mathematics Anxiety Rating Scale - A**

Name \_\_\_\_\_

Total Score \_\_\_\_\_

**MATHEMATICS ANXIETY RATING SCALE (MARS-A)**

The items in the questionnaire refer to things and experiences that may cause tension or apprehension. For each item, place a check (✓) in the circle under the column that describes how much you would be made anxious by it. Work quickly, but be sure to think about each item.

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
1. Deciding how much change you should get back from buying several items.		<input type="radio"/>				
2. Having someone watch you as you add up a column of numbers.		<input type="radio"/>				
3. Having someone watch you as you divide a five digit number by a two digit number.		<input type="radio"/>				
4. Being asked to add up $976 + 777$ in your head.		<input type="radio"/>				
5. Adding up $976 + 777$ on paper.		<input type="radio"/>				
6. Figuring out a simple percentage, like the sales tax on something you buy.		<input type="radio"/>				
7. Figuring out how much you will get paid for $6\frac{1}{2}$ hours of work if you get paid \$3.75 an hour.		<input type="radio"/>				
8. Listening to a person explain how your share of expenses on a trip was figured out (including meals, transportation, housing, etc.).		<input type="radio"/>				
9. Counting a pile of change.		<input type="radio"/>				
10. Adding up a bill for a meal when you think you have been over-charged.		<input type="radio"/>				

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
11.	Telling the cashier that you think the bill for the meal was wrong and watching the cashier add up the bill again.	<input type="radio"/>				
12.	Being asked to make change.	<input type="radio"/>				
13.	Adding up the dues received and the expenses for a club you belong to.	<input type="radio"/>				
14.	Reading a formula in a science class.	<input type="radio"/>				
15.	Doing a word problem in algebra.	<input type="radio"/>				
16.	Solving a problem such as: If $x = 11$ , and $y = 3$ , then the result of $x/y$ is equal to _____?	<input type="radio"/>				
17.	Solving the problem such as: If $x = 12$ , and $y = 4$ , then the ratio of $x$ to $y$ is equal to _____?	<input type="radio"/>				
18.	Figuring out your grade average for last term.	<input type="radio"/>				
19.	Reading an article on the basketball team, showing what percentage of free throws each player made, the percentage of field goals made, the total number attempted, etc.	<input type="radio"/>				
20.	Reading a novel with many dates in it.	<input type="radio"/>				
21.	Being asked to remember the telephone numbers of three people you met.	<input type="radio"/>				
22.	Being asked to guess at the number of people at a large gathering you are attending.	<input type="radio"/>				
23.	Receiving a math textbook.	<input type="radio"/>				

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
24.	Watching a teacher work an algebra problem on the blackboard.	<input type="radio"/>				
25.	Figuring out whether you have enough change to pay for the gum and magazine you want to buy, plus the sales tax.	<input type="radio"/>				
26.	Signing up for a math course.	<input type="radio"/>				
27.	Listening to another student explain a math formula.	<input type="radio"/>				
28.	Walking into a math class.	<input type="radio"/>				
29.	Having to figure the miles per gallon of gas for a car.	<input type="radio"/>				
30.	Watching someone work with a calculator.	<input type="radio"/>				
31.	Looking through the pages of a math text.	<input type="radio"/>				
32.	Signing up for a course in Algebra.	<input type="radio"/>				
33.	Being called on to put a problem on the board when you are not sure your answer is right.	<input type="radio"/>				
34.	Studying for a math test.	<input type="radio"/>				
35.	Starting to read a new chapter in a math book.	<input type="radio"/>				
36.	Walking to class and thinking about a math course.	<input type="radio"/>				
37.	Meeting your math teacher while walking in the hall.	<input type="radio"/>				
38.	Reading the word "Statistics".	<input type="radio"/>				

	How anxious ...	Not at all	A little	A fair amount	Much	Very much
39.	Sitting in a math class and waiting for the teacher to begin.	<input type="radio"/>				
40.	Solving a square root problem.	<input type="radio"/>				
41.	Signing up for a course in Geometry.	<input type="radio"/>				
42.	Collecting money for admission tickets to a show or a game at the door.	<input type="radio"/>				
43.	Taking the math section of a standardized test, like an achievement test.	<input type="radio"/>				
44.	Measuring how much border to leave and how to place five pictures on a bulletin board.	<input type="radio"/>				
45.	Raising your hand in a math class to ask a question about something you do not understand.	<input type="radio"/>				
46.	Reading and interpreting graphs or charts.	<input type="radio"/>				
47.	Reading a cash register receipt after you buy something.	<input type="radio"/>				
48.	Figuring the sales tax for something that costs more than \$1.00.	<input type="radio"/>				
49.	Having to know how to balance a checkbook by adding up every amount that was spent and subtracting it from the amount you started with.	<input type="radio"/>				
50.	Figuring how you would make more money: by taking a job that has a lower salary, but includes, room, meals, and travel; or a job that has a higher salary, but no other benefits.	<input type="radio"/>				
51.	Having someone explain bank interest rates while describing savings accounts.	<input type="radio"/>				

	How anxious	Not at all	A little	A fair amount	Much	Very much
52.	Hearing a lecture in a social studies class where the teacher is commenting on some figures, like the percentage of each socio-economic group who voted Republican.	<input type="radio"/>				
53.	Taking an examination (quiz) in a math course.	<input type="radio"/>				
54.	Taking an examination (final) in a math course.	<input type="radio"/>				
55.	Hearing two of your friends talking about the best way to figure out the actual cost of a product.	<input type="radio"/>				
56.	Having someone ask you to recheck the numbers in a simple calculation, such as division or addition.	<input type="radio"/>				
57.	Being asked by a friend to answer the question: "How long will it take to get to the state capital if I drive at 30 miles per hour?"	<input type="radio"/>				
58.	Studying for a driver's license test and memorizing the numbers involved, such as the distances it takes to stop a car going at different speeds.	<input type="radio"/>				
59.	Hearing friends quote the odds on a game as they make bets.	<input type="radio"/>				
60.	Playing cards where numbers are involved, like poker or blackjack.	<input type="radio"/>				
61.	Having a friend try to teach you how to do a math problem and finding that you cannot understand what is being said.	<input type="radio"/>				
62.	Making a schedule for your daily routine, setting aside times for classes, study time, meals, recreation, etc.	<input type="radio"/>				

	How anxious ...	Not at all	A little	A fair amount	Much	Very much
63.	Learning the part of a game dealing with scoring and remembering numbers.	<input type="radio"/>				
64.	Deciding which courses to take in order to come out with enough credit hours for promotion or graduation.	<input type="radio"/>				
65.	Working a math problem that is important in your life, like figuring out how much you can spend on recreational activities such as movies after buying other things you need.	<input type="radio"/>				
66.	Working on a math problem which seems less important in your life, such as "if $x$ = outstanding bills, and $y$ = total income, calculate how much is left for recreational purposes."	<input type="radio"/>				
67.	Being given a set of addition problems to solve on paper.	<input type="radio"/>				
68.	Being given a set of subtraction problems to solve on paper.	<input type="radio"/>				
69.	Being given a set of multiplication problems to solve on paper.	<input type="radio"/>				
70.	Being given a set of division problems to solve on paper.	<input type="radio"/>				
71.	Picking up your math textbook to begin working on a homework assignment.	<input type="radio"/>				
72.	Being given a homework assignment of many difficult math problems, which is due the next time the class meets.	<input type="radio"/>				
73.	Thinking about an upcoming math test one week before.	<input type="radio"/>				

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
74.	Thinking about an upcoming math test one day before.	<input type="radio"/>				
75.	Thinking about an upcoming math test one hour before.	<input type="radio"/>				
76.	Thinking about an upcoming math test five minutes before.	<input type="radio"/>				
77.	Checking the time and figuring out whether or not you can stop in two more stores and still meet a friend at the exact time you said you would.	<input type="radio"/>				
78.	Waiting to get a math test returned on which you expected to do well.	<input type="radio"/>				
79.	Waiting to get a math test returned on which you expected to do poorly.	<input type="radio"/>				
80.	Asking your math teacher after class about something you did not understand.	<input type="radio"/>				
81.	Realizing that you have to take a certain number of math classes to meet the requirements for graduation.	<input type="radio"/>				
82.	Picking up a math textbook to begin a difficult reading assignment.	<input type="radio"/>				
83.	Being called on to answer a question in a math class on a topic you have spent some time studying.	<input type="radio"/>				
84.	Not knowing the formula needed to solve a particular problem.	<input type="radio"/>				
85.	Receiving your final math grade on your report card.	<input type="radio"/>				
86.	Figuring out how much material you will need to do a project so that you will waste as little as possible.	<input type="radio"/>				

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
87.	Being responsible for collecting the dues for a club and keeping track of the amount received.	<input type="radio"/>				
88.	Opening a math or statistics book and seeing a page full of problems.	<input type="radio"/>				
89.	Watching someone use a graph to explain something.	<input type="radio"/>				
90.	Listening to a lecture in a math class.	<input type="radio"/>				
91.	Being given a "pop" quiz in a math class.	<input type="radio"/>				
92.	Seeing a computer printout.	<input type="radio"/>				
93.	Having to use the tables in the back of a math book.	<input type="radio"/>				
94.	Comparing the prices of two brands of soft drinks that are different sizes and deciding which is cheaper.	<input type="radio"/>				
95.	Deciding how much of a tip to leave in a restaurant after a meal.	<input type="radio"/>				
96.	Being asked to explain how you arrived at a particular answer for a problem.	<input type="radio"/>				
97.	Adding up the results of a vote, such as for class or student body representative.	<input type="radio"/>				
98.	Acting as secretary, keeping track of the number of people signing up for an event.	<input type="radio"/>				

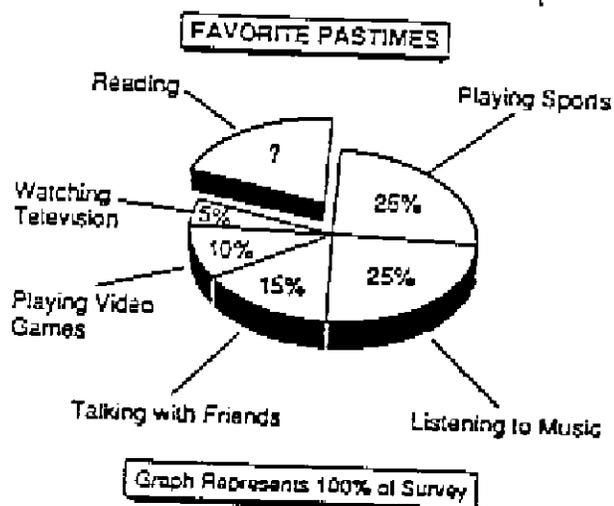
## Appendix C

### Early Warning Test Problems

# MATHEMATICS PART 1

**DIRECTIONS:** Work each problem. Mark the letter for your answer in the appropriate space provided for Mathematics Part 1 on page 1 of your Answer Folder. **UNLESS THE PROBLEM STATES OTHERWISE, DO NOT FIGURE SALES TAX IN YOUR ANSWERS TO PROBLEMS INVOLVING PURCHASES.**

Directions: Use this graph to answer question 1.



- Paul surveyed all his eighth-grade classmates to determine their favorite pastimes. According to the graph above, what percent of his classmates preferred reading?  
A. 10%  
B. 15%  
C. 20%  
D. 25%
- In which of these lists are the numbers ordered from LEAST to GREATEST?  
A. -8, -4, 0, 3  
B. 0, 3, -4, -8  
C. -4, -8, 0, 3  
D. -8, -4, 3, 0

Directions: Use this picture of a bill to answer question 3.

<i>Carnello's Cafe</i>	
1 hamburger	\$4.50
1 grilled cheese	\$2.25
1 soda	.95
1 milk	.90
TAX	.60
TOTAL	<input type="text"/>

- If you left a tip of about 15% of the total of this bill, which of these amounts did you leave?  
A. \$0.15  
B. \$0.60  
C. \$1.50  
D. \$2.90
- About how many hours would an automobile trip of 285 miles take if the car's speed varied between 45 mph and 55 mph?  
A. between  $6\frac{1}{2}$  and 8 hours  
B. between 5 and  $6\frac{1}{2}$  hours  
C. between  $3\frac{1}{2}$  and 5 hours  
D. between 2 and  $3\frac{1}{2}$  hours

**GO ON.**

Directions: Use this picture of a calendar page to answer question 5.

APRIL						
Sun	Mon	Tue	Wed	Thur	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

5. Jamal has an appointment to see his doctor exactly three weeks from today. Today is April 17th. On what date is that appointment with his doctor?
- April 30
  - May 1
  - May 8
  - May 15

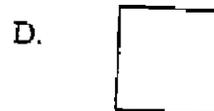
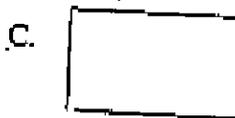
6. When coloring maps, mapmakers follow two important rules:
- All of a country or state must be colored the same color.
  - A color may be repeated, but different colors must be used for countries or states that share a common border.

Following only these rules, what is the minimum number of different colors required to color the map below?



- 2
- 3
- 4
- 5

7. Nick claims that any quadrilateral is a square if all of its sides are equal in length and both of its pairs of opposite sides are parallel. Which figure below can be used to prove that Nick's claim is wrong?



Directions: Use this table to answer question 8.

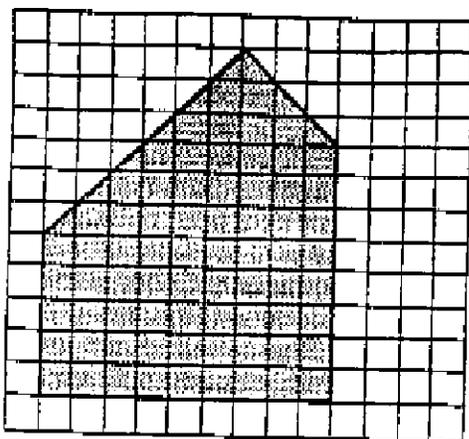
WILL YOU VOTE FOR RITA?		
8th-Grade Room Number	Yes	No
104	6	4
217	8	2
284	5	5
148	8	2
128	6	4
170	7	3

8. Rita is running for eighth-grade treasurer. There are 200 eighth-graders in Rita's school. Her friend Lorna wanted to predict the number of votes Rita would get, so Lorna surveyed a sample of 60 eighth-grade students. Ten students were selected at random from each of the six eighth-grade rooms. The results of that survey are shown in the table above.

Based on the information above and in the table, which of the following most likely represents the number of votes that Rita will get if everyone in the eighth grade at her school votes in that election?

- 40
- 60
- 130
- 180

Directions: Use this figure to complete item 9.



Each  $\square$  = 1 square unit

9. The area of the figure on the grid above is between \_\_\_\_\_.
- 60 and 70 square units
  - 70 and 80 square units
  - 80 and 90 square units
  - 90 and 100 square units

10. Thirteenth-century mathematician Leonardo Fibonacci studied a sequence of numbers like the first one shown below. In his honor, this sequence is now called the Fibonacci sequence.

1, 1, 2, 3, 5, 8, 13, 21, ...

If the sequence shown below follows the same pattern as the one in the Fibonacci sequence, which of the numbers indicated in the answer choices belongs in the blank?

2, 2, 4, 6, 10, 16, \_\_\_\_\_, ...

- 20
- 22
- 24
- 26

Directions: Use this picture of an advertisement to answer question 11.

## ZANY-WACKY TOYS

3560 NEW JERSEY AVENUE, OUR TOWN  
555-1000



IN-LINE  
SKATES

\$69.90



If you can find them cheaper at any other store, we'll sell you a pair for 10% less than our competitor's price for them.

11. If you found the same model of Joy Brand in-line skates at another store for \$59.90, which of these processes could you use to find the price Zany-Wacky Toys would charge you for a pair of them?
- Multiply \$59.90 by 0.1 and subtract the result from \$59.90.
  - Multiply \$69.90 by 0.1 and subtract the result from \$69.90.
  - Multiply \$59.90 by 0.9.
  - Multiply \$69.90 by 0.9.
- I only
  - II only
  - I or III only
  - II or IV only

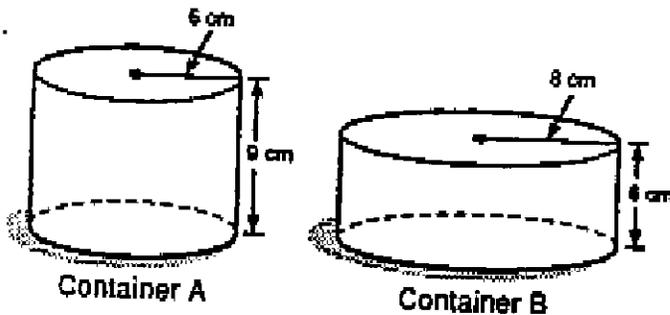
GO ON

12. Which of the improper fractions below has all three of the following characteristics?

- It is less than 2.
- It represents a non-terminating (repeating) decimal.
- It has a 6 in its tenths place when written in decimal form.

- A.  $\frac{5}{3}$   
 B.  $\frac{14}{12}$   
 C.  $\frac{16}{6}$   
 D.  $\frac{8}{5}$

Directions: Use these diagrams to answer question 13.



13. For an experiment, Pete used the two containers pictured above. Which of these statements about the capacities of these containers is correct?
- A. The capacity of container A is greater than the capacity of container B.  
 B. The capacity of container B is greater than the capacity of container A.  
 C. The capacity of container A is the same as the capacity of container B.  
 D. Based on the information given, it is impossible to determine the relationship between the capacities of the two containers.

14. Ms. Smith took nine of her eighth-grade students to the Museum of Science. The cost of adult tickets to the museum is \$10.00; the cost of student tickets to the museum is \$3.00. Which of the following equations could be used to find the total cost of the ten tickets to the museum for Ms. Smith and her 9 students? (TC represents total cost.)

- A.  $(1 \times 3) + (9 \times 10) = TC$   
 B.  $(1 + 10) \times (9 \times 3) = TC$   
 C.  $(1 + 3) \times (9 + 10) = TC$   
 D.  $(1 \times 10) + (9 \times 3) = TC$

15. Janice can jog about three times as fast as she can walk. If her average walking rate is one mile in 20 minutes, about how far could she jog in 2 hours?

- A. 3 miles  
 B. 6 miles  
 C. 18 miles  
 D. 30 miles

Directions: Use this picture of an advertisement to answer question 16.

**THE COMPLETE SKATEBOARDER**

Skate Clothes

Trucks (axes) \$25-\$35 each

Boards \$50-\$75 each

Each pair of wheels \$10-\$25

Stickers

Grip Tape

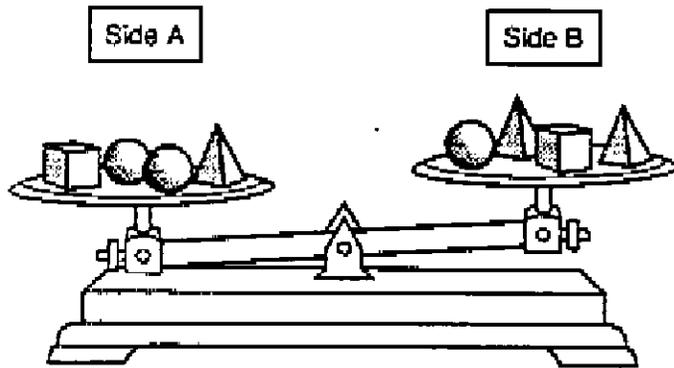
2500 New Jersey Avenue 222-1212

16. What is the least amount it would cost to buy the parts at the Complete Skateboarder to build a skateboard—one board, two trucks, and four wheels?
- A. \$85.00  
 B. \$95.00  
 C. \$120.00  
 D. \$140.00

17. Greg and Nadia performed a calculator experiment together. Greg began with a display of 0 on his calculator, and Nadia began with a display of 75 on her calculator. Each time Greg pressed the  $+$   $5$   $=$  keys on his calculator, Nadia pressed the  $-$   $10$   $=$  keys on her calculator. After repeating this key-pressing process for a while, they noticed that their calculators were both displaying the same number. What number was it?

- A. 20
- B. 25
- C. 35
- D. 50

Directions: Use this diagram to answer question 18.



18. In the situation described in this item, all objects with the same geometric shape have equal weights. Suppose that the weight of 1 cube is the same as the weight of 2 spheres, and that the weight of 1 sphere is the same as the weight of 2 pyramids. Which of these actions would balance the scale pictured above?

- I. Add 1 pyramid to side B.
  - II. Remove 1 sphere from side A.
  - III. Add 1 pyramid to side A and add 1 sphere to side B.
  - IV. Remove 1 pyramid from side B.
- A. I or III only
  - B. II or IV only
  - C. I only
  - D. IV only

Directions: Use this picture of a number cube to answer question 19.



19. All the faces of the cube pictured above have been numbered with consecutive multiples of 5. If no number is repeated, what numbers appear on the three hidden faces of this cube?
- A. 10, 20, 30
  - B. 10, 15, 35
  - C. 20, 25, 30
  - D. 20, 30, 40

Directions: Use this table to answer question 20.

AMOUNT CHARGED FOR MOWING LAWN		
Student	Charge	
Keith	\$9.00	
Sylvia	\$8.00	
Ronnie	\$8.50	
Amy	\$9.00	
Terry	\$8.00	
Faye	\$8.00	Mode: \$8.00
Morris	\$10.00	Median: \$8.25
Wanda	\$7.50	Mean: \$8.50

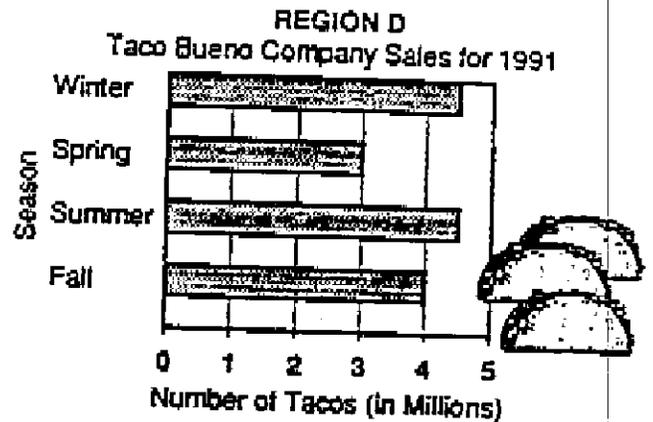
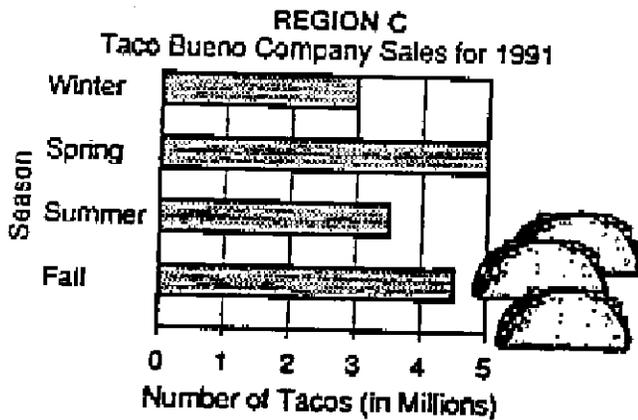
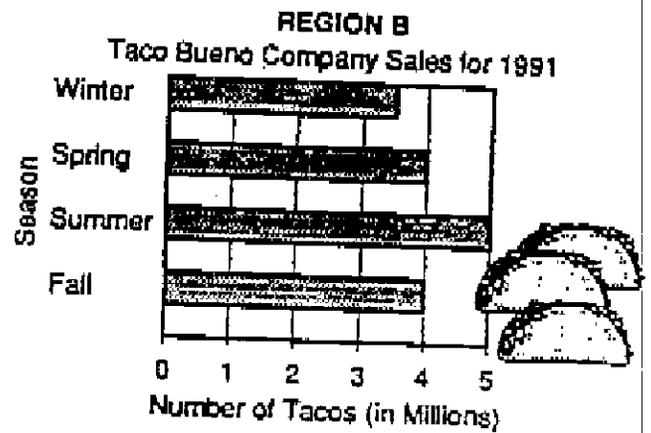
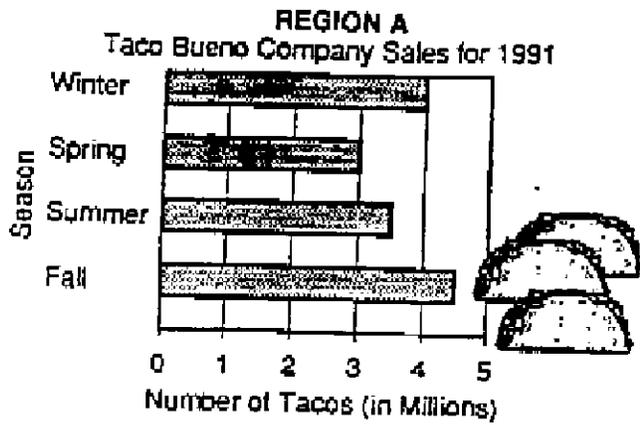


20. Seth charged \$12.00 for mowing a lawn. If his name and charge were added to the table above, which of these statements would correctly describe the effects on the statistics indicated above?
- A. The mode would change, but the median would not.
  - B. The median would change, but the mean would not.
  - C. The mode and the mean would change, but the median would not.
  - D. The mean and median would change, but the mode would not.

GO ON



Directions: Use these graphs to answer question 25.



25. The Taco Bueno Company operates restaurants in just 4 regions. At the end of 1991, each region reported its sales for the year. Using the information contained in the graphs above, the company gave awards to its employees in the region with the greatest total sales for that year. Which of these regions had the greatest total sales for 1991?

- A. Region A
- B. Region B
- C. Region C
- D. Region D

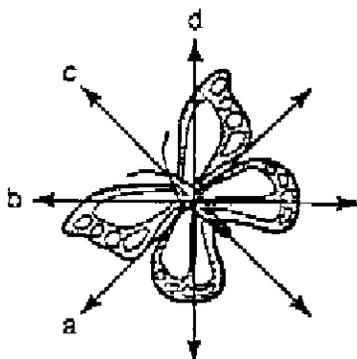
END OF PART 1 - You may check your work on this part only. DO NOT GO ON TO THE NEXT PART.



## MATHEMATICS PART 2

**DIRECTIONS:** Work each problem. Mark the letter for your answer in the appropriate space provided for Mathematics Part 2 on page 2 of your Answer Folder. UNLESS THE PROBLEM STATES OTHERWISE, DO NOT FIGURE SALES TAX IN YOUR ANSWERS TO PROBLEMS INVOLVING PURCHASES.

Directions: Use this picture to answer question 26.

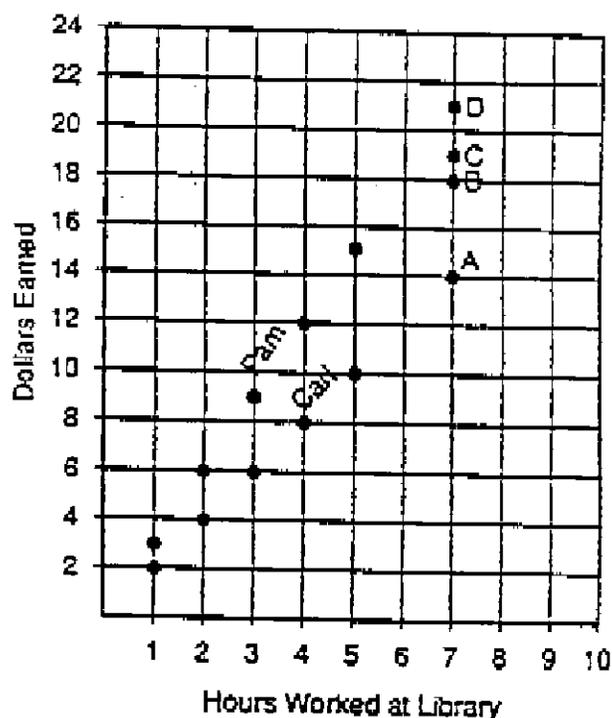


26. Which line above appears to be a line of symmetry of the drawing of the butterfly?
- A. line a  
B. line b  
C. line c  
D. line d
27. For the eighth-grade play, Ted is setting up only 185 chairs in the multi-purpose room. He sets up all the chairs in rows of exactly 16, except for the last row. How many chairs are in the last row?
- A. 5  
B. 9  
C. 11  
D. 12
28. Which of the following symbols would produce a true statement if written in the blank?

$$-2.482 \quad \underline{\hspace{1cm}} \quad -2.481$$

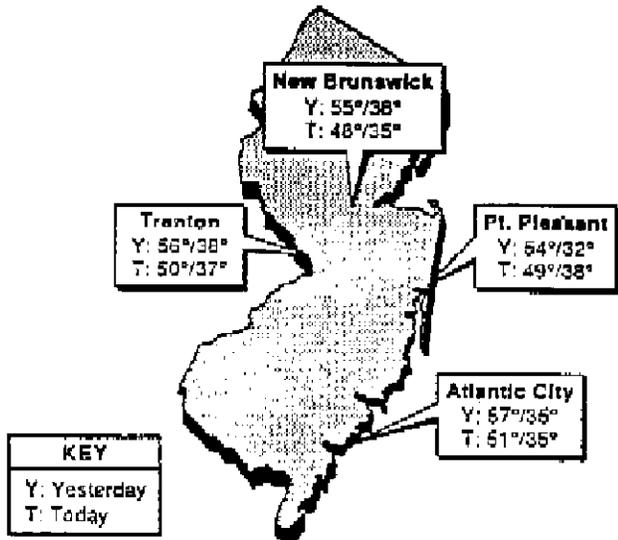
- A.  $>$   
B.  $=$   
C.  $<$   
D.  $\geq$

Directions: Use this graph and the straightedge provided in your testing materials to answer item 29.



29. Pam and Carl work at different libraries on Saturday. The graph above shows how much each of them earns for up to five hours. This graph indicates a linear relationship between the number of hours worked and the amount of money earned for working that many hours. Use this graph and the straightedge provided in your testing materials to tell which point represents how much Pam would earn if she worked 7 hours.
- A. point A  
B. point B  
C. point C  
D. point D

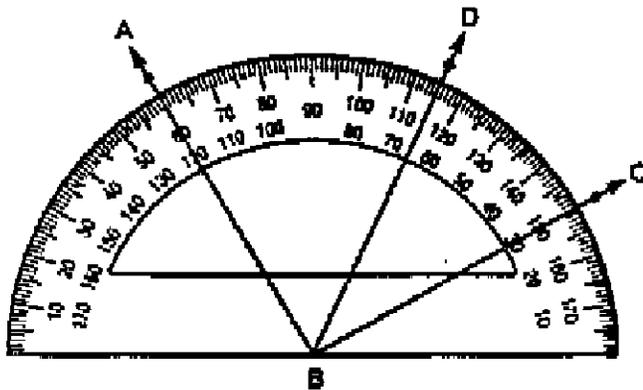
Directions: Use this information and map to answer question 30.



Temperatures are highs and lows for yesterday and today. Some values are estimated.

30. Based on the information given with this map, which of the following represents the difference between the high temperatures in New Brunswick and Atlantic City today?
- A. 1°
  - B. 2°
  - C. 3°
  - D. 4°

Directions: Use the figure and protractor pictured below to complete item 31.

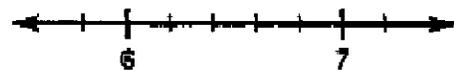


31. The measure of angle DBC is most likely to be \_\_\_\_\_.
- A. less than 33°
  - B. between 33° and 37°
  - C. between 37° and 41°
  - D. greater than 41°

32. In which list below are the units of measurement arranged in order from GREATEST to LEAST?
- A. minute, second, hour
  - B. yard, inch, foot
  - C. pint, quart, gallon
  - D. ton, pound, ounce

33. A certain type of jeans jacket was on sale at 30% off its price at Compton Mall. The same type of jeans jacket was 25% off its price at Belton Mall. Anne decided to buy a jacket of that type at Compton Mall. By buying there, did she save more than she would have saved by buying at Belton Mall?
- A. Yes, because a 30% savings is greater than a 25% savings.
  - B. Yes, because this jacket costs 30% less at Compton Mall.
  - C. No, because the jacket was less expensive at Belton Mall than at Compton Mall.
  - D. Not necessarily, because the prices of the jackets may not have been the same at the two malls.

34. Which of the following most likely represents the length of the smallest subdivision marked off between the two integers shown on the number line pictured below?



- A. 0.1
- B. 0.2
- C. 0.5
- D. 1.0

GO ON

Directions: Use these figures to answer question 35.



35. If the pattern indicated above were continued, how many x's in all would be in the next figure in this pattern?

- A. 21
- B. 22
- C. 25
- D. 26

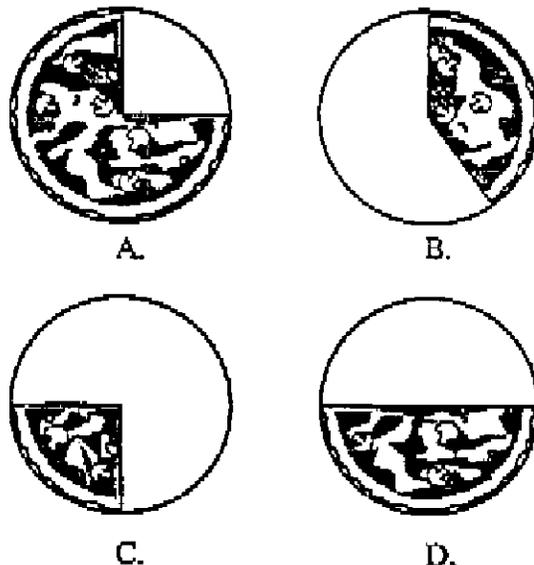
Directions: Use this picture of a receipt to answer question 36.

YOUR RECEIPT	
JERSEY SHORE MARKET	
\$6.43	MT
\$1.99	PR
\$3.64	MT
\$0.89	PR
\$1.25	GR
\$0.71	PR
\$1.05	GR
<b>\$15.96 TOTAL</b>	

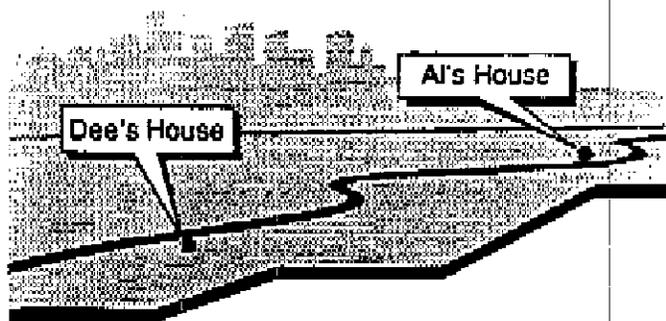
36. Miranda purchased the seven items indicated on the receipt. If she gave the clerk a twenty-dollar bill and a penny to pay for those purchases, how much change should she have received?

- A. \$4.04
- B. \$4.05
- C. \$4.14
- D. \$5.05

37. A pizza was sliced into eight nearly congruent pieces. Warren saw that just two slices had been eaten. He was hungry, so he ate exactly two more slices of that pizza. Which of these diagrams shows how much of the pizza was left after that?



Directions: Use this diagram to answer question 38.



38. The homes of Dee, Al, and Joy are along the same road. Dee's home is about 20 miles from Al's home. Joy's home is about 5 miles from Dee's home. About how far apart are Joy's home and Al's home?

- A. either about 5 or about 15 miles apart
- B. either about 15 or about 25 miles apart
- C. about 5 miles apart
- D. about 20 miles apart

GO ON

## Appendix D

### Test Best Problems

Directions: For questions 1-27, darken the circle for the correct answer. For questions 28 and 29, write your answers on the response grids provided. For questions 30 and 31, write your answers on the paper provided by your teacher.

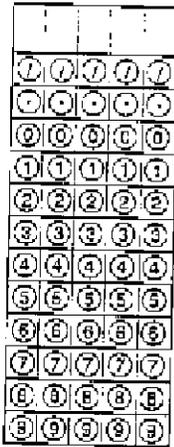
Sample A

Which is the greatest common factor of 16 and 40?

- A 2
- B 4
- C 6
- D 8

Sample B

A large bowl filled with marbles weighs 7.85 kilograms. The bowl itself makes up 24% of the total weight. What is the weight of the marbles in kilograms rounded to the nearest hundredth?



3. How would the product  $3 \times 3 \times 7 \times 5 \times 5$  be expressed in exponential notation?

- A  $3^3 \times 7 \times 5^5$
- B 23
- C  $3^2 \times 7 \times 5^2$
- D 105

4. Which expression does not produce the same result as the others?

- A  $\sqrt{16}$
- B  $2^2$
- C  $4 \cdot 4$
- D  $\frac{8}{2}$

5. After the party there were  $1\frac{1}{2}$  pepperoni pizzas,  $\frac{5}{6}$  of a hamburger pizza, and  $\frac{1}{3}$  of a cheese pizza left. What was the total amount of pizza left?

- A  $\frac{16}{11}$
- B  $2\frac{2}{3}$
- C  $3\frac{1}{6}$
- D  $3\frac{1}{2}$

1. Written in lowest terms, what is the ratio of 21 to 35?

- A 2 to 5
- B 3 to 5
- C 3 to 7
- D 42 to 70

2. A box of computer disks costs \$23.59. What would be the total cost of 36 boxes if the sales tax is 7%? Round your answer to the nearest cent.

- A \$908.69
- B \$849.24
- C \$235.90
- D \$59.44

6. Carl has 36 fish in the first aquarium and 52 fish in the second aquarium. How many fish should he move to the first aquarium so that both aquariums have an equal number of fish?

- A 24
- B 16
- C 12
- D 8

Answers

- A  B  C  D
- 1 A  B  C  D

- 2 A  B  C  D
- 3 A  B  C  D

- 4 A  B  C  D
- 5 A  B  C  D

- 6 A  B  C  D

7. What is  $\overline{.52}$  rounded to the nearest whole number?
- A 6  
B 7  
C 8  
D 9
8. The monarch butterfly migrates as many as 1,582 miles each way during its winter migration. What would be the total mileage for a round trip, rounded to the nearest 100 miles?
- A 4,500 miles  
B 3,200 miles  
C 1,600 miles  
D 1,500 miles
9. Which of the numbers listed below is a multiple of both 8 and 12?
- A 64  
B 84  
C 88  
D 144
10. Our city records show that 45% of the population are registered voters, and 65% of these people voted in the last election. If the city's population is currently 12,900, how many people voted in the last election?
- A 3,773  
B 5,805  
C 6,545  
D 8,385
11. Which of the following is equivalent to  $5 \cdot \frac{6}{2} + 10$ ?
- A  $\frac{15}{3} + 3$   
B  $(5 \div 2) + (6 \div 10)$   
C  $5 \cdot 3 + 10$   
D  $(30) \cdot (12)$

12. If a box can hold a total of 5 pounds of chalk, how much chalk would be in  $\frac{1}{4}$  of the box?
- A  $2\frac{3}{4}$  pounds  
B  $1\frac{1}{4}$  pounds  
C  $\frac{5}{4}$  pounds  
D  $\frac{5}{8}$  pounds

Use this advertisement to answer question 13.

# Sale!

This Weekend Only!!

## 20% off on all cars in stock!

13. The Golding family bought a used car during the sale. The car's original price was \$9,650.00. They decided to add air conditioning for \$657.29 and new tires for \$239.99. What was the total cost of the car, including 6% sales tax? Round your answer to the nearest cent.
- A \$9,134.32  
B \$10,547.28  
C \$11,180.12  
D \$13,416.14
14. Choose the symbol that will make this statement true.
- $$\frac{5}{12} \text{ \_\_\_\_\_\_ } \frac{7}{18}$$
- A >  
B =  
C <  
D None of the above

**Answers**

- 7 A B C D      9 A B C D      11 A B C D      13 A B C D  
8 A B C D      10 A B C D      12 A B C D      14 A B C D

15. Which group contains only ratios that are equivalent to  $\frac{2}{5}$ ?
- A  $\frac{1}{5}, \frac{6}{15}, \frac{8}{25}$   
 B  $\frac{2}{10}, \frac{2}{15}, \frac{2}{20}$   
 C  $\frac{4}{10}, \frac{8}{20}, \frac{10}{25}$   
 D  $\frac{3}{6}, \frac{4}{7}, \frac{5}{8}$
16. Luis ordered 300 computers last week for his computer store in Camden. He sold 75 computers during the weekend. What percent of the 300 computers did Luis sell?
- A 25%  
 B 40%  
 C 65%  
 D 80%
17. The painting crew painted  $1\frac{1}{2}$  rooms this morning and  $2\frac{3}{4}$  rooms this afternoon. If there is a total of 6 rooms to be painted, how many rooms are there left to be painted?
- A  $1\frac{1}{4}$   
 B  $1\frac{3}{4}$   
 C  $3\frac{3}{4}$   
 D  $4\frac{1}{4}$
18. In Rico's aquarium  $\frac{1}{3}$  of the fish are males, and  $\frac{3}{4}$  of the fish have red tails. Which of these statements about the fish in Rico's aquarium is true?
- A Males with red tails make up  $\frac{2}{3}$  of the total fish.  
 B Females make up  $\frac{1}{2}$  of the total fish.  
 C Females with red tails make up  $\frac{3}{4}$  of the total fish.  
 D Fish that do not have red tails make up  $\frac{1}{2}$  of the total fish.
19. Debbie puts 40% of her \$3.00 weekly allowance into savings each month. What fraction of her allowance does Debbie put into savings?
- A  $\frac{1}{12}$   
 B  $\frac{2}{5}$   
 C  $\frac{2}{3}$   
 D  $\frac{3}{4}$
20. April was a very rainy month. It rained an average of 0.08 inches per day. At this rate how many total inches of rain fell during April?
- A 2.4 inches  
 B 2.04 inches  
 C 0.24 inches  
 D 0.204 inches
21. What is the ratio of the number of a's to the total number of letters in the word "Passaconaway," written in lowest terms?
- A 4 to 1  
 B 1 to 4  
 C 1 to 2  
 D 1 to 3
22. The regular price of a baseball mitt is \$45.00. It is on sale at 20% off the regular price. What is the sale price?
- A \$36.00  
 B \$28.00  
 C \$17.00  
 D \$9.00
23. What is the ratio of 12 to 60, written in lowest terms?
- A 1 to 5  
 B 4 to 5  
 C 3 to 20  
 D 24 to 72

Answers

15 A B C D

17 A B C D

19 A B C D

21 A B C D

23 A B C D

16 A B C D

18 A B C D

20 A B C D

22 A B C D

24. Yesterday it rained  $\frac{1}{3}$  of the day. What percent of the day was rainy?
- A 267%  
 B 37.5%  
 C 24%  
 D 12.5%

25. The ratio of girls to boys on a hiking trip is 4 to 3. If there are 28 people on the hike, how many are girls?
- A 7  
 B 12  
 C 16  
 D 21

26. Mr. Hawkins mowed  $\frac{3}{8}$  of the lawn yesterday. Today he mowed  $\frac{1}{8}$  of the lawn. What part of the lawn still needs to be mowed?
- A  $\frac{1}{8}$   
 B  $\frac{4}{11}$   
 C  $\frac{2}{5}$   
 D  $\frac{7}{24}$

27. Bernard's average for the last 3 Spanish tests is 85. What is the highest average Bernard could achieve after taking 1 more test? Round your answer to the nearest percent.
- A 100  
 B 89  
 C 87  
 D 85

Write your answers to numbers 28 and 29 on the response grids.

28. Last month Grissom Junior High School used a total of 9,853 gallons of water. What is this number rounded to the nearest thousand gallons?
29. A car rental agency charges \$29.95 per day to rent a car. They provide 125 miles per day free of charge, then charge \$0.29 per mile for each additional mile. What would be the total cost of renting a car for 4 days, traveling a total of 1,200 miles?

**28**

7	7	7	7	7
6	6	6	6	6
5	5	5	5	5
4	4	4	4	4
3	3	3	3	3
2	2	2	2	2
1	1	1	1	1
0	0	0	0	0
9	9	9	9	9
8	8	8	8	8
7	7	7	7	7
6	6	6	6	6
5	5	5	5	5
4	4	4	4	4
3	3	3	3	3
2	2	2	2	2
1	1	1	1	1
0	0	0	0	0

**29**

7	7	7	7	7	7	7	7	7	7
6	6	6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0
9	9	9	9	9	9	9	9	9	9
8	8	8	8	8	8	8	8	8	8
7	7	7	7	7	7	7	7	7	7
6	6	6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0

**STOP**

Write your answers to numbers 30 and 31 on a separate sheet of paper.

30. Use the digits 5, 6, 7, 8, and 9 to form a subtraction problem made up of a 3-digit number minus a 2-digit number. You may use each digit only once. Arrange the digits to make the smallest answer possible.
- Is there more than one correct combination? Explain.
31. There are 9 boys in classroom A and 12 boys in classroom B. These numbers represent  $\frac{2}{3}$  of the students in each of these two classrooms. How many students are there altogether?
- Explain your answer.

**Answers**

- 24 A B C D      26 A B C D  
 25 A B C D      27 A B C D

**STOP**

Directions: For questions 1-26, darken the circle for the correct answer. For questions 27-29, write your answers on the response grids provided. For questions 30 and 31, write your answers on the paper provided by your teacher.

Sample A

Sammy caught a catfish that was  $2\frac{2}{3}$  feet long. How many inches long was the catfish?

- A 16 inches
- B 26 inches
- C 29 inches
- D 32 inches

Sample B

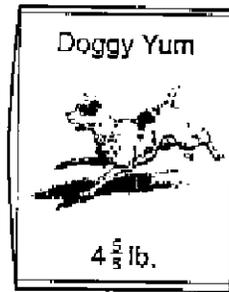
If 4 centimeters represent 100 miles on a map, what is the distance between 2 capital cities that are 17 centimeters apart on the map?

1	2	3	4
5	6	7	8
9	0	1	2
3	4	5	6
7	8	9	0
1	2	3	4
5	6	7	8
9	0	1	2
3	4	5	6
7	8	9	0
1	2	3	4
5	6	7	8
9	0	1	2
3	4	5	6
7	8	9	0

1. On Mr. Harrow's diet he eats 6 ounces of fruit each day. This morning he bought 2 pounds 3 ounces of oranges, 4 pounds 8 ounces of grapes, and 1 pound 9 ounces of apples. How many days will this fruit last?
  - A 137 days
  - B 22 days
  - C 10 days
  - D 15 days
2. Which set of measurement units is listed in order from greatest to least?
  - A Kilogram, gram, milligram
  - B Gram, milligram, kilogram
  - C Milligram, kilogram, gram
  - D Gram, kilogram, milligram

3. The number of right angles in a right triangle is \_\_\_\_\_.
  - A 4
  - B 3
  - C 2
  - D 1

4. Which bag of dog food pictured here weighs the least?



Bag A



Bag B



Bag C



Bag D

- A Bag A
- B Bag B
- C Bag C
- D Bag D

5. Which of the following does not belong with the others?
  - A Quadrilateral
  - B Rectangle
  - C Rhombus
  - D Equilateral

Answers

- A 1 A B C D
- 2 A B C D
- 3 A B C C
- 4 A B C D
- 5 A B C D

6. One jar of Roasty Toasty peanut butter weighs 867 grams. How much would 5 jars weigh in kilograms?
- A 0.4335 kilograms  
 B 4.335 kilograms  
 C 43.35 kilograms  
 D 433.5 kilograms

Use the following recipe to answer question 7.

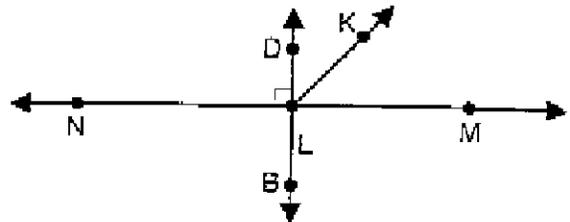
**Jan's Trail Mix**

- 2 cups oats  
 1 cup banana chips  
 1 cup roasted pumpkin seeds  
 1 cup peanuts  
 1 cup raisins  
 $\frac{1}{4}$  cup margarine, melted

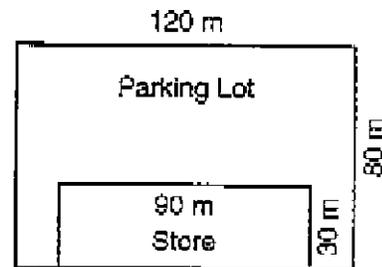
Mix dry ingredients in ungreased baking pan. Pour margarine over mixture; toss lightly. Cook uncovered in 350° oven about 20 minutes. Cool. Store in tightly covered container.

7. How many 1-quart jars could Jan fill with the trail mix, if she doubles the recipe?
- A 2  
 B 3  
 C 6  
 D 8
8. Which is not a unit of measure for weight and/or mass?
- A Milliliter  
 B Gram  
 C Pound  
 D Kilogram

9. The measure of  $\angle KLM$  is  $45^\circ$ . What is the measure of  $\angle NLK$ ?



- A  $135^\circ$   
 B  $125^\circ$   
 C  $90^\circ$   
 D  $45^\circ$
10. A rhombus is a type of \_\_\_\_\_.
- A rectangle  
 B triangle  
 C quadrilateral  
 D square
11. A cereal box measures 9 centimeters wide by 23 centimeters long by 34 centimeters high. What is the volume of the cereal box?
- A 66 cubic centimeters  
 B 1,766 cubic centimeters  
 C 4,356 cubic centimeters  
 D 7,038 cubic centimeters
12. What is the area of the parking lot shown here?



- A 9,600 square meters  
 B 6,900 square meters  
 C 2,700 square meters  
 D 400 square meters

**Answers**

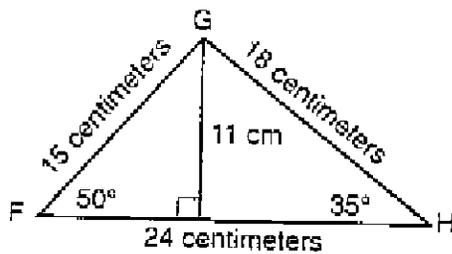
6 A B C D  
 7 A B C D

8 A B C D  
 9 A B C D

10 A B C D  
 11 A B C D

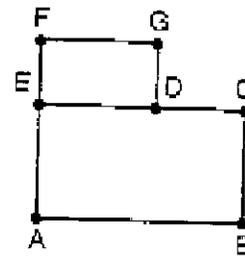
12 A B C D

Use the figure below to answer questions 13 and 14.



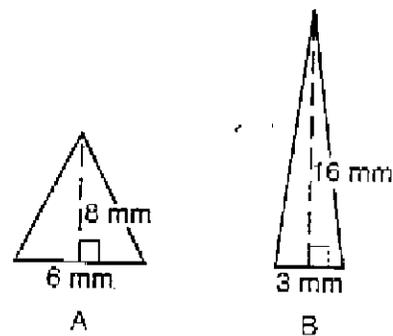
13. What is the measure of angle  $\angle FGH$ ?
- A  $180^\circ$   
 B  $95^\circ$   
 C  $85^\circ$   
 D  $45^\circ$
14. What is the area of  $\triangle FGH$ ?
- A 132 square centimeters  
 B 212 square centimeters  
 C 264 square centimeters  
 D 360 square centimeters
15. The base of a cone is a \_\_\_\_\_.
- A square  
 B triangle  
 C circle  
 D sphere
16. If a ball that measures 12 inches across rolls 10 times, how far does it travel?
- A 3.768 inches  
 B 37.68 inches  
 C 376.8 inches  
 D 3768 inches

17. Rectangle  $DEFG$  is similar to rectangle  $BAEC$ . Which line segments are perpendicular?



- A  $\overline{FG}$  and  $\overline{DC}$   
 B  $\overline{AB}$  and  $\overline{ED}$   
 C  $\overline{EA}$  and  $\overline{AB}$   
 D  $\overline{CB}$  and  $\overline{FE}$
18. Which three-dimensional figure has exactly five faces?
- A Cube  
 B Triangular prism  
 C Rectangular prism  
 D Cylinder

Use the two triangles shown here to answer question 19.



19. Which symbol, if written in the blank, would make the statement true?
- The area of  $\triangle A$  \_\_\_\_\_ the area of  $\triangle B$ .
- A  $>$   
 B  $<$   
 C  $=$   
 D  $\approx$

Answers

- 13 A B C D    14 A B C D    15 A B C D    16 A B C D    17 A B C D    18 A B C D    19 A B C D

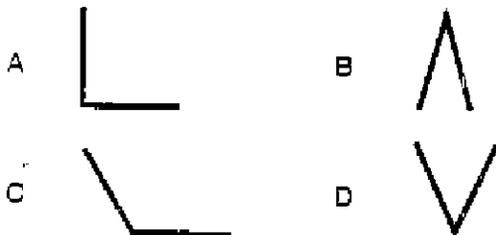
20. Which of the following does not belong with the others?

- A Polygon
- B Rectangle
- C Cube
- D Triangle

21. The height of a rectangular prism is 7 feet, its width is 14 feet, and its length is 28 feet. If you double each of these measurements, how is the volume of the prism affected?

- A The volume doubles.
- B The volume triples.
- C The volume quadruples.
- D The volume more than quadruples.

22. Which of these angles appears to be an obtuse angle?

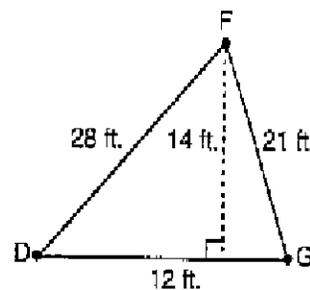


- A  $\angle A$
- B  $\angle B$
- C  $\angle C$
- D  $\angle D$

23. The distance from the edge to the center of a circle is called the \_\_\_\_\_.

- A vertex
- B diameter
- C radius
- D circumference

Use the triangle shown here to answer questions 24 and 25.



24. If you constructed a rectangle with the same perimeter as  $\triangle DFG$ , its area would be \_\_\_\_\_.

- A equal to the area of  $\triangle DFG$
- B greater than the area of  $\triangle DFG$
- C less than the area of  $\triangle DFG$
- D Not enough information is given.

25. Assume that the base of the triangle remains the same. If the height of  $\triangle DFG$  was reduced to 7 feet, what effect would this have on the measure of  $\angle DFG$ ?

- A It would remain the same.
- B It would increase.
- C It would double.
- D It would decrease.

26. Marty tests water samples for the state park department. This morning she is preparing to test water from Lost Hollow Stream. How many 2.5-liter beakers can Marty fill with the 15 liters of water she has collected from the stream?

- A 2
- B 6
- C 8
- D 12

Answers

20 A B C D  
21 A B C D

22 A B C D  
23 A B C D

24 A B C D  
25 A B C D

26 A B C D

GO ON

Write your answers to questions 27–29 on the response grids.

27. Mario volunteered to bring some snacks to take on the camping trip to the Kittatinny Mountains. He brought 8 pounds of peanuts, 15 ounces of walnuts, 4 pounds 11 ounces of cashews, and 2 pounds 7 ounces of pecans. How many ounces of nuts did Mario bring?

28. Patty hiked 5,640 meters on the beach along the Atlantic Ocean on Saturday. She walked 3,250 meters on Sunday. How many kilometers did she walk altogether?

29. Give the sum of the measures of two supplementary angles.

27

1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

28

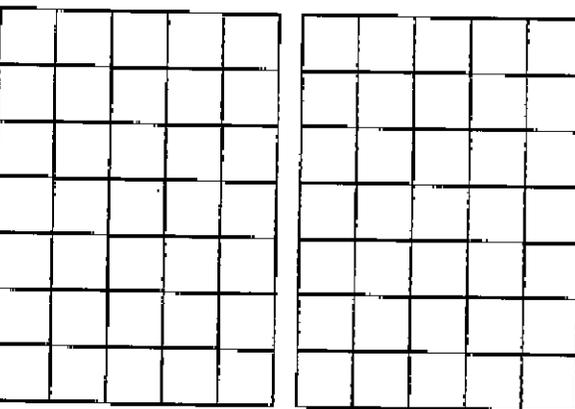
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

29

1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

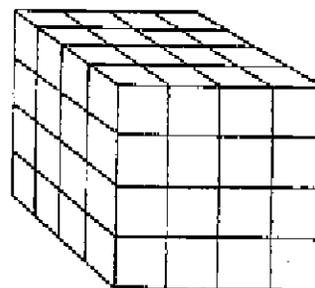
Write your answers to questions 30 and 31 on a separate sheet of paper.

30. The grid below on the left shows a square with an area of 9 square units. Use the blank grid to draw a right triangle with an area equal to that of the square shown. Label the sides of the triangle with their appropriate lengths.



Is there more than one possible solution? Explain your answer.

31. The three-dimensional figure below is made up of 1-inch by 1-inch by 1-inch cubes. How would the volume of the figure be affected if its height were cut in half but the other dimensions remained the same?



STOP

STOP

Directions: For questions 1-19, darken the circle for the correct answer. For questions 20-22, write your answers on the response grids. For questions 23 and 24, write your answers on the paper provided by your teacher.

### Sample A

What number would come next if the pattern continues?

5, 10, 20, 40, ...

- A 80
- B 70
- C 60
- D 50

### Sample B

The mouse population of a given location doubles every 3 weeks. Assuming there was only 1 male mouse and 1 female mouse to begin with, how many mice would there be in 27 weeks?



1. Which digit should be in the ones place in the standard form of  $5^{35}$ ?
  - A 0
  - B 8
  - C 5
  - D 7
  
2. What is the sum of this set of numbers once the pattern is completed?
 
$$5 + 10 + 15 + 20 + \_ + \_ + \_ + \_ + \_ + 50$$
  - A 175
  - B 275
  - C 285
  - D 315

3. Molly's dog Cassidy has had three litters of puppies. In each litter there were five puppies. Molly has kept all the dogs. Which expression represents the number of dogs that Molly owns?
  - A  $1 + 3(5)$
  - B  $3(1 + 5)$
  - C  $(1 + 5) + 3$
  - D  $1 + 3 + 5$

Use the figures below to answer question 4.



4. How many stars would be in the eleventh figure if this pattern continues?
  - A 25
  - B 28
  - C 35
  - D 42
  
5. Carleta's class is building a domino pyramid on the floor of the gymnasium. There is 1 domino in the first row, 2 dominoes in the second, 3 in the third, and so on. How many dominoes are needed to build a pyramid that has 18 rows?
  - A 108
  - B 151
  - C 152
  - D 171

### Answers

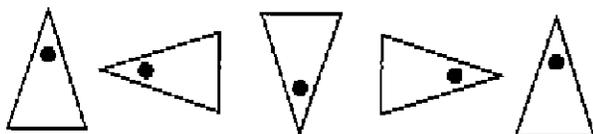
- |   |   |   |
|---|---|---|
| A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/>                         | 2 <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> | 4 <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> |
| 1 <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> | 3 <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> | 5 <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> |

6. If the pattern shown here continues, what would be the sum of the first ten numbers?

$\frac{1}{2}, 1\frac{1}{2}, 2\frac{1}{2}, 3\frac{1}{2}, \dots$

- A 20  
 B  $24\frac{1}{2}$   
 C 50  
 D  $62\frac{1}{2}$
7. Which of the following represents the expression "the sum of a number and 4 times that number is more than 65"?
- A  $x + x + x = < 65$   
 B  $x + 4x < 65$   
 C  $x + 4 \cdot 65 < x$   
 D  $x + 4x > 65$

8. Which is the seventy-fifth figure if the pattern shown here continues?



- A
- B
- C
- D

9. In her exercise routine, Naomi can do 30 sit-ups in 60 seconds. If the second hand on a timer is pointing to three when Naomi begins, what number will it be pointing to when she finishes her forty-fifth sit-up?

- A 6  
 B 7  
 C 8  
 D 9

10. The table shown here represents the relationship between  $x$  and  $y$ . Based on the relationship shown here, what number belongs in the empty box in column  $x$ ?

$x$	$y$
7	21
8	24
9	27
10	30
11	33
.	.
.	.
.	.
<input type="text"/>	48

- A 12  
 B 16  
 C 24  
 D 30

11. Mr. Castillo designed a pattern in the rock wall around his garden. He used two brown rocks, then five gray rocks, then eight tan rocks, then three white rocks in his pattern. If he continued this pattern, what would be the color of the thirty-fifth rock in his rock wall?

- A Brown  
 B Gray  
 C Tan  
 D White

Answers

- 6 A B C D  
 7 A B C D

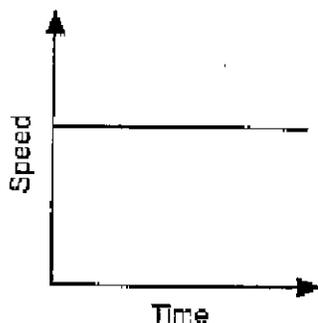
- 8 A B C D  
 9 A B C D

- 10 A B C D  
 11 A B C D

12. Gwen spent 1 hour 30 minutes doing her homework on Monday, 2 hours 17 minutes doing her homework on Tuesday, and 52 minutes doing her homework on Wednesday. Which expression represents the total number of minutes Gwen did her homework during the three days?

- A  $1 + 3 + 2 + 17 + 52$   
 B  $1(60) + 30 + 2(60) + 17 + 52$   
 C  $30(1 + 2) + 17 + 52$   
 D  $1(30) + 2(17) + 52$

13. Which of the events described here are represented on the graph?



- A A car is stopped at a traffic light.  
 B A turtle is traveling at a steady rate of speed.  
 C A tree falls after being cut down.  
 D A jet steadily increases speed as it flies.

14. Francis earns \$5.25 per hour for mowing lawns. He divides his work into four-hour workdays so that he works every day during the summer. Which expression represents the total amount of money Francis will earn after eight days of mowing lawns?

- A  $(8 \div 4) 5.25$   
 B  $8 + 4 + 5.25$   
 C  $8(4 \cdot 5.25)$   
 D  $(5.25 + 4) 8$

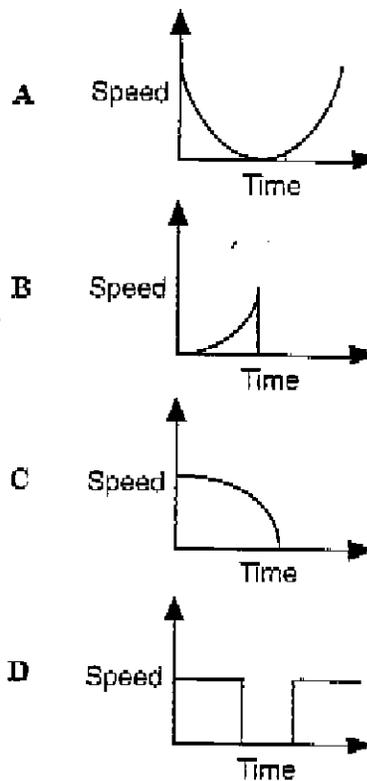
15. A popcorn recipe calls for  $1\frac{1}{2}$  tablespoons of oil to be added to the popper for each cup of popping corn. How many tablespoons of oil would you use to pop 6 cups of popping corn?

- A  $1\frac{1}{2}$  tablespoons  
 B 4 tablespoons  
 C 6 tablespoons  
 D 9 tablespoons

16. A customer was given 2 quarters, 2 dimes, and 2 pennies as change after purchasing a watch for \$38.00. Which expression represents the amount of change the customer received?

- A  $2 + 2 + 2$   
 B  $2(25 + 10 + 2)$   
 C  $\frac{25}{2} + \frac{10}{2} + 2$   
 D  $2(25) + 2(10) + 2$

17. Which graph best represents a bird in flight that lands on a bird feeder to eat?



**Answers**

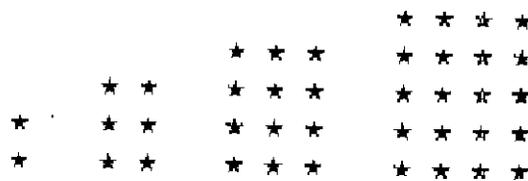
- 12 A B C D    13 A B C D    14 A B C D    15 A B C D  
 16 A B C D    17 A B C D

18. What is another way to write  $120 \times 8 = 960$ ?
- A  $960 \div 8 = 120$   
 B  $8 \times 960 = 7680$   
 C  $120 + 8 = 128$   
 D  $120 \div 8 = 15$

19. Which expression could be used to find the sum of the consecutive numbers from 1 through 18?
- A  $\frac{18(18+1)}{2}$   
 B  $\frac{18}{2} + \frac{18}{2}$   
 C  $2 \cdot 18 + 2 \cdot 19$   
 D  $(2 + 18)(2 + 19)$

Write your answers to numbers 20–22 on the response grids.

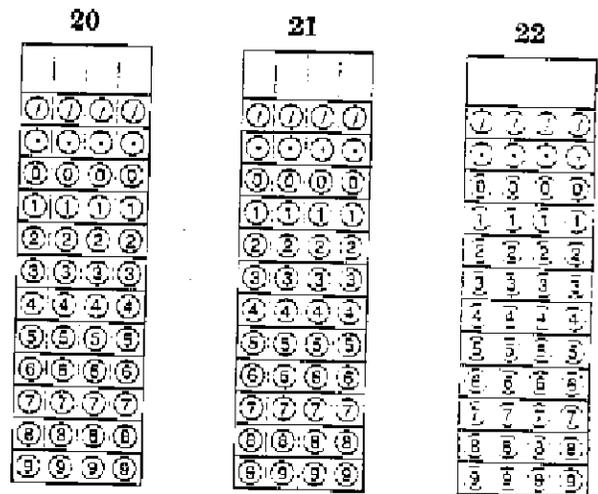
20. If the pattern shown here continues, how many stars would there be in the tenth figure in the pattern?



21. The seventh number in this pattern would be \_\_\_\_\_.

$2\frac{1}{2}, 3\frac{3}{4}, 5, 6\frac{1}{4}, 7\frac{1}{2}, \dots$

22. Each day 15 apples ripen on a particular apple tree. Assuming the tree began the week with 24 ripe apples, how many ripe apples could be harvested from the tree after 7 days?



**STOP**

Write your answers to questions 23 and 24 on a separate sheet of paper.

23. Study the pattern shown here. Then sketch the ninetieth figure in this pattern. Explain the method you used to find this answer.



24. Mr. Yasuda's math class divided into two teams to play a game. For every correct answer a team gave, it received five points. For every incorrect answer, the team lost two points. At the end of the game, Team A had given twelve correct answers and five incorrect answers. Team B had given eleven correct answers and three incorrect answers. Which team received the greater number of points? Show your work.

**Answers**

- 18 A B C D  
 19 A B C D

**STOP**